

Profiting from Innovation by Managing Intellectual Property

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St. Gallen, October 26, 2011

The President:

Prof. Dr. Thomas Bieger

Für meine Mutter, für wen sonst ...

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Abbreviations

CEO	Chief Executive Officer
CTO	Chief Technology Officer
EMI	Electric & Musical Industries Ltd.
EO	Entrepreneurial orientation
FBI	Federal Bureau of Investigation
GDP	Gross Domestic Product
IE	International Entrepreneurship
INV	International New Venture
IP	Intellectual Property
IPR	Intellectual Property Rights
MNC	Multinational Corporation
NGO	Non Governmental Organization
R&D	Research and Development
RIAA	Recording Industry Association of America
SIPO	State Intellectual Property Office of the People's Republic of China
SME	Small and Medium-sized Enterprises
WIPO	World Intellectual Property Organization

Abstract

Research on intellectual property (IP) management usually starts with two assumptions. *Firstly*, the assumption that IP rights can be taken to court and that a court will make a fair and comprehensible decision. And *secondly*, the assumption that firms have the necessary funds to take legal actions regarding their IP. This dissertation is a compendium of five individual articles that consider settings where one of the two assumptions does not hold.

The *first article* introduces IP, explains why it is such a contentious topic, and reviews recent relevant literature. Furthermore, does the first article provide a superstructure for the following four articles.

The *second article* considers Swiss life science Small and Medium-sized Enterprises (SME) and their approach towards IP. This article analyses different SME's approaches toward IP to derive distinct underlying constructs that affect these firms' decision-making processes.

The *third article* concerns international new ventures (INVs). These firms internationalize early on and are therefore exposed to multiple IP regimes. Being small and active in several countries makes it especially difficult for INVs to profit from innovation. The article shows how INVs craft novel IP protection strategies that have not been previously reported in the literature.

The *fourth article* discusses IP in China. Theory predicts that firms should appropriate rents from innovation with informal protection measures and not by patents. However, for the last decade patent applications of foreign firms in China have been growing exponentially. This article aims to explain why China has defied theoretical predictions.

And lastly, the *fifth article* explores how SME can ensure that their innovations are worthwhile. This article causally pinpoints the presence of firm-level appropriation capabilities to the firms' organizational characteristics.

Ultimately this dissertation provides insights on how firms deal with appropriation in specific hitherto neglected settings.



Introduction: When Four Parties Try to Tell One Story

Oracle sued Google over Java patents, Viacom appeals YouTube ruling, Rupert Murdoch sues Skype, EMI takes down ‘Empire State of Mind’ parodies, music festival producer pre-sues bootleggers, FBI prioritizes copyright issues over missing persons, yet another study shows how copyright hinders the spread of knowledge, the Irish Red Cross sues Google, Pfizer Inc. (the world’s largest drug company) sued Iceland’s Actavis Group hf, UBS sued for copying oil reports in investor research, how the Pentagon’s reaction to Wikileaks is like the RIAA’s reaction to Napster ...

These are all headlines, which happened on a single business day in August 2010. There is hardly a term in the business world that is more emotionally charged. There is hardly a subject in the business world that receives more media coverage than intellectual property (IP). And the opinions on IP could not differ more. While some tell us that the current system has major flaws and hinders what it actually wants to promote, others explain that only stronger enforcements of intellectual property rights are the proper way to go. This clash of perspectives will be briefly discussed in the introduction because of its relevance to the topic of IP.

In its essence IP can be regarded as any creation of the mind (WIPO, 2010). A picture a child draws, a song a musician composes, an invention an inventor makes, a book someone writes or a logo an advertising agency designs, all and many more are intellectual properties. All are creations of the mind. But this idea alone would hardly lead to the mentioned clash of opinions if the law didn’t grant exclusive rights to the creators of IP. These rights are comprised by the umbrella term intellectual property rights (IPR) (WIPO, 2010).

1.1 Intellectual Property Protection

This section is meant to ensure the understanding of the difference between formal and informal protection measures. This distinction will help to understand several arguments made throughout this dissertation. As said, the conflict does not begin with the creation of intellectual property but with its protection, more precisely with exercising IPRs. Protecting IP can be understood as a prohibition. This prohibition is intended to ensure that no one uses an intellectual property in

a way the owner of this IP disapproves of. In reality, this concept can mean many things: it can be a well kept secret, it can forbid someone to reprint a book, remix a song, use an invention, or use a certain logo, among many other possibilities.

As these examples show, the protection of IP can mean quite different things. However, all the possible protections of intellectual properties fall into either of two categories: *formal* protection measures and *informal* protection measures (Levin et al., 1987; Howells et al., 2003; Amara et al., 2008).

1.1.1 Formal Protection Measures

When hearing about intellectual property, what most people associate with the term is probably what is known as formal protection measures. A formal protection measure is a protection instrument granted by national legislations, which can be taken to court (WIPO, 2010). The following paragraphs introduce the most important formal protection measures in a condensed manner, providing a short overview for those unfamiliar with the topic.

Patents are a type of formal protection measure for technological inventions. A patent grants an inventor the right to forbid others to commercialize his or her invention in exchange for the public disclosure of the invention. This exclusive right to forbid lasts for 20 years in most legislations and cases. Not all inventions are patentable. What exactly is patentable varies among legislations and while certain inventions might be patentable in the U.S. this is not necessarily the case in Europe. An inventor has to apply for a patent in all legislations he or she wants to have the invention patented in.

The *utility model* is often referred to as the ‘small patent’ because it also protects technological inventions. This formal protection measure offers, in most cases, less protection than a patent but is easier to obtain. Not all countries offering patents offer utility models, too. The duration varies from legislation to legislation. While some legislations, such as Mexico or France, offer a protection period of five years, others offer protection periods which are three times as long (e.g. Brazil or South Korea).

Table 1.1 Formal protection measures according to WIPO

Name	Property	Obtainment	Duration	Example
Patent	Technological invention	Registration at national level	20 years in most legislations (upgradable to 25 year in some cases)	1876: Telephone 1916: Tennis racket 1917: Submarine
Utility model	Technological invention	Registration at national level (many countries do not use utility models)	Varies (min. 5 years i.e. in Mexico or France, max. 15 years i.e. in Brazil or South Korea)	Devices with short life cycles or lower technological creativity than a patent
Trademark	Sign which distinguishes goods and services	Registration at national level	Can be perpetual through active use and re-registration	Coca-Cola Calvin Klein Mercedes-Benz
Industrial design	Visible forms, both 2D and 3D	Registration at national level	15 years in Japan Up to 25 years in Europe 14 years in the U.S.	Voss bottle Shape of a car
Copyright	Art such as literature, music, paintings ...	Automatically through the creation	Depends on the legislation and varies	Beatles' songs Warhol's paintings Hemingway's texts
Geographical indication	Geographical indication	Through the geographic origin of the product or service	As long as the product or service is from the indicated area	Champagne Kölsch

A *trademark* is a sign to distinguish products—either goods or services—of one enterprise from those of other enterprises. In addition to the main function as an indication of origin, trademarks have an advertising function as well, serving to communicate the quality of the products or the reputation of the trademark owner. Trademarks can be owned by individuals or legal entities like business companies, NGO's, or administrative bodies. Usually, a trademark is protected once it has been entered in a national trademark register. However, some legislations grant trademark protection by use. Generally, trademark protection is limited to the territory of the country in which the mark is registered or protected by use. In most legal systems, trademark protection is granted for a period of ten years; however, the term of protection can be renewed indefinitely so that, theoretically, a trademark can be perpetual.

An *industrial design* is a formal protection measure that protects two or three dimensional forms like the design and the shape of a bottle. The duration for the protection varies among legislations. A design is registered at national level, too.

Original works such as writings, paintings, or music are automatically protected by *copyright*. The duration of copyright varies from legislation to legislation. However, it is a finite time span which is longer than the patent protection (usually more than 50 years) and after which the work falls into the public domain.

A *Geographic indication* is also often referred to as formal protection measures. This measure allows products or services to use a certain geographic location as a means of differentiation and an indicator of quality. Famous examples are Champagne or Kölsch (a German beer, brewed in Cologne). However, it might be misleading to label a geographic indication as a form of intellectual property protection, as the geographic region is no creation of the mind.

1.1.2 Informal Protection Measures

Informal protection measures also referred to as factual protection measures (Gassmann & Keupp, 2007) are the second subset of IP protection measures (Levin et al., 1987; Howells et al., 2003; Amara et al., 2008). Informal protection measures much like formal protection measures aim to ensure that others do not use the intellectual property; however, they do not rely on juridical enforceability. There is quite a variety of informal protection measures. Most importantly, there is *secrecy* (Brown & Prescott, 2000; Thumm, 2001). Keeping an intellectual property of any kind secret will in many cases ensure that no one else is able to use it. Not feasible for artists of any kind, secrecy is a protection measure that is popular among corporations. Popular examples include production steps or the composition of certain soft drinks.

Many other informal protection measures exist. For instance, some companies use *fast innovation cycles* to make it difficult for other firms to copy and market the made inventions. This is often referred to as lead time advantages (Brown & Lattin, 1994; Datar et al., 1997). Once another company has copied the made invention, the original company has usually already moved on to a newer and better version, which oftentimes makes it difficult for the copycat to sell the outdated product. Other examples are known where companies publish their inventions to make sure no other company can obtain a patent for them. Some companies involve their customers in order to protect their intellectual

properties, others use red herrings to mislead the competition (Gassmann & Bader, 2011).

The variety of informal protection measures is large, and the explicit informal protection measure used in a certain case depends on various factors. *Who is protecting the IP? What kind of IP is protected? Where is the IP protected? What are the available funds for this protection? And who has an interest in the protected IP?* These are only a few questions that can lead to a diverse set of protection measures.

1.2 The Clash of Perspectives

As said before, the clash of perspectives regarding IP begins with the protection. Protecting IP automatically creates two separate parties: one party in possession of the IP and another party somehow prohibited from using it. Thus, coming from two fundamentally different starting points, it is often the case that the two parties disagree wholeheartedly about how the intellectual property should be treated.

Industries that went through noticeable changes in the way IP is handled, traded, or exchanged illustrate this paradigm vividly. The music and the movie industries are two well-documented examples that faced such changes in recent years. The digitalization of both audio and video content made it possible to share, exchange, and distribute both music and movies in novel ways (Romer, 2002). While the party *not* in possession of the IP embraced the new technologies and the associated possibilities, the other party, the party in possession of the IP, was not as enthusiastic about the changes and what they might mean to its business model. This example is meant to illustrate how the protection of IP automatically forms two separate parties and is not meant to evaluation either party's actions.

Similar scenarios can be found in many other industries, too. Holders of pharmaceutical patents explain that the patenting system makes research possible, while others argue that this leads to overpriced drugs, the lack of available drugs in many regions of the world, and even slowed development of new drugs desperately needed by many (Heller & Eisenberg, 1998; Gewertz & Amado, 2004; Miles et al., 2004; Chan, 2010). Many publishers argue that publishing through

the internet drives down revenues and thus decreases the quality of journalism (Sulzberger, 2011). Others argue that this makes it possible to compare publications and trace down sources for given arguments. While some large firms build patent fences to protect their investments in R&D, others argue that this makes it almost impossible for firms to enter the market and compete (Ziedonis, 2004), which in turn leads to over-priced products.

All of these examples show that the protection of IP alone creates two separate parties with fundamentally different ideas about how IP should be used. It is important to understand these underlying motivations especially when the topic of discussion is as emotionally charged as intellectual property. Appreciating this makes it possible to understand why seemingly objective articles on intellectual property come to fundamentally different conclusions.

However, there are actually two additional parties invested in IP, both of whom have a different view on the issue. Firstly, there are economic scholars. These are scholars who look at the economic system as a whole and derive their conclusions from that. Secondly, there are business scholars. They observe companies active in the system and use theories to explain why these companies act the way they do.

1.2.1 Intellectual Property as Seen by Economic Scholars

Economic scholars see IP as a variable that effects growth in an economic system. As such, a working IP system should do its part to maximize economic growth. In their scientific writings, economic scholars usually explain how IP legislations should be changed in order to maximize economic growth. To get there, the argument is typically broken down into two sub-arguments. The first one states that the IP system is supposed to foster innovations (Boldrin & Levine, 2002) and the second argument emphasizes that innovations lead to economic growth (Arrow, 1962; Besen & Raskind, 1991). Hence, economic scholars argue that a better IP system leads to more economic growth via innovations (Gould & Gruben, 1996; Eicher & García-Peñalosa, 2008; Dinopoulos & Segerstrom, 2010).

The major drawback in this kind of research is the fact that, unfortunately, economic scholars cannot make changes to an IP system and then observe their effect on economic growth. And even if they could, it would take the system years if not decades to show results. In addition, new technologies, production techniques, or a recession might explain the changes in economic growth better than the changes they could make to the IP system. Being aware of this, economic scholars utilize tools (such as mathematical models, data, or logical arguments) to answer their research questions. With the help of these tools, such scholars predict how changing the IP system would affect economic growth. The following paragraphs summarize the works economic scholars have done on intellectual property.

Firstly, economic scholars use *mathematical models* to describe the effect IP legislation has on economic growth. In their mathematical models, economic scholars make certain assumptions, for instance about the cost of an innovation or how long it is protected. They alter these assumptions in their models and derive a computed outcome, which explains whether a certain change in the IP system will lead to more economic growth. Doing that, economists have come to conclusions such as: no copyright will lead to more innovation than copyright (Boldrin & Levin, 2002), stronger IPRs do not lead to more economic growth (Helpman, 1993), and welfare losses caused by strict IPRs are small compared to those caused by under-protection (Kwan & Lai, 2003). Others economic scholars teach us that the protection of intellectual property rights enhances world efficiency when productivity in R&D is great, but not when innovations are likely to be small (Shavell & Ypersele, 2001). The results economists derive from their mathematical models then sound somewhat like this:

“When there are many firms competing for monopoly rents, and market conditions are such that rents can be obtained even with some degree of competition, the rent-seeking behavior of competing monopolists dissipates the social surplus by overproduction of too many similar items. When we allow for creativity in the use of markets by having consumers submit contingent bids, then no copyright is unambiguously better than copyright.”

— Boldrin & Levine, 2002

Secondly, economic scholars use available *data* to derive their findings. This data comes in various forms. Some scholars, like economic historian Höffner use historical data. Höffner (2010) compared data from Germany and the British Empire from the eighteenth and nineteenth century and concluded that the lack of a copyright law in Germany helped the country to outpace the Empire. While books in Britain were expensive and appeared in very limited editions, books in Germany were virtually accessible to almost anyone due to reprints and low prices. Knowledge could spread far more easily. Other economic scholars have used historical data to explain things such as how changes in specific IP systems have influenced economic growth (Coriat & Orsi, 2002). Others have observed a correlation between the GDP per capita and the level of patent protection (Gould & Gruben, 1996). Ginarte and Park (1997) explain that there is a threshold effect in the relationship between IPR strength and innovation. This means that stronger IPRs will only improve economic performance if the research intensity surpasses a certain threshold.

Thirdly, economic scholars use *logical arguments* to derive conclusions about intellectual property. The most famous article of this kind, in this case written by a law professor, is probably Heller's (1998) 'The Tragedy of the Anticommons'. In this article, Heller describes how multiple owners, each endowed with the right to exclude others from a scarce resource, can create a situation where no one has an effective privilege of use. Based on this idea, Heller (Heller & Eisenberg, 1998) explains how patents in biomedical research prevent useful and affordable products from reaching the marketplace, which is a bitter result for the economy. Hall (2007) uses a logical argument, too, when he explains that protecting inventions in different industries in a homogeneous way is counterproductive. While a patent might be an incentive to some companies, it is considered a necessary evil to others.

The research on intellectual property conducted by economic scholars is extensive and often contradictory. Jaffe (2000) even states, in an extensive literature review, that it is not possible to draw robust conclusions from economic literature in regard to intellectual property. Table 1.2 offers an overview of the primary scientific contributions by economic scholars on intellectual property.

Table 1.2 Literature overview, economic scholars on intellectual property

Author(s)	Title	Method	Results
Boldrin & Levin, 2002	The Case Against Intellectual Property	Mathematical model	When allowing creativity in the use of markets by having consumers submit contingent bids, no copyright is better than copyright.
Chin & Grossman, 1988	Intellectual Property Rights and North-South Trade	Mathematical model	Protection of intellectual property rights enhances world efficiency when productivity in R&D is great, but not when innovations are likely to be small.
Coriat & Orsi, 2002	Establishing a New Intellectual Property Rights Regime in the United States: Origins, Content and Problems	Historical data from one legislation over several decades	<ul style="list-style-type: none"> - Most observers have concluded that the extension of patents into new fields poses a number of future threats and uncertainties. - Contemporary doubts about the viability of changes reflect the harmful long-term economic effect of the privatization of basic knowledge.
Ginarte & Park, 1997	Determinants of Patent Rights: A Cross-national Study	Data from 120 countries	Only if the R&D intensity passes a certain threshold do strong IPRs lead to more economic growth.
Gould & Gruben, 1996	The Role of Intellectual Property Rights in Economic Growth	Data on GDP and economic growth from different legislations	Partial correlation between average yearly per capita growth (1960–1980) and the level of patent protection.
Grossman & Lai, 2004	International Protection of Intellectual Property	Mathematical model	The socially optimal degree of protection is not necessarily full IPR protection.
Heller, 1998	The Tragedy of the Anticommons	Logical argument fed with case examples	In the anticommons, multiple owners are each endowed with the right to exclude others from a scarce resource, and no one has an effective privilege of use.
Heller & Eisenberg, 1998	Can Patents Deter Innovation? The Anticommons in Biomedical Research	Logical argument fed with case examples from biomedical research	Patents in biomedical research prevent useful and affordable products from reaching the marketplace.
Helpmann, 1993	Innovation, Imitation, and Intellectual Property Rights	Mathematical model	Stronger IPRs do not lead to more economic growth. Stronger IPRs move the terms of trade against the country and bring about a reallocation of manufacturing.

Table 1.2 Literature overview, economic scholars on intellectual property (continued)

Author(s)	Title	Method	Results
Höffner, 2010	Geschichte und Wesen des Urheberrechts	Comparison of historical data from Germany and the United Kingdom	Germany's weak copyright law helped the country to outpace the British Empire. The absence of a copyright law in Germany resulted in more than five-times as many publications per capita compared to the British Empire, where a copyright law was in place in the 19 th century.
Jaffe, 2000	The U.S. Patent System in Transition: Policy Innovation and the Innovation Process	Review of theoretical and empirical literature	It is not possible to make robust statements about the effects of policy changes and the innovation process.
Kwan & Lai, 2003	Intellectual Property Rights Protection and Endogenous Economic Growth	Mathematical model	Welfare losses due to strict IPRs are small compared to those associated with under-protection.
Shavell & Ypersele, 2001	Rewards Versus Intellectual Property Rights	Mathematical model	A system in which innovators can choose between rewards and intellectual property rights is superior to intellectual property rights.

It states the methods used as well as the conclusions they drew from their research. A remarkable observation one can make, when skimming through works by economic scholars on intellectual property, is the fact that the majority of all scholars explain that weaker intellectual property laws would lead to more innovation and thus to more economic growth. At the same time however, most legislations undergo changes towards stronger intellectual property rights (Coriat & Orsi, 2002). In other words, lawmakers in the field of intellectual property show a notable tendency to contradict economists with their actions. A second noteworthy observation is the fact that economic scholars are likely to question the present IP system; however, they do not question the notion that an IP system's sole purpose is its contribution to economic growth. The purpose of the IP system as an engine for economic growth—with a few exceptions like Heller's (1998) 'Tragedy of the Anticommons'—is hardly ever questioned.

1.2.2 Intellectual Property as Seen by Business Scholars

The last group heavily contributing to the knowledge pool of intellectual property is business scholars. Unlike economic scholars, business scholars do not look at the entire system but rather at individual players in the system, firms. Business scholars consider the rules of the system as a given and describe how firms act within these rules. The main idea behind what business scholars look at is the fact that it is a crucial factor for a firm to determine whether and how to protect its intellectual properties (Taylor & Silberston, 1973; Mansfield, 1984; Teece, 1986; Hanel, 2006; Gassmann & Bader, 2011).

Among business scholars the topic of IP is usually considered part of a field called ‘technology and innovation management’. This field studies the entire process from an initial idea to an innovation, which is accepted by the market. Scholars tend to break this process down into two subprocesses, with the former labeled *creating value* and the latter labeled *capturing value*. Creating value deals with the development of new technologies or innovations (Teece et al., 1997; Amit & Zott, 2001; Thomke & Von Hippel, 2002), while capturing value deals with the question of how firms can make the most of their innovations (Teece, 1988; Chesbrough & Rosenbloom, 2002). Mainstream scholars consider intellectual property to be part of what is called capturing value. Occasionally, the topic of intellectual property is also picked up by other fields such as entrepreneurship (De Castro et al., 2008; Lichtenthaler, 2008), or strategic management (Somaya, 2003; Leiponen, 2008; Reitzig & Puranam, 2009).

Works by business scholars may include policy recommendations but do not necessarily do so. Observing multiple firms struggling with certain practices, for instance, might lead to policy recommendations. However, most business scholars contribute by describing how firms act in given IP legislations, what the theoretical explanation for these actions is and what others can learn from both things.

The present dissertation has a business background. As such, describes how firms cope with the given system and what might be learned from that. Therefore, this dissertation does not raise the economic question of whether the IP system as a whole is useful or not. Even though, many of the interviewed managers contributing to this dissertation had their very own notions about this.

1.3 Appropriability

The most important theory business scholars use in regard to intellectual property is called *appropriability*. It describes the degree to which a single firm can capture rents from its innovations. A concept that might sound abstract to some. But, in its essence this only describes how quickly or easily a competitor can copy an innovation. Teece (1986) noted that appropriability is a necessary building block for innovation: if a company fails to appropriate, others will imitate and commercialize the innovation. This leaves the initial firm without an incentive (and likely without funds) to innovate again, Teece (1986) argues. As such, business and economics go seemingly hand in hand. On a micro level, a firm has to have the ability to appropriate in order to keep innovating. On a macro level, a legislation has to provide instruments to make sure that firms can appropriate in order to promote economic growth, the argument goes.

As described earlier, many economists disagree with this argument, which leaves business scholars in an interesting position. However, it is a fact that firms have to keep on innovating in order to keep up with the market (Arrow, 1962). Once firms stop innovating, other firms will become better and more cost-effective and thus are able to take over the market. All firms are exposed to IP legislation. Regardless whether these IP legislations actually promote or hinder innovation, every single firm has to deal with them and every single firm has to utilize them in the best way possible in regards to their own innovation activities. Now, it is up to the business scholars to describe the underlying theoretical motivations which make firms act the way they do.

Today, twenty five years after Teece's (1986) article 'Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy', appropriation is still an important topic for business scholars. In recent years many scholars looked into this field of research and answered fundamental questions. It is important to note that the idea of profiting from innovation has shifted during the past decades. While previously, profiting from innovation was solely associated with financial returns, this is not necessarily the case anymore. Teece's article (1986) can be considered as empirically based reasoning, introducing transaction costs and evolutionary economics into a framework that could help us understand how firms benefit from innovation

(Jacobides et al., 2006). In the two following decades, this notion began to shift and more dynamic aspects were introduced. That does not invalidate the idea of appropriation, but rather suggests that, today, appropriation is more complex. This is because the success of an innovation and a company's ability to appropriate are not necessarily coupled anymore. Not every innovation is made with direct profits in mind. Today, many innovations are made to access a certain market; profits are generated later for instance by additional services (Teece, 2010; Chesbrough, 2007). Furthermore, there are examples in which the success of an innovation is actually due to its inimitability (De Castro et al., 2008). Open Source Software, for example, owes a great deal of its success to the fact that anyone can imitate it and therefore participate in and enhance it (von Hippel & von Krogh, 2003). The adaptive nature of a firm dealing with intellectual property has thus prevailed, and more complex structures can be found in both literature and practice (von Krogh & von Hippel, 2006).

