Paper to be presented at the

DRUID Society Conference 2014, CBS, Copenhagen, June 16-18

Navigating the IP landscape ? Exploring firms? usage of defensive IP strategies

Annika Lorenz
Technische Universität Berlin
Chair of Innovation Economics
annika.lorenz@tu-berlin.de

Abstract

One commonly understood strategic use of intellectual property (IP) is to prevent the imitation of the firm?s rent-yielding assets, which represents a proprietary IP strategy. By contrast, firms also often employ defensive IP strategies that are designed to respond to IP that can be potentially acquired and enforced against them by other firms and entities. However, research has remained largely focused on defensive patent portfolios or thickets, while a range of alternative defensive
strategies ? such as inventing around IP, terminating R&D projects to avoid infringement, licensing-in rights, opposing or revoking rights ? remains underexplored. In this paper, we investigate the prevalence and predictors of companies? usage of a range of different defensive IP strategies. The empirical setting of this study is based on 2,995 innovative German manufacturing and service companies. We apply multiple correspondence analysis ? a categorical data analysis technique ? and find evidence for different combinations of defensive IP strategies among sector and size classes. Our results have implications for policy and the strategic management of IP.

Jelcodes:O32,-

Navigating the IP landscape – Exploring firms' usage of defensive IP strategies

Abstract

One commonly understood strategic use of intellectual property (IP) is to prevent the imitation of the firm's rent-yielding assets, which represents a proprietary IP strategy. By contrast, firms also often employ defensive IP strategies that are designed to respond to IP that can be potentially acquired and enforced against them by other firms and entities. However, research has remained largely focused on defensive patent portfolios or thickets, while a range of alternative defensive strategies – such as inventing around IP, terminating R&D projects to avoid infringement, licensing-in rights, opposing or revoking rights – remains underexplored. In this paper, we investigate the prevalence and predictors of companies' usage of a range of different defensive IP strategies. The empirical setting of this study is based on 2,995 innovative German manufacturing and service companies. We apply multiple correspondence analysis – a categorical data analysis technique – and find evidence for different combinations of defensive IP strategies among sector and size classes. Our results have implications for policy and the strategic management of IP.

Keywords: IP strategy; Appropriation; Invent around; Licensing; Out-of-court settlement; Patent thicket; Multiple correspondence analysis

1 Introduction

A dramatic growth in patenting since the early 1980s (also known as the patent surge) has raised the awareness of researchers who argue that firms increasingly use patents as a strategic weapon in technology competition (Blind et al., 2009; Neuhäusler, 2012).

Therefore, scholars have sought to understand the linkages between intellectual property (IP) as a strategic tool and its impact on firms' competitive advantage and performance (for a review see Pisano, 2006; Somaya, 2012). One commonly understood use of IP is to prevent the imitation of – or to 'isolate' – the firm's rent-yielding assets (Mahoney and Pandian, 1992; Rumelt, 1984), which represents a proprietary IP strategy. By contrast, firms also often employ defensive IP strategies that are designed to respond to IP that can be potentially acquired and enforced against them by other firms and entities. The ultimate goal of a defensive IP strategy is to retain freedom to operate (FTO) and commercialize (despite the IP held by others), and avoid being held up for exorbitant rents. Freedom to operate is a legal concept that comprises a relative assessment of IP landscapes 'whether the making, using, selling, or importing of a specified product, in a given jurisdiction, in a given geographic market, at a given time, is free from the potential infringement of third-party IP or tangible property rights' (Krattiger et al., 2007, p. 1317). Thus, an FTO analysis reveals potential hold-up situations that in turn influence firms' strategic decision making in relation to R&D investments and product commercialization.

Prior research on companies' reasons for obtaining patents has revealed a number of motives that are consistent with a defensive IP strategy, such as (defensive) blocking, building (defensive) thickets, avoiding litigation by others, and as bargaining chip in negotiation and exchange (e.g., Blind et al., 2009; Blind et al., 2006; Cohen et al., 2002; Cohen et al., 2000; Duguet and Kabla, 1998). Indeed, the idea that firms build patent portfolios or thickets to defend themselves against litigation by other patent owners is well understood (Hall and Ziedonis, 2001; Reitzig, 2004b; Ziedonis, 2004), and it is also recognized that these portfolios are often cross-licensed to avoid

litigation (Galasso, in press; Galasso et al., 2011; Grindley and Teece, 1997). Recent trends in the smartphone industry have shown that strong patent portfolios can serve as a bargaining chip on the one hand but also as a means to obtain value from IP by generating licensing income (see TABLE 1).

Insert TABLE 1 about here.

Furthermore, an increasing patent thicket problem makes it nearly impossible for these innovative firms to foresee potential infringements. Thus, non-transparent mobile patent lawsuits between various device and equipment manufacturers are the result (e.g., Apple vs. Samsung). While research has remained largely focused on these defensive patent portfolios or thickets, a range of alternative defensive strategies – such as inventing around IP, terminating R&D projects to avoid infringement, licensing-in rights, opposing or revoking rights, and so on – remains underexplored. Each of these strategies bears its own risks and advantages. Even, having no defensive strategy at hand or taking no action carries risk. For example, deferring or forgetting to obtain a license from a third-party could eventually lead to expensive licensing conditions, the decline of a license, or a patent infringement lawsuit (Krattiger et al., 2007). Additionally, we currently know very little about the prevalence of different defensive strategies and their distribution across different types of industries and firms. Thus, in this paper we investigate the prevalence and predictors of companies' usage of a range of different defensive IP strategies. Rather than focusing on a single defensive strategy – such as the building of deterrent IP portfolios – we take a broad exploratory approach to contribute to our neglected understanding of a wide range of defensive strategies.

The empirical setting of this study is based on 2,995 innovative German manufacturing and service companies. The data we use come from the 2008 German MIP (Mannheim Innovation Panel; ZEW) which represents the German Community Innovation Survey (CIS). We detect and interpret

underlying structural relationships among the different defensive strategies in an exploratory fashion with the help of multiple correspondence analysis – a categorical data analysis technique. Categorical data are common results of survey research. However, the analysis of such data is often hindered by the requirements and limitations of many familiar research tools (e.g., factor analysis). Correspondence Analysis (CA) is a versatile and easily implemented analytical method to detect and interpret relationships among variables and thus, understand complex management phenomena. The empirics reveal interesting differences for manufacturing and non-manufacturing sectors as well as for subclasses within the manufacturing sectors, which can be explained by differences in the underlying IP regime in each sector. In general, we find that the two most common defensive strategies used by manufacturing firms are inventing around others' IP and in-licensing whereas the two least common ones are the cancellation of R&D projects due to missing access to property rights and cross-licensing. Evidently, the portfolio of defensive IP strategies used varies by size such that smaller firms mainly rely on one or two strategies whereas bigger firms employ a larger defensive IP strategy arsenal. We also find evidence for different combinations of defensive IP strategies among sector and size classes.