Patenting in the 1980s and 1990s increased notably, which was somewhat surprising. It was surprising because several studies (Mansfield, 1984; Levin et al., 1987; Cohen et al., 2000) showed that while firms did not increase their reliance on patents for appropriation, they did increase their patenting activities. This contradiction was labeled the *patent paradox* and was revisited again in 2001 when Hall and Ham-Ziedonis (2001) asked, why firms were patenting in such an aggressive manner when they were not also increasingly relying on patents. The two researchers interviewed semiconductor firms and were able to carve out several reasons why firms were patenting. The most common answer the two received was that firms used patents as bargaining chips. In a complex and ever-changing industry such as the semiconductor industry, patent infringements happen regularly. Oftentimes, these infringements are not taken to court but are resolved in cross-licensing agreements (Grindley & Teece, 1997). Cross-licensing agreements are arrangements which allow one participating party the use of formal protection measures (usually patents) in exchange for the permission to a second party to do the same. These agreements only work because both parties know that they own formal protection measures which they could take to court. This functions as a threat. As court cases are expensive and can take years, many firms consider cross-licens-

Table 1.3 Literature overview, appropriation from innovation in chronological order

Author(s)	Title	Sample	Results
Teece, 1986	Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy	Theoretical paper with exemplary cases	<ul style="list-style-type: none"> - Imitators can often outperform innovators. - Markets do not work well when imitation is easy. - Innovation will fail when ill positioned in the market. - Firms have to protect their innovations in order to benefit from them. - There is no one protection strategy that fits all companies.
Levin et al., 1987	Appropriating the Returns from Industrial Research and Development	650 firms (mostly large firms)	<ul style="list-style-type: none"> - Non-patenting measures are often more important than patents. - Varies among industries.
Arundel & Kabla, 1998	What Percentage of Innovations are Patented?	604 European firms (large firms)	<ul style="list-style-type: none"> - Propensity to patent increases with firm size. - Firms that prefer secrecy patent less.
Kitching & Blackburn, 1998	Innovation, Intellectual Property and Informality	400 English firms (SME)	<ul style="list-style-type: none"> - Small firms placed most emphasis on informal methods to protect intellectual property. - Formal methods such as patents are less important to SME.
Brouwer & Kleinknecht, 1999	Innovative output, and a firm's propensity to patent. An exploration of CIS micro data	Dutch Community Innovation Survey 1300 manufacturing firms	<ul style="list-style-type: none"> - Smaller firms have a lower probability of applying for a patent. - Smaller firms that do apply for patents, however, tend to have higher numbers of patent applications than larger firms (per employee).
Cohen et al., 2000	Protecting their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent	1478 U.S. R&D labs (all firm sizes)	<ul style="list-style-type: none"> - Firms use a range of protection mechanisms (patents, secrecy, lead time advantages, complementary marketing, manufacturing capabilities). - Patents least emphasized by firms. - Secrecy and lead time advantages most emphasized. - Patenting is not mainly done to protect. - Industry differences.
Mogee, 2000	Foreign Patenting Behavior of Small and Large Firms	5569 patents issued in 1988 (small and large firms)	<ul style="list-style-type: none"> - Small firms patent less than large firms. - When only patents that are also filed outside the U.S. are considered, however, there is no difference in the number of countries in which small and large company patents are filed.
Arundel, 2001	The Relative Effectiveness of Patents and Secrecy for Appropriation	1993 European Community Innovation Survey: 2849 R&D-performing firms	<ul style="list-style-type: none"> - A higher percentage of firms (in all size classes) rate secrecy as more valuable than patents. - The probability that a firm rates secrecy as more valuable than patents declines with an increase in firm size for product innovations, while there is no relationship for process innovations.

Table 1.3 Literature overview, appropriation from innovation in ... (continued)

Author(s)	Title	Sample	Results
Hall & Ham-Ziedonis, 2001	The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995	Interviews with semiconductor firms and econometric data from 95 semiconductor firms	<ul style="list-style-type: none"> - Patents have an increasing value as 'bargaining chips'. - Blocking of competitors and preventing lawsuits are the second and third most important motivation to patent (after the prevention of copying). - Patents are important in attracting venture capital funds.
Chesbrough, 2003	Open Innovation: The New Imperative for Creating And Profiting from Technology	Exemplary cases	<ul style="list-style-type: none"> - Collaboration in R&D is increasing, R&D is becoming 'open'. - IP is turning into a commodity. - IP is increasingly traded.
Blind et al., 2006	Motives to Patent: Empirical Evidence from Germany	522 German firms	<ul style="list-style-type: none"> - Large firms have stronger incentives to patent (position in negotiations with partners, licensees, or to use patents as incentives for R&D personnel or performance indicators). - Patents often have a 'strategic' reason.
Jacobides et al., 2006	Benefiting from Innovation: Value Creation, Value Appropriation and the Role of Industry Architectures	Theoretical paper	There is a notable shift in the understanding of appropriability from transaction costs to more dynamic capabilities.
Arbussa & Coenders, 2007	Innovation Activities, Use of Appropriation Instruments and Absorptive Capacity: Evidence from Spanish Firms	Survey of Spanish firms: 11'778 firms	<ul style="list-style-type: none"> - Firms investing in appropriation instruments to reduce outgoing spillovers tend to do more R&D and downstream activities than firms that do not. - The effects of incoming spillovers are stronger for firms that invest in appropriation instruments.
Leiponen & Byma, 2009	If You Cannot Block, You Better Run: Small Firms, Cooperative Innovation, and Appropriation Strategies	504 Finnish firms (small firms)	<ul style="list-style-type: none"> - Informal means of protection (speed to market, secrecy, ...) more important than patenting. - Patents in firms with university cooperations. - Cooperation strategy has main influence on choice of protection.

ing agreements to be a superior option. Having patents is a basic requirement to take part in these cross-licensing agreements and is therefore a reason to patent inventions. Hall & Ham-Ziedonis (2001) also found that firms use formal protection measures to block competitors and prevent lawsuits. Cohen et al. (2000) noted that firms rely heavily on informal measures when appropriating. The scholars used a sample of 1478 U.S. R&D-labs and explained that the two informal measures of secrecy and lead time advantages were most emphasized by the firms.

Another aspect that heavily influenced appropriation was the advent of Open Innovation. Open Innovation describes the trend towards more collaborative R&D (Chesbrough, 2003; Gassmann, 2006). This means that firms increasingly work together while developing. Once collaboration is emphasized in R&D, appropriation changes, too. On the one hand, collaboration requires the partnering firms to share their IP. On the other hand, it does turn intellectual property into a commodity. Intellectual property is increasingly traded and more and more firms develop not to market a product, but to sell or license their intellectual property (Chesbrough, 2006).

Table 1.3 summarizes the most important contributions to appropriation in a chronological order, starting with Teece (1986).

The research on appropriation is based on two premises. Firstly, it is based on the assumption that any formal protection measure can be taken to court and can be enforced. Secondly, it is based on the assumption that firms have the necessary funds and resources to take their formal protection measures to court and hence enforce them. I will break these two arguments down in the following paragraphs.

Firstly, being able to take formal protection measures to court is what gives these measures a value. Others will only respect a measure if the enforceability of this formal protection measure is likely. In other words, hardly anyone will value a formal protection measure if this measure cannot be enforced. As described earlier, Hall and Ham-Ziedonis (2001) showed that patents are often used not only to protect an invention, but for other reasons as well. All of the reasons patents are used for are based on the assumption that these measures can be taken to court and can be enforced (Shapiro, 2003; Jaffe & Lerner, 2004). Formal protection measures are registered at the national level. From there, scholars differentiate between strong and weak appropriability regimes. Strong appropriability regimes describe regimes where firms can enforce formal protection measures through aggressive litigation (Somaya, 2003). Weak appropriability regimes on the other hand, are regimes where formal protection measures are far less likely to be enforceable.

Secondly, scholars looking at appropriation start with the assumption that the firms possessing formal protection measures have the resources to enforce them. That is why the majority of all studies on appropriation are based on

large firms. These large firms typically commit extensive resources to secure appropriation and operate in-house IP departments where engineers and patent attorneys actively seek possibilities for appropriation (Blind et al., 2003; Blind et al., 2005).

These two premises led to a literature on appropriation that is focused on large multinational companies active in strong appropriation regimes (Arundel et al., 1995; Cohen, et al., 2000; Cohen et al., 2002; Grandstrand, 1999; Levin et al., 1987). As a result we gained a deep understanding of how these firms appropriate. However, we know little about how firms appropriate if one of the two premises does not hold.

1.4 Aim and Structure of This Dissertation

This dissertation deals with IP in settings where one of the two just mentioned premises does not hold up. This means that this dissertation describes settings in which firms a) are active in legislations where formal protection measures are not easily enforceable or b) do not have the financial means or other resources to protect their IP in a way the literature suggests that they would.

As such, this dissertation contains five individual articles. This first article is meant as an introduction to the field.

The second article is on Swiss life science SME and their approach towards intellectual property (chapter 2). The article describes how three firms make their IP related decisions and which underlying constructs affect the decision making process. In this article a set of factors that influence the IP related decision making in these three SME is presented. Firstly, endogenous factors, meaning factors that lie inside each single company are investigated. These include (1) financial resources, (2) experience with litigation, (3) collaborations and (4) market strategy. Secondly, exogenous factors, or those that stem from the SME's competitive environment are investigated. These factors are (1) technology's risk of imitation, (2) market's competitive structure and (3) technological level. The seven factors combined explain IP related decision making.

The third article (chapter 3) is about international new ventures (INVs). These are firms that internationalize very early and thus are exposed to several

intellectual property regimes. Being small and active in several countries makes it especially difficult to profit from innovation. How INVs can appropriate returns from innovation is an important yet under-researched question. This inductive article causally pinpoints the presence of a firm-level appropriation capability to firm-level organizational characteristics. Successful INVs craft two novel strategies that have not been previously reported in the literature. Firstly, they use defensive publishing in order to obtain a freedom to operate. Secondly, they educate their customers on IP issues and use them as outposts in market where the INVs are not present themselves. Furthermore, successful INVs combine these novel measures into hybrid protection strategies.

The fourth article (chapter 4) deals with IP in China. Theory predicts that in weak appropriability regimes, like that of China, firms should appropriate rents from innovation by lead time advantage, co-specialized assets, or secrecy, but not by patents. For the last 10 years, the case of China has been a persistent anomaly to this prediction. Since 2000, patent applications of foreign firms in China have been growing at an exponentially increasing rate, although China still represents a weak appropriability regime. This study attempts to resolve this paradox by an exploratory inductive approach. 11 cases of foreign firms that have filed patents in China, are analyzed and the motives for patenting in a weak appropriability regime are presented. The findings suggest that once the stable economic environments of developed nations on the basis of which the current theoretical frameworks were created are no longer available, additional motives and considerations may interact with and even supersede theoretical predictions. Specifically, four different archetypes of firms whose existence is not predicted by current theory are presented. The article offers some qualifiers to Teece's appropriation regime, as it explains that there are reasons for patenting in weak appropriation regimes that are unheard of in literature, so far.

The final article (chapter 5) deals with SME in general. The article explains how these firms can make sure that their innovations are worth the effort. It is an inductive article that causally pinpoints the presence of a firm-level appropriation capability to firm-level organizational characteristics. It shows that a SME's capability to appropriate returns is associated with its capability to design and deploy informal appropriation measures, as well as with its entrepre-

neurial behavior. Entrepreneurial behavior positively moderates the development of protection capacities.



Intellectual Property Protection: The Case of Three Swiss Life Science SME

This article, coauthored by Marcus Matthias Keupp and Oliver Gassmann, describes how three Swiss Life Science SME make their IP-related decisions and which underlying constructs affect the decision making process. In this article a set of factors that influence the IP-related decision making in these three SME is presented. *Firstly*, endogenous factors, meaning factors that lie inside each single company are investigated. These include (1) financial resources, (2) experience with litigation, (3) collaborations and (4) market strategy. *Secondly*, exogenous factors, or those that stem from the SME's competitive environments are investigated. These factors are (1) technology's risk of imitation, (2) market's competitive structure and (3) technological level. The seven factors help to understand the IP-related decision making in SME.

2.1 Introduction

To capitalize on their investments in innovation, companies have to have the ability to appropriate rents from these investments (Cockburn & Griliches, 1988; Teece, 1986). Hence, the protection of a company's intellectual property (IP) is an important topic in the innovation literature. IP is increasingly regarded as a source of competitive advantage for corporations (Hanel, 2005; Blind, 2009). The methods firms use to protect their IP can be divided into three main categories: juridical (legal) methods, complementary measures, and de-facto protection methods. Juridical protection methods comprise the use of registrable rights (such as patents, industrial designs and trademarks) and non-registrable rights (such as copyrights and licensing agreements). Complementary methods comprise measures such as lead time advantages, secrecy or strong distribution channels which all offer additional benefit to the customer (Teece, 1986; Hussinger, 2006). De-facto protection methods comprise strategies crafted by firms themselves to protect their IP when juridical protection methods are ineffective or when it is impossible to enforce registrable rights in the institutional environment of a specific country (Gassmann & Keupp, 2007; Keupp & Gassmann, 2009).

The way firms use these three methods to protect their IP and to appropriate the economic returns from it has become a subject of growing interest (Grandstrand, 1999; Kingston, 2001). However, the literature has focused on how (large) multinational corporations (MNCs) protect their IP and appropriate returns from it. In contrast, these questions have been studied very little in the context of small firms, and, even worse, studies are virtually non-existent in an international entrepreneurship context. Large firms often benefit from applying resource endowments to finance a broad legal protection strategy. Their own patent departments staffed with engineers and patent attorneys allow them to actively seek patenting possibilities as well as to explore other means of IP protection (Blind et al., 2003, 2005). In contrast, the literature is relatively pessimistic when it comes to appraising the competence of small firms to protect their IP. Large firms appear to use patents to a much greater extent than small firms (Levin et al., 1987; Hussinger, 2006; Arundel, 2001; Arundel et al., 1995; Blind et al., 2006). High expected litigation costs can deter small firms from patenting (Lerner, 1994; Cohen et al., 2000; Lanjouw and Schankerman, 2001).

The field of international entrepreneurship (IE) that examines how international new ventures (INVs) use their entrepreneurial skills and their exposure to the international domain to create value is an important area of study in business theory (Oviatt and McDougall, 1994; Autio, 2005). However, while recent literature has investigated how these firms can create competitive advantage, very little is known about how these firms appropriate the economic benefits from IP they build up as a result of this competitive advantage.

With very few exceptions (Gassmann and Keupp, 2007; McGaughey et al., 2000), the way internationally active small firms decide about the specific setup of their IP strategy, mechanisms and defense has not been studied. This is in stark contrast to the IP strategies and setups of MNCs, which are intensively studied, e.g. by Ghauri and Rao (2009), Yang et al. (2008) and Yang (2005). A recent literature review on IE found that only five out of 179 studies were concerned with IP and appropriation issues (Keupp and Gassmann, 2009). The authors reviewed these studies but none of them was concerned with explaining how small firms manage to protect their IP.

Small firms have very little international patenting activity, although their export rate is high. However, domestic patents play a significant role in pushing firms to start or increase their internationalization. This means that very active technological firms carry out international activities more frequently (Molero, 1998). Possession of a patent was not found to be a significant predictor of the adoption of an international strategy by SME (Baird et al., 1994). On the other hand, Autio et al. (2000) have pointed to the possibility that imitability may not be an impediment to international growth under specific circumstances such as a fast-moving technological environment. However, they note that the effect of imitability on growth in a cross-border context is not unambiguous; also the appropriate strategic treatment of imitability may depend on the configuration of knowledge strategies employed by a firm (Bierly & Chakrabarti, 1996).

There is a considerable research gap on the question of how internationally active small firms protect their IP and this question has not yet been addressed in the IE literature. The findings here suggest that the international context leads small firms towards acting entrepreneurially. This action, in turn, leads to the development of new hybrid IP strategies that are effective while resource-saving.

Given the scarcity of literature on this topic, this study is exploratory in nature. It analyses qualitative data obtained from in-depth interviews with three internationally active SME from the life science sector in order to study the systematic differences of IP protection methods across the three case studies. Finally, the results and their implications for theory and practice are discussed.

Given the focus of this book on the life science sector three case studies of internationally active Swiss SME from this very sector will be presented: *firstly*, a company that produces isolators for the pharmaceutical industry, *secondly*, a producer of medical devices, and *thirdly*, a SME that produces analytical instruments. The case studies are taken from a larger sample of case studies. All three companies originate from the Basel region, one of the most renowned industry clusters for life science in Europe.

2.2 Methods

This is comparative, cross-sectional, multiple-level, inductive research. This type of research is appropriate when one wants to understand the phenomena under investigation within their rich organizational contexts, an aim of this study. The approach to sampling the firms analyzed in this paper was theoretical in Eisenhardt's sense that 'the goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory' (Eisenhardt, 1989: 545). The multiple-case approach allows for cross-site comparison, so that idiosyncratic aspects of any one site can be seen in perspective. This enhances the robustness of the findings (Miles, 1979) and by using this approach, the authors strived to causally pinpoint those characteristics and theoretical mechanisms that determine how life science SME protect their IP.

2.2.1 Data Collection

The firms were identified using a database which the authors' institute maintains. These three firms were chosen by theoretical sampling, not by random sampling. The aim was to identify different types of firms that differed in the ex-

Table 2.1 Structural data

Case	Industry sector	Product made	Employees	Founded
1	Pharmaceutical supplies	Isolators for the pharmaceutical industry	180 (+40 extern)	1968
2	Medical devices	Shakers and fermenters	130	1965
3	Medical diagnostics	Analytical instruments for research purposes	6	2000

tent to which they use and defend intellectual property rights. By cross-comparison of these different types of firms, a high analytical variance can be expected, and these differences may be traced back to systematic differences between the firms (Eisenhardt, 1989). In addition to this theoretical sampling approach, a number of comparisons and statistical tests was conducted between these three cases and the total of 859 firms present in the database to analyze whether the three cases were over-representing a specific type of firm. As this was not the case, concerns about possible self-selection bias were alleviated. Given the depth of the research involvement, absolute anonymity and confidentiality was guaranteed to the three firms. This is why the names of the firms have been disguised in this article.

Table 2.1 gives details about the firms. Each case was studied in a longitudinal manner; the research presence in the three firms lasted from January 2008 to May 2009.

2.2.2 Data Sources

Data were collected by means of personal in-depth interviews, archival documents, and on-site observations. Such triangulation of various types of data collected by different methods enhances construct validity by overcoming the limitations of using only one method and thus provides a solid foundation for theory development (Jick, 1979). Table 2.2 informs in detail about all data sources.

Table 2.2 Sources of data

Case	# Interviews (confirmatory interviews)	Archival documents
1	4 (3)	Business plans, websites, patents, company presentations, organigrams.
2	3 (3)	Business plans, websites, patents, company presentations, organigrams.
3	5 (4)	Business plans, websites, patents, internal memos, organigrams, sector analysis.

For the interviews a multiple-informant approach was adopted. Interviewees were sought on a top hierarchical level to ensure the interviewee had detailed and substantiated knowledge. They were identified by ‘snowball sampling’. In each firm the Chief Executive Officer (CEO) was asked to name those individuals that were most involved with the firm’s IP activities. These informants were asked to name other individuals who were central to the firm’s IP protection.

This process converged on a set of key managers who were interviewed. The interviews asked for both past and real-time data to create greater depth of understanding of how events had evolved over time (Leonard-Barton, 1990). The interviews were organized following the same semi-structured interview guide. This guideline comprised a series of open-ended questions that allowed the informant to relate his or her experience. The questions concentrated on facts and events rather than on respondents’ interpretations (Eisenhardt, 1989).

All interviewees were native German speakers, and all interviews were conducted in German. All verbal quotes appearing in this paper have been translated into English, using the translation-back-translation procedure to guarantee the accuracy of the translations. These personal interviews lasted between 90 and 120 minutes and were tape-recorded and transcribed verbatim which resulted in more than 200 pages of transcripts. A second round of interviews was conducted to ensure a correct replication of answers and to clarify issues which emerged during the process of transcription.

The authors tried to control for potential respondent bias as far as possible by not mentioning any element of the emergent theory to interviewees and by

keeping a passive and unobtrusive presence during company visits and interviews. Further, to reduce bias from recall and rationalization, table 2.2 shows that the authors triangulated the collected interview data with both firm-internal data sources and external analyses from third parties. The authors believe that by using these procedures and additional data sources it is likely that potential respondent bias was significantly reduced.

2.2.3 Data Analysis

During the research, the collected data were continuously entered in a case database. When data collection on one firm was complete, all data on this firm were synthesized into individual case histories. The authors began the writing of these histories without formulizing any expectations of the extent to which firms could successfully develop exploratory innovations.

The case histories were between 15 and 20 double-spaced pages in length and included narrative, selected quotes from the informants, and tables and timelines summarizing key facts. Two assistants read through the original interviews and formed an independent view of each case history, the analyses, and the emerging constructs. These independent opinions were used to cross-check the emerging case histories. While reading and analyzing interview transcripts, field notes and documents, the authors engaged in an iterative process of comparing the documentation with the literature to assess the fit of case data (Eisenhardt, 1989). This iterative process of constantly comparing emergent theory and data often led to a more qualified understanding. After all individual case histories had been completed, the authors enabled cross-case comparisons by tabulating the data following techniques for cross-case pattern sequencing and pair-wise comparisons (Eisenhardt, 1989) and tabular displays (Miles & Huberman, 1984). Later, tentative propositions were developed by examining whether similar themes emerged across cases.

2.3 Results

The three case studies differ substantially in regard to their IP management, as can be seen in table 2.3. Concerning juridical protection company (3) has only three patents while the other two companies have ten or more. The companies also differ in their use of complementary methods. All the companies rely on complementary protection methods to some extent, but while company 3 relies heavily on secrecy (such as secret know-how or hidden software code), company 2 focuses on publications to guarantee its freedom to operate. Company 1 mixes the two approaches and works with secrecy agreements as well as publications.

To explain the differences in their IP strategies the authors identified two diverse sets of factors that influence the IP-related decision making in these three SME. Firstly, *endogenous factors*, meaning factors that lie inside each single company. These factors are (1) financial resources, (2) experience with litigation, (3) collaborations and (4) market strategy. Secondly, *exogenous factors*, meaning factors that stem from the SME's competitive environments. These factors are (1) technology's risk of imitation, (2) market's competitive structure and (3) technological level. The seven factors combined explain the IP-related decision making.

2.3.1 Endogenous Factors of Influence

1. Financial Resources

The financial resources the three life science SME have at their disposal influence their decision making towards IP. However, the importance of this instrument differs across firms. Companies 2 and 3 claimed they would use registrable rights more extensively if they had more financial resources whilst company 1 explained that financial resources were no such impediment (see table 2.4). Once the company decides that a patent is the most adequate protection method, the company usually comes up with the financial resources needed to apply for the patent and to keep it.

Table 2.3 Extent of IP protection and structural properties of firms

Case	1	2	3
Juridical protection measures	Around 10 patents.	30–40 patents, trademarks.	Trademarks and corresponding internet domains, 3 patents.
Complementary protection methods	Secrecy agreements, publications for freedom of action, need-to-know principle.	Publications to archive freedom to operate, secrecy (hard to archive, other companies copy within months), secrecy agreements with other companies.	Secret know-how on assembling process, secret software code, try not to give out confidential information and keep core processes in the company.
Collaborations	Suppliers and universities.	Several collaborations in the past; fewer today.	EU research projects, universities.
Market strategy	Market leader in a niche market, few products.	Technology leadership.	Unparalleled machines; unique features.
Technological level	High.	Medium.	Medium.
International activities	Export ratio: 80 %.	Export ratio: 85 %.	Almost 100 %.
Differentiation	Leading-edge products.	Leading-edge products.	Focus on certain features competitors do not offer.
Time of first internationalization	The company's first project was an international one.	First customers were abroad.	The company went international after four years.
Reason for fast internationalization	Active in the pharmaceutical industry. Customers are internationally active therefore a "Swiss only" offer would not make sense.	The market in Switzerland is too small to support the company.	No market for the product in Switzerland.

All three companies have multiple patents (see table 2.3). So resources are not a reason to eschew the use of juridical protection methods. As can be seen in table 2.4 companies 2 and 3 claim they would patent more if they had more resources. Company 2 already has 30–40 patents and therefore a very large IP budget compared to the other companies. Having a large budget for IP allows company 2 to have a certain level of patenting activity; the CEO regards it as desirable to have many patents and would patent more given the financial resources. Company 3, which also stated that more resources would lead to more juridical protection, is a micro firm. Having less than ten employees this company has the least resources in the sample; however it already holds several patents even though taking out patents is much more expensive than other protection methods. However, financial resources are still an impediment for company 3.

Resources have an additional effect on the SME's IP-related behavior. Resources shape the actions the SME take in order to resolve infringement cases. All three companies are facing the threat of infringements. They explained that the costs of an infringement case pose a serious risk for SME (see table 2.5). Given this risk all of the companies try to avoid lawsuits.

“The costs of a litigation process are much higher than the value of any patent we own.”

— Vice president, company 1

The firms are aware of the fact that a lawsuit can be life-threatening to any small firm. Hence, they try to find bilateral solutions to conflicts. Table 2.5 shows how financial resources determine the strategies the SME choose to resolve IP-related conflicts. None of the firms take infringement cases to court on a regular basis, even though they would like to do so as they are aware of the financial consequences. Instead they often opt for complementary protection methods.

The SME take the potential costs of a lawsuit into consideration and therefore go for complementary protection methods instead of juridical ones. As the CEO of Company 3 said:

“We focus on complementary protection to avoid conflicts.”

Table 2.4 Do resources determine the choice of IP protection?

Case	Do resources determine the choice of IP protection	Consideration
1	No	“The costs of patents and trademarks do not determine the choice of IP protection.”
2	Yes	“It is always a trade-off between costs and benefits.” Company is heavily active in patenting and currently holds 30–40 patents. More patents would be desirable given the company’s business model.
3	Yes	“Our company’s limited resources force us to protect only certain aspects.” As a micro firm with only six employees resources are far more limited than in other SME. Patents are expensive compared to the firm’s total revenues.

2. Experience with Infringements

All three companies have experienced infringements of some sort and have altered their approach towards intellectual property protection. Firms that have experienced infringements take what they have learned into consideration when making IP-related decisions. Table 2.6 illustrates the SME’s experiences with litigation.

Having experienced several infringement cases company 1 makes sure that the fate of the company does not depend on a single patent. The company’s CEO said that he could hardly imagine a case where the value of a patent would be higher than litigation costs. Company 2 explained they were involved in a lawsuit protecting one of their patents. The lawsuit lasted several years and even though they won they only received a small amount of compensation. Subsequent to this the company tries to avoid lawsuits, preferring to accept the potential loss of profit.

Company 3 uses its close bonds with its customers to counter infringements. The company informs its customers whenever counterfeited products are in circulation and has ensured that customers who produce products such as medical equipment, where safety issues are critical, are aware of the dangers of using counterfeited products.

Table 2.5 How financial resources determine SME's strategy to resolve IP-related conflicts

Case	Financial resources	Consideration	Strategy to resolve conflicts
1	Resources make the difference between having and defending a patent.	"We are trying to save the money and invest it in research projects."	Trying to avoid patent attorneys and costly conflicts.
2	Litigation costs can kill SME.	"Small companies do not have the financial stamina to engage in such conflicts."	Avoiding conflicts with large corporations.
3	The possible lack of resources in case of litigation is a problem.	"There seems to be no insurance to cover litigation costs for SME."	Trying not to get involved in litigation processes.

"How to settle a conflict depends on the situation. If you have somebody on the other side who is mainly interested in generating some license fees, you would probably find a solution. If you have a competitor on the other side who is trying to get you out of business, it's more difficult."

— CEO, company 3

For all the case companies IP is a fundamental asset in the life science sector. Often, however, defending this asset holds more risks than potential benefits. Table 2.6 shows that companies, which experienced litigation know that defending their IP in court is a costly and dangerous endeavour. So the companies not only try to avoid litigation but also rely on complementary protection methods such as secrecy to make it difficult for infringing companies to copy their products.

3. Collaborations

For the companies studied collaborations play an important role in their success. Developing solutions solely within the firm is often not possible with the resources these SME have at hand, hence collaboration activities can be found

Table 2.6 Experiences with infringements

Case	Company's experience	Learnings	Strategy to resolve conflicts
1	IP was copied several times.	"The costs of a litigation process are much higher than the value of any patent we own."	Trying to avoid patent attorneys and costly conflicts.
2	Competitor copied a patent protected product. It took the company years and several attempts to settle the dispute. Company received a minor compensation.	"Being right is not as important as having the financial stamina to show that the company is right."	Trying to avoid conflicts with large corporations.
3	Several cases of IP infringement. Never enforced by a legal process.	"There is no insurance that covers IP litigation costs."	Informal discussions with infringing parties.

in each of the firms (see table 2.3). These collaborations with other companies or institutions shape the firms' decisions about IP protection. Firms engaging in collaborations on a regular basis are forced to take into consideration the effects of collaborations on the companies' IP.

"Other small firms are of no use as a collaboration partner. In the beginning the big firms with similar products always seem to be of use but later in the collaboration they want to absorb your entire company."

— Founder, company 2

One key distinction is the collaboration partner the SME choose. Collaborations with suppliers or universities only have a minor influence on the companies' IP management. The firms studied have different objectives from both universities and suppliers and so do not fear loss of knowledge to them, but this is not the case with enterprises active in the same or a similar market. The

firms studied also explained that knowledge that passes to a larger corporation is impossible to recover.

Company 2, for instance, was engaged in product development with a large competitor and gave crucial information to its partner. After a while, company 2 found out that the partner had copied its entire product line. In response, company 2 quickly told its customers that the competitor's products used an outdated technology and that they were currently developing a more sophisticated product. Company 2 maintains that this was the only reason they survived the infringement.

As can be seen in table 2.3, the three SME are involved in collaborations with diverse partners. The companies know that a lawsuit against a large corporation can be life-threatening and they try to avoid such situations. All the SME explained that collaboration with competitors or potential competitors encourages them to use complementary protection methods. Hence, the SME try to bring products to market as quickly as possible to benefit from any lead they may have over their competitors. They also conduct their collaborations quite cautiously, operating on a need-to-know basis. This is especially true when collaborating with larger firms.

4. Market Strategy

The SME have different market strategies, company 1 focuses on a few key products, company 2 on technology leadership, and company 3 on special features other companies do not offer (see table 2.3). All these strategies have an impact on how the firms manage their IP.

Company 1 follows a market strategy used by many SME, which is to produce high-quality products for a niche market: a protection mechanism in itself. Customers occasionally switch to cheaper, lower-quality products from competitors but they usually come back after a short period of time regretting the switch. Company 2's market strategy is technology leadership. Its competitive advantage is selling products other firms are not yet able to offer and relies heavily on publications to guarantee its 'freedom to operate'. Company 3 focuses

on special features that no other competitor offers and thus its IP management focuses on patents for these special features.

It is important to adapt the IP management to a SME's market strategy. The companies studied are well aware of their core competencies and focus their IP management on those aspects that differentiate them from their competitors. While the market strategy itself can be an IP protection for some SME, others try not to protect their IP but focus their juridical protection efforts on differentiating features.

2.3.2 Exogenous Factors of Influence

In addition to the endogenous factors the authors identified three exogenous factors, which influence IP decision making in the firms. These factors all relate to the competitive environment.

1. Technology's Risk of Imitation

The companies are exposed to risk if their technologies are copied by other market participants. The companies spoke about two main risks. *Firstly*, where competitors patent a technology the firms already use but have not patented, and *secondly*, lost sales revenue and profits where a competitor sells similar or counterfeit products. All three companies explained that for them unprotected technology was the more serious risk of the two.

Given this the SME said they sought to protect their IP either through 'freedom of action' or by 'blocking competitors'. The companies 1 and 2 explained that freedom of action can be considered as their main reason to use IP protection while for company 3 it was to block competitors. Given this, the companies all have their preferred protection methods (see table 2.7).

Fearing that a competitor might patent a technology they use, company 1 uses publications and secrecy agreements to maintain its freedom of action and company 2 uses publications and patents, the rationale being that once

Table 2.7 Main risk of unprotected technologies

Case	Main risk of unprotected technologies	Main motive to use IP protection	Preferred IP protection method to counter main risk
1	Competition might patent a known technology.	Freedom of action. “We have to try to be vanguard in the pharmaceutical industry.”	Publications, secrecy agreements.
2	Competition might patent a known technology.	Freedom of action. “It is our strategy to be simply better.”	Publications to guarantee freedom of action, patents.
3	Competition might patent a known technology.	Blockage of competitors. “We are focusing on the special features of the product, so the technology is different.”	Patents.

a technology has been publicized it cannot be patented. Company 3—actively wanting to block its competitors—prefers juridical protection methods such as patents.

2. Market’s Competitive Structure

The characteristics of the markets the SME are active in foster certain perceptions within the SME and thus influence the decisions they make about IP protection (see table 2.8). Company 1 is active in an oligopolistic market. So, having only a few competitors, the company does not see the need to patent all new technologies. The company’s CEO explained that focusing on complementary protection methods such as publications and secrecy is a preferable strategy. Company 2 produces and sells highly sophisticated machines with features that other companies do not offer, so innovating and exploiting lead time advantages are important aspects of the company’s strategy.

Table 2.8 Market characteristics

Case	Market characteristics	Perception	Effects on IP activity
1	Niche market, few competitors.	“There is no need for a strong IP protection in an oligopolistic niche market.”	Minor patent activity, main focus on complementary protection methods.
2	Demanding customers, customers are willing to pay premiums for new features.	“To survive in this market we must sell highly sophisticated products that other companies do not offer to this point.”	Lead time advantages are used to establish a reputation as innovation leader.
3	Several companies offer quite similar products in the market.	“To gain market we have to offer products with special features.”	Patenting these special features to maintain singularity.

Company 3’s market is highly competitive. Thus, the company focuses on special features customers will not find elsewhere. As indicated earlier, this strategy allows the firm to focus its IP protection efforts on the special features.

“It’s a new technology, which is different from other technologies used for the same kind of measurement in the sense that it relies on a different physical principle for measurement. This would be a specific feature setting it apart from other technologies.”

— CEO, company 3

The competitive structures in the SME’s markets foster particular approaches to protection within each SME. Depending on the market some protection strategies are more plausible than others and are therefore chosen by the companies.

3. Technological Level

The level of technology has an effect on the preferred IP protection method(s). Company 1 is active in a high technology field and produces goods that have

Table 2.9 Technological level

Case	Technological level	Technological characteristics	Preferred method to protect technology
1	High	Niche technology, few competitors.	Secrecy, publications, few patents.
2	Medium	Technology is easy to copy and IP is needed to guarantee freedom of action.	IP-mix: 30–40 patents, publications, secrecy agreements.
3	Medium	Certain patentable features.	Patents, secrecy (at least one patent per product).

short product-life-cycles. New generations of products are brought to market within five years and therefore the company does not see patents as an adequate means of protection for their innovations. Although company 1 hold patents, the firm explained that it would focus on complementary protection methods in view of how quickly products change in the market.

Companies 2 and 3 use medium level technologies where the development times are longer so juridical protection methods better fit their needs together with publicity and secrecy agreements for company 2 and secrecy for company 3 respectively.

2.4 Discussion

The companies from the life science sector that were studied are driven by seven key factors when making decisions on IP protection (see figure 1). Four of the factors (financial resources, experience with litigation, collaborations and market strategy) lie within the companies and are fed by the companies' assets, its strategy and its experiences. The remaining three factors (the risk of technology being imitated, the structure of the market and the level of technology) lie within the companies' competitive environment.

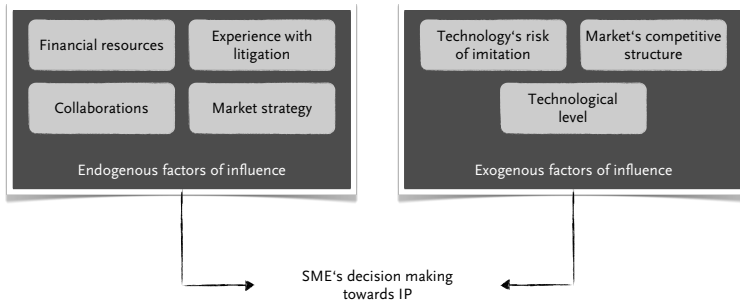


Figure 2.1 Decision making towards IP

The influence of every factor varies from company to company. The internal factors depend on the companies' past and present management while the external factors are part of the diverse competitive environments.

“I think, in terms of intellectual property, we eat humble pie but we try to eat it at the right places.”

— CEO, company 3

Currently, little is known about the management of intellectual property in internationally active SME. The analytical model presented in this chapter gives a first insight into how these life science SME approach their IP management. Further research is needed to deepen our understanding of IP in these firms.

More theory-building also seems necessary, as the findings show that the conventional theory of intellectual property management in the field of appropriation of rents from innovation is not applicable to international entrepreneurship. While large corporations have their own patent departments and a pool of resources for the protection of IP, SME follow a strategy that can be summed up by the words ‘as little as possible and as much as necessary’.

The literature suggests that small firms are deterred from patenting by the cost of litigation (Lerner, 1994) yet, the present findings suggest that this may only be half the truth. The sampled SME are hardly deterred from patenting but rather from litigating. Patents are used to guarantee freedom of action or to threaten infringing companies and all three companies pointed out that no patent any SME possesses is worth as much as litigating it would cost.

Overall, these findings suggest to managers of SME the key factors that should be considered when deciding on an IP protection strategy. Managers of such companies should be aware of the value of their intangible assets. The internal and external factors derived from the case studies can serve as guidelines for strategy—but readers should keep in mind that more research on this topic is advisable and that this chapter is merely an initial stimulus rather than a conclusive observation. The seven factors vary from company to company and it is therefore inadvisable to give SME general advice on IP protection.



Crafting Novel Measures in Appropriation: How International New Ventures Profit from Innovation

This article, coauthored by Marcus Matthias Keupp, is about international new ventures (INVs). These are firms that internationalize very early and thus are exposed to several intellectual property regimes. Being small and active in several countries makes it especially difficult to profit from innovation. This inductive article causally pinpoints the presence of a firm-level appropriation capability to firm-level organizational characteristics. Successful INVs craft two novel strategies that have not been previously reported in the literature. Firstly, they use defensive publishing in order to obtain a freedom to operate. Secondly, they educate their customers on IP issues and use them as outposts in markets where the INVs are not present themselves. Furthermore, successful INVs combine these novel measures into hybrid protection strategies.

3.1 Introduction

An enduring issue in management science is the question how firms appropriate rents from their innovations. Although studies on appropriation are not rare, we know little about how international new ventures (INVs) manage to do so, (Teece, 1986). At the same time is the field of international entrepreneurship that studies how INVs act entrepreneurially and create value in an international sphere an important area of study (Autio, 2005; Oviatt & McDougall, 1994). The question how these specific firms can appropriate is an important research topic because conflicting theoretical predictions and considerable research gaps exist. The present article uses six case studies to answer this question.

When investigating appropriation scholars mainly focus on large firms (Arundel, van de Paal, Soete, 1995; Cohen, Nelson, Walsh, 2000; Cohen, Goto, Nagata, Nelson, Walsh, 2002; Grandstrand, 1999; Levin, Klevorick, Nelson, Winter, 1987). Many studies are based on quantitative data derived from patent databases, others work with surveys. As a result, we gained a deep understanding that explains how these large firms appropriate. INVs on the other hand are small firms active in several legislations. Taking resource constrains into consideration it is assumable that many of the strategies favored by large firms will not work for INVs. Still, there are many successful INVs, which are able to appropriate well.

Therefore, the purpose of this study is to investigate the question: How can INVs successfully appropriate returns from their innovation activities? Our paper features an inductive study of six INVs that differ considerably with respect to the extent to which they can achieve this. Whereas one group of firms is highly successful, another group is struggling to appropriate returns from innovation. By comparing the two groups, we wish to pinpoint this variance to the presence of certain appropriation methods. We use a qualitative approach to data collection and analysis for the following reasons: qualitative approaches are appropriate in a setting where little or no theory exists that could guide hypothesis-testing work (Eisenhardt, 1989), which we believe is the case here. Due to resource constraints and their exposure to a magnitude of IP legislations it should be very unlikely that INVs use patents to a great extent, thus, quantita-

tive measurements that model the strength of appropriation by patent counts could likely be misleading.

Our study contributes to the literature by showing how INVs appropriate returns from innovation using self-made and inventive methods, which are not common in large corporations and which are hardly touched upon in the literature. While INVs use, to no surprise, some measures, which are similar to those used by larger firms, we found two particular unique strategies that have not been reported in such a context, before. Firstly, the use of ‘defensive publishing’ in order to obtain a freedom to operate. Within this strategy INVs publish their inventions to make sure no other company can patent them and thus making sure that the INVs themselves will be able to market their own products. Secondly, ‘educate the customer’, an appropriation strategy, which informs the customer base on IP issues and uses them as outposts in markets where the INVs are not present themselves. Furthermore, we found that successful INVs do not rely on a single appropriation strategy but rather use their entrepreneurial behavior to combine multiple appropriation methods into a fully operative appropriation strategy.

3.2 Theoretical Review

Innovation can be broken down into two fundamental processes: firstly, the creation of innovation and secondly, the appropriation from innovation (Mizik & Jacobson, 2003). These two processes are also often referred to as ‘creating value’ and ‘capturing value’ (Teece, 1988; Saloner & Spence, 2001; Bowman, 2000). Thus, appropriation describes the ability to profit from innovativeness, capturing the value from innovations. Firms need to have this ability, need to appropriate in order to benefit from their innovativeness (Cockburn & Griliches, 1988; Teece, 1986; Jacobides et al., 2006; Mizik & Jacobson, 2003). The returns from innovations are critically affected by the appropriability conditions (Cockburn & Griliches, 1988). Greater appropriability has a large, positive, and significant impact on a firm’s economic performance (Ceccagnoli, 2009).

However, the research on appropriation mainly focuses on how large firms can appropriate using resource intensive measures (Arundel, van de Paal, Soete,

1995; Cohen, Nelson, Walsh, 2000; Cohen, Goto, Nagata, Nelson, Walsh, 2002; Grandstrand, 1999; Levin, Klevorick, Nelson, Winter, 1987). Such large firms typically commit extensive resources to secure appropriation and operate in-house intellectual property (IP) departments where engineers and patent attorneys actively seek possibilities for appropriation by patents and other means (Blind et al., 2003; Blind, Edler, Friedewald, 2005).

International new ventures (INVs) on the other hand, are small and young firms. Typically, exports constitute more than 25 % of their sales, so that they are exposed to a multitude of international markets and IP legislations (Oviatt McDougall, 1994; Oviatt & McDougall, 2004; Zahra, 2004). The literature on small firms and intellectual property is wanting (Blackburn, 2003, emphasis in original), and this want applies all the more to the case of INVs. Only a few articles have touched upon the intersection of appropriation and INVs. Baird, Lyles and Burdeane Orris (1994) explain that INVs tend to build their strategy on a patent or manufacturing capability and process changes. Molero (1998) comes to know that domestic patents and to a lesser extent external ones, play a significant role in pushing firms to increase their level of internationalization meaning that active technological firms carry out international activities more frequently. Coombs, Mudambi, Deeds (2006) found out that the number of patents granted to an INV positively relates to the total alliance capital this firm receives. Gassmann and Keupp (2007) state that knowledge intensity, if properly protected, forms the basis of INVs competitive advantage. And lastly, Mathews and Zander (2007) explains that INVs make innovation sustainable through one or more means of protection. However, not a single scholar touched upon the question how INVs actually protect their intellectual property and hence appropriate from their innovativeness. This stands in stark contrast to the great number of studies that analyze measures and strategies of appropriation among large internationally active firms (e.g., Ghauri & Rao, 2009; Yang, 2005; Yang & Kuo, 2008).

As said, the research on appropriation suggests that appropriation is a resource intensive process. Being active in several markets an INV would have to file and protect its intellectual property in every single one. Given the limited resources of these small firms, we would expect them to quickly go out of business. A lack of professionalism and understanding may imply a risk that a for-

own firm's IP is disregarded or infringed involuntarily. This may lead to costly litigation for which an INV, according to the above findings, could devote only little resources. Moreover, small firms are found to protect their IP predominantly at the national level, while large firms protect it on an international basis (Mogee, 2000; Leiponen & Byma, 2009). If this finding holds for INVs, their exposure to international markets should imply great risks for the appropriability. Yet, the field of international entrepreneurship teaches us that many INVs are successful, thus must be able to appropriate, raising the present question of how do they do it?

3.3 Method

We carried out comparative cross-sectional multiple-level inductive research. This type of research is appropriate when one wants to understand the phenomena under investigation within their rich organizational contexts, a motivation that applies to our setting. Our approach to sampling the firms we analyze in this paper was theoretical in Eisenhardt's sense that 'the goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory' (Eisenhardt, 1989: 545). The multiple-case approach allows for cross-site comparison, so that idiosyncratic aspects of any one site can be seen in perspective. This enhances the robustness of the findings (Miles, 1979). By this approach, we strived to causally pinpoint those organizational-level and individual-level characteristics and theoretical mechanisms that determined why some firms could successfully appropriate returns from innovation whereas others were less successful.

3.3.1 Data Collection

Switzerland provides an interesting setting in which to examine INVs, in that cross-border activity is often a necessity given the limited domestic market size. We identified the six firms in our sample from an INV database which our institute has created. The six firms were chosen by theoretical sampling, not by

random sampling. We wanted to identify different types of firms that differed in the extent to which they managed to appropriate returns from innovation successfully. By a cross-comparison of these different types of firms, a high analytical variance can be expected, and these differences may be traced back to systematic differences between the firms (Eisenhardt, 1989). In addition to this theoretical sampling approach, we conducted a number of comparisons and statistical tests between these six cases and the total of 159 firms in the database to analyze whether the six cases were not over-representing a specific type of firm. As this was not the case, concerns of about a possible self-selection bias were alleviated. Given the depth of our research involvement, we guaranteed the six firms absolute anonymity and confidentiality, which is why the names of the firms have been disguised in this article.

Table 3.1 gives details about these firms. The sample size meets the suggested target of four to ten cases for theory development studies (Eisenhardt, 1989). Each case was studied in a longitudinal manner; our research presence in the six firms lasted from January 2008 to May 2009. The R&D intensity of all firms suggests the high emphasis these firms put on innovation as their primary source of competitive advantage.

3.3.2 Data Sources

We collected data by means of personal in-depth interviews, archival documents, and on-site observations. Such triangulation of various types of data collected by different methods enhances construct validity by overcoming the limitations of using only one method and thus provides a solid foundation for theory development (Jick, 1979). Table 3.2 informs in detail about all data sources.

For the interviews we adopted a multiple-informant approach, interviewing both managers and R&D staff with different task and education backgrounds. Interviewees were sought on a top hierarchical level to ensure the interviewee had detailed and substantiated knowledge. They were identified by ‘snowball sampling’. In each firm we asked the Chief Executive Officer (CEO) or the founders (who were always interviewed) to name those individuals that were most involved with the firm’s intellectual property activities. We asked these

Table 3.1 Descriptive data for the six INVs

Firm	Industry sector	Main product(s)	Employees	Years from foundation to first internationalization	Export ratio	Foreign IP legislations INV is exposed to	R&D intensity
1	Pharmaceutical supplies	Isolators for the pharmaceutical industry	180	2	80 %	Europe, USA, Singapore, Japan	5 %
2	Medical devices	Shakers and fermenters for microbiological research	130	1	85 %	Germany, France, Netherlands, UK, China	7 %
3	Medical diagnostics	Analytical instruments for research purposes	6	2	Almost 100 %	Europe, USA, Canada, Japan, Korea, China, India	Does not give out turnover numbers.
4	Wood / toys	Wooden toys	5	3	90 %	Europe, USA, Japan	4 %
5	Machinery	Made to order special machines	26	2	70 %	Europe, USA	5 %
6	Plastics	Glass-fiber reinforced plastics	15	2	50 %	Europe, USA, Japan, China, India	3 %

Table 3.2 Sources of data

Firm	# Inter-views (con-firmatory interviews)	Archival documents	Workshop participation # of work-shops (# of participants)	Workshop objective	Demographic of workshop participants
1	4 (3)	Business plans, websites, patents, company presentations, organigrams	4 (19)	Technological future strategy	R&D manager, project managers, product managers
2	5 (3)	Business plans, websites, patents, company presentations, organigrams	5 (10)	Budgeting of innovation activities, innovation controlling	R&D managers, product managers, project managers, controller
3	5 (4)	Business plans, websites, patents, internal memos, organigrams, sector analysis	4 (4)	Innovation strategy, protection strategy, sales strategy	CEO, co-founders
4	6 (3)	Business plans, websites, company presentations, organigrams, product brochures	4 (3 + 2 external)	Company strategy, international markets, distribution channels	CEO, founders, inventors, sales, distribution partners
5	5 (4)	Business plans, websites, company presentations, organigrams, process maps, R&D flow charts, internal memos, product brochures	8 (4)	Innovation activities, collaboration strategy	CEO, R&D managers
6	4 (3)	Business plans, websites, patents, company presentations	2 (6 + 3 external)	Patent strategy	R&D managers, patent attorneys, product managers

informants to name other individuals who were central to the firm's intellectual property protection. This process converged on a set of key managers whom we interviewed. This set typically included the head of R&D, heads of business units and segments, and experienced line managers. In the interviews we asked for both past and real-time data to create greater depth of understanding of how events evolved over time (Leonard-Barton, 1990). We organized the interviews by consistently using one and the same semi-structured interview guide. This guideline comprised a series of open-ended questions that allowed the informant to relate his or her experience. The questions concentrated on facts and events rather than on respondents' interpretations (Eisenhardt, 1989).

All interviewees were native German speakers, and all interviews were conducted in German. All verbal quotes appearing in this paper have been translated into English by us, using the translation-backtranslation procedure to guarantee the accuracy of our translations. These personal interviews lasted between 90 and 120 minutes and were tape-recorded and transcribed verbatim which resulted in more than 700 pages of transcripts. After the interviews, we conducted follow-up interviews to ensure a correct replication of answers and to clarify issues which emerged during the process of transcription. We tried to control for potential respondent bias as far as possible by not mentioning any element of our emergent theory to interviewees and by keeping a passive and unobtrusive presence during company visits, and interviews. Further, to reduce bias from recall and rationalization, table 3.2 shows that we triangulated our collected interview data with both firm-internal data sources (such as company magazines, patents (if any), business plans, internal memos and presentations, confidential strategy papers and minutes of past meetings) and external analyses from third parties (such as database information and analyst reports). We believe that by using these procedures and additional data sources it is likely that potential respondent bias can be significantly reduced.

3.3.3 Data Analysis

The data collected during the research were continuously entered in a case database. When data collection on one firm was complete, we synthesized all data on this firm into individual case histories. We began the writing of these histories without formalizing any expectations of the extent to which firms could successfully appropriate.

The case histories were between 35 and 60 double-spaced pages in length and included narrative, selected quotes from the informants, and tables and timelines summarizing key facts. We used within-case analysis to describe the specific way the firm managed appropriation in order to derive constructs (Eisenhardt, 1989). Two assistants read through the original interviews and formed an independent view of each case history, our analyses, and the emerging constructs. We used these independent opinions to cross-check our emerg-

ing case histories. While reading and analyzing interview transcripts, field notes and documents, we engaged in an iterative process of comparing our documentations with the literature to assess the fit of case data (Eisenhardt, 1989). This iterative process of constantly comparing emergent theory and data led often to a more qualified understanding. After all individual case histories were completed; we enabled cross-case comparisons by tabulating the data following techniques for cross-case pattern sequencing and pairwise comparisons (Eisenhardt, 1989) and tabular displays (Miles & Huberman, 1984). We then developed tentative propositions by examining whether similar themes emerged across cases. Our overall aim in the cross-case analysis was to find any association between a firm's ability to successfully appropriate and specific firm-level characteristics. We therefore examined how, if at all, the absence or presence of this ability could be related to the presence or absence of one or more specific firm-level characteristics.

3.4 Results

There was considerable variation among the six cases with respect to the extent to which they could successfully appropriate returns from innovation. The cases formed two subsets: one group which mastered appropriation well (cases 1, 4, 5), and another group which found appropriation difficult to attain and was dissatisfied with the results of their actions (cases 2, 3, 6). Table 3.3 summarizes this variance.