2 Literature Review

2.1 Defensive IP strategies

Patent offices have witnessed an increase in patenting beginning in the 1980s (also known as the patent surge) which can only partly be explained by an increase in patent races. A proprietary patent strategy seeks to prevent imitation of valuable rent-generating assets and thus, creates or protects a competitive advantage position. Generally, most inventions represent minor advances on the current state-of-the-art, which implies that obtaining patent protection requires firms to demonstrate and describe the originality and superiority of their invention (Reitzig and Puranam,

2009). Granted protection rights for these small improvements mainly serve strategic purposes afterwards.

By using IP strategically, firms on the one hand seek to protect themselves from being blocked by competitors and on the other hand seek to force or negotiate access to rivals' technologies on better conditions (Cohen et al., 2000; Hall and Ziedonis, 2001).

Additionally, firms may use patents and other formal IP to exhibit strategic commitment to a technological or research trajectory in order to drive competitors into exiting R&D competition, patent races or terminating their R&D efforts (Agrawal and Garlappi, 2007; Baker and Mezzetti, 2005; Gill, 2008; Somaya, 2012) or to prevent patenting by others (Guellec et al., 2011). In this vein, firms increasingly use the patent system to create their own freedom of design and operation. Firms actively file for patents or acquire already granted patents to be able to in-license competitors, new entrants and others. Moreover, this strategy provides the firm with a bargaining chip for cross-licensing deals in case it (un)intentionally infringes on other companies' patents (Pisano, 2006; Pisano and Teece, 2007).

Additionally, due to increased technology competition, accelerated product life cycles and shortened time-to-market, firms may need to have a viable strategy for defending against patents owned (and potentially enforced) by others to guarantee that they are not put at a competitive disadvantage or at risk of being held up for rents (Somaya, 2012). Furthermore, a typical innovation process exposes firms to uncertainty regarding which patents will be needed or who will own them and thus requires an effective defensive strategy.

In turn, the owners of such patents can bargain for significant rents (e.g., by generating licensing incomes, trading IP in cross-licensing agreements or negotiating access to new technologies) and thus, hold up the alleged infringer with the threat of an injunction (Hall and Ziedonis, 2001; Neuhäusler, 2012; Somaya, 2012).

The goal of this so-called defensive strategy is to retain the freedom of the firm to operate and commercialize its technologies without interference of other firms' patents.

In this paper, we focus on a range of alternative defensive strategies – such as inventing around IP, terminating R&D projects to avoid infringement, licensing-in rights, opposing or revoking rights, and so on – which remains underexplored. The main question of when and how to pursue any of the options is discussed hereunder.

Abandonment

At the beginning of an innovation project, possible infringements cannot be easily predicted, as firms cannot foresee the R&D and product development plans of competitors. Therefore, patent races may occur. Before making large investments in risky innovation projects, a firm needs to be sure that IP developed by other firms' product development efforts will not hamper the commercialization of its own technology.

To tackle this issue, firms may try to identify all infringements as they arise and negotiate separate licenses for each. However, this approach is complex and leads to an explosion of transaction costs and at the same time induces large risks for the potential licensee. Thus, a project could be abandoned early on releasing resources for safer and more promising innovation investments. The best time to abandon a project thus is before starting any research and development when regular planning meetings with experts already conceivably show that the project is associated with great risks and costs to obtain access to all IP rights needed (Krattiger, 2007).

Cancellation

Sometimes, an innovation project is cancelled after a firm has started it. There are two possible reasons for this behavior. Firstly, the firm may have realized that it will not obtain all IP necessary to commercialize the technology or it is too expensive. Thus, by cancellation the firm tries to avoid infringement and litigation. Secondly, companies often use IP information strategically and lay a false trail of which technological trajectory they are pursuing. After having misguided their competitors, companies may cancel ongoing R&D projects (Reitzig, 2004a). Occasionally, firms redirect their R&D and innovation activities into technological areas where litigation is less likely and thus, current projects are cancelled due to missing access to IP or resources (Lerner, 1995).

Invent around

Inventing around a patented product requires a research team to seek new, unknown alternatives to develop the product in question and concurrently seek patent protection. It often takes substantial time to invent around patents (Mansfield, 1985) which is why the main disadvantage is that costs are high. Thus, this option would slow down product development but could lead to significant advantages in terms of innovations, new intellectual property as a bargaining chip for cross-licensing, and perhaps improved products. Inventing around is more likely to happen the longer the patent life of the product (Gallini, 1992). Thus, the costs and benefits of developing an entirely new product should be weighed against the costs and benefits of licensing. In reality, both strategies are pursued in parallel.

Nonetheless, following an invent around strategy will only work if at least one alternative exists that would work at least equally well as the technology in question and an analysis of potential infringements is conducted in the early stages of the R&D process. This is necessary to avoid fruitless years of work where a license unexpectedly seems quite attractive, if not necessary, in order to gain freedom to operate (Krattiger, 2007).

Wait and see

Another option is to commercialize the technology in question despite access to all relevant property rights and wait if the IP holder notices this and requests a license. This is a rather risky strategy as it is not clear a priori whether it will still be possible to negotiate a licensing deal. In addition, this strategy involves the intentional and conscious abandonment of access to relevant IP and can cause litigation suits. On the other hand, a cross-license might be offered in exchange if the technology in question or other IP of the alleged infringer are of value to the IP holder.

Cross-licensing

Cross-licensing happens when two IP holders exchange intellectual property to ensure that they enjoy the freedom to manufacture without infringement: ‘Firm A’ licenses a set of patents to ‘Firm B’ and in exchange B licenses a set of patents to A. In many high-technology and complex products

(e.g., electronics and semiconductors) one innovation builds on another and a single firm cannot develop the entire product internally. Thus, unavoidably overlapping developments and mutually blocking patents are the rule and firms will try to develop, search and hold a portfolio of quality patents that their competitors also use (Hall and Ziedonis, 2001) to place the company in a stronger cross-licensing position regarding certain competitors. Otherwise, they must increasingly pay royalties. It is however important not to necessarily compete with the portfolio of a potential cross-licensing partner but to bundle R&D in those areas in which it has the most expertise to develop patents that cover large areas of the partner's product markets. This will yield maximum bargaining power in negotiations (Grindley and Teece, 1997). Bargaining positions via licensing will be constrained if a patentee is not dependent on access to the focal firm's patents. In recent years, many companies have faced severe and heavy injunctions and out-of-court settlements caused by specialized patent-holding firms or so-called patent 'trolls' (also 'sharks' or non-practicing entities (NPEs)) that are invulnerable against mutually held patents (Fischer and Henkel, 2012; Reitzig et al., 2010; Reitzig et al., 2007).

In-licensing

As IP portfolios are proactively developed and defended, industry participants find it increasingly necessary to license in technology to ensure freedom to operate avoiding the risk of being held up by other firms with similar technology. This option hardly causes any costs associated with patenting but can be quite risky in case no license is acquired as time and resources invested in R&D up to this point are irrevocably lost. Therefore, acquiring a license from the owners/assignees for each IP right that the product is likely to infringe solves all problems related to freedom to operate but at the same time can be very costly and effortful (Krattiger, 2007).