In an attempt to understand these differences, we extensively studied the longitudinal evidence of the six cases. What emerged from this evidence were insights that suggested a causal link between strong appropriation and two capabilities: first, a capability to craft novel and adequate protection measures as a foundation for a firm's IP protection ('defensive publishing' and 'educate the customer'). And second, a capability to enhance these measures with further formal and informal measures into what we call hybrid appropriation strategies. We further found that the emergence of both of these capabilities was positively conditioned by entrepreneurial behavior. We identified these effects by follow-

Table 3.3 Variation of the extent to which the firms can successfully appropriate returns from innovation

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Resource impediments for appropriation	Low Appropriation not affected by resources.	High Litigation costs are a problem for the firm.	High Litigation costs are a problem for the firm.	Low Appropriation not affected by resources.	Low Appropriation not affected by resources.	Low Appropriation not affected by resources.
Risks for appropriation from collaborations	Low High degree of imitability prevents infringements by collaborators.	High Firm's IP was repeatedly infringed by cooperation partners.	Low Collaborators are mostly with Swiss Universities that have no interest in infringing.	Low Despite high observability, cooperators do not infringe firm's IP.	Low Collaborators cannot observe complete technological information.	High Firm's IP was repeatedly infringed by cooperation partners.
Ability to defend IP if attacked by competitors	High "They can try, but they would need a very long time to achieve our level."	Low "We try to innovate faster if we have been infringed."	Low "We fear litigation."	High "Customers come back to us very fast."	High "Some competitors offer complex solutions, but they cost almost twice the price we charge"	Low "It's not worth taking the litigation risk."
International coverage of appropriation protection	Strong "Our technology is protected globally."	Moderate "Our products get infringed from time to time—we can only try to be ahead."	Weak "If a large global firm steals our technology we can't do very much."	Strong "We sell worldwide and infringements are scarce."	Strong "So far we have never been infringed, neither here nor internationally."	Weak "We were lucky so far. We couldn't litigate if we were attacked in our export markets."
IP Infringements occurred?	Yes	Yes	Yes	Yes	No	Yes
Damage suffered from infringed IP	No damage	High damage Several years of disputes; high litigation cost, only minimal compensation awarded.	Considerable damage Damage was limited by informal discussions with infringers.	Minimal damage Customers quickly renounced the counterfeits.	No damage So far firm's technology has never been infringed	Considerable damage Due to fear of high litigation cost no counter-action was taken.
Overall assessment of capability to appropriate returns from innovation	Strong "We are well protected."	Weak "It's not optimal. There is room for improvement."	Weak "All we can do is to introduce the next generation technology as fast as possible."	Strong "Even if there are infringements, they don't live long."	Strong "I think we are doing it right. So far we are fine."	Weak "The lack of resources does allow us to defend patents in court"

ing the development of the firms' appropriation strategies over time, tracking employees' actions, and analyzing managerial behavior. The firms that appropriated successfully had strongly developed the two above-mentioned capabilities, and they were characterized by a strong entrepreneurial attitude. In contrast, the unsuccessful firms exhibited little or none of the two capabilities, and entrepreneurial behavior was much less distinct in these firms. In the following paragraphs, we will discuss these effects and show how and why each of them is associated with the extent to which a firm can achieve successful appropriation.

3.4.1 Defensive Publishing

All three successful INVs, in our sample, showed the ability to craft novel and adequate protection measures. These protection measures fit the conditions the INVs face and therefore form a critical building block in the INVs protection strategy. The successful INVs either used 'defensive publishing' or 'educate the customer' as this critical building block or foundation of their IP protection. We will now discuss the first appropriation method our successful INVs applied, which is called 'defensive publishing'. Firm 1 and firm 5 use it as the foundation of their appropriation strategy. The goal of defensive publishing, at least to our two firms, is to guarantee a firm's freedom to operate. This means that the firm is able to sell its own innovations. To understand the intellectual game behind this concept we have to understand how the patent system works, in particular under which circumstances a patent is granted.

The Novelty Argument

A patent is a formal protection measure that is granted to the inventor in exchange for the public disclosure of an invention. In all major IP legislations such as the USA, Europe, Japan and China a patent is only granted if the public does not know the underlying invention, prior. This is called the novelty argument; it is one of three conditions a patent application has to meet in order to be granted (WIPO). The other two are (1) the inventive step and (2) the applicability in a

business sense. The European Patent Convention expresses the requirements for patentability in Article 52(1): “European patents shall be granted for any inventions, which are susceptible of industrial application (3), which are new (1), and which involve an inventive step (2).” Defensive publishing makes use of the novelty argument. A firm utilizing defensive publishing makes its invention public, for instance by publishing it in a scientific journal, and thus, in theory, hinders other from patenting it, as there is no novelty, anymore. The European Patent Convention argues that an invention is new “if it does not form part of the state of the art” (Article 54(1)). It is called ‘defensive’ to illustrate that the firm using it is not in it to claim rights itself but to make sure no one else does so.

Reasons for Defensive Publishing

In academic theory defensive publishing has been discussed several times. However, the focus here were either economic arguments (Adams, 2002) or the patent race (Lichtman et al., 2001; Baker & Mezzetti, 2005; Bar, 2006). These scholars argue that defensive publishing is a promising method to hinder another company to patent a technology before one is able to do so, on one’s own. This idea is mainly applicable to large corporations, which are laggards in a patent race, and which want to hinder another company from patenting. However, the two INVs in our sample, which heavily rely on defensive publishing uttered different reasons to deploy this measure. The number one reason, the two firms expressed, to utilize defensive publishing, is to guarantee the firms’ freedom to operate. A patent is an exclusive right that entitles the owner to forbid others to market the patented technology. As the name suggests, defensive publishing is a defense mechanism. It prevents the restraint of the use of a certain technology. Thus, the two firms using it are not trying to hinder others to use or market a certain technology but rather want to make sure that they, themselves, can use and market their own technology. This is a crucial argument in favor of defensive publishing. The two firms (1 and 5) strongly rely on it do not see a major threat in competing enterprises. Firm 1 goes even further and expressed a desire for more competition. The firm explained that this would foster innova-

tion in the market. However, both firms (1 and 5) see a major threat in possible lawsuits and therefore try to avoid them by utilizing defensive publishing.

To them, defensive publishing is an effective instrument to fight the possibility of a patent by another firm. It happens that a patent is granted despite the fact that its technology is already state-of-the-art. In such a case a publication can easily prove that a technology has been known before. As such, defensive publishing is a cost-effective instrument that can guarantee a firm's freedom to operate.

Applying Defensive Publishing

The method of defensive publishing works well for firms 1 and 5 and is a crucial building block to both companies' appropriation strategy. Firm 5 uses the measure predominantly to prevent university researchers (with whom the firm collaborates) to patent joint developments, but also because the firm's customers fear lock-in effects if the international niche market firm 5 operates in should be 'closed' by patents:

“These [university] people always want to patent things quickly, but we don't want that because it blocks the market (...) Customers don't want us to become a monopolist. We don't want that too, we want to stay innovative and flexible. So we publish the basic technology freely and then build specialized innovations on top of that new basis.”

— Co-founder, firm 5

Firm 1 has other motives; the founders explained they used defensive publishing on a regular basis to circumvent the problem of litigation costs if patents should be infringed. Interestingly, they use defensive publishing in a tactical way by publishing the technological principle, but not the highly relevant details:

“Defending patents costs a lot of money and you have to think whether it’s smart to invest in that. We think it’s much smarter to do a quick and dirty publication where you write just anything about the principle to have it published. Of course nobody forces you to publish the real secrets that are associated with it.”

— Co-founder, firm 1

Both INVs explained that they work on a tight budget and that resource constraints are a serious issue to these companies. Furthermore, both companies explained that patenting is a costly endeavor. However, both companies stated that they would be able to come up with the needed resources to patent. But, having a patent and defending a patent are two separate issues. Both companies explained that the resources that would go into a patent infringement case would not be worth it. Defending these imaginary patents would not be cost effective. Arguing so, the only thing patents offer the two firms is freedom to operate. Defensive publishing however, guarantees the same, but at a considerably lower price point.

3.4.2 Educate the Customer

The third successful firm in our sample, firm 4, crafted a different method as its appropriability regimes’s foundation. We named this method ‘educate the customer’. Similar to firms 1 and 5 does firm 4, by using ‘educate the customer’, employ a very cost effective method with strong results. The idea behind ‘educate the customer’ is to teach customers, in all the company’s different markets, as much as possible about the products they buy from firm 4. Knowing about the firm’s products, for instance company 4’s wooden marble run, makes the customers conscious of counterfeits, guarantees a loyal customer base, and informs the firm about infringements.

The Quality Argument

Company 4 is positioned as a high-end manufacturer in a niche market. The firm sells toys, which are mostly made of wood and could be copied by any talented and patient carpenter. Thus, the products are not patentable as most of them lack the inventive step necessary for a patent. This situation would leave many firms unarmed, as the product is easily replicable and at the same time not protectable by a patent. Firm 4 however uses the quality of its workmanship as a differentiation tool. All toys the firm sells are made from expensive materials and are crafted in a way that ensures the best possible quality. Consequently, the firm's products sell at a premium retail price. The company's customers are willing to pay the charged price for the unmatched quality the firm offers.

Reasons for Educate the Customer

Selling a product that has a high production-quality and sells at a premium price but is, at the same time, a low-tech product attracts counterfeiters. These counterfeits, the firm explained, never come close to the company's quality; the materials are cheaper and not as good, the same applies for the workmanship. Most customers satisfied with firm 4's products do not want to switch to cheaper and lower quality alternatives. Therefore, firm 4 actively informs its customers about counterfeits and their lower quality. There are two main reasons for educate the customer. *Firstly*, letting customers know that there are counterfeits out there and that they have a lower quality, which explains their lower price point. *Secondly*, using the customers as spies: customers aware of counterfeits inform firm 4 about them. This is crucial for the INV, as the small company cannot monitor all the markets it is active in. However, the firm learned that its customers can. Once a counterfeit is detected the company can still take action, for example contacting the dealer or using its trademarks to stop the commercialization. Experience has shown that once a counterfeit is encountered it is very helpful to inform the firm's customers about this. The firm's customers are mostly toy stores or sophisticated department stores and typically do not want to sell counterfeits and their lesser quality. Thus, informing the customers about

counterfeits and explaining that these products do not come from firm 4 helps to stop the diffusion of these counterfeits.

Applying Educate the Customer

Applying ‘educate the customer’ seems somewhat counter-intuitive because it does not aim to counteract the counterfeits of the firm’s products. Moreover, the firm does not attempt to stop counterfeiting activities by any other means. The managers of firm 4 explained the rationale behind this seemingly irrational behavior:

“The quality of similar or copied products is often minor, and customers normally do not buy the cheaper product more than once. Customers are our spies so to speak; they tell us where they bought it and come back to us quickly. We do not actively search for copied products; usually the sales and service people get feedback from customers that counterfeits exist.”

— R&D manager, founder firm 4

Firm 4 takes advantage of a learning effect that influences the customers of counterfeiters. Most counterfeits offer poor quality, so the customer learns, over time, that the more expensive but high-quality original product will better serve him or her than the low-cost, low-quality counterfeit. In addition to relying on this learning effect, the managers in firm 4 offers additional benefits, quality guarantees and services (i.e., informal measures) to customers who buy the original.

All successful firms in our sample rely either on ‘defensive publishing’ or on ‘educate the customer’ as a foundation for their IP protection. All INVs face an external pressure, which is quite different from the one large companies face when it comes to the protection of intellectual property. In order to successfully appropriate INVs rely on methods, which are not commonly used among large multinational firms. The three successful firms were able to craft protec-

Table 3.4 Capability to develop hybrid appropriation strategies

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Formal protection measures	10 patents filed, some more pending	40 patents (products and processes), trademarks	Trademarks, three patents	Four Trademarks, industrial designs, copyrights	One Trademark	Two Trademarks, five patents
Informal protection measures	De-facto secrecy, complexity, defensive publishing, superior service	Complexity (inside value chain only)	Complexity (inside value chain only)	'Educate the customer'	Defensive publishing, lead time advantages	None
Combined protective effect / interaction of the above measures	Strong Patent provide basic protection, but effective appropriation works by informal measures.	Weak Enforcement of patents unsatisfactory; informal measures cannot compensate.	Strong Trademark and 'educate' strategy work hand in hand and complement each other. Interaction with protected design effectively impedes supplier imitation.	Strong Each element provides part of protection / appropriation, together, they form an effective set.	Strong Each element provides part of protection / appropriation, together, they form an effective set.	Weak Firm failed to develop a hybrid strategy although appropriation from institutional measures is unsatisfactory.
Structuredness of approach	High Hybrid strategy is evaluated and refined after every project. Patent attorney makes international screening before patent application is pondered.	Low No, designed ad-hoc "You just have to see and the rest is luck."	Low Designed ad-hoc, no systematic approach.	High Plans were made even before first international exposure.	High IP strategy was designed together with patent lawyer, refined by experience.	Low No planned strategy; measures developed ad-hoc over time.
Strength of appropriation position	High Combination of informal measures enables firm to protect those areas that formal measures cannot or only imperfectly protect.	None Firm tries to compensate doubtful patent protection by innovation leadership. No additional protective effect from informal strategies.	None Elements do not interlock, problematic patient situation is not mitigated.	High Trademark protection is strengthened much by the 'educate the customer' strategy.	High The combination provides protection over and above pure trademark protection.	None Firm failed to develop other protection measures than institutional ones.

tion measures, which were suitable to their individual situations. The three unsuccessful INVs, on the other hand, were not able to craft novel and adequate protection measures. These firms either heavily relied on patents or used the informal protection strategy ‘complexity’ which in their individual contexts did not result in a successful protection, at all.

3.4.3 Combining Appropriation Measures into Hybrid Strategies

We did not find that the successful firms only relied on the two above mentioned protection strategies. Rather, they used ‘defensive publishing’ and ‘educate the customer’ as a foundation, a sort of groundwork, on which they build their IP strategy. The two firms creatively combined this groundwork with further protection measures to achieve a strong overall protective effect. We labeled this creative recombination of different appropriation measures a hybrid appropriation strategy. Table 3.4 demonstrates how the combination of the different measures is associated with a greater protective effect among the successful firms, whereas this effect is absent among the unsuccessful firms. The firms all differed with respect to the specific hybrid strategy they devised, but each strategy was closely tied to the peculiarities of their innovation strategy and to their international market position.

Firm 1

Firm 1 uses defensive publishing as a ‘groundwork’, whereas actual appropriation is attained by de facto secrecy and by superior services. Patents serve to protect radical technological developments the firm has made. The technological speed in its industry is relatively slow; technological progress is created by few breakthrough innovations that “... happen once in a decade” (R&D manager, firm 1). In contrast, defensive publishing is used for incremental developments, such that competitors cannot build ‘patent thickets’ (Grandstrand, 1999) on the basis of incremental innovations around the patents firm 1 has. These

two measures in conjunction protect the technological basis of the firm and maintain its freedom to operate.

Firm 4

Firm 4 adopted a two-step approach: Firstly, every product is protected by at least one trademark oftentimes combined with an industrial design in order to deliver a cost-effective international protection effect. This step serves to closely align the product, brand name and design before any product is marketed. Actual appropriation is then attained, as detailed above, by the measure ‘educate the customer’.

Firm 5

Finally, firm 5 uses a similar ‘fundament strategy’ as firm 1: They first use defensive publishing to block competitors from patenting and in order to retain their freedom to operate. Then, they use their technological leadership in the market to come up with lead time advantages that endow their products with a competitive edge over their competitors. Since the defensive publication groundwork implies that competitors cannot block the market, competition in international markets takes place by innovation leadership, and firm 5 has a leading edge here.

Also, table 3.4 demonstrates that those firms, which developed hybrid protection strategies, did so by processes characterized by a high degree of planning and structured thinking. The way the successful firms developed their hybrid approach to appropriation, in our view, is a sign for a planned strategy, rather than an arbitrary set of decisions that led to a hybrid approach by chance. Cases 1 and 5 developed their approaches after a long-lasting process of consulting with external patent attorneys and by continuous refinement of their defensive publishing and patent activities. Firm 1 made the ability to draft a patent mandatory for the job descriptions of senior R&D staff. Firm 4 worked with both an external patent attorney and the Swiss and World IP Offices to devise its trademark and industrial design protection strategy, whereas the founder

CEO, and senior managers developed and implemented the ‘educate the customer’ measures about one year before the firm’s first product was introduced in international markets.

The Unsuccessful Firms

In contrast to these findings, hybrid protection strategies were strikingly absent among the unsuccessful firms, where only one category of measures prevailed (firms 3, 6) or where a firm did use more than one category of measures, but where the firm failed to align the different categories of measures into a hybrid appropriation strategy (firm 2). Thus, the single measures remained relatively isolated and failed to provide a strong protective effect as the successful firms could attain.

Firm 2 is an example where the two measures it uses neither reinforce nor complement each other. The firm has the highest count of institutional measures (40 patents), yet the measure essentially failed to provide the firm with a strong appropriation position, and that the firm’s resulting focus on lead time advantages can be interpreted as a ‘running away’ behavior to counter the fear of litigation costs.

Table 3.4 also demonstrates the lack of structure and planning associated with the absence of hybrid appropriation strategies. Rather, ad-hoc approaches seemed to prevail among the unsuccessful firms, and a systematic planned approach that would lead to the design of hybrid strategies was absent among all three cases. This fact, if compared to the planned, structured approaches of firms 1, 4 and 5 suggests that hybrid appropriation strategies are indeed the outcome of the capability of the firms to purposefully plan and devise such strategies.

3.5 Discussion

By focusing on an INV context, our study complements approaches that have analyzed appropriation measures used by large firms (Arundel et al., 1995; Co-

hen et al., 2000; Cohen et al. 2002; Grandstrand, 1999; Levin et al., 1987). We find that an INV's ability to appropriate the returns from its innovations in an international setting is influenced by its capability to craft adequate appropriation measures and by its capability to devise hybrid appropriation strategies that creatively combine protection measures. These findings also illustrate the advantage of using a qualitative method for research questions of the sort we investigated. Had we used conventional quantitative measures like the number of patents to measure a firm's strength of appropriation, or even survey-based methods that measure the strength of formal and informal measures by scale scores, neither the crafted protection measures nor the hybrid strategies the successful INVs use would likely have been discovered. Rather, firms like firm 2, which have a weak appropriation position despite a relatively high patent count, would have likely (and erroneously) been interpreted as enjoying a strong appropriation position.

We found that INVs use several protection measures, which are hardly discussed in the literature. *Firstly*, we found that firms can actively integrate their customers into the protection process. The method 'educate the customer' shows how firms can appropriate from innovation despite imitations. Firm 4 explained that expressing the real value of their offerings to their customers, thus, educating them, can be part of an effective protection strategy. The findings on the informal measures 'educate the customer' help to clarify the ambiguous finding that imitability, under certain circumstances, can increase firm growth (Autio, Sapienza, Almeida, 2000; Bierly & Chakrabarti, 1996). By using counterfeits as 'advertisement' for their trademarks or customers as 'spies' to identify where counterfeits appear, firm 4 increases its visibility in international markets while exploiting the quality difference between original and counterfeit to retain customers. A related argument in the literature is that a firm can actually grow by using imitation to its advantage (Conner, 1995). In turn, this increased appropriability should, *ceteris paribus*, increase firm performance and firm growth. Future research could empirically test whether this explanation holds for a larger sample of INVs. *Secondly*, we found two firms that use 'defensive publishing' to obtain a freedom to operate. Again, these firms do not try to create and sustain a monopoly, they rather try to prohibit others from creating one. Agarwal and Henderson (2002) mentioned this strategy, yet only in a context

where they studied knowledge transfer between firms and universities. Other scholars (Baker & Mezzetti, 2005; Bar, 2006; Lichtman, Baker, Kraus, 2000; Parchomovsky, 2000) have mentioned defensive publishing, too. But, using this strategy as a cost-effective protection mechanism, which small firms can use to guarantee their own freedom to operate is a noteworthy observation. Both measures do not rely on the judicial system for enforcement and thus demand very little resources. Therefore, confirming the theoretical argument that firms can create barriers to imitation by tacitness and complexity (Reed & DeFillippi, 1990). Moreover, these measures are an applied example of the conceptual proposition that raising the costs of imitation raises the costs of complexity and thus can be interpreted as a tax on imitation (Glass & Saggi, 2002). Specifically, our findings on how the successful firms use defensive publishing to appropriate returns from innovation challenges Arrow's assertion that the ability to exclude others from using the underlying technology is a precondition to innovate (Arrow, 1962).

Firms that use hybrid appropriation strategies do not substitute formal for informal protection measures. Rather, they judge the efficacy in a highly planned and structured manner before deciding how, if at all, to use them. If they decide to not use patents, this decision is the outcome of thoughtful consideration and comparison of costs and benefits and not unprofessionalism. This finding qualifies earlier literature that portrays small firms to be poorly informed about institutional rights, or to lack the resources to finance them or the capability to administer them effectively (Arundel & Kabla, 1998; Arundel & Steinmuller, 1998; Cohen et al., 2000; Kitching & Blackburn, 2003).

Until now, combinations of appropriation categories were mostly discussed as combination possibilities within a group of measures, predominantly formal measures, e.g. how trademarks and patents may be combined to increase the total protective effect (Cook, 2002; Mathews et al. 2003). Our study develops this literature further by showing how measures may be combined across categories. The finding that the successful firms combine different categories of appropriation measures to form a superior protective effect is, to the best of our knowledge, the first illustration for Teece's (2000) conceptual argument that firms, which understand how to appropriate successfully have an ability to

reconfigure knowledge and complementary assets to achieve sustainable competitive advantage.

The findings on the hybrid strategies also do not support the claim that patents fare relatively badly as a measure of appropriation (Arundel, 2001; Cohen et al., 2000; Cohen et al., 2002; Harabi, 1995; Levin et al., 1987; Sattler, 2003; Taylor & Silberston, 1973). The example of the unsuccessful firms demonstrates that this is only the case if formal measures are used in isolation.

Another aspect of these findings is that neither the informal measures nor the hybrid appropriation strategies we found are dependent on firm size or industry sector (table 3.3). This result challenges previous contributions that find that the efficacy of particular appropriation measures strongly differs with the industry context (Mansfield, 1981, 1986) and with firm size (Arundel & Kabla, 1998; Arundel & Steinmuller, 1998; Cohen et al., 2000). Specifically, firm 4 shows that strong appropriation can be attained even in 'low-tech' industry sectors. These findings in our view illustrate the argument that appropriation is a firm capability, rather than a result of industry specificities (Reitzig & Puranam, 2009). By identifying determinants that influence the emergence of this capability, our study suggests that the successful firms have a capability to devise effective informal appropriation measures and hybrid appropriation strategies.

Further, our results challenge previous views that firm strategies characterized by a strong entrepreneurial orientation (EO) are resource intensive (George, 2005; Wiklund & Shepherd, 2005). The findings demonstrate that successful measures can consume very little resources, and by combining them into hybrid appropriation strategies, the firm saves resources that otherwise would likely have been devoted to patent enforcement and litigation. Thus, we cannot subscribe to the view that EO is a resource-consuming strategic orientation (Covin & Slevin, 1991; Romanelli, 1987).

Finally, we believe that these contributions have implications for managers in both large firms and INVs. Our findings demonstrate how INVs can appropriate returns from innovation at little cost, and how a unilateral reliance on institutional measures might prove counterproductive. We further highlight specific informal measures and hybrid strategies managers of INVs can use, and we emphasize the importance of entrepreneurial behavior for the success of both. These findings are not specific to a particular industry, so that a vari-

ety of firms is likely to benefit from them. However, managers in large firms are likely to benefit from these findings, too. The use of informal measures has the potential to save considerable resources. Managers could review their appropriation strategies and assess whether there are cost saving potentials to be realized. This specifically applies to the use of defensive publishing as a measure to secure the freedom to operate. For example, managers may opt to defensively publish a platform technology and then build specific applications using this technological basis, which could then be patented. Thus, the firm could reduce expenditures for institutional measures and litigation and impede competitors from building up patent thickets. However, such moves are likely to depend on the tolerance of autonomous entrepreneurial behavior of managers by large firms, and they are likely to be risky when routine and resource rigidity are high.

Like any contribution that tries to capture complex firm-level organizational configurations, our paper has certain limitations that stress the need for future research. Our study attempted to create new rather than testing existent theory. Due to this inductive method, our findings cannot be readily generalized. The firms we analyzed could have unobserved idiosyncratic characteristics that had additional impacts on their innovatory behavior. Although we believe that our findings have a strong intuitive appeal, future deductive research is needed that can empirically test the claims and propositions we have offered here.

IV

Why Do Foreign Firms Patent in Weak Appropriability Regimes? Some Qualifiers to Teece's Appropriation Framework

This article, coauthored by Marcus Matthias Keupp and Maximilian von Zedtwitz, deals with IP in China. Theory predicts that in weak appropriability regimes, like that of China, firms should appropriate rents from innovation by lead time advantage, co-specialized assets, or secrecy, but not by patents. For the last 10 years, the case of China has been a persistent anomaly to this prediction. Since 2000, patent applications of foreign firms in China have been growing at an exponentially increasing rate, although China still represents a weak appropriability regime. This study attempts to resolve this paradox by an exploratory inductive approach. 11 cases of foreign firms that have filed patents in China, are analyzed and the motives for patenting in a weak appropriability regime are presented. Specifically, four different archetypes of firms whose existence is not predicted by current theory are presented. The article offers some qualifiers to Teece's appropriation regime, as it explains that there are reasons for patenting in weak appropriation regimes that are unheard of in literature, so far.

4.1 Introduction

An appropriability regime refers to the environmental factors, excluding the firm and market structure, that govern the technology proprietor's ability to capture profits generated by the technology (Teece, 1987). Appropriability conditions reflect the possibilities of protecting innovations and knowledge from imitation and of appropriating the profits from them (Van Dijk, 2000). In developed economies with strong appropriability regimes, firms can make effective use of the main functions of patents: appropriation and strategic positioning (Davis, 2004). In a strong appropriability regime, firms can protect innovations by patenting and aggressive patent litigation (Somaya, 2003). In such a setting, the total number of patents granted can be expected to increase since firms are given strong incentives to patent (Hall and Ziedonis, 2001), and since firms can rely on the legal system for enforcement of their patents and the punishment of infringers (Shapiro, 2003; Jaffe and Lerner, 2004).

However, in emerging economies that have weak appropriability regimes, firms can hardly, if at all, achieve such enforcement and punishment. This is because at the beginning of economic development, countries are very interested in attracting foreign intellectual property (IP), but much less so in enforcing it in order to enable technological spillovers to the domestic economy (Allred and Park, 2007; Pasco, 1998; LaCroix and Konan, 2002; Correa, 1995; Braga, 1989; Siebeck et al., 1990). Consistent with this observation, theory predicts that in weak appropriability regimes where imitation is relatively easy from both a technical and legal standpoint, firms should appropriate rents from innovation by secrecy and complementary assets (such as lead time advantage, co-specialized assets, or secrecy), whereas only in strong appropriation regimes firms can rely on institutionalized appropriation mechanisms such as patents or licensing agreements (Teece, 1986, 1988; Levin et al., 1987; Cohen et al., 2000).

The case of China is an illustration for a weak appropriability regime. While the legal design and structure of the Chinese patent system may not differ much from that of Western nations (Sun, 2003), there are great differences to developed economies regarding the extent to which foreign-owned patents are enforceable. Although, since 1994 China has taken many 'de jure' steps to create IP laws and has joined all major IP conventions, de facto protection and en-

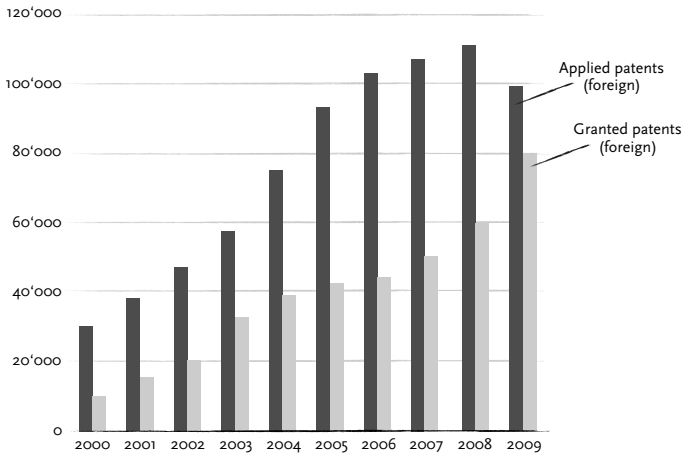


Figure 4.1 Growth of foreign firms' patenting activity in China (Source: SIPO, 2010)

forceability of foreign firms' IP remain weak (European Commission, 2004; United States Trade Representative, 2005; You and Katayama, 2005; Yang, 2008; Cheng, 1998; Feng, 1997; Bosworth and Yang, 2000; Yang, 2003; Liu, 2005; Yang, Sonmez, Bosworth, 2004). These problems even force foreign firms in China to develop 'de facto' protection strategies because the legal system provides no effective protection and enforcement of their IP (Anand and Galetovic, 2004; Keupp et al., 2010).

Yet, despite this weak appropriability regime, foreign firms in China have applied for and been granted Chinese patents at an exponentially increasing rate. Both the number of patent applications made by and patents awarded to foreign firms in China by the Chinese State Intellectual Patent Office (SIPO) show a significant increase on a year-to-year basis (viz. figure 1). Unlike in the past, where foreign patent growth in China tended to concentrate on a small number of advanced sectors (Sun, 2003), this trend now spans all industries (Wu and Liu, 2004; Wei and Liu, 2006). From 1995 to 2002, foreign patent grants accounted for over 63 % of all patent grants at the SIPO (Yang and Clarke, 2005). Those ten U.S. firms that owned the most U.S. patents as of 2005 had at least moderately

increased their number of patents granted at the Chinese Office of Intellectual Property; six of these firms show exponential growth of the number of patents they were granted in China (O’Keeffe, 2005). In the time span from 2006 to 2008 alone, the number of granted patents to foreign firms in China increased by 35 %, in the period 2000 to 2009 the number more than tripled, as figure 1 demonstrates (SIPO, 2010).

One could argue that this exponential growth is the result of Chinese legislation whereby scientific discoveries made in China must be registered at the SIPO (Article 20 of the Patent Law of the People’s Republic of China, 2010; Lo & Tian, 2005). While we do not deny that parts of the above growth may be attributable to this law, we point to the inconsistency with the theoretical prediction that firms operating in weak appropriability regimes should not use patents for appropriation or negotiation (Tece, 1986, 1988). According to this prediction, one would rather expect that these laws should deter foreign firms from bringing patents into China, since foreign firms should not want to reveal scientific discoveries in a weak appropriability regime, and they should be unwilling to re-register patents already filed elsewhere in a regime where the protection and enforceability of the knowledge and capabilities revealed in the patent document is questionable. Moreover, since the Third Amendment to China’s Patent Law was passed on December 27, 2008, it is no longer necessary to re-register patents in China to claim technological novelty; having demonstrated novelty in a country abroad is now sufficient. Thus, it should be even more unlikely that the exponential growth of foreign patenting is due to a mere ‘replication’ of existing patents since growth rates did not significantly decline after 2008.

This inconsistency presents a consistent anomaly to the above theoretical predictions. In our view, extant research does not provide convincing explanations to resolve this inconsistency. Studies that consider appropriability conditions restrict their analysis to between-industry studies within developed Western economies (Cohen et al., 2000; Levin et al., 1987; Cohen et al., 2002; Blind et al., 2006; Harabi, 1995). Moreover, these studies have compared different industries within a single country but remain silent about the impact of different appropriability regimes across countries. Studies on the patenting activities of foreign firms in emerging economies with weak appropriability regimes are very rare, and almost all of them have China as their empirical context. While

this literature has produced helpful descriptive evidence on the phenomenon (O’Keeffe, 2005; Sun, 2003; Wei and Liu, 2006; Yang and Clarke, 2005), it focuses almost completely on macro-level data with a country or industry level of analysis, while it does not investigate the firm-level antecedents that may determine foreign firms’ patenting behavior. Studies that do so restrict their analysis to patents granted to domestic firms, leaving aside the question of the determinants of foreign firms’ patenting activities (e.g., Hu and Jefferson, 2009).

This paper is an attempt to close this gap. Its purpose is to analyze how and why foreign firms may want to patent in a weak appropriability regime like China despite the fact that Teece’s appropriation framework does not predict such a behavior. To achieve this goal, the paper features an exploratory inductive analysis of the antecedents of 11 foreign firms’ patenting activities in China. The remainder of this paper is structured as follows. We first describe how we collected and analyzed the data on the 11 cases (section 2). The findings (section 3) suggest that there are different archetypes of firms with very different motives of how and why to patent; further, they identify antecedents that govern how each firm is assigned to a specific archetype, and they synthesize three major motives of why foreign firms patent in weak appropriability regimes. Finally, the discussion (section 4) highlights theoretical implications for the literature on appropriability beyond the specific empirical context of China.

4.2 Methods

4.2.1 Data Collection

We conducted a comparative, cross-sectional, multiple-level inductive research project. This type of research is appropriate for understanding phenomena under investigation within their rich organizational contexts. Our approach for sampling the firms we analyze in this paper was theoretical, in the sense that “the goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory” (Eisenhardt, 1989: 545). A multiple-case approach also allows for cross-site comparisons, so we can consider the idiosyncrasies of any one site in perspective, which enhances the robustness of the

findings (Miles 1979). With this approach, we also strive to causally pinpoint organization- and individual-level characteristics and theoretical mechanisms that might determine why foreign firms in China use patents to appropriate rents from innovation despite the weak appropriability regime. Therefore, our investigation did not focus on a comparison between foreign firms in China that held Chinese patents and those that did not since the case of the latter would be perfectly explained by extant theory. Rather, we wanted to explore in detail the IP strategies of those firms that were seemingly at odds with the predictions of extant theory. Similar to Oviatt and McDougall (1994) who determined types of a new empirical phenomenon (international new ventures), our study was designed to discover archetypes of foreign firms in China that have been granted local Chinese patents, and to identify antecedents that determine the emergence of these different archetypes.

From a database of foreign-invested firms in China maintained by Tsinghua University (Beijing), we filtered those that held at least 10 patents granted by the SIPO. We chose this cut-off to ensure their patent positions were significant. We called senior managers of the 87 firms filtered from the database by telephone and explained our research project to them. Finally, 11 firms chose to cooperate. The interview data were collected from June to September 2008. Considering the depth of our research involvement and the topic of IP which was highly sensitive to the involved firms, we guaranteed them absolute anonymity and confidentiality; therefore the names of the firms have been disguised in this article.

Table 4.1 presents descriptive statistics for these firms. We also performed additional t-tests on all descriptive variables to ensure the 11 firms were not over-representing a specific type of firm. Although all firms were similar regarding important characteristics (possession of Chinese patents, foreign-invested firm, headquartered in the Shanghai and / or Beijing city and area, high R&D intensity), the firms differed strongly regarding the extent to which they had Chinese patents, they had different motives that drove them to apply for Chinese patents, and they came from heterogeneous industries. This analytical variance allowed us to trace the differences back to systematic differences between the firms (Eisenhardt, 1989).

Table 4.1 Descriptive data

Case ID	Industry	Number of employees of firm's operations in China	Country headquartered in	Number of local SIPO patents	Growth rate of patents registered in China	R&D intensity	Homebase-augmenting vs. homebase-exploiting function of Chinese operation
A	Engineering	China is one of ten global R&D centers, 100 in this R&D center	Switzerland	2387	Increasing	3-4 %	Mostly knowledge that comes from the research centers and is used in China.
B	Consumer goods	5000 employees in China, 400 in R&D	USA	4993	Increasing	2.5 %	Both
C	Energy	3000 employees in China, less than 50 in R&D	United Kingdom	581	Increasing "Our Chinese scientists have promising ideas." (R&D Manager)	0.2 %	Both. Some of C's best experts are living in China, their role is to transfer knowledge and build capabilities in partnerships.
D	Refrigerators, air-conditioning, water & water, motion controls	2700 employees in China, 75 in R&D	Denmark	399	Strongly increasing	4.8 %	Gradual development of subsidiary: manufacturing, complex manufacturing, then sourcing, and R&D.
E	Communication devices	6000 employees in China, 2000 in R&D	Finland	5143	Moderately increasing	12.9 %	Knowledge transfer to other parts of the company. Also inbound knowledge flows to China. Global R&D structure.
F	Security printing, smart cards, cash handling systems.	1000 employees in China, 80 in R&D	Germany	262	Strongly increasing	6.4 %	R&D in China. Innovation advantage. Other western firms have no R&D in China.
G	Communication	170 employees in China, 70 in R&D	France	8500 (world-wide) 400 new ones per year, all new patents also in China	Increasing "We expect more R&D in China in the future." (Patent Officer)	3.3 %	Contribution of locally produced technology to the group. Examples: in the beginning of 2008 service software system was developed in China provided to the group.

Table 4.1 Descriptive data (continued)

Case ID	Industry	Number of employees of firm's operations in China	Country headquartered in	Number of local SIPO patents	Growth rate of patents registered in China	R&D intensity	Homebase-augmenting vs. homebase-exploiting function of Chinese operation
H	Engineering	50,000 employees in China, 5,000 in R&D	Germany	6,691	Increasing "China will be our third biggest market." (Product Manager)	5.1 %	Both
I	Consumer product, brown goods, military	550 in R&D in China	France	4,853	Increasing till today "We expect a stable trend, R&D in China is still young." (R&D Manager)	7.1 %	Both
J	Consumer good, engineering, aerospace	900 employees in China	USA	1,303	Increasing	4.3 %	Both
K	Automotive	250 employees in China—no R&D in China yet, will change in the next few years	Germany	157	Strongly increasing "We have no R&D in China, yet." (Patent officer)	5.3 %	Firm sees China as a center for competence creation in the future.

4.2.2 Data Sources

We collected the data through personal, in-depth interviews and archival documents. By triangulating the various types of data, we enhance the construct validity and overcome the limitations of using only one method, which provides a solid foundation for theory development (Jick, 1979).

All interviews were conducted in China (Shanghai and Beijing areas). For the interviews, we adopted a multiple-informant approach and interviewed both IP managers and R&D staff from different organizational subunits with different tasks and education backgrounds. However, all interviewees represented senior hierarchical levels, to ensure they had detailed, substantiated knowledge. With a snowball sampling technique, we began in each foreign firm with the local Chief Technology Officer (CTO) or equivalent, whom we asked to name persons who were most involved in the firm's IP activities. We then asked the informants to name other employees central to these activities. This process converged on a set of key managers whom we interviewed, such as the CTO, senior R&D managers, heads of business units and segments, and experienced line managers. In the interviews, we asked for both past and real-time data to create a greater depth of understanding of how events evolved over time (Leonard-Barton, 1990). We organized the interviews according to the same, semi-structured interview guide, which featured a series of open-ended questions that prompted informants to relate their experiences. The questions concentrated on facts and events rather than interpretations (Eisenhardt, 1989).

Interviewees included both Chinese and foreign nationals, the latter mostly from the Western hemisphere. Since all were highly proficient in English, all interviews were conducted in English. The personal interviews lasted between 60 and 140 minutes and were tape-recorded and transcribed verbatim. We also conducted follow-up interviews to ensure our correct understanding of the answers and clarify issues that emerged during the transcription.

We tried to control for potential respondent bias by not mentioning any element of our emergent theoretical insights to interviewees. To reduce the potential for bias due to recall issues and rationalization, we triangulated our collected interview data with both firm-internal data sources (e.g., company magazines,

business plans, internal memos and presentations, confidential strategy papers, minutes of past meetings) with external analyses from third parties (e.g., database information, analyst reports). These procedures and additional data sources make it unlikely that potential respondent bias is a significant concern.

4.2.3 Data Analysis

The data collected for this research were continuously entered into a case database. When data collection for one firm was complete, we synthesized all the data about this firm into its individual case history. The case histories were 35–60 double-spaced pages in length and included narratives, selected quotes from informants, and tables and timelines with key facts. We used within-case analysis to describe the specific way the foreign firm organized its IP activities and to derive antecedents that could explain the existence of the different groups (Eisenhardt, 1989). Two assistants read the original interviews and formed an independent view of each case history, our analyses, and the emerging constructs. We then employed those independent opinions to cross-check our emerging case histories. While reading and analyzing the interview transcripts, field notes, and documents, we engaged in an iterative process of comparing our documentation with existing literature to assess fit (Eisenhardt, 1989). This iterative process often led to a more qualified understanding. After completing all the individual case histories, we supported the cross-case comparisons by tabulating the data, following established techniques for cross-case pattern sequencing, pair wise comparisons (Eisenhardt, 1989), and tabular displays (Miles and Huberman, 1984). We then developed tentative propositions, examining whether similar themes emerged across cases.

Our overall aim in the cross-case analysis was threefold: First, to identify differences in the way the foreign firms in China used patents. Second, to construct groups of related firms on the basis of these differences, and third, to identify the antecedents that were responsible for the variation of use observed.

4.3 Findings

The analysis of the findings suggested that the 11 foreign firms differed considerably. While all firms had registered a significant number of patents at the SIPO, their motives of doing so and their expectations for the future development of China's appropriability regime varied considerably. We identified four archetypes of foreign firms that possess Chinese patents despite China's weak appropriability regime: *the strategist*, *the struggler*, *the speculator*, and *the signaler*. These archetypes differ substantially regarding their approaches towards intellectual property protection in China.

Moreover, we identified three antecedents that, together, determined which archetype a firm could be subsumed under. The findings suggested a strong relationship between the respective value of these three antecedents and the specific archetype a firm could be assigned to. Figure 2 presents a diagram that shows the connection between the antecedents and the archetypes, and table 4.2 details how the specific values of the antecedents are associated with specific archetypes. These archetypes can be described as follows.

Firms of the *strategist type* (cases, B, C, and G) think positively of China's formal and legal measures to strengthen the appropriation system and expect that China's appropriability regime will develop into a strong appropriability regime similar to those in European countries or the U.S. Since they assume that in a few years' time it will be possible to enforce patents without problems by resorting to the judicial systems, they have been applying for patents in the past and are still active in order to build a portfolio. This expectation also leads these firms to believe that there should be no significant difference regarding the way a patent is filed, thus, China is treated as one of many countries where IP rights are registered globally without applying specific procedures for a particular country.

Similar to the above type, firms of the *struggler type* (cases D and I) have a global approach to registering IP rights and therefore they have no specific policy for China. However, in contrast to the above type, they have rather negative expectations regarding the future development of China's appropriability regime since they have experienced IP infringements by Chinese firms in the past.

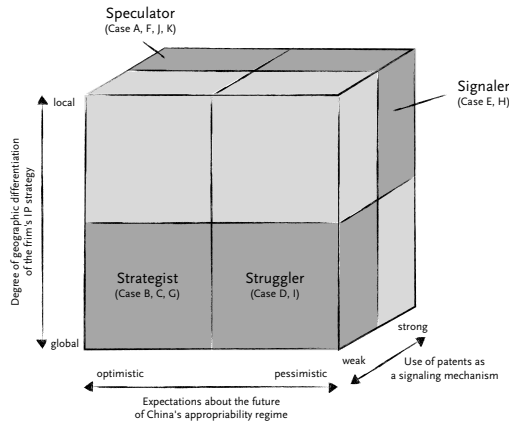


Figure 4.2 Archetypes of foreign firms patenting in China

Like the strategist type, firms of the *speculator* type (cases A, F, J, and K) expect that China's appropriability regime will considerably improve in the future. However, they differ from the strategist type since they have a specific local patent policy for China that is distinct from the way these firms use patents in the rest of the world. They also differ from both types by using patents in order to signal to Chinese firms that they will defend their IP rights in public. They strongly believe that to register patents in China now is an investment that should yield the more return the more China's appropriability system strengthens over time. Our findings suggest that firms of this archetype file 30–50 % of all their corporate patents in China.

Finally, the *signaler* type shares the importance of patenting as an indicator of technological capabilities. However, it is distinct from the speculator type by its negative expectations on the development of China's appropriability regime; it shares these expectations with the struggler type. The signaler type of firm is fully aware of the many problems the current appropriability system has. Still, these firms use patents for the exclusive aim of signaling superior technological capabilities to Chinese firms, marketing these capabilities and threatening that

Table 4.2 Archetypes of foreign firms patenting in China

Case ID	Expectations about the future of China's appropriability regime	Degree of geographic differentiation of the firm's IP strategy	Use of patents as a signaling mechanism	Patenting activity in China	Archetype
A	Optimistic "The situation is getting better. The government is behind it. Signs of improvement can be seen everywhere." (Head of R&D, China)	Local Yes, the firm has a new strategy for China	Yes "Image as a high-tech company." (Head of R&D, China)	Moderate Not all patents are replicated in China. Company strongly utilizes the Chinese utility model.	Speculator
F	Optimistic Firm sees developments towards Western standards.	Local Firstly, the firms sees image reasons. Secondly, Chinese competitors try to block the market. "Business people see number of patents as a competence indicator. Chinese getting stronger in innovation." (Head of R&D, China)	Yes "Patents are a bigger image factor in China." (Patent officer)	Strongly growing Company will file more patents in China as it predicts the Chinese system to catch up to Western standards.	Speculator
J	Optimistic "System is getting westernized." (Patent officer)	Local "Chinas IP environment is improving. Corporate strategy is to increase IP protection in China." (Patent officer)	Yes	Increasing Today only 20 % of all patents are filed in China, too. But this number will increase in the future.	Speculator
K	Optimistic Firms sees visible improvements are. "System will improve till it reaches Western standards." (R&D manager in Europe)	Local "It's a growing market where we will increasingly patent." (Patent officer)	Yes	Strongly growing China is a growing but new market to the company. Patents have hardly been replicated to China but this will change in the future.	Speculator
B	Optimistic "Yes, because the global Chinese players demand this enforceability of patents to be competitive on a global base." (R&D manager)	Global strategy "The strategy is not different for China because the decision if a patent is filed or not is made on a global base." (Global patent officer)	No	Strong Company replicates 100 % of all patents to China.	Strategist

Table 4.2 Archetypes of foreign firms patenting in China (continued)

Case ID	Expectations about the future of China's appropriability regime	Degree of geographic differentiation of the firm's IP strategy	Use of patents as a signaling mechanism	Patenting activity in China	Archetype
C	Optimistic Firm explains that the enforceability is getting better over time. "China recognizes the need to join the world IP system, it is in their own interest." (Global patent officer)	Global "No. There is no difference in the motivation. The decision of whether or not to file a patent is driven by potential commercial advantage and China is part of the global sphere." (Global patent officer)	No	Strong Company replicates 100 % of all patents to China.	Strategist
G	Optimistic "China's IP system is very close to Western standards" (Patent officer)	Global "One firm-wide IP policy. Patenting is centralized." (Patent officer)	No	Strong Company replicates 100 % of all patents to China.	Strategist
D	Pessimistic "China is moving to Western style, but not sure whether they really mean it or it is lip service. They know what we like to hear." (R&D manager, China)	Global "No difference between Europe and China." (Patent officer)	No	Strong Despite the companies doubts almost all patents are replicated in China.	Struggler
I	Pessimistic "The Chinese system has included some time bombs such as compulsory licenses." (Head of R&D China)	Global "Patent applications of Chinese competitors are strongly rising." (Patent officer)	No	Strong Company is active in China for a long time.	Struggler
E	Pessimistic "Chinese get more experience but the progress has not been that great." (Patent officer)	Local strategy "Main reason not to replicate patents in China are the problems with litigation." (Patent officer)	Yes "Chinese companies are applying large numbers." (Patent officer)	Moderate Approximately every third patent is filed in China, too.	Signaler
H	Pessimistic "The system was catching up to Western standards but we see strong nationalistic tendencies lately." (R&D manager)	Local "The market is becoming more important. More patents in general." (R&D manager)	Yes "Image reasons!" (Patent officer)	Little China is the third biggest market for this company but it only files about 15 % of all the companies patents there.	Signaler

any attempts of imitation will be met with retaliation measures from judicial and administrative bodies in China. These bodies will eventually force the domestic imitator to a excuse in public, forcing him or her to ‘lose face’.

From the above description of the archetypes, three antecedents emerge that, together, determine the specific archetype a firm can be subsumed under. These antecedents are the firm’s expectations on the future development of China’s appropriability system, the degree of geographic differentiation of the firm’s IP strategy, and the use of patents as a signaling mechanism.

4.3.1 Expectations about the Future of China’s Appropriability Regime

Foreign firms in China have very different assumptions about the future development of China’s appropriability regime. The data in table 4.3 suggest that these assumptions emerge predominantly as a result of the respective firm’s experience with litigation and competitors’ attempts to imitate. Moreover, the firms’ expectations for the future differ according to the specific way they interpret the development of formal and legal measures the respective bodies in China take.

Firms A, B, C, F, G, J and K have positive expectations about the future development of China’s appropriability regime since their experience with past IP infringements was rather limited. Moreover, even if losses occurred, they still thought that these were outweighed by China’s future market potential. Firms B, F, and J explained that they had not experienced any IP infringements at all despite having registered a considerable number of patents at the SIPO and continue to do so. Firms A, C, G and K only experienced minor infringements; firm K never went to court. All of these firms believe that China’s appropriability system is improving, will reach Western standards soon and that Chinese administration, rather than court rulings, will instill the necessary pressure to foster this development. Thus, they are highly willing to patent in China even if the situation might still be risky today since they expect the appropriability regime to improve significantly in the future.

Their optimism distinguishes these firms from firms D, E, H and I that judge these developments in a much more negative way. In their opinion, these improvements are rather sporadic—do not signify that China’s appropriability system is becoming ‘Westernized’ in any way. These firms have encountered several serious infringement cases; firm E even experiences such cases on a weekly basis. As a result of these experiences, these firms conclude that the Chinese appropriability system is far from reaching Western standards and that improvements are only incremental. These firms have had mostly negative experiences with infringement cases and the verdicts of Chinese courts:

“The Chinese get more experience with IP but progress has not been great. For sure there is an issue with the system, Chinese courts are not really familiar with patent infringements.”

— Patent officer, case E

Finally, firms H and I pointed to problematic loopholes in the law that might have negative consequences for the future of foreign-owned IP in China:

“The system was catching up, but strong nationalistic tendencies can be seen lately. We as a large corporation are worrying especially considering compulsory licensing. Companies are forced to license if there is a need for the public welfare. But, it is not clear how the need for the public welfare is defined.”

— R&D manager, case H

Despite these negative assessments, the firms voluntarily choose to patent at the SIPO although they are aware that they are infringed almost immediately after registration. However, for all four firms China constitutes one of their most important markets. They see no alternative to patenting in China in the near future since Chinese competitors could infringe their IP and subsequently patent it as their own, which would have a disastrous implications for the firm’s future market position. Therefore, these firms tend to patent only what is absolutely necessary to sustain their market presence, while all four admit that even this reduced patenting activity does not resolve the problem of continuous infringement.