In particular, firms with strong patent portfolios are able to capture significant value from their patent estates by generating royalty income (Grindley and Teece, 1997). In some cases, in-licensing

has become a source of funds for R&D or the sole business model which generates all profits.[1] Nokia possesses 30,000 patents, which it can now leverage to generate licensing income. Before the sale of its handset business to Microsoft, Nokia hardly took advantage of its strong portfolio as the firm's main objective was to protect the IP in its own devices.

Revocation

A patent is not necessarily valid once it is granted as alleged infringers may counter by challenging the scope, validity, and enforceability of patent rights issued in the first stage by the patent office (Kesan and Ball, 2006).[2]

Essentially, in U.S. law patents can be challenged on grounds of novelty, utility, and non-obviousness. A successful challenge on the basis of any of these three criteria will invalidate a patent claim, and sometimes the entire patent. Patent enforcement implies an uncertain outcome and considerable direct[3] and indirect costs mainly attributable to the time and effort in terms of manpower involved (e.g., key managers, lawyers, engineers, and scientists of a firm). Moreover, a patent-invalidity trial comprises significant ex-ante research and investigation that is similar to a freedom to operate analysis. Lerner (1995) suggests that litigation generally leads to a 2–3.1 percent average decline in the market value of the firms involved. Another possible drawback is that the assignee/inventor of the patent at stake may return to court and countersue with additional claims. Lanjouw and Schankerman (2004) find evidence that reputation building plays a significant role in the case of patent litigation.[4] In addition, litigation suits can help build strategic positions (Teece et al., 1997) that can confer advantages in future rounds of competition (Somaya, 2003, 2004). Moreover, to secure a bargaining position, patentees are more likely to go to court to protect patents

---

1 Being a pure 'licensing company' not directly involved in the product market and increasingly disconnected from the manufacture and design of the product itself can be a risky strategy. Such a strategy on the one hand can generate less revenue than developing and commercializing products and on the other hand lead to a decline in innovation activities.

2 Due to an increasing volume of patent applications, patent offices have large backlogs which in turn puts pressure on examiners and leads to misjudgments of relevant prior art and obviousness. Moreover, there is uncertainty about patentability in many new technology areas.

3 Direct legal costs alone can run in the range of $1.0–3.0 million (in 1997 U.S. dollars) for each side through trial (Somaya, 2012).

4 Hence, litigation risk is much higher for patents that are owned by individuals and firms with small patent portfolios.

particularly if they form the base of a cumulative chain or technological trajectory. Hence, a firm's ability to appropriate value from their subsequent, incremental inventions, either through direct manufacturing or licensing, depends on their control over the initial invention (Lanjouw and Schankerman, 2001).

Out-of-court settlement

Sometimes out-of-court settlement is used to avoid any legal disputes or litigation over protection rights. Different authors find evidence that approximately 80-95% of all patent cases settle. Thus, the legal system encourages firms to settle their disputes out of court implying that the courts may be fulfilling their role of protecting patent rights at relatively low cost. However, the small number of final verdicts shows that very few patents are being examined to determine the scope, validity, and infringement of patent rights (Kesan and Ball, 2006). Settlements of IP conflicts can comprise different arrangements such as unrestricted or restricted licenses, cross-licensing arrangements, pools, agreements not to license third parties or to license only jointly, market division or field-of-use agreements (Krattiger, 2007). Further, out-of-court settlement agreements raise antitrust concerns as they are quite typically horizontal, particularly in patent cases, between either actual or potential competitors in the market.[5] Moreover, companies can exert out-of-court settlement as well as revocation to raise market entry barriers and thus impose a threat to potential new market entrants.

2.2 Determinants of defensive IP strategies

Although a lot of research has focused on the determinants of formal measures (for a recent review see James et al., 2013) and a new stream of literature is increasingly dealing with the determinants for the choice of either strategic or formal protection measures (e.g., Cohen et al., 2002; Cohen et

[5] As a result, IP settlement agreements raise significant antitrust issues. Indeed, some of those agreements would be illegal per se if created in the absence of a genuine IP dispute (Hovenkamp et al., 2002).

al., 2000), the drivers for defensive strategies have not been investigated, as yet. The reasons why firms use different defensive IP strategies may vary across industries and technologies.

Most prior research focuses on the determinants of patent litigation (Bessen and Meurer, 2005; Cremers, 2004; Lanjouw and Schankerman, 2001; Ziedonis, 2003).

In addition to the litigation emphasis, several determinants such as firm size, sector affiliation and research intensity or the existence of a patent department potentially explain the wide range of defensive strategies. Large firms tend to possess more resources, market power, financial capacity and experience in patenting to defend themselves against infringements than smaller firms (Neuhäusler, 2012). Nonetheless, the size of the infringing company (small vs. large firm) in relation to the size of the infringed company (small vs. large) can also have an impact on the usage of all defensive strategies. Additionally, large or research-intensive companies usually generate more patents with substantial economic benefits (‘valuable patents’) (Allison et al., 2004; Harhoff et al., 2003) and thus induce a greater threat potential due to the mere presence of a large patent portfolio which in turn unlocks potential for cross-licensing negotiations or trade with other firms (Cohen et al., 2000; Hall and Ziedonis, 2001). Nonetheless, they also incur greater costs, since, relatively seen, they are more likely to challenge IP rights and negotiate licensing deals which requires more financial resources. Another driving factor identified in prior literature is technological opportunity, which is high when the cost of developing an invention is low e.g., in emerging sectors with a low concentration of firms (Cohen and Klepper, 1992). Technological opportunity describes another determinant for the usage of defensive strategies assuming that the more technological opportunities exist, the greater a firm’s likelihood to exert these strategies.

The sector that a company operates in and the underlying appropriation regime (i.e., patent competition) similarly influence the decision to use defensive strategies as does research intensity.

Neuhäusler (2012) argues that in complex product industries, i.e. the electrical engineering and automotive industry, the number of patents per market-exploitable innovation is considerably larger than in discrete product industries, like the chemical sector. Particularly, companies in complex

industries use patents strategically more often (e.g., to force rivals into negotiations), than companies in discrete industries which use patents to block rivals (Cohen et al., 2000). Thus, firms operating in these sectors should be more prone to using defensive strategies as they have to defend more IP.

Institutional and environmental factors such as rules, norms, routines, business processes, policies and the behavior of other firms may also impact firms' usage of defensive strategies. Moreover, the degree of internationalization of a company can also influence its usage of defensive IP strategies assuming that more international companies operate in more markets and thus face more potential competition. Furthermore, increased market competition is associated with more strategic patenting which in turn relates to defensive strategies as the threat of being sued rises (Neuhäusler, 2012).

The mere existence of a patent department is an indicator that a firm has developed routine in information and FTO searches and enforcing patents as well as that it is able to identify own infringements and thus, the likelihood of exercising any form of defensive strategy rises (Somaya et al., 2007). In sum, a cost-benefit analysis of exercising each defensive option determines the usage of the same.