Table 4.3 Expectations about the future of China's appropriability regime

Case ID	Experience with IP infringements	Assessment of these infringement cases	Implications of infringement experience	Expectation for future development	Influence on planned future patenting activity
A	Multiple times, mostly low tech, no major cases.	First cases have been won, still lots of corruption, system is steadily improving.	Firm expects litigation problems to decrease in the future. "The situation is getting better. The government is behind it. Signs of improvement can be seen everywhere." (Head of R&D, China)	Positive	Increasing patent applications.
B	No patent violations worth to get behind.	Patent violation is not so much the problem. Design violations is much worth as small firms can easily copy designs. Global Chinese firms demand a working IP system. Patent violations will hurt their image.	Firm sees Chinese companies as the driving force that demand a better IP system. Firm furthermore believes that these Chinese firms will get their will. "Yes, because the global Chinese players demand this enforceability of patents to be competitive on a global base." (R&D manager)	Positive	Already replicates 100 % of all patents to China and will continue to do so.
C	Ongoing lawsuits, frustrating but necessary. Western firms winning cases is still the issue.	Clear improvements over the last 5–6 years. China recognizes the need to join world IP system. System is improving on a scale of 1:10 with the U.S. as a basis.	Firm expects the system to get better as China is forced to adapt to Western standards. "Enforceability is getting better over time: China recognizes the need to join the world IP system, it is in their own interest." (Global patent officer)	Positive	Already replicates 100 % of all patents to China and will continue to do so.
D	Several infringement cases, compensation does not cover losses.	First cases won in recent years, the system changed in the last 2–3 years. Government wanted to visibly protect foreign IP.	Firm does not believe that the system is really getting better. It rather sees the Chinese efforts as a lip service. "China is moving to Western style, but not sure whether they really mean it or it is lip service. They know what we like to hear." (R&D manager, China)	Negative	Will keep applying for Chinese patents. Company sees no alternative.
E	Faces counterfeits on a weekly basis.	Large corporations act similar to Western firms. Licensing negotiations possible. Small firms have no interest in licensing. Counterfeit is the main issue in China.	Firm believes that the Chinese IP system will improve someday, but does not see these improvements happening anytime soon. "Chinese get more experience but the progress has not been that great." (Patent officer)	Negative	Main reason not to patent more in China is the problem with litigation.
F	No major infringements. Thus, no experience with litigation.	Companies have the awareness that patents should not be abused.	Firm expects the Chinese IP system to get better as firms active in China demand this. "Development towards Western standards."	Positive	Strongly increasing the number of patents in China. Firm has an incentive program to motivate patenting in China.

Table 4.3 Expectations about the future of China's appropriability regime (continued)

Case ID	Experience with IP infringements	Assessment of these infringement cases	Implications of infringement experience	Expectation for future development	Influence on planned future patenting activity
G	Only one case, minor damages.	Patents alone might not be enough. Confronting the infringers is important today.	Firm expects a reliable system in China, soon. "China's IP system is very close to Western standards." (Patent officer)	Positive	Already replicates 100% of all patents to China and will continue to do so.
H	Several infringement cases. The compensation does not cover the costs.	The system is getting better, patents start to be useful, but it is still a long way. Two scenarios are possible, 1. the Chinese system stays nationalistic, 2. the Chinese cannot withstand the international pressure.	Firm does not believe that the system is really getting better. It believes that the nationalistic tendencies in China will prevail. "The system was catching up to Western standards but we see strong nationalistic tendencies lately." (R&D manager)	Negative	China: third biggest market thus firm will patent there in the future. Today 15% of all corporate patents are also filed in China. This might increase but not drastically.
I	Lots of infringement cases. Company planned to generate revenues from royalties but sees that it is very hard to enforce patents.	It is easy to get a patent in China but very hard to enforce it.	Firm does not believe that the system is getting Westernized. "The Chinese system has included some time bombs such as compulsory licenses." (Head of R&D China)	Negative	Stable. China is still young but company does not see the system catching up soon.
J	No real problem. Company produces high-tech products which are not easy to copy.	The government has made great efforts to improve protection.	Firm expects litigation problems to decrease in the future. "System is getting Westernized." (Patent officer)	Positive	Increasing as the IP system in China is improving.
K	Minor infringements, manageable damage. No court interaction.	Only patenting in China because company assumes that the system is getting better.	Firm wholeheartedly believes that the Chinese IP system will catch up to Western standards. "Improvements are visible. System will improve till it reaches Western standards." (R&D manager in Europe)	Positive	Strongly increasing. China is becoming a bigger market.

4.3.2 Degree of Geographic Differentiation of the Firm's IP Strategy

The firms also differ strongly regarding whether they have a global approach to managing their IP in which China is one of many countries, or whether they have implemented a specific IP strategy for China. The data in table 4.4 summarize this variance and suggest that both the way the firms judge specific properties of China's appropriability regime as well as the firm's motives for using patents in the Western hemisphere have an influence on the firm's tendency to create a local IP strategy for China. This tendency, in turn, influences their propensity to register patents in China.

Firms that follow a global approach (cases B, C, G, D, I) see no peculiarities which, according to their assessment, would demand a China-specific approach to protecting their IP. Their motives to patent are basically the same as in Western appropriability regimes: Protecting innovations and ensuring their freedom to operate in the Chinese market (i.e., to operate unhindered by competitors' patenting activities). Their IP strategy is global, such that innovations are patented globally in all markets where commercialization of these innovations is intended. Thus, to them China represents 'just another' market where patents are filed:

"We have a firm-wide IP strategy. This strategy is global, the patenting decision is centralized. All patents which we file in the U.S. or in Europe are filed in China, too. The same holds true vice-versa. All Chinese patents are also filed in the U.S. and in Europe."

— Patent officer, case G

"Our IP strategy is not different for China because the decision if a patent is filed or not is made on a global basis."

— Global patent officer, case B

Interestingly, a subset of these firms—those that constitute the strategist archetype—are not put off by the adverse implications of China's weak appropriability regime. On the contrary, the data in table 4.2 suggest that these firms tend to file more patents at the SIPO than other firms.

By contrast, the other firms (cases A, E, F, H, J, K) do see peculiarities within China's appropriability regime that make a China-specific approach to protecting their IP necessary. Firms A, E and J strongly emphasized that IP litigation before Chinese courts seldom yields adequate compensation payments if infringements have occurred. Therefore, these firms decided not to replicate all of their patents to China, as they see no effective possibility to enforce them. Only those patents that are needed to guarantee the firm's freedom to operate in the Chinese market are filed at the SIPO, whereas key patents are kept out of China. Firm J explained this motivation as follows:

“Anything that can be filed will be patented in the U.S.; we are more reserved when it comes to China. A patent has to be reproducible in China and it is a great danger that people will do exactly that. And in China, you cannot just go to court and get a warrant, gathering information is difficult. So we only patent to an extent that competitors cannot take our products and protect it with their own patents.”

— Patent officer, case J

4.3.3 Use of Patents as a Signaling Mechanism

The last central criterion by which the firms differed was the extent to which they considered the filing of patents at the SIPO as a means of signaling that they had superior technological capabilities. The data in table 4.5 summarize these differences. They also suggest that a firm's propensity to use patents for signaling, rather than for appropriation or bargaining purposes, is an expressly planned strategy.

Those firms that use patents to signal superior technological capabilities (cases A, F, J, K, E, H) make use of the Chinese 'Indigenous Innovation Program' which entitles Chinese (but not foreign) firms to receive tax credits and premiums for each patent they register at the SIPO (Zhang et al., 2009; Lazonick, 2004; OECD, 2008). Cases A, E, F, H, J, and K emphasize that, as a

Table 4.4 Degree of geographic differentiation of the firm's IP strategy

Case ID	Motives to patent in China vs. motives to patent in the West	Peculiarities of the Chinese IP system as perceived by the firm	Implications derived from these peculiarities	Resulting IP approach for China	Implementation of this IP approach
A	Protecting the company's technological leadership, freedom of action, image as a high-tech company. "The motives are basically the same, but the Chinese system demands a special strategy. The Chinese utility model makes it difficult to protect innovations." (Patent officer, China)	The utility model and the enforcement of intellectual property rights in China vary drastically from Western IP legislations.	Firm sees the need for a China specific IP strategy.	Local strategy	Not all patents are replicated in China, strong emphasis on the utility model, strong emphasis on designs as they are easier to enforce.
B	Motives are the same as in other markets, protecting technologies and designs. Processes are not patented. "The strategy is not different for China because the decision if a patent is filed or not is made on a global base." (Global patent officer)	Firm sees the poor enforcement in China as the only singularity.	Firm has a global IP strategy and sees no need to adapt it for the Chinese Market.	Global strategy	All patents are replicated in China, as they are in all other markets the firm is active in.
C	Nothing is solely patented in China. "No, there is no difference in the motivation. The decision of whether or not to file a patent is driven by potential commercial advantage and China is part of the global sphere." (Global patent officer)	Firm sees no major singularity in the Chinese IP system. China is a young but rising market.	Firm sees no need to carve its IP strategy to the Chinese market.	Global strategy	All patents are replicated in China, as they are in all other markets the firm is active in.
D	Avoid copyist, protect own right to market products in China. "No difference between Europe and China." (Patent officer)	Enforcement is still an issue but getting better. Besides that no singularities.	No need to change the company's global strategy to the Chinese market.	Global strategy	Almost all patents are replicated in China.
E	No special motives to patent in China, protection of R&D in general. "Main reason not to replicate patents in China are the problems with litigation." (Patent officer)	The ongoing problems with litigation are seen as a major obstacle.	Firm sees no possibility in simply applying their Western IP strategy to the Chinese market.	Local strategy	About 30 % of all patents are replicated in China. Besides that the firm uses factual protection methods and works closely with customers.
F	"Image reasons. Chinese competitors try to block the market. Business people see number of patents as a competence indicator. Chinese getting stronger in innovation." (Head of R&D, China)	Lately, the firm sees the Chinese firms as innovative competitors. "Chinese firms are getting better in R&D. They do not copy any more, they invent." (Head of R&D, China)	In order to protect the company's freedom to operate a China specific IP strategy is necessary.	Local strategy	China specific strategy which encourages patenting in China in order to protect the company's freedom to operate.

Table 4.4 Degree of geographic differentiation of the firm's IP strategy (continued)

Case ID	Motives to patent in China vs. motives to patent in the West	Peculiarities of the Chinese IP system as perceived by the firm	Implications derived from these peculiarities	Resulting IP approach for China	Implementation of this IP approach
G	China is seen as a growing market among many other markets. "One firm-wide IP policy. Patenting is centralized." (Patent officer)	Firm sees no major difference in the Chinese IP system.	Patenting in centralized, one firm-wide IP policy.	Global strategy	All patents are replicated in China, as they are in all other markets the firm is active in.
H	Other companies copy Western patents and apply them in China. "The market is becoming more important. More patents in general." (R&D manager)	Danger of copied patents in China which can block the company.	China specific IP strategy in order to protect the company's freedom to operate.	Local strategy	Only the key patents are replicated to China. The core of the firm's strategy is to guarantee its own freedom to operate.
I	Image reasons, licensing earnings, freedom to operate. "Patent applications of Chinese competitors are strongly rising." (Patent officer)	The Chinese competitors are catching up.	Company patents in China in order to generate licensing earnings.	Global strategy	Firm applies all patents to China the goal of this are licensing earnings and the company's freedom to operate.
J	Corporate strategy to increase IP protection. "Chinas IP environment is improving. Corporate strategy is to increase IP protection in China." (Patent officer)	Enforcement is the major issue.	Company sees no use in patent all its inventions if these patents are not enforceable.	Local strategy	Only about a third of all patents are replicated to China.
K	Growing market and increasing use of European patents in China. "It's a growing market where we will increasingly patent." (Patent officer)	Only exception is the Chinese Utility model and that the Chinese market is not that advanced, yet.	Competitors are mainly Western firms, therefore it is important to guarantee its own freedom to operate.	Local strategy	Firm only applies a few patents to China but this will increase as the Chinese market is growing and more technology is needed.

Table 4.5 Use of patents as a signaling mechanism

Case ID	IP consequences of high-tech vs. low-tech products the firms makes in China	Influence of these consequences on firm's IP approach	Implications for IP approach	Resulting use of patents
A	Complex technologies are hard to copy. Chinese firms mainly copy low-tech products.	Strong influence Low-tech products are protected by designs rather than patents in China.	High-tech products are rarely copied but patents function as an indicator of R&D capabilities.	Firm patents high-tech products to guarantee freedom to operate and to indicate R&D capabilities to Chinese firms.
B	Company does not see a fundamental difference in the protection of high-tech vs. low-tech products.	No influence Company follows a global strategy.	No implications	All patents are replicated in China, as they are in all other markets the firm is active in.
C	Firm explains that high-tech products are hardly copied.	No influence Company follows a global strategy.	No implications	All patents are replicated in China, as they are in all other markets the firm is active in.
D	Firm explained that high tech parts of the products are hardly ever imitated, rather low-tech parts such as mechanics or cooling principles. "Our] Products are very hard to imitate, the technology is very complex. Some parts like mechanics or cooling principles could be copied, but not the software code of the major algorithms. Copying only helps you as long as you are a small firm. Large Chinese firms don't copy." (Site manager, China)	No influence Company follows a global strategy.	No implications	Almost all patents are replicated in China, as they are in all other markets the firm is active in.
E	Almost all infringements happen in low-tech. Small Chinese firms copy chassis and logos.	Strong influence Strong cooperation with customs to counter low-tech infringements.	Chinese high-tech firms see patents as an indicator of R&D capabilities. Enforcing low tech property rights has a strong effect. Chinese companies fear open apologies. "For a Chinese company it's a kind losing one's face. Such an open apology will scare other possible infringers." (CTO, China)	Firm patents all high-tech inventions and radical innovations in China and strictly enforces low tech infringements. The royalties hardly pay the attorney fees but it scares away other companies which might infringe.

Table 4.5 Use of patents as a signaling mechanism (continued)

Case ID	IP consequences of high-tech vs. low-tech products the firms makes in China	Influence of these consequences on firm's IP approach	Implications for IP approach	Resulting use of patents
F	Complexity of products used to be an effective protection measure but is not anymore. Chinese firms are catching up.	No influence Low-tech and high-tech inventions are patented alike	Patents serve as an image factor in China.	Firm heavily increasing its patenting in China. To do both: not being blocked by Chinese patents and to signal R&D capabilities.
G	Company does not see a fundamental difference to Western IP legislations.	Strong influence Company abandoned low-tech products from the Chinese market and is focusing on high-tech industrial products.	No implications	All patents are replicated in China, as they are in all other markets the firm is active in.
H	Chinese firms used to copy consumer products the company made. Less infringement in the high-tech sector.	No influence Company follows a global IP strategy.	Patents in China serve as a prestige issue.	Firm sees the prestige issue of patents as a further reason to patent in China.
I	Company explained that it had no major infringements by Chinese firms due to the high complexity of the company's products.	Strong influence Suing all infringers to scare others off.	No implications	All patents are replicated in China, as they are in all other markets the firm is active in.
J	Nobody copies high-tech products, low tech products are imitated by Chinese firms. "This is a serious concern." (Head of operations, China)	Strong influence Cooperation with customs.	In China patents are an important image factor. And possible infringers can only be scared away if the company persecutes infringers.	Patenting of high-tech products. And the strict prosecution of low-tech infringers. Regardless if the infringement are on patents or trademarks.
K	Low-tech is often copied, high-tech hardly. "To some degree, yes, designs and low-tech parts are copied, complex technologies are not." (Patent officer)	Strong influence Cooperation with customs.	Patents serve as an indicator of R&D capabilities. Firms have to patent to be taken seriously. But high tech products are not copied. Infringers are only copying low-tech. This means that low-tech infringements have to be prosecuted. Primarily on the basis of designs and trademarks.	Technological leadership in certain areas. In these areas heavy patenting. Scaring away of possible infringers by the prosecution of design and trademark violations.

side effect of this policy, patents are seen as an indicator of the R&D capability of a firm, be it foreign or domestic. Thus, two beneficial effects for foreign firms can result:

First, the above cases report that signaling the status as a high-tech company by filing patents helps to attract domestic business partners when collaboration is needed:

“Patents are more than just protection, in China it is often a prestige issue.”

— Patent officer, case H

“It often has image reasons; local competitors are increasingly applying for patents. Businessmen in China see the number of patents as proxy for the capabilities and know-how.”

— Head of R&D in China, case F

Second, and perhaps more importantly, domestic firms are deterred from competing in the same or related high-tech areas since the firms aggressively defend these patents, even if this defense does not make sense from an economic point of view since litigation costs outweigh compensation payments by far. At the same time, these firms tolerate imitation in low-tech product segments (in which they do have utility patents) since they expect that future business will primarily be driven by high-tech products. They find that the majority of the IP infringements they suffer relate small domestic firms that imitate in low-tech segments of the market by copying designs and logos (table 4.5).

By contrast, the high-tech market segments are contested by domestic firms. Here the threat does not originate so much from attempts to imitate but rather from the pressure to maintain the firm’s freedom to operate:

“In our sector, imitation is not such an important topic anymore. Chinese companies became serious competitors—they don’t copy anymore, they develop themselves.”

— Head of R&D in China, case F

“The main issue is the counterfeit problem. Many products are copied in China—but that is not a patent issue. It is more a challenge to deal with those small imitators. But those competitors in China we have to watch are already behaving like Western companies; they seem to care more about the patenting question.”

— CTO in China, case E

Due to this increased importance of defending patents, the firms are set to defend these patents fiercely. However, they aim more for public excuses than damage if infringements by domestic have occurred since such excuses make the imitator lose face: “We manage it the Chinese way; we confront infringers publicly with their deeds. This ‘penal character’ of retaliation is much worse for a Chinese person than compensation payments.” (Case H). Firms aim to “spread the message that we are defending our IP” (case J). Thus, despite the weak appropriability regimes, these firms can use patents to deter imitators since they make use of such cultural factors.

By contrast, those firms that do not use patents for signaling technological capabilities and the strong intention to defend them (cases B, C, G, D, I) do not have a specific approach to managing their IP in China. Figure 2 suggests that all of these firms have a global IP strategy where China plays no specific role. Therefore, these firms do emphasize that they do not have any specific signaling and defense measures since they are not needed to implement their global approach.

4.3.4 Synthesis: Foreign Firms’ Motives to Patent in a Weak Appropriability Regime

On the basis of the archetypes and their determinants we identified above, we can derive three motives of why foreign firms patent in a weak appropriability regime like China.

(1) **Forced use.** This motive is particularly visible among firms of the struggler archetype. These firms would prefer not to patent in weak appropriability regimes, however, they see no other choice than doing in order to preserve their

freedom to operate and to defend their markets against domestic firms who are likely to patent foreign technology as their own if it should be unprotected. Due to this rather negative motivation to patent, they only patent the necessary minimum to achieve the above purposes.

(2) Signaling use. Deployed primarily by firms of the signaler archetype, this usage of patents aims to signal superior capabilities and the firm's strong intention to defend these. Thus, the firm presents itself both as an attractive collaboration partner to domestic firms which regard patents as an indicator of technological capabilities, and it deters imitators by the threat of strong retaliation measures that do not rely on the judicial system, but rather on culture-bound factors such as the important of not to lose face in China.

(3) Pre-emptive use. Firms of the archetypes strategist and speculator are primarily driven by this motive. They expect a significant improvement of China's appropriability regime and a development towards Western standards regarding IP enforceability in the very near future. Therefore, their motivation is to secure the market already at today's stage and to block it against domestic competitors by registering as many patents as possible at the SIPO, including the replication of patents already registered in legislations outside China.

4.4 Discussion

In an attempt to explain the recent exponential growth of Chinese patents owned by foreign firms operating in China, we studied 11 foreign firms in China using an exploratory technique. We found that there is no single dominant motivation for foreign firms to patent in China, rather, firms can be grouped into four different archetypes (strategist, struggler, speculator, and signaler) according to their specific motivations. Further, we found that three antecedents—the firm's expectations on the future development of China's appropriability system, the degree of geographic differentiation of the firm's IP strategy, and the use of patents as a signaling mechanism—are strongly associated with the specific archetype a firm can be assigned to, and we analyzed the origin of these antecedents. Finally, on the basis of these findings we synthesized three different motives that drive firms to patent in weak appropriability regimes: forced

use, signaling use, and pre-emptive use. These results have several implications for the literature and for management practice.

A direct implication of our study is that it helps to identify the determinants of foreign patenting in China since extant literature has almost exclusively focused its attention on the antecedents of domestic (Chinese firms') patenting (e.g., Hu and Jefferson, 2009). Moreover, to the best of our knowledge our study closes a gap in explaining firms' patenting behavior in China since it focuses on identifying the reasons that lead firms to patent in this appropriability regime. This approach extends the studies of Wu and Liu (2004), Wei and Liu (2006) and Yang and Clarke (2005) that have more emphasized the descriptive account of this phenomenon rather than its analysis and explanation. Our study is also one of the very few that analyzes foreign patenting on an organizational level of analysis, an area that merits much further research attention (Keupp et al., 2010). We can thus extend the country-level based approach of Sun (2003) by adding an organizational-level perspective to foreign patenting in China.

Further, our study presents evidence that adds to the discussion of Keupp et al. (2010) of how foreign firms can appropriate rents from innovation in weak appropriability regimes. Whereas Keupp et al. (2010) also study the case of China and draw the conclusion that appropriation in weak appropriability regimes is only likely to work by 'de facto' protection strategies, our findings somewhat relativize these claims. All four archetypes we studied use patents to appropriate rents from innovation. In our view the approach of these firms represents a risk trade-off: They are willing to take the risk of IP infringements in exchange for securing a position in the Chinese market now that is unlikely to be attainable in the future, let alone due to the danger of Chinese firms patenting infringed Western technology. The firms are therefore willing to patent since not to patent, in their view, would be even riskier. We believe that in this setting, appropriation by patents is rational despite the weak appropriability regime, since the risk of domestic competitors appropriating foreign firms' rents by their indigenous patenting activity would be even greater. This finding corresponds to the presumption of foreign patenting in China as a pre-emptive response to a 'nightmare scenario' when a new technology is only protected by patents in a small number of leading countries while coverage is found lacking in significant

peripheral countries resulting in a free-for-all in those countries and a risk of re-export, though illegal, to patent-covered countries (O’Keefe, 2005).

Our study also adds to the debate on Teece’s (1986) appropriability framework and to the debate how the appropriability regime influences a firm’s choice of appropriation measures. In the introduction we have pointed to the inconsistency with the theoretical prediction that firms operating in weak appropriability regimes should not use patents for appropriation or negotiation (Teece, 1986; Levin et al., 1987; Cohen et al., 2000). Our findings can contribute to resolve this inconsistency in a number of ways.

First, it is interesting to note that firms do exist at all whose IP strategy is not predicted by Teece’s framework (maybe with the exception of the struggler archetype which suffers from the weak appropriability conditions). The rest of the three archetypes seem to have other motives which in our case supersede motivations from the immediate sphere of IP-related strategy making. Signalers, for example, seem to care more about building a strong reputation for enforcement in the market using culture-bound means. This particular finding contributes to the understanding of how foreign firms might defend themselves against aggressive domestic firms, a question explored relatively little (Jaffe et al., 2005; Wu and Pangarkar, 2006). It also shows that patents can be used as a signaling mechanism even in weak appropriability regimes and thus complements studies of studies that show how patents in strong appropriability regimes can be used to construct patent ‘thickets’ and ‘fences’ to deter potential imitators and to signal that a certain technology has been ‘blocked’ by the innovator (Cohen et al., 2002; Granstrand, 1999; Ceccagnoli, 2009). Whereas in a strong appropriability regime, the motive of blocking competitors is prevalent, the firms we found use patent signaling in conjunction with culture-bound retaliation measures such as forcing imitators to excuse publicly, rather than pay compensation, to make them lose face. Thus, their motive might be not so much to block competitors but to build a reputation of possessing highly valuable yet fiercely defended technology, which in turn makes them attractive as a business partner in the eyes of domestic firms.

By contrast, strategists and speculators put more emphasis on future developments than on today’s appropriability conditions. Thus, the two latter archetypes make their strategic decisions as if China were already a strong appropri-

ability regime. For these two archetypes, these expectations for the future seem to have more weight than the immediate prediction from Teece's framework. Our findings also relativize the finding of Cohen et al. (2000) of a strong link between patent effectiveness and patent behavior. By their patenting behavior, the archetypes we identified pursue goals that are not immediately related to patent effectiveness. All in all, these motives may imply that once appropriability conditions on a between-country, rather than on an industry level within the same country, firms are not necessarily 'free' to decide according to a strategic matrix or flow diagram like those of Teece (1986) since a foreign economy's appropriability may lack the stability and predictability of the U.S.'s economic environment in the context of which these predictions were derived. In a foreign country with a weak appropriability regime, firms could therefore be expected to behave in different ways according to the environmental influences and appropriability conditions they experience there. In our results, this effect is probably most prevalent in the finding that there is a forced use of patents. Although some of the firms would rather not patent could they freely choose, they nevertheless have to do so in order to guarantee their freedom to operate and to block aggressive domestic competitors firms from taking their market share, irrespective of whether or not these patents may be infringed.

Further, to the best of knowledge, our study is one of the very few that uses a country-level, rather than industry-level understanding of appropriability conditions. Specifically, 'classic' papers on IP strategy and appropriation (Teece, 1986; Levin et al., 1987; Cohen et al., 2000) have exclusively studied appropriability conditions in the U.S., using examples from specific U.S. industries to support their claims. Our findings might suggest that IP strategy-making in an international context where appropriability conditions of a whole economy and not merely of industries within a single economy is considered, additional motives may interact with and even override the predictions from Teece's framework. Since there are several emerging economies besides China whose appropriability conditions are also problematic (such as Turkey or Vietnam), more research would be desirable that tests the predictions of Teece's framework with foreign firms actives in these economies.

Our results also have managerial implications. First, they provide managers of foreign firms in China with guidance of how patents can be useful even in

weak appropriability regimes, but they also inform managers about potential dangers, as the motive of ‘forced use’ of patents and the problematic situation of firms of the struggler archetype show. We can further inform managers that the exponential growth rate of foreign patenting in China is not a singular phenomenon, but rather a composite effect of different archetypes of firms pursuing different motives. A final insight for managers is that local peculiarities rooted in the foreign economy’s idiosyncrasies may interact with and even supersede strategic decisions that the firm would make in a strong appropriability regime. Finally, it is not impossible that the archetypes and motives we have found here in the specific empirical context of China may serve as an analogy for other economies with problematic appropriability conditions.

Still, our findings have some limitations that need to be overcome by future research. The purpose of this study was to offer some explanations that can help resolve a theoretical inconsistency, not to test hypotheses. Due to our inductive method of collecting and interpreting data, we cannot claim generalizability for our findings, nor do we attempt to do so. Rather, we suggest that our findings provide a launch point for further explorations and quantitative testing of the causal paths we have conceptualized. Moreover, although analytical grid we show in figure 2 theoretically allows for eight archetypes, we could identify only four in our data. It may be possible that firms exist that could fill in the other archetypes and explain their behavior, thus, more exploratory studies that build on our approach would be desirable.



Informal Measures, Hybrid Strategies and Entrepreneurial Orientation: Appropriation of Returns from Innovation Among Small and Medium Enterprises

This article, coauthored by Marcus Matthias Keupp, deals with SME and explains how these firms can make sure that their innovations are worth the effort. This inductive article causally pinpoints the presence of a firm-level appropriation capability to firm-level organizational characteristics. It shows that a SME's capability to appropriate returns is associated with its capability to design and deploy informal appropriation measures, as well as with its entrepreneurial behavior, which positively moderates the development of protection capacities.

5.1 Introduction

To this day, we know very little about how small and medium enterprises (SME) manage to appropriate returns from innovation, i.e. to capture the benefits or profits generated by innovations that the SME has produced (Teece, 1986). This question is in our view an important area of study because we believe that conflicting theoretical predictions and considerable research gaps exist regarding the question of how SME can successfully appropriate returns from innovation.

Firms need to appropriate the returns from their investments in innovation in order to benefit from their innovativeness (Cockburn & Griliches, 1988; Teece, 1986). Returns to innovation are critically affected by appropriability conditions (Cockburn & Griliches, 1988). Greater appropriability has a large, positive, and significant impact on a firm's economic performance (Ceccagnoli, 2009). Extant literature focuses mostly on how large firms can appropriate by using formal protection measures such as patents, trademarks, copyrights and industrial designs (Arundel et al., 1995; Cohen et al., 2000; Cohen et al., 2002; Grandstrand, 1999; Levin et al., 1987) and by complementary measures (Teece, 1986). Such large firms typically commit extensive resources to secure appropriation and create in-house intellectual property (IP) departments where engineers and patent attorneys actively seek possibilities for appropriation by patents and other means (Blind et al., 2003; Blind et al., 2005). Small firms, however, seem to use formal measures very little, either because of a lack of resources that could be devoted to acquiring and defending formal rights, because they are poorly informed about these rights, or because they lack the capability to administer them effectively. Instead, they seem to prefer informal measures such as secrecy and lead time advantages (Arundel & Steinmuller, 1998; Blind et al., 2006; Cohen et al., 2000; Hall & Ham-Ziedonis, 2001; Kitching & Blackburn, 2003; Lanjouw & Schankerman, 2001; Lerner, 1994; Macdonald, 2004; Scherer & Ross, 1990). None of these articles however raises the question how SME choose among protection methods and why they use precise methods to a certain extend.

Concurrently, a growing body of literature can be found that focuses on the management of SME and its fundamental difference to large multinational corporations (de Jong & Marsili, 2006). Besides the quantitative difference in

size, revenues and resources several key distinctions between SME and multinational companies are recorded. SME have a low management hierarchy, their business is less formalized and several operative tasks are performed by the same employee (Julien, 1993; Gélinas & Bigras, 2004; Acs, 1992). The literature on management in SME furthermore teaches us that many SME are quite successful and innovative in their fields. Hence, they have the ability to appropriate innovation rents (Smallbone, et al., 1995, de Jong & Marsili, 2006). If SME are fundamentally different from large corporations and still have the ability to appropriate innovations rents the question remains how does the IP related decision making process in SME work?

Extant literature offers almost no guidance that could resolve this research gap. The literature on small firms and intellectual property is particularly wanting (Blackburn, 2003, emphasis in original). The question of how, if at all, SME can appropriate returns from their IP has been hardly touched (McGaughey et al., 2000). And when it is touched it leaves us with truisms like ‘If you cannot block you better run’ (Leiponen & Byma, 2009). This stands in stark contrast to the great number of studies that analyze measures and strategies of appropriation among large internationally active firms (e.g., Ghauri & Rao, 2009; Yang, 2005; Yang & Kuo, 2008).

The purpose of this study, therefore, is to investigate the question: How and why can SME successfully appropriate returns from their innovation activities? Our paper features an inductive study of six SME that differ considerably with respect to the extent to which they can achieve this: Whereas one group of firms is highly successful, another group is struggling to appropriate returns from innovation. By comparing the two groups, we wish to causally pinpoint this variance to the presence of certain firm-level characteristics. We use a qualitative approach to data collection and analysis for the following reasons. Qualitative approaches are appropriate in a setting where little or no theory exists that could guide hypothesis-testing work (Eisenhardt, 1989), which we believe is the case here. Moreover, if the above findings hold, it should be very unlikely that INVs use patents to a great extent, thus, quantitative measurements that model the strength of appropriation by patent counts could likely be misleading.

Our study contributes to the literature by showing how SME appropriate returns from innovation, and by showing that their actions differ significantly

from the predictions the literature on intellectual property makes. Our findings suggest that successful SME have created new and fitting appropriation measures (informal measures). Further, we contribute to the literature by showing how they have combined these measures with formal measures into effective strategies (hybrid appropriation strategies) that can appropriate returns from innovation at little cost. These findings have important implications for the literature on both, small firms, and appropriation.

5.2 Method

We carried out comparative cross-sectional multiple-level inductive research. This type of research is appropriate when one wants to understand the phenomena under investigation within their rich organizational contexts, a motivation that applies to our setting. Our approach to sampling the firms we analyze in this paper was theoretical in Eisenhardt's sense that 'the goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory' (Eisenhardt, 1989: 545). The multiple-case approach allows for cross-site comparison, so that idiosyncratic aspects of any one site can be seen in perspective. This enhances the robustness of the findings (Miles, 1979). By this approach, we strived to causally pinpoint those organizational-level and individual-level characteristics and theoretical mechanisms that determined why some firms could successfully appropriate returns from innovation whereas others were less successful.

We identified the six firms in our sample from a SME database which our institute has created. The six firms were chosen by theoretical sampling, not by random sampling. We wanted to identify different types of firms that differed in the extent to which they managed to appropriate returns from innovation successfully. By a cross-comparison of these different types of firms, a high analytical variance can be expected, and these differences may be traced back to systematic differences between the firms (Eisenhardt, 1989). In addition to this theoretical sampling approach, we conducted a number of comparisons and statistical tests between these six cases and the total of 159 firms in the database to analyze whether the six cases were not over-representing a specific type of

firm. As this was not the case, concerns of about a possible self-selection bias were alleviated. Given the depth of our research involvement, we guaranteed the six firms absolute anonymity and confidentiality, which is why the names of the firms have been disguised in this article.

Table 5.1 gives details about these firms. The sample size meets the suggested target of four to ten cases for theory development studies (Eisenhardt, 1989). Each case was studied in a longitudinal manner; our research presence in the six firms lasted from January 2008 to May 2009. The R&D intensity of all firms suggests the high emphasis these firms put on innovation as their primary source of competitive advantage.

We collected data by means of personal in-depth interviews, archival documents, and on-site observations. Such triangulation of various types of data collected by different methods enhances construct validity by overcoming the limitations of using only one method and thus provides a solid foundation for theory development (Jick, 1979). Table 5.2 informs in detail about all data sources.

For the interviews we adopted a multiple-informant approach, interviewing both managers and R&D staff with different task and education backgrounds. Interviewees were sought on a top hierarchical level to ensure the interviewee had detailed and substantiated knowledge. They were identified by ‘snowball sampling’. In each firm we asked the Chief Executive Officer (CEO) or the founders (who were always interviewed) to name those individuals that were most involved with the firm’s intellectual property activities. We asked these informants to name other individuals who were central to the firm’s intellectual property protection. This process converged on a set of key managers whom we interviewed. This set typically included the head of R&D, heads of business units and segments, and experienced line managers. In the interviews we asked for both past and real-time data to create greater depth of understanding of how events evolved over time (Leonard-Barton, 1990). We organized the interviews by consistently using one and the same semi-structured interview guide. This guideline comprised a series of open-ended questions that allowed the informant to relate his or her experience. The questions concentrated on facts and events rather than on respondents’ interpretations (Eisenhardt, 1989).

Table 5.1 Descriptive data for the six SME

Firm	Industry sector	Main product(s)	Employees	Export ratio	IP legislations SME is active in	R&D intensity
1	Pharmaceutical supplies	Isolators for the pharmaceutical industry	180	80 %	Europe, USA, Singapore, Japan	5 %
2	Medical devices	Shakers and fermenters for microbiological research	130	85 %	Germany, France, Netherlands, UK, China	7 %
3	Medical diagnostics	Analytical instruments for research purposes	6	Almost 100 %	Europe, USA, Canada, Japan, Korea, China, India	Does not give out turnover numbers.
4	Wood / toys	Wooden toys	5	90 %	Europe, USA, Japan	4 %
5	Machinery	Made to order special machines	26	70 %	Europe, USA	5 %
6	Plastics	Glass-fiber reinforced plastics	15	50 %	Europe, USA, Japan, China, India	3 %

All interviewees were native German speakers, and all interviews were conducted in German. All verbal quotes appearing in this paper have been translated into English by us, using the translation-backtranslation procedure to guarantee the accuracy of our translations. These personal interviews lasted between 90 and 120 minutes and were tape-recorded and transcribed verbatim which resulted in more than 700 pages of transcripts. After the interviews, we conducted follow-up interviews to ensure a correct replication of answers and to clarify issues which emerged during the process of transcription. We tried to control for potential respondent bias as far as possible by not mentioning any element of our emergent theory to interviewees and by keeping a passive and unobtrusive presence during company visits, and interviews. Further, to reduce bias from recall and rationalization, table 5.2 shows that we triangulated our collected interview data with both firm-internal data sources (such as company magazines, patents (if any), business plans, internal memos and presentations, confidential strategy papers and minutes of past meetings) and external analyses from third parties (such as database information and analyst reports). We believe that by using these procedures and additional data sources it is likely that potential respondent bias can be significantly reduced.

Table 5.2 Sources of data

Firm	# Inter-views (con-firmatory interviews)	Archival documents	Workshop participation # of work-shops (# of participants)	Workshop objective	Demographic of workshop participants
1	4 (3)	Business plans, websites, patents, company presentations, organigrams	4 (19)	Technological future strategy	R&D manager, project managers, product managers
2	5 (3)	Business plans, websites, patents, company presentations, organigrams	5 (10)	Budgeting of innovation activities, innovation controlling	R&D managers, product managers, project managers, controller
3	5 (4)	Business plans, websites, patents, internal memos, organigrams, sector analysis	4 (4)	Innovation strategy, protection strategy, sales strategy	CEO, co-founders
4	6 (3)	Business plans, websites, company presentations, organigrams, product brochures	4 (3 + 2 external)	Company strategy, international markets, distribution channels	CEO, founders, inventors, sales, distribution partners
5	5 (4)	Business plans, websites, company presentations, organigrams, process maps, R&D flow charts, internal memos, product brochures	8 (4)	Innovation activities, collaboration strategy	CEO, R&D managers
6	4 (3)	Business plans, websites, patents, company presentations	2 (6 + 3 external)	Patent strategy	R&D managers, patent attorneys, product managers

The data collected during the research were continuously entered in a case database. When data collection on one firm was complete, we synthesized all data on this firm into individual case histories. We began the writing of these histories without formalizing any expectations of the extent to which firms could successfully appropriate.

The case histories were between 35 and 60 double-spaced pages in length and included narrative, selected quotes from the informants, and tables and timelines summarizing key facts. We used within-case analysis to describe the specific way the firm managed appropriation in order to derive constructs (Eisenhardt, 1989). Two assistants read through the original interviews and

formed an independent view of each case history, our analyses, and the emerging constructs. We used these independent opinions to cross-check our emerging case histories. While reading and analyzing interview transcripts, field notes and documents, we engaged in an iterative process of comparing our documentations with the literature to assess the fit of case data (Eisenhardt, 1989). This iterative process of constantly comparing emergent theory and data led often to a more qualified understanding. After all individual case histories were completed; we enabled cross-case comparisons by tabulating the data following techniques for cross-case pattern sequencing and pairwise comparisons (Eisenhardt, 1989) and tabular displays (Miles & Huberman, 1984). We then developed tentative propositions by examining whether similar themes emerged across cases. Our overall aim in the cross-case analysis was to find any association between a firm's ability to successfully appropriate and specific firm-level characteristics. We therefore examined how, if at all, the absence or presence of this ability could be related to the presence or absence of one or more specific firm-level characteristics.

5.3 Results

There was considerable variation among the cases with respect to the extent to which they could successfully appropriate returns from innovation. The cases formed two subsets: one group which mastered appropriation well (cases 1, 4, 5), and another group which found appropriation difficult to attain and was dissatisfied with the results of their actions (cases 2, 3, 6). Table 5.3 summarizes this variance.

In an attempt to understand these differences, we extensively studied the longitudinal evidence of the six cases. What emerged from this evidence were insights that suggested a causal link between strong appropriation and two capabilities: first, a capability to develop informal protection measures, and second, a capability to combine these with formal protection measures into what we call hybrid appropriation strategies. We further found that the emergence of both of these capabilities was positively conditioned by entrepreneurial behavior. We identified these effects by following the development of the firms' ap-

Table 5.3 Variation of the extent to which the firms can successfully appropriate returns from innovation

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Resource impediments for appropriation	Low Appropriation not affected by resources	High Litigation costs are a problem for the firm	High Litigation costs are a problem for the firm	Low Appropriation not affected by resources	Low Appropriation not affected by resources	Low Appropriation not affected by resources
Risks for appropriation from collaborations	Low High degree of imitability/prevents infringements by collaborators	High Firm's IP was repeatedly infringed by cooperation partners	Low Collaborators are mostly with Swiss Universities which have no interest in infringing	Low Despite high observability, cooperators do not infringe firm's IP	Low Collaborators cannot observe complete technological information	High Firm's IP was repeatedly infringed by cooperation partners
Ability to defend IP if attacked by competitors	High "They can try, but they would need a very long time to achieve our level"	Low "We try to innovate faster if we have been infringed"	Low "We fear litigation"	High "Customers come back to us very fast"	High "Some competitors offer complex solutions, but they cost almost twice the price we charge"	Low "It's not worth taking the litigation risk"
International coverage of appropriation protection	Strong "Our technology is protected globally"	Moderate "Our products get infringed from time to time - we can only try to be ahead"	Weak "If a large global firm steals our technology we can't do very much"	Strong "We sell worldwide and infringements are scarce"	Strong "So far we have never been infringed, neither here nor internationally"	Weak "We were lucky so far... we couldn't litigate if we were attacked in our export markets"
IP Infringements occurred?	Yes	Yes	Yes	Yes	No	Yes
Damage suffered from infringed IP	No damage	High damage Several years of dispute, high litigation cost, only minimal compensation awarded	Considerable damage Damage was limited by informal discussions with infringers	Minimal damage Customers quickly renounced the counterfeits	No damage So far firm's technology has never been infringed	Considerable damage Due to fear of high litigation cost no counter-action was taken
Overall assessment of capability to appropriate returns from innovation	Strong "We are well protected" (CEO)	Weak "It's not optimal. There is room for improvement" (CTO)	Weak "All we can do is to introduce the next generation technology as fast as possible" (Founder)	Strong "Even if there are infringements, they don't live long" (Engineer)	Strong "I think we are doing it right. So far we are fine" (Head of R&D)	Weak "The lack of resources does allow us to defend patents in court"

propriation strategies over time, tracking employees' actions, and analyzing managerial behavior. The firms that appropriated successfully had strongly developed the two above-mentioned capabilities, and they were characterized by a strong entrepreneurial attitude. In contrast, the unsuccessful firms exhibited little or none of the two capabilities, and entrepreneurial behavior was much less distinct in these firms. In the following paragraphs, we will now discuss these effects and show how and why each of them is associated with the extent to which a firm can achieve successful appropriation.

5.3.1 Capability to Achieve Appropriation by Informal Measures

The first significant source of differences between the two groups related to their capability to generate strategies and procedures that protected their IP and allowed to appropriate the returns from it without using formal measures for protection and enforcement. We labeled these strategies informal measures to emphasize this fact. We observed that those firms that appropriated returns successfully (1, 4, 5) made intensive use of these measures, whereas the unsuccessful firms (2, 3, 6) failed to develop such measures. It is interesting to note that the informal measures are not mutually exclusive. We assigned specific labels to the four informal measures we found (de facto secrecy, complexity, defensive publishing, and 'educate the customer'). Table 5.4 demonstrates that there is an association between the informal measures the three successful firms (1, 4, 5) employ and their respective strength of appropriation, both within the value chain and in international markets. Vice versa, table 5.4 also shows that the three unsuccessful firms whose appropriation situation is rather weak do not or only to a limited extent employ informal measures.

Firms 1 and 5 use three different informal measures at the same time: de facto secrecy, complexity, and defensive publishing. De facto secrecy refers to the fact that the two firms do not achieve secrecy by nondisclosure agreements with employees or other forms of contract-based means. Rather, the measures aim at restricting unauthorized access to key documents, blueprints and technical descriptions. The firms do not document the most important technological knowledge in writing at all, and only the firm's founders and few senior R&D

Table 5.4 Capability to develop informal appropriation measures

Firm	Does firm use informal appropriation measures (if so, which?)	Strength of appropriation within the firm's value chain	Strength of appropriation in international markets	Resource expenditure needed to attain strong appropriation
1	Yes - De facto secrecy - Complexity - Defensive publishing	Strong De facto secrecy provides collaborators only with a fraction of the problem.	Strong Cost of imitation raised beyond feasibility due to complexity of modules and secrecy of knowledge. Defensive publishing maintains freedom to operate.	Low Informal measures exert strong protective effect. No litigation needed to attain appropriation.
2	Partially - Complexity (inside value chain only)	Strong Protection against knowledge outflow and imitation works as long as only the internal value chain is affected.	Weak Patents do not provide effective protection in firm's international markets.	Very high Observability of technology implies infringements and subsequent litigation costs. Patent application and maintenance costs consume resources.
3	Partially - Complexity (inside value chain only)	Strong Protection against knowledge outflow and imitation suppliers works as long as only the internal value chain is affected.	Weak Patents do not provide effective protection in firm's international markets.	High Firm's has to limit patent protection to 'key' countries. Patents are expensive compared to the firm's total revenues. Needs external patent lawyers.
4	Yes - 'Educate the customer'	Not applicable Firm has no joint R&D activities with suppliers or other third parties.	Strong Informal measure effectively fights imitated products.	Very low Informal measure exerts strong protective effect, no litigation needed. Additional formal measures (trademarks) come at very little cost.
5	Yes - De facto secrecy - Complexity - Defensive publishing	Not applicable Firm has no joint R&D activities with suppliers or other third parties.	Strong Complexity largely prevents imitation; defensive publishing maintains freedom to operate.	Low Informal measures exert strong protective effect, no litigation needed. Additional formal measures (trademarks) come at little cost.
6	No	Not applicable Firm has no joint development activities with suppliers or other third parties.	Weak Firm tries to compensate unsatisfactory appropriation from formal measures by strengthening bonds with customers.	High Firm has only limited resources for patenting and thus chooses only to patent core technologies. Risky approach; firm has been infringing more than once in the past.

managers are aware of the core aspects of the technology the firm's competitive advantage is based on. Contrary to patents, in which text and formulae are openly accessible, de facto secrecy tries to keep the complete knowledge secret or to reserve a 'key' of tacit, specialized knowledge, without which the final product is not useable. By this measure, firms 1 and 5 effectively raise the information costs of imitation such that it becomes infeasible. Firm 1 mostly relied on this strategy when they were offered to equip a recently opened pharmaceutical R&D centre in China owned by a large MNC:

“From the outside you don't even perceive the many secrets that are in there. Very few people know about them, and they are all here in Switzerland. And even here not everybody knows about everything. As a competitor, you could deconstruct the appliance, but that doesn't help if you don't know the secret. Our decontamination system has been in the market for over 10 years, there are hundreds of variants, and nobody has succeeded to copy it.”

— Vice president industrial division, firm 1

Firm 5 began to use de facto secrecy on a regular basis when it introduced a radically new technology for its production processes:

“Laser welding is the most sophisticated technology; we were the first to use it here. Our advantage is the extremely high quality and precision we can offer. Only two founding partners know exactly how to calibrate the lasers because they worked with them at the university. You see, we are talking about nanometers here. It's their experience, they don't write it down. And I do not want them to do that either. It's better for us if only few people know.”

— Lead engineer, firm 5

Another informal measure both firms use is complexity. Since firm 1 is active in the pharmaceutical appliances industry, it is obliged by the so-called GP-regulations to document every detail of the technological components that are delivered to customers. However, while this documentation must be provided,

the firms explained that it is the complex interaction of these components that makes imitation so hard. They were acutely aware of these regulations that demanded complete documentation and thus designed their technology in such a way that complex interface problems have to be solved to make the whole technology work. The appliances firm 1 produces, just as the special machinery firm 5 makes, are composed of hundreds of modularized components with a high degree of technological complexity. Even if a competitor succeeds at copying one component, it is virtually impossible to combine them, to manage the interface problems of this combination, and to acquire the process knowledge to assemble the final product. Complexity also raises the cost of imitation because even the complete knowledge of the documentation does not allow potential imitators to copy the appliance or product technology unless they solve the interface problems. Thus, firms 1 and 5 increase the technological complexity of their product technology and thus also raise the costs of imitation beyond the realm of feasibility. In effect, the ‘big picture’ of the technology remains hidden, so that any potential damage is restricted to a relatively small and isolated fraction of the problem.

Both firms use this measure to prevent supplier-side imitations (“every supplier only gets a small part of the problem (...) and it’s the same with the universities. They don’t see the big picture”, lead engineer, firm 5) and to protect its technology in international markets (“it would take you a very long time to figure out how to combine the different parts, especially if you are not in Switzerland where everything comes together (...) but even if you would understand, by then we would have already introduced the next generation technology”, senior R&D manager, firm 1)

Both firms also use a third informal measure, defensive publishing. A defensive publication discloses details about a technological innovation to the public, such that the innovation lacks the criterion of novelty and can no longer be patented. Thus, the firm preserves its freedom to use the innovation by preventing others from patenting it (Parchomovsky, 2000). This measure works well for firms 1 and 5. Firm 5 uses the measures predominantly internally to prevent university researchers with whom the firm collaborates to patent joint developments, but also because the firm’s customers fear lock-in effects if the international niche market firm 5 operates in should be ‘closed’ by patents:

“These [university] people always want to patent things quickly, but we don’t want that because it blocks the market (...) Customers don’t want us to become a monopolist. We don’t want that too, we want to stay innovative and flexible. So we publish the basic technology freely and then build specialized innovations on top of that new basis.”

— Co-founder, firm 5

Firm 1 has other motives; the founders explained they used defensive publishing on a regular basis to circumvent the problem of litigation cost if patents should be infringed. Interestingly, they use defensive publishing in a tactical way by publishing the technological principle, but not the highly relevant details:

“Defending patents costs a lot of money and you have to think whether it’s smart to invest in that. We think it’s much smarter to do a quick and dirty publication where you write just anything about the principle to have it published. Of course nobody forces you to publish the real secrets that are associated with it.”

— Co-founder, firm 1

Firm 4 uses yet another informal appropriation strategy we termed ‘educate the customer’. This measure seems somewhat counter intuitive because it does not aim to counteract counterfeits of the firm’s products. Moreover, the firm does not attempt to stop counterfeiting activities by any other means. The managers of firm 4 explained the rationale behind this seemingly irrational behavior:

“The quality of similar or copied products is often minor, and customers normally do not buy the cheaper product more than once. Customers are our spies so to speak; they tell us where they bought it and come back to us quickly. We do not actively search

for copied products; usually the sales and service people get feedback from customers that counterfeits exist.”

— R&D manager, founder, firm 4

Firm 4 thus takes advantage of a learning effect that influences the customers of counterfeiters. Most counterfeits offer poor quality, so the customer learns over time that the more expensive but high-quality original product will better serve him or her than the low-cost, low-quality counterfeit. In addition to relying on this learning effect, the managers in firm 4 offers additional benefits, quality guarantees and services (i.e., complementary measures) to customers who buy the original.