2.3 Research question and contribution

Although a considerable body of literature investigates firms' usage of formal and informal appropriation mechanisms, Somaya (2012) argues on a general account that strategic and competitive determinants of protection strategies are still not fully explored. Scholars have found a positive relationship between both proprietary (Hall et al., 2005; Reitzig, 2004b) and defensive (Reitzig, 2004b) patent strategies on firm market value (Somaya, 2012); however, the drivers of companies' use of defensive IP strategies remain to be studied. In addition to Arora and Ceccagnoli (2006) and Arora (1997), who emphasize the need to better understand the interplay between different formal and strategic IP instruments available, we analyze firms' use of defensive IP strategies in their pursuit to appropriate rents from innovation. This paper tries to shed some

more light onto the question which firm characteristics exert an influence on the decision for or against a specific defensive strategy. Additionally, we currently know very little about the prevalence of different defensive strategies and their implementation across different types of industries and firms. Research has remained largely focused on defensive patent portfolios or thickets, while a range of alternative defensive strategies – such as inventing around IP, terminating R&D projects to avoid infringement, licensing-in rights, opposing or revoking rights, and so on – remains underexplored. Thus, in this paper we investigate the prevalence and predictors of companies' usage of a range of different defensive IP strategies by taking a broad exploratory approach to contribute to our neglected understanding of these strategies. In sum, we complement the extant discussion on formal versus strategic appropriation instruments by analyzing determinants of firms' usage of defensive IP strategies as well as different combinations of them among sector and size classes.

3 Empirical analyses

3.1 Sample

We use data from the Mannheim Innovation Panel (MIP), ZEW, Mannheim, which is the German version of the Eurostat Community Innovation Survey (CIS). Among scholars (e.g., Belderbos et al., 2004; Cassiman and Veugelers, 2002; Leiponen and Helfat, 2011; Miotti and Sachwald, 2003; Tether, 2002), the interest in CIS data has risen for two reasons. Firstly, the data provide indicators for innovation performance, and secondly, CIS data are used as a supplement to traditionally used patent data (Kaiser, 2002; Leiponen and Helfat, 2011), thus downsides of patent data can be tackled. We analyze data from the MIP 2008, containing information about defensive strategies and protection measures used by the companies in the sample. Furthermore, we match patent and trademark stock data on a 1:1 basis using an ID variable unique to each company throughout the MIP. The final data set contains 2,995 innovative companies and is cross-sectional. In particular,

the sample comprises 1,758 companies active in manufacturing and 1,247 in service sectors. For firms to be included in the analysis they had to have selected one of the prescribed answers ('yes' or 'no') for all eight defensive strategies outlined above; 2,995 (83.9%) of the 3,517 firms in the full sample did this and were retained for further analysis. This high percentage suggests that most of the surveyed firms were content that the prescribed answers reflected their defensive strategy orientations and activities.

3.2 Measures

Variables

As major variables of interest, we employ eight different types of defensive strategies. The operationalization is derived from the question 'In the years from 2005-2007, did your company encounter any incidents concerning the access to IPR?' and results in the eight strategies 'Abandonment', 'Cancellation', 'Invent around', 'Wait and see', 'In-licensing', 'Cross-licensing', 'Revocation' and 'Out-of-court settlement'. Hence, the variable for each strategy is binary, 1 coding that a company has exercised a particular strategy, and 0 coding that it has not employed a strategy. In our estimations, we also include variables, which potentially influence the likelihood of exercising defensive IP strategies. For firm size, we examine the number of employees in a company, which reflects a categorical variable on a scale from 0 to 4. Firm size codes 0 for a company with less than ten employees and, hence, codes a small company. A value of 4 represents a firm with more than 300 employees. By size, firms were divided into five classes: with sampling divided across these five bands, 12.3% had less than 10 employees, 23.5% 11-30 employees, 23.9% 31-100 employees, 18.9% 100-300 employees, and 21.2% over 300 employees[6].

[6] The analysis contains seven missing values for firm size.

Moreover, we investigate sectorial differences based on the OECD sector classification[7]. Additionally, we differentiate between manufacturing and service firms but also include various sector subclasses to gain a fine-grained picture of the distribution of defensive IP strategies among them. We also account for firms' usage of different formal appropriation mechanisms (patents, utility patents, design patents, trademarks, and copyright) which we derived from the survey question 'Which of the following formal IPR mechanisms have been used in your company from 2005-2007?'. Both sector and appropriation variables are binary and their coding resembles that of the defensive strategy variables. Furthermore, patent and trademarks stock (Patent Stock (ln); Trademark Stock (ln)) variables are added. For an overview of all employed variables, please refer to TABLE 2.

Insert TABLE 2 about here.

Descriptives

The descriptive statistics in FIGURES 1-5 reveal interesting differences for manufacturing and non-manufacturing sectors as well as for subclasses within the manufacturing sectors, which can be explained by differences in the underlying IP regime in each sector.

Insert FIGURE 1-5 about here.

We find that the two most common defensive strategies used by manufacturing firms are inventing around others' IP (22.9%) and in-licensing (19.3%) whereas the two least common ones are the

[7] The information on sectors is provided by NACE codes and is translated into the OCED classification based on Eurostat (2009).

cancellation of R&D projects (3.4%) due to missing access to property rights and cross-licensing (4.6%). Moreover, for companies in non-manufacturing sectors the most pursued strategy is in-licensing (18.1%) followed by inventing around the IP held by other entities (8.9%); the least employed strategies are cross-licensing (1.5%), abandonment (1.9%) and cancellation (1.9%) of innovation projects (see FIGURE 4). TABLE 3 shows a more fine-grained picture and reveals that particularly the chemical and pharmaceutical, the mechanical engineering and non-metallic goods manufacturing sectors are prone to applying revocations and out-of-court settlements as defensive mechanisms. In-licensing is most often used in chemical and pharmaceutical and electrical engineering industries whereas inventing around is dominant among firms operating in electrical or mechanical engineering and the manufacturing of non-metallic goods. With regards to services, in-licensing is the most frequent strategy in information and communication as well as finance and insurance sectors.

Insert TABLE 3 about here.

FIGURE 1 shows that the portfolio of defensive IP strategies used varies by size such that smaller firms mainly rely on one or two strategies whereas bigger firms simultaneously employ a larger defensive IP strategy arsenal. TABLES 4-6 show that there are different combinations of defensive IP strategies among sector classes. In manufacturing, inventing around is most frequently accompanied by in-licensing, revocations and out-of-court settlements. In service sectors, inventing around others' IP is frequently pursued simultaneously with in-licensing and in-licensing in turn appears parallelly with out-of-court settlement, but at a much lower level than in manufacturing industries.

In manufacturing, the majority of companies has 31-100 employees; in services the majority of firms falls into the category of 11-30 employees (FIGURE 3). We also see that larger companies

possess a greater number of formal IP rights than smaller companies (FIGURE 2). Patents and trademarks are the dominating formal protection measures in manufacturing sectors whereas firms operating in service sectors seem to rely on trademarks and copyrights (FIGURE 5).