By these measures, firms 1, 4 and 5 attain a dual protective effect for the appropriation of returns from innovation. Inside the firm’s value chain, they protect the firm against infringements of IP and unwanted outflow of knowledge to collaboration partners and suppliers. Table 5.4 demonstrates how firms 1 and 5 achieve protective effects from their informal measures against suppliers and collaborators. In firm 1, complexity limits the activity of each supplier and scientific collaboration to solving only a relatively small part of the problem. This is important since the firm commissions many joint R&D projects and research studies; it also interacts with other firms in complex projects of building large-scale pharmaceutical appliances. These activities imply a high risk of technological observability. But as the knowledge of the completed technology is protected by de facto secrecy, each collaborator only gets a relatively small subset of the technological problem to be solved or development to be made; thus, complete imitation is impossible. Firm 4 works closely with one supplier, but does not give out critical technological information to them; de facto secrecy is applied. Only the firm’s founder and one R&D manager are aware of the exact specifications that are needed, and they do not document these specifications anywhere. An additional benefit of the de facto secrecy measure is that secrecy is truly and sustainably achieved; this is in contrast to nondisclosure or other forms of contractual agreements which can always be breached.

A more important protective effect the informal measures provide is that they enable efficient appropriation of returns from innovation in international markets. All firms report that the competitive intensity in the international

markets they operate in is very strong. Most firms compete against at least some large MNCs. Their markets are globalised, and as table 5.1 shows, they are exposed to a multitude of foreign IP legislations. This setting implies huge information cost—the firm cannot know all foreign IP legislations, and it can hardly inform itself about all foreign markets and about whether or not its IP may be infringed there. Against this setting which should make appropriation of returns from innovation especially difficult, the informal strategies the successful firms use seem to provide an especially strong protective effect. They make imitation impossible, either because of technological complexity which raises the cost above imitation feasibility (complexity), or because they do not allow competitors to block the market (defensive publishing), or because they effectively fight counterfeits by convincing customers of the superiority of the original technology (educate the customer).

A further beneficial effect the successful firms can attain is the great reduction of appropriation cost that is achieved as a result of the use of informal measures. This particularly includes litigation cost or the fear of having to finance these. This is because the informal strategies come at virtually no cost to the firm, compared to formal measures. Further, informal appropriation measures make excess resource demands for patent litigation very improbable, precisely because they do not rely on the judicial system to exert their protective effect. Table 5.4 demonstrates that the users of informal appropriation measures all committed very few resources to appropriation and yet they were successfully appropriating returns from their IP. All firms noted that they were unaffected by costly patent litigation trials:

“We have patents, but we have never litigated. Our [informal] measures protect us pretty well.”

— R&D manager, firm 1

“Freedom to operate is what protects us, we don’t need to litigate.”

— Co-founder, firm 5

“Our customers don’t buy counterfeits more than once, we only need trademarks to spread our brand name, but these costs are negligible.”

— Head of R&D, firm 4

These findings were in stark contrast to what we found in the firms that were relatively unsuccessful at achieving strong appropriation of returns from their innovation (cases, 2, 3 and 6). First, table 5.4 demonstrates that these firms did either not use any informal measures at all (firm 6), or they limited their use to preventing IP infringement by suppliers and collaborators by employing the informal measures ‘complexity’ (cases 2, 3). While these firms’ motivation for this particular measure was the same as that of the successful firms—preventing imitation by suppliers and R&D collaborators:

“They get plans from us and according to these plans they manufacture that. So we get, let’s say, ‘building blocks’ from them and then we do the critical stuff like high precision assembly adjustment, and testing.”

— CEO, firm 3

“We let suppliers develop only parts, not complete machines.”

— R&D manager, firm 2

Firms 2 and 3 restricted these measures to prevent supplier imitation and did not use them to attain appropriation in their respective international markets. Instead, all three unsuccessful firms relied almost exclusively on patents, i.e., formal protection measures, to secure appropriation. However, table 5.4 demonstrates that this use was associated with high costs since the patents of firms 2, 3 and 6 were often infringed and challenged. Often, large competing firms simply disregarded the patents the firms owned and speculated that they would not survive long-lasting lawsuits, as firm 2 illustrates:

“We sued them, and they just appealed on points of law. The courts don’t understand the technology. They always came from the U.S.”

with a whole crew of patent attorneys. In the end we won, but if I would have had to pay all the litigation costs and attorney fees, we would not exist anymore. In the end we were awarded a ridiculous compensation of a few thousand [Swiss] francs.”

— Founder/CEO, firm 2

Similarly, cases 3 and 6 cannot afford to finance long-lasting court procedures and therefore use a risky measure: They only patent their technology in certain areas they deem particularly important (“we cannot defend everything, therefore we only patent core technological areas”, head of R&D, firm 6). In a desperate attempt of trying to compensate this imperfect protection, the firms attempt to attain appropriation by focusing on lead time advantages in an extreme way:

“We are essentially helpless if infringements occur, so we must focus on being innovation leaders.”

— CEO, firm 6

“If [competitor company] comes along tomorrow and copies our devices, I would be mad to sue them. They have their legal departments; they will kill me before I can say ‘beep’. Instead, we just have to be faster. By the time they have copied us, we must have the next generation technology device on the market.”

— Founder/CEO, firm 2

The firms’ appropriation position is thus reduced to a relatively problematic passive position. Instead of enjoying strong patent protection, they are under intense pressure to continuously come up with new developments on a tight schedule to always maintain a competitive edge over their large firm rivals. Firms 2, 3 and 6 seem to have considerable difficulties to attain effective appropriation once these patents are challenged. This result is in stark contrast to the resource-saving way by which firms 1, 4, and 5 simply circumvent litigation by using informal measures.

Proposition 1: The extent to which a SME can successfully appropriate returns from its technological innovations will be positively associated with its capability to create and deploy informal appropriation measures.

5.3.2 Capability to Combine Appropriation Measures into Hybrid Appropriation Strategies

We did not find that the successful firms substituted formal for informal appropriation measures. Rather, the informal measures these firms used were creatively combined with formal to achieve a strong overall protective effect. We labeled this creative recombination of different categories of appropriation measures a hybrid appropriation strategy. By such a hybrid strategy, formal and informal measures complement and reinforce each other. Table 5.5 demonstrates how the combination of the different measures is associated with a greater protective effect among the successful firms, whereas this effect is absent among the unsuccessful firms.

The firms all differed with respect to the specific hybrid strategy they devised, but each strategy was closely tied to the peculiarities of their innovation strategy and to their international market position. Firm 1 uses formal measures and defensive publishing as a ‘fundament’, whereas actual appropriation is attained by de facto secrecy and by superior services (complementary measure). Patents serve to protect radical technological developments the firm has made for a long time. The technological speed in its industry is relatively slow; technological progress is created by few breakthrough innovations that “happen once in a decade” (R&D manager, firm 1). In contrast, defensive publishing is used for incremental developments, such that competitors cannot build ‘patent thickets’ (Grandstrand, 1999) on the basis of incremental innovations around the patents firm 1 has. These two measures in conjunction thus protect the technological basis of the firm and maintain its freedom to operate. Actual appropriation, then, is achieved by both de facto secrecy as described in the preceding section, and by superior services (i.e., by complementary measures). Firm 4 adopted a two-step approach: First, every product is protected by at least one trademark and one industrial design in order to deliver a cheap in-

Table 5.5 Capability to develop hybrid appropriation strategies

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6
Formal protection measures	10 patents filed, some more pending	40 patents (products and processes), trademarks.	Trademarks, Three patents.	Four Trademarks, industrial designs, copyrights.	One Trademark	Two Trademarks, five patents.
Complementary measures	Superior service	Lead time advantages	None	None	Lead time advantages	None
Informal protection measures	De-facto secrecy Complexity Defensive publishing	Complexity (inside value chain only)	Complexity (inside value chain only)	'Educate the customer'	Defensive publishing	None
Combined protective effect/interaction of the above measures	Strong Patent provide basic protection, but effective appropriation works by informal measures.	Weak Elements do not interlock	Weak Enforcement of patents unsatisfactory; informal measures cannot compensate.	Strong Trademark and 'educate' strategy work hand in hand and complement each other. Interaction with protected design effectively impedes supplier imitation.	Strong Each element provides part of protection / appropriation, together, they form an effective set.	Weak Firm failed to develop a hybrid strategy although appropriation formal measures is unsatisfactory.
Structuredness of approach	High Hybrid strategy is evaluated and refined after every project. Patent attorney makes international screening before patent application is pondered.	Low No, designed ad-hoc "You just have to see and the rest is luck."	Low Designed ad-hoc, no systematic approach	High Plans were made even before first international exposure.	High IP strategy was designed together with patent lawyer, refined by experience.	Low No planned strategy; measures developed ad-hoc over time.
Strength of appropriation position	High Combination of informal measures enables firm to protect those areas that formal measures cannot or only imperfectly protect.	None Firm tries to compensate doubtful patent protection by innovation leadership. No additional protective effect from informal strategies.	None Elements do not interlock, problem of problematic patent situation is not mitigated.	High Trademark protection is strengthened much by the 'educate the customer' strategy.	High The combination provides protection over and above pure trademark protection.	None Firm failed to develop other protection measures than formal ones.

ternational protection effect. This step serves to closely align the product, brand name and design before any product is marketed. Actual appropriation is then attained, as detailed above, by the informal measure ‘educate the customer’.

Finally, firm 5 uses a similar ‘fundament strategy’ as firm 1: They first use defensive publishing to block competitors from patenting the market and in order to retain their freedom to operate. Then, they use their technological leadership in the market to come up with lead time advantages that endow their products with a competitive edge over competitors. Since the defensive publication ‘fundament’ implies that competitors cannot block the market, competition in international markets takes place by innovation leadership, and firm 5 has a leading edge here.

Also, table 5.5 demonstrates that those firms which developed hybrid protection strategies did so by processes characterized by a high degree of planning and structured thinking. The way the successful firms developed their hybrid approach to appropriation, in our view, is a sign for a planned strategy, rather than an arbitrary set of decisions that led to a hybrid approach by chance. Cases 1 and 5 developed their approaches after a long-lasting process of consulting with external patent attorneys and by continuous refinement of their defensive publishing and patent activities. Firm 1 made the ability to draft a patent mandatory for the job descriptions of senior R&D staff. Firm 4 worked with both an external patent attorney and the Swiss and World IP Offices to devise its trademark and industrial design protection strategy, whereas the founder-CEO and senior managers developed and implemented the ‘educate the customer’ measures about one year before the firm’s first product was introduced in international markets.

In contrast to these findings, hybrid protection strategies were strikingly absent among the unsuccessful firms, where only one category of measures prevailed (firms 3, 6) or where the firm did use more than one category of measures, but where the firms failed to align the different categories of measures into a hybrid appropriation strategy (cases 2). Thus, the single measures remained relatively isolated and failed to provide a protective effect as strong as the successful firms could attain. Firm 2 is an example where the two measures it uses neither reinforce nor complement each other. The firm has the highest count of

formal measures (40 patents), yet the preceding section showed how these measures essentially failed to provide the firm with a strong appropriation position, and that the firm's resulting focus on lead time advantages can be interpreted as a 'running away' behavior to counter the fear of litigation cost. Table 5.5 also demonstrates the lack of structure and planning associated with the absence of hybrid appropriation strategies. Rather, ad-hoc approaches seemed to prevail among the unsuccessful firms, and a systematic planned approach that would lead to the design of hybrid strategies was absent among all three cases. This fact, if compared to the planned, structured approaches of firms 1, 4 and 5 suggests that hybrid appropriation strategies are indeed the outcome of the capability of the firm to purposefully plan and devise such strategies.

Proposition 2: The extent to which a SME can successfully appropriate returns from its technological innovations will be positively associated with its capability to recombine different IP protection measures such that they interlock to result in a joint protective effect.

5.3.3 Conditioning Effect of Entrepreneurial Behavior

We further found that both informal appropriation measures and the creation of hybrid strategies were strongly influenced by the firm's entrepreneurial behavior. Entrepreneurship is generally referred to as a capability to recognize and exploit opportunities (Kirzner, 1973; Eckhardt and Shane, 2003). Table 5.6 shows how the firm's ability to recognize opportunities positively conditioned the development of informal appropriation measures and hybrid appropriation strategies, respectively.

The extent to which the firms could recognize opportunities differed significantly. The successful firms were characterized by an impatient, aggressive, and opportunity-seeking mind-set. Their founders and senior managers engaged in multiple consulting, brainstorming, and own creative development activities to find and exploit opportunities to optimize their firms' appropriation position. These managers shared a general feeling of impatience with existing measures, and a strong will to do whatever was necessary to guarantee appropriation. They were not oriented towards a specific goal; rather, they judged each

Table 5.6 Conditioning influence of entrepreneurial orientation

Firm	Level of opportunity recognition in the firm	Effect on development of informal measures	Effect on development of hybrid strategies
1	High Firm actively sought and recognised possibilities to reduce resource demand for patent protection. Firm sponsored brainstorming sessions, bought consulting from patent attorneys.	Positively conditioning Firm learned about defensive publishing; developed 'complexity' measure. Firm learned to use both measures for appropriation.	Positively conditioning Recognised opportunities were combined in a purposefully planned hybrid IP strategy.
2	Moderate Firm's founder recognized power of 'complexity' measures, but failed to exploit it for appropriation purposes.	Positively conditioning Firm developed 'complexity', but only uses it to prevent supplier imitation; no strong effect for appropriation in international markets.	None Firm did not develop a hybrid appropriation strategy. No combination of formal and complementary measures.
3	Moderate R&D managers recognized power of 'complexity' measures.	Positively conditioning Firm developed 'complexity', but only uses it to prevent supplier imitation; no strong effect for appropriation in international markets.	None Firm did not develop a hybrid appropriation strategy.
4	High Firm was aware of litigation cost issue before internationalising. Managers aggressively sought alternative protection solutions.	Positively conditioning Firm developed informal measure 'educate the customer'.	Positively conditioning Firm learned to combine formal and informal measures.
5	High Firm systematically sought and evaluated possibilities for appropriation beyond formal measures.	Positively conditioning Firm learned about defensive publishing and managed to successfully use this measure for appropriation.	Positively conditioning Firm developed ways to combine formal and informal measures.
6	Low Company consulted with a patent attorney but did not discover opportunities.	None Firm did not develop informal measures.	None Firm did not develop a hybrid appropriation strategy.

possibility in a neutral way. Table 5.6 shows how the three successful firms had aggressive attitudes and were constantly seeking to recognize and exploit opportunities to develop and continuously improve their appropriation measures.

In firms 4 and 5, the search for opportunities started from a feeling that given the special position of the company as a SME, they should not just repeat appropriation strategies that are used by much larger firms. As firm 5 explained:

“We are small, and we are facing sharp international competition. You have to be ahead. We wanted to come up with something that keeps us safe for the years to come. So we started thinking, if patents are not optimal, what other measures can we use?”

— Founder, firm 5

Subsequently, top management and R&D staff, over the course of several months, evaluated appropriation options and measures together with external experts. Firm 1 shared this impatience with existing measures:

“In the past we were often dissatisfied with what patents could offer, so we started thinking about alternative solutions. We had interviews with patent attorneys and all sorts of experts. We wanted to know what was out there.”

— Founder, firm 1

In contrast, the unsuccessful firms were characterized by low levels of opportunity recognition. They could not identify many possibilities that could have helped them to devise a sustainable appropriation strategy. Their mindset lacked the successful firms’ impatience and will to come up with new measures if existing ones were suboptimal. This lack of opportunity recognition was associated with a very low degree of opportunity exploitation: The firms did not develop any informal measures (firm 6) or they restricted their use within their value chain to prevent supplier imitation, but were unable to exploit opportunities to develop informal measures and hybrid appropriation strategies (cases 2, 3).

Proposition 3a: A SME’s capability to create and deploy informal appropriation measures will be positively associated with its degree of entrepreneurial behavior.

Proposition 3b: A SME’s capability to recombine different IP protection measures such that they interlock to result in a joint protective effect will be positively associated with its degree of entrepreneurial behavior.

5.4 Discussion

By focusing on a SME context, our study complements approaches that have analyzed appropriation measures used by large firms (Arundel et al., 1995; Cohen et al., 2000; Cohen et al. 2002; Grandstrand, 1999; Levin et al., 1987). We find that a SME's ability to appropriate the returns from its innovation is influenced by its capability to design and deploy informal appropriation measures, by its capability to devise hybrid appropriation strategies that creatively combine measures of appropriation, and by its entrepreneurial behavior which positively moderates the development of the two above capabilities. These findings also illustrate the advantage of using a qualitative method for research questions of the sort we investigated. Had we used conventional quantitative measures like the number of patents to measure a firm's strength of appropriation, or even survey-based methods that measure the strength of formal measures by scale scores, neither the informal measures nor the hybrid strategies the successful SME use would likely have been discovered. Rather, firms like firm 2 that has a weak appropriation position despite a relatively high patent count would have likely (and erroneously) been interpreted as enjoying a strong appropriation position.

Further, these findings have important implications for the literature. Informal measures do not rely on the judicial system for enforcement and thus demand very little resources. Specifically, the existence of measures 'de facto secrecy' and 'complexity' confirms the theoretical arguments that firms can create barriers to imitation by tacitness and complexity (Reed & DeFillippi, 1990). Moreover, these measures are an applied example of the conceptual proposition that raising the costs of imitation raises the costs of complexity and thus can be interpreted as a tax on imitation (Glass & Saggi, 2002).

The findings on the informal measure 'educate the customer' helps to clarify the ambiguous finding that imitability, under certain circumstances, can increase firm growth (Autio et al., 2000; Bierly & Chakrabarti, 1996). By using counterfeits as 'advertisement' for their trademarks and customers as 'spies' to identify where counterfeits appear, firm 4 increases its visibility in international markets while exploiting the quality difference between original and counterfeit to retain customers. A related argument in the literature is that a firm can

actually grow by using imitation to its advantage (Conner, 1995). While firm 4 is not a direct illustration for this argument because it does not legitimize counterfeits, its example could explain how a firm can make use of imitability and proliferation to increase its capability to appropriate returns from innovation. In turn, this increased appropriability should, *ceteris paribus*, increase firm performance and firm growth. Future research could empirically test whether this explanation holds for a larger sample of SME. Moreover, the findings on the *de facto* secrecy measure illustrate important differences to the sort of secrecy that has been discussed in the literature so far, namely, secrecy enabled by non-disclosure agreements (Teece, 1986). Instead, *de facto* secrecy utilizes the fact that tacit, complex knowledge is a very good protection against imitation (Teece, 2000), but it adds the express non-documentation aspect to this argument: Even if tacit knowledge could, at least partially, be codified, it is not done. Thus, the protective effect is even stronger.

Further, our findings show that SME are acutely aware of the possibilities that formal measures offer as well as of their limitations. Firms that use hybrid appropriation strategies do not substitute informal for formal protection measures. Rather, they judge the efficacy in a highly planned and structured manner before deciding how, if at all, to use them. If they decide to not use patents, this decision is the outcome of thoughtful consideration and comparison of costs and benefits and not unprofessionalism. This finding qualifies earlier literature that portrays small firms to be poorly informed about formal rights, or to lack the resource to finance them or the capability to administer them effectively (Arundel & Kabla, 1998; Arundel & Steinmuller, 1998; Cohen et al., 2000; Kitching & Blackburn, 2003).

Until now combinations of appropriation categories were mostly discussed as combination possibilities within a group of measures, predominantly formal measures, e.g. how trademarks and patents may be combined to increase the total protective effect (Cook, 2002; Mathews et al., 2003). Our study develops this literature further by showing how measures may be combined across categories. The finding that the successfully firms combine different categories of appropriation measures to form a superior protective effect is, to the best of our knowledge, the first illustration for Teece's (2000) conceptual argument that firms which understand how to appropriate successfully have an ability to re-

configure knowledge and complementary assets to achieve sustainable competitive advantage.

The findings on the hybrid strategies also do not support the claim that patents fare relatively badly as a measure of appropriation (Arundel, 2001; Cohen et al., 2000; Cohen et al., 2002; Harabi, 1995; Levin et al., 1987; Sattler, 2003; Taylor & Silberston, 1973). The example of the unsuccessful firms demonstrates that this is only the case if formal measures are used in isolation. However, if they are used in conjunction with informal measures, a strong protective effect can be attained. These findings also suggest an alternative view to the claim that the possibilities of small firms to appropriate returns from innovation are limited, so that policy measures are needed to increase small firms' use of formal measures (Kingston, 2001). In contrast, the findings on the hybrid strategies show that firms do not refrain from using formal measures because they lack resources to administer them or because of unprofessionalism or lack of knowledge about them—they have just found more efficient means which combine a relatively low usage of formal measures with complementary and informal measures to achieve a very strong combined effect.

A specific element of the hybrid appropriation strategies of cases 1 and 5 is the use of defensive publishing. The way they use this measure sheds new light on this measure which has received only limited attention so far. Past contributions on defensive publishing restrict to game-theoretic and legal discussions (Baker & Mezzetti, 2005; Bar, 2006; Lichtman et al., 2000; Parchomovsky, 2000). To the best of our knowledge, our findings provide the first empirical illustration that shows how defensive publishing, in conjunction with other measures, can be used to attain a strong appropriation position—despite the counterintuitive thought that the firm freely publishes information about a technological novelty in order to maintain its freedom to operate. Specifically, our findings on how the successful firms use defensive publishing to appropriate returns from innovation challenges Arrow's assertion that the ability to exclude others from using the underlying technology is a precondition to innovate (Arrow, 1962).

Another aspect of these findings is that neither the informal measures nor the hybrid appropriation strategies we found are dependent on firm size or industry sector (table 5.3). This result challenges previous contributions that find that the efficacy of particular appropriation measures strongly differs with the

industry context (Mansfield, 1981, 1986) and with firm size (Arundel & Kabla, 1998; Arundel & Steinmuller, 1998; Cohen et al., 2000). Specifically, firm 4 shows that strong appropriation can be attained even in 'low tech' industry sectors. These findings in our view illustrate the argument that appropriation is a firm capability, rather than a result of industry specificities (Reitzig & Puranam, 2009). By identifying determinants that influence the emergence of this capability, our study suggests that the successful firms have a capability to devise effective informal appropriation measures and hybrid appropriation strategies.

The finding that the existence of such a capability is strongly influenced by the firm's strength of entrepreneurial behavior has implications for both the entrepreneurship and the small business literature. Our findings illustrate that entrepreneurial orientation (EO), i.e. the composite measure of autonomy, innovativeness, risk taking, proactiveness, and competitive aggressiveness (Lumpkin & Dess, 1996), is an important conditioning influence for the extent to which a SME can generate the capability to appropriate. By its indirect yet strongly positive influence on both the capability to develop informal appropriation measures and to develop hybrid appropriation strategies, EO contributes to strengthening the firm's overall capability to appropriate returns from innovation. This result illustrates the mechanism that EO seems to have a larger positive effect on performance in hostile than in benign environments (Covin & Slevin, 1989; Zahra & Covin, 1995). The result how EO influences the emergence of hybrid appropriation strategies illustrates the postulate that those firms that appropriate successfully need an ability to sense and then to seize new opportunities (Teece, 2000).

Further, our results challenge previous views that firm strategies characterized by a strong EO are resource intensive (George, 2005; Wiklund & Shepherd, 2005). The findings demonstrate that the informal measures consume very little resources, and by combining them with other measures into hybrid appropriation strategies, the firm saves resources that otherwise would likely have been devoted to patent enforcement and litigation. Thus, we cannot subscribe to the view that EO is a resource-consuming strategic orientation (Covin & Slevin, 1991; Romanelli, 1987).

Further, we believe our findings can help to clarify the complex and disputed relationship of how, if at all, EO is associated with superior firm perfor-

mance (Lumpkin & Dess, 1996). While some studies find a positive and significant association between EO and firm performance (Wiklund, 1999; Zahra & Covin, 1995), others do not (Hart, 1992; Smart & Conant, 1994). Our findings might point to an indirect relationship between EO and firm performance: EO indirectly influences the firm's capability to devise informal appropriation measures and hybrid appropriation strategies, both of which strengthen the firm's ability to appropriate returns from innovation. This increased appropriability should, *ceteris paribus*, lead to better firm performance. Future research could study whether this alleged mechanism survives empirical testing.

Finally, we believe that these contributions have implications for managers in both large firms and SME. Our findings demonstrate how SME can appropriate returns from innovation at little cost, and how a unilateral reliance on formal measures might prove counterproductive. We further highlight specific informal measures managers and hybrid strategies managers of SME can use, and we emphasize the importance of entrepreneurial behavior for the success of both. These findings are not specific to a particular industry, so that a variety of firms is likely to benefit from them. However, managers in large firms are likely to benefit from these findings, too. The use of informal measures has the potential to save considerable resources. Managers could review their appropriation strategies and assess whether there are cost saving potentials to be realized. This specifically applies to the use of defensive publishing as a measure to secure the freedom to operate. For example, managers may opt to defensively publish a platform technology and then build specific applications using this technological basis which could then be patented. Thus, the firm could reduce expenditures for formal measures and litigation and impede competitors from building up patent thickets. However, such moves are likely to depend on the tolerance of autonomous entrepreneurial behavior of managers by large firms, and they are likely to be risky when routine and resource rigidity are high.

Like any contribution that tries to capture complex firm-level organizational configurations, our paper has certain limitations that stress the need for future research. Our study attempted to create new rather than testing existent theory. Due to this inductive method, our findings cannot be readily generalized. The firms we analyzed could have unobserved idiosyncratic characteristics that had additional impacts on their innovatory behavior. Although we believe that our

findings have a strong intuitive appeal, future deductive research is needed that can empirically test the claims and propositions we have offered here.

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