While the descriptive statistics already shed some light on the incidences of defensive strategies across sectors and firm sizes, only multivariate analyses can reveal relationships between the variables. The results of these analyses are reported herein.

Insert TABLES 4-6 about here.

Bivariate analysis

In this section, we present a number of bivariate tables in order to assess the relationship of firm size, sector affiliation, usage of IP with the incidence of using each type of defensive strategy. We explicitly do not presume causal relationships.

FIGURE 1 suggests that the firm size correlates with the usage of defensive strategies, that is larger firms use more types of defensive IP strategies simultaneously than smaller firms. Furthermore, the probability of the implementation of the strategies 'Invent around', 'In-licensing', 'Revocation' and 'Out-of-court settlement' is higher for firms with more than 300 employees. In general, the association of all defensive strategies with the firm size is statistically significant. Only for the strategy 'Cancellation' the contingency tests (both χ^2 test and Fisher's exact test) do not suggest a statistically significant relationship (see Table A.1 in the appendix). This might be due to the fact that 'Cancellation' is a very infrequently exercised strategy across all firms. Next, the usage of protection mechanisms (patents, utility models, design patents, trademarks, copyrights) is significantly correlated with firm size. Thus, the probability of having any type of protection mechanism increases the larger the firm (see Table A.2 in the appendix). The panels in FIGURE 4

show differences between manufacturing and service sectors regarding the usage of defensive strategies. The contingency analysis reveals that the differences between manufacturing and services in using different defensive strategies are statistically significant except for the strategy 'In-licensing' which seems to have an equivalent importance within both sectors. These results highlight the necessity and increased usage of defensive mechanisms in manufacturing sectors (see Table A.3 in the appendix). These results seem to be reflected in firms' usage of formal protection mechanisms. Firms operating in manufacturing sectors have a greater usage of protection mechanisms as compared to firms in service sectors. However, for the protection mechanism 'copyright' the contingency tests (both χ^2 test and Fisher's exact test) do not find a statistically significant relationship (see Table A.4 in the appendix) suggesting that this protection measure is equally important for firms in manufacturing and services.

3.3 Statistical method

We were interested in whether underlying patterns exist in which defensive strategies are pursued together by firms, and we therefore used multiple correspondence analysis, an exploratory statistical technique equivalent to principal components analysis for categorical data, to examine the data. Correspondence analysis (CA) has received considerable attention in the statistical and psychometric literature under a variety of names, including dual scaling, method of reciprocal averages, optimal scaling, canonical analysis of contingency tables, categorical discriminant analysis, homogeneity analysis, quantification of qualitative data, and simultaneous linear regression. Complete histories are given by Leeuw (1973), Greenacre (1984), and Nishisato (1980). Though very few applications of CA have been reported in the management literature, it has been frequently analyzed in marketing research (e.g., Carroll and Green, 1988; Hoffman and Franke, 1986; Hoffman and Leeuw, 1992) and interest in management research is increasing.

The joint graphical display obtained from a correspondence analysis can help in detecting structural relationships among the variable categories, which permits a rapid interpretation and understanding

of the data. Finally, CA has flexible data requirements. The only strict requirement for conducting CA is a rectangular data matrix with non-negative entries (Hoffman and Franke, 1986).

Moreover, multiple correspondence analysis (MCA) extends simple CA as it incorporates more than two variables simultaneously. Basically, it is a simple CA executed on an indicator matrix containing some measure of correspondence between cases (in our case firms) as rows and categories of variables (in our case defensive strategies) as columns. Similar to the identification of components in principal components analysis, or factors in factor analysis, (multiple) correspondence analysis identifies and extracts a number of dimensions which capture the deviations from the expected values (which would be zero if the variables were statistically independent). The idea of this method is to estimate and maximize the distances between the row or column points in the tables. Hence, the first few dimensions will capture the greatest part of the overall deviation from statistical independence between the variables whereas the following dimensions will do so less.

In general, (multiple) correspondence analysis is used for exploratory, inductive research rather than hypothesis testing and deductive research (Le Roux and Rouanet, 2009; Tether and Tajar, 2008). This exploratory approach generates scatter-plots with the scores of the column variables plotted in the dimensions obtained from MCA. MCA disentangles variables with a high degree of coherence, which have similar scores in the analyzed dimensions and hence lie close together. For interpretation, it is also important to note that points and groups that are further away from the origin of the plots, are also associated stronger. Usually, MCA produces as many scatter-plots as there are binary combinations of the dimensions. Nonetheless, scholars mainly analyze and interpret the first two or three dimensions because these capture the greatest deviance from statistical independence in the data (Le Roux and Rouanet, 2009; Tether and Tajar, 2008).

3.4 Results

The multiple correspondence analysis for the full sample reveals 8 dimensions, each of which accounts for between 34.6% and 5.9% of the total variation in the data (see TABLE 7). For our interpretation, we will focus on the first two dimensions, which individually account for the largest amount of variation in the data, and together account for roughly 50% of the variance.

Insert TABLE 7 about here.

FIGURE 6 shows the plot of the defensive strategy variables for the full sample included in the multiple correspondence analysis according to their scores in dimensions 1 and 2.

Insert FIGURE 6 about here.

As explained earlier, where variables are closely grouped together, particularly if this is at some distance from the origin, this shows variables with high levels of association. A clear cluster of variables appears in the bottom left corner of FIGURE 6. This includes positive answers to the question whether a firm has abandoned (Q8_2_a=1) or cancelled (Q8_2_b=1) an innovation project due to missing access to property rights. A second cluster of variables is found slightly to the left along the horizontal axis. This group of variables consists of all other strategies (Invent around, Wait and see, In-licensing, Revocation and Out-of-court settlement) except for cross-licensing (Q8_2_f=1) which appears to be a single point in the upper left corner of the plot suggesting that it either is a strategy that is less frequently employed or radically different from all other defensive strategies. The plot also shows another cluster of variables, located close to the center of the plot.

This is comprised of the corresponding negative variables (‘no’ answers) for all defensive strategies and hence identifies the variables of the strategies that firms do not employ. We conducted the same analysis by comparing both manufacturing and service sectors. FIGURE 7 reveals some interesting differences. For manufacturing, we identify four clusters of variables similar to the ones revealed in the full sample suggesting that the manufacturing sector seems to be a better representation of the full sample than the service sector.

Insert FIGURE 7 about here.

As the descriptives have already shown, most larger companies and firms operating in the manufacturing sectors also have a greater arsenal of defensive strategies they employ which may explain the stronger association of the variables for this sector affiliation. Another reason might be due to the fact that the service sector is very diverse and comprises small sector subclasses. For the service sector, the picture is less clear. The variables ‘Abandonment’ and ‘Cancellation’ group together in the lower left corner. Another cluster consists of ‘Invent around’ (Q8_2_c=1) and ‘Wait and see’ (Q8_2_d=1) and a third group comprises the strategies ‘Revocation’ (Q8_2_g=1) and ‘Out-of-court settlement’ (Q8_2_i=1). In the service sector, ‘In-licensing’ (Q8_2_e=1) and ‘Cross-Licensing’ (Q8_2_f=1) reflect separate strategies. For a more precise overview, FIGURE 8 shows different associations of defensive strategies based on two selected sectors (Chemicals and Pharmaceuticals as well as Information and Communication sectors).

Insert FIGURE 8 about here.

For Chemicals and Pharmaceuticals, we find five different clusters of defensive strategies. Cluster one comprises the strategy ‘Cancellation’ in the bottom of the plot, cluster two the strategies ‘Abandonment’, ‘Invent around’ and ‘Wait and see’, cluster three ‘In-licensing’, ‘Revocation’ and ‘Out-of-court settlement’. In the top left corner of the plot, we find ‘Cross-licensing’ reflecting another cluster with a single strategy. In contrast, the graphical representation for the Information and Communication sector shows a different pattern of six defensive strategy combinations. Cluster one represents the strategies ‘Abandonment’ and ‘Cancellation’, in another cluster at the top of the plot the strategies ‘Cross-licensing’, ‘Revocation’ and ‘Out-of-court settlement’ appear together. However, the strategies ‘In-licensing’, ‘Invent around’ and ‘Wait and see’ seem to reflect separate strategies in this sector. All these differences among the sectors may be due to the underlying IP regime in each sector.

In sum, the results suggest that there is evidence for different combinations of defensive IP strategies among sector classes. A drawback of the method relates to the ratio distortion of the maps; the scales on the vertical axes are usually different from that on the horizontal axes (Tether and Tajar, 2008).

4 Discussion and implications

Adding to the work of Arora and Ceccagnoli (2006) and Arora (1997), this study examines the interplay between different defensive IP instruments available to firms in their quest to appropriate rents from innovation. From a theoretical perspective, this paper sheds some light on the prevalence of different defensive strategies and their distribution across different types of industries and firms. With a broad exploratory approach, we are able to identify different combinations of defensive IP strategies among sector and size classes.

Moreover, prior research suggests that management of the different options of defensive IP strategies remains unclear. In this paper, we contribute to resolve this issue by linking firm determinants to defensive IP instruments. By doing so, we hope that managers gain a better

understanding of the general relevance and hence the impact of exercising these different strategies. For example, the patent and the legal landscape co-evolve as the specifications of products are modified and improved, and as patent applications are filed, issued, expired, or invalidated.

Furthermore, very early in the innovation process freedom to operate has to be considered an integral component of firms' endeavors. The greater the R&D investments, the more difficult the bargaining position. Therefore, a sound strategy for obtaining FTO for an innovation comprises all defensive strategies and a cost-benefit analysis of each in relation to the institutional context, the product type, and market dynamics. Nonetheless, a detailed and early investigation on every potential product can be complex, expensive and thus just not feasible (Krattiger et al., 2007). In reality, the different defensive strategies are executed simultaneously and dynamically adapted to changing circumstances. Inventing around for example may be a more viable strategy during the R&D stages, whereas litigation or abandonment of a project may become the only strategy if nothing else works. Integrating and effectively managing FTO as part of a firm's strategy requires cooperation and a shared understanding among many different actors such as R&D staff, strategic decision makers, IP managers, and employees in business development or finance. In sum, the focus is not only on having an FTO strategy – but using it (Krattiger et al., 2007). Moreover, firms and their managers should be aware of the prevalent defensive strategies employed in the sectors they are operating in. Especially smaller firms – that usually apply less of these strategies – can benefit from this analysis here.

In this paper, we use MCA to disentangle associations of companies' use of specific defensive strategies. Correspondence analysis has a long research tradition as a technique for exploratory data analysis with a few exceptions; management scholars have not reported many applications of its use. Moreover, CA has received little attention in the management literature (Carroll and Green, 1988). Researchers often need to detect and interpret underlying relationships among variables. The purpose of our article is to increase awareness of the business research community for a

multivariate descriptive statistical method that represents graphically the rows and columns of a categorical data matrix.

MCA does have limitations. It is a multivariate descriptive statistical method and hence is not suitable for testing hypotheses. Finally, it must be recognized that in many ways MCA is a subjective technique. Often it is possible to obtain many different representations of a data set, resulting in different analysis categories and solutions. Nonetheless, MCA offers great flexibility which can initiate more insight into the underlying relationships of the variables studied due to the different portrayal options. Hence, flexibility comes at the cost of subjectivity of the analysis (Hoffman and Franke, 1986).

A crucial feature of our data is that the unit of observation is at company level – not at product level. This might be important when analyzing defensive IP strategies as these often refer to specific products or components of technologies rather than entire product portfolios. Nonetheless, we assume a certain extent of homogeneity in the product portfolio of the firms in the sample.

Our analysis provides two main insights. First, innovating companies must early on assess the benefits and drawbacks of the different organizational IP strategies, and then decide for the most effective defensive strategy for the given context. Second, a valid defensive strategy at hand and as an essential part of the firm's business strategy is important and should not just be treated as an ‘afterthought’ (Somaya et al., 2011). The technological and research trajectories of a company have to be well aligned with its usage of defensive strategies. Hence, IP becomes a strategic weapon in the corporate arsenal (Reitzig, 2004a). This paper further shows that firms may not only file patents for proprietary reasons but rather to be strategically well positioned in case of counter-lawsuits and in terms of competition. Thus, companies more often use patents as a strategic weapon in the competitive arena. Recent figures provided by the United States Patent and Trademark Office (USPTO) seem to support this assumption: The number of patent applications has roughly quadrupled between 1983 and 2010. By contrast, neither innovation nor R&D expenditures have exhibited any particular upwards trend, not to speak of factor productivity. While patent litigation

has increased, few patents are actively used (Boldrin and Levine, 2012). The same is true for the European Patent Office (EPO) which has seen a patent application upsurge since the 1990s (Blind et al., 2006). Discouraged by a growing fear of lawsuits, firms are increasingly afraid to invest in expensive research projects. Especially small companies, which only own few patents, increasingly invest more carefully as they cannot a priori assess whose patents they infringe upon (Schwiebacher, 2012).

In sum, companies having had experience with infringement situations might have developed their arsenal of defensive strategies based on these prior experiences and hence, a successful invent around experience may induce the use of this strategy again.

For policy-makers, this study delivers some interesting aspects of defensive strategies with regard to frequency and increasing importance across all sectors but particularly in the manufacturing industries. Companies seem to feel the urge to exercise these types of strategies due to a non-transparent patent system. Oftentimes firms face severe difficulties in gathering all necessary information on already existing patents. Particularly, in some industries (e.g., information and communication technologies or semiconductors), it is difficult to develop innovations or new products without infringing on other companies' rights. This leaves room for improvement of the patent system which needs to become more coherent and accessible. Additionally, the above mentioned weaknesses raise another voice for a more efficient patent system especially against the background of the new European patent announced to be introduced in 2014.

5 Conclusion and further research

The ultimate goal of a defensive IP strategy is to retain freedom to operate and commercialize and avoid being held up for exorbitant rents by other entities. Defensive strategies have increasingly raised awareness as they seem to become companies' strategic weapon in an ever faster moving, complex business environment with growing competition and shorter product life cycles. We detect and interpret underlying structural relationships among the different defensive strategies in an

exploratory fashion with the help of multiple correspondence analysis – a categorical data analysis technique. The empirics reveal interesting differences for manufacturing and non-manufacturing sectors as well as for subclasses within the manufacturing sectors, which can be explained by differences in the underlying IP regime in each sector. Evidently, the portfolio of defensive IP strategies used varies with size such that smaller firms mainly rely on one or two strategies whereas bigger firms employ a larger defensive IP strategy arsenal. We also find evidence for different combinations of defensive IP strategies among sector and size classes. Due to the limitations of the statistical method we employ, we are not able to detect any causal relationships. However, in a further paper we focus particularly on the drivers and determinants of companies' use of defensive IP strategies. From a theoretical perspective, this paper emphasizes the importance for managers to understand the importance of defensive IP strategies as crucial for value appropriation from innovation. According to Reitzig (2004a), firms should govern and exploit their IP assets more effectively and integrate their defensive IP strategy into a cohesive corporate strategy (Somaya et al., 2011). The results of this study have implications for policy. Companies' use of defensive strategies reveals weaknesses and inefficiencies which call for a reform of the patent system.

References

Agrawal, A.K., Garlappi, L., 2007. Public Sector Science And The Strategy Of The Commons: Economics of Innovation and New Technology. Economics of Innovation and New Technology 16 (7), 517–539.

Allison, J.R., Lemley, M.A., Moore, K.A., Trunkey, R.D., 2004. Valuable Patents. Georgetown Law Review 92, 435–1309.

Arora, A., 1997. Patents, licensing, and market structure in the chemical industry. Research Policy 26 (4–5), 391–403.

Arora, A., Ceccagnoli, M., 2006. Patent Protection, Complementary Assets, and Firms' Incentives for Technology Licensing. Management Science 52 (2), 293–308.

Baker, S., Mezzetti, C., 2005. Disclosure as a Strategy in the Patent Race. Journal of Law & Economics 48 (1), 173–194.

Belderbos, R., Carree, M., Lokshin, B., 2004. Cooperative R&D and firm performance. Research Policy 33 (10), 1477–1492.

Bessen, J.E., Meurer, M.J., 2005. The Patent Litigation Explosion. SSRN Electronic Journal.

Blind, K., Cremers, K., Mueller, E., 2009. The influence of strategic patenting on companies' patent portfolios. Research Policy 38 (2), 428–436.

Blind, K., Edler, J., Frietsch, R., Schmoch, U., 2006. Motives to patent: Empirical evidence from Germany. Research Policy 35 (5), 655–672.

Boldrin, M., Levine, D., 2012. The Case Against Patents. Federal Reserve Bank of St. Louis, Working Paper 2012-035A.

Carroll, J.D., Green, P.E., 1988. An INDSCAL-Based Approach to Multiple Correspondence Analysis. Journal of Marketing Research 25 (2), 193–203.

Cassiman, B., Veugelers, R., 2002. R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium. The American Economic Review 92 (4), 1169–1184.

Ceccagnoli, M., 2009. Appropriability, preemption, and firm performance. Strategic Management Journal 30 (1), 81–98.

Cohen, W.M., Goto, A., Nagata, A., Nelson, R.R., Walsh, J.P., 2002. R&D spillovers, patents and the incentives to innovate in Japan and the United States. Research Policy 31 (8–9), 1349–1367.

Cohen, W.M., Klepper, S., 1992. The tradeoff between firm size and diversity in the pursuit of technological progress. Small Business Economics 4 (1), 1–14.

Cohen, W.M., Nelson, R.R., Walsh, J.P., 2000. Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not). National Bureau of Economic Research Working Paper Series No. 7552.

Cremers, K., 2004. Determinants of Patent Litigation in Germany. Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim, Discussion Paper No. 04–72.

Duguet, E., Kabla, I., 1998. Appropriation Strategy and the Motivations to Use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing. Annals of Economics and Statistics / Annales d'Économie et de Statistique (49/50), 289–327.

Eurostat, 2009. 'High-technology' and 'knowledge based services' aggregations based on NACE Rev. 2 (downloaded on 09-22-2011 from http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an3.pdf).

Fischer, T., Henkel, J., 2012. Patent trolls on markets for technology – An empirical analysis of NPEs' patent acquisitions. Research Policy 41 (9), 1519–1533.

Galasso, A., in press. Broad cross-license negotiations. Journal of Economics and Management Strategy.

Galasso, A., Schankerman, M., Serrano, C.J., 2011. Trading and enforcing patent rights.

Gallini, N.T., 1992. Patent Policy and Costly Imitation. The RAND Journal of Economics 23 (1), 52–63.

Gill, D., 2008. Strategic Disclosure of Intermediate Research Results. Journal of Economics & Management Strategy 17 (3), 733–758.
Greenacre, M.J., 1984. Theory and Applications of Correspondence Analysis. Academic Press, Inc., London.
Grindley, P.C., Teece, D.J., 1997. Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics. California Management Review 39 (2), 8–41.
Guellec, D., Martinez, C., Zuniga, P., 2011. Pre-emptive patenting: securing market exclusion and freedom of operation: Economics of Innovation and New Technology. Economics of Innovation and New Technology 21 (1), 1–29.
Hall, B.H., Jaffe, A.B., Trajtenberg, M., 2005. Market value and patent citations. The RAND Journal of Economics 36, 16–38.
Hall, B.H., Ziedonis, R.H., 2001. The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995. The RAND Journal of Economics 32 (1), 101–128.
Harhoff, D., Scherer, F.M., Vopel, K., 2003. Citations, family size, opposition and the value of patent rights. Research Policy 32 (8), 1343–1363.
Hoffman, D.L., Franke, G.R., 1986. Correspondence Analysis: Graphical Representation of Categorical Data in Marketing Research. Journal of Marketing Research 23 (3), 213–227.
Hoffman, D.L., Leeuw, J., 1992. Interpreting multiple correspondence analysis as a multidimensional scaling method. Marketing Letters 3 (3), 259–272.
Hovenkamp, H., Janis, M., Lemley, M.A., 2002. Anticompetitive settlement of intellectual property disputes. Minnesota Law Review 87, 1719–1766.
James, S.D., Leiblein, M.J., Lu, S., 2013. How Firms Capture Value From Their Innovations. Journal of Management 39 (5), 1123–1155.
Kaiser, U., 2002. Measuring knowledge spillovers in manufacturing and services: An empirical assessment of alternative approaches. Research Policy 31 (1), 125–144.
Kesan, J.P., Ball, G.G., 2006. How are patent cases resolved? An empirical examination of the adjudication and settlement of patent disputes. Washington University Law Review 84 (2), 237–312.
Krattiger, A., 2007. Freedom to operate, public sector research, and product-development partnerships: strategies and risk-management options, in: Krattiger, A., Mahoney, R.T., Nelsen, L., Thomson, J.A., Bennett, A.B., Satyanarayana, K., Graff, G.D., Fernandez, C., Kowalski, S.P. (Eds), Intellectual property management in health and agriculture innovation. A handbook of best practices, 1 and 2. MIHR; PIPRA, Oxford, U.K, Davis, Calif, pp. 1317–1327.
Krattiger, A., Mahoney, R.T., Nelsen, L., Thomson, J.A., Bennett, A.B., Satyanarayana, K., Graff, G.D., Fernandez, C., Kowalski, S.P. (Eds), 2007. Intellectual property management in health and agriculture innovation: A handbook of best practices. MIHR; PIPRA, Oxford, U.K, Davis, Calif.
Lanjouw, J.O., Schankerman, M., 2001. Characteristics of Patent Litigation: A Window on Competition. The RAND Journal of Economics 32 (1), 129–151.
Lanjouw, J.O., Schankerman, M., 2004. Protecting Intellectual Property Rights: Are Small Firms Handicapped? Journal of Law and Economics 47 (1), 45–74.
Le Roux, B., Rouanet, H., 2009. Multiple Correspondence Analysis. SAGE Publications.
De Leeuw, J., 1973. Canonical analysis of categorical data. Unpublished doctoral dissertation, Psychological Institute, University of Leiden, The Netherlands.
Leiponen, A., Helfat, C.E., 2011. Location, Decentralization, and Knowledge Sources for Innovation. Organization Science 22 (3), 641–658.
Lerner, J., 1995. Patenting in the Shadow of Competitors. Journal of Law & Economics 38, 463–495.
Lippman, S.A., Rumelt, R.P., 2003. A bargaining perspective on resource advantage. Strategic Management Journal 24 (11), 1069–1086.

Mahoney, J.T., Pandian, J.R., 1992. The resource-based view within the conversation of strategic management. Strategic Management Journal 13 (5), 363–380.
Mansfield, E., 1985. How Rapidly Does New Industrial Technology Leak Out? The Journal of Industrial Economics 34 (2), 217–223.
Miotti, L., Sachwald, F., 2003. Co-operative R&D: why and with whom?: An integrated framework of analysis. Research Policy 32 (8), 1481–1499.
Neuhäusler, P., 2012. The use of patents and informal appropriation mechanisms—Differences between sectors and among companies. Technovation 32 (12), 681–693.
Nishisato, S., 1980. Analysis of categorical data: Dual scaling and its applications. University of Toronto Press, Toronto.
Pisano, G., 2006. Profiting from innovation and the intellectual property revolution: Special issue commemorating the 20th Anniversary of David Teece's article, "Profiting from Innovation", in Research Policy. Research Policy 35 (8), 1122–1130.
Pisano, G.P., Teece, D.J., 2007. How to Capture Value from Innovation: Shaping Intellectual Property and Industry Architecture. California Management Review 50 (1), 278–296.
Reitzig, M., 2004a. Strategic Management of Intellectual Property. MIT Sloan Management Review 45 (3), 35–40.
Reitzig, M., 2004b. The private values of ‘thickets’ and ‘fences’: towards an updated picture of the use of patents across industries: Economics of Innovation and New Technology. Economics of Innovation and New Technology 13 (5), 457–476.
Reitzig, M., Henkel, J., Heath, C., 2007. On sharks, trolls, and their patent prey - Unrealistic damage awards and firms’ strategies of “being infringed”. Research Policy 36 (1), 134–154.
Reitzig, M., Henkel, J., Schneider, F., 2010. Collateral damage for R&D manufacturers: how patent sharks operate in markets for technology. Industrial and Corporate Change 19 (3), 947–967.
Reitzig, M., Puranam, P., 2009. Value appropriation as an organizational capability: the case of IP protection through patents. Strategic Management Journal 30 (7), 765–789.
Rumelt, R., 1984. Towards a strategic theory of the firm, edited by Foss, NJ, Resources, firms and strategies (1997). Oxford Management Readers, Oxford.
Schwiebacher, F., 2012. Complementary Assets, Patent Thickets and Hold-Up Threats – Do Transaction Costs Undermine Investments in Innovation? SSRN Electronic Journal.
Somaya, D., 2003. Strategic determinants of decisions not to settle patent litigation. Strategic Management Journal 24 (1), 17–38.
Somaya, D., 2004. Firm Strategies and Trends in Patent Litigation in the United States, in: Libecap, G.D. (Ed), Intellectual property and entrepreneurship, vol. 15. Elsevier, Amsterdam, Boston, pp. 103–147.
Somaya, D., 2012. Patent Strategy and Management. Journal of Management 38 (4), 1084–1114.
Somaya, D., Teece, D., Simon Wakeman, 2011. Innovation in Multi-Invention Contexts: Mapping Solutions to Technological and Intellectual Property Complexity. California Management Review 53 (4), 47–79.
Somaya, D., Williamson, I.O., Zhang, X., 2007. Combining Patent Law Expertise with R&D for Patenting Performance. Organization Science 18 (6), 922–937.
Teece, D.J., 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research Policy 15 (6), 285–305.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strategic Management Journal 18 (7), 509–533.
Tether, B.S., 2002. Who co-operates for innovation, and why: An empirical analysis. Research Policy 31 (6), 947–967.
Tether, B.S., Tajar, A., 2008. The organisational-cooperation mode of innovation and its prominence amongst European service firms. Research Policy 37 (4), 720–739.
Ziedonis, R.H., 2003. Patent litigation in the US semiconductor industry, in: Committee on Intellectual Property Rights in the Knowledge-Based Economy (Ed), Patents in the Knowledge-Based Economy. The National Academies Press, pp. 180–213.

Ziedonis, R.H., 2004. Don't Fence Me In: Fragmented Markets for Technology and the Patent Acquisition Strategies of Firms. Management Science 50 (6), 804–820.

Tables

TABLE 1. Estimated patent revenue for some phone makers, per year

Phone maker	**Estimated revenue per year in €**
Nokia	**500** million
Apple	**200** million
Samsung	Less than **100** million
Microsoft	**50** million
BlackBerry	**40** million
HTC	**10-30** million
Others	**90** million

Source: Sanford C. Bernstein estimates, The Wall Street Journal 16/12/2013

TABLE 2. Summary statistics (N=2,995)

Variable	Mean	Std. Dev.	Min.	Max.
Defensive strategies				
Abandonment	0.038	0.192	0	1
Cancellation	0.028	0.164	0	1
Invent around	0.171	0.376	0	1
Wait and see	0.102	0.303	0	1
In-licensing	0.188	0.391	0	1
Cross-licensing	0.033	0.180	0	1
Revocation	0.121	0.326	0	1
Out-of-court settlement	0.129	0.335	0	1
Formal protection mechanisms				
Patents	0.373	0.484	0	1
Utility Patents	0.297	0.457	0	1
Design Patents	0.110	0.313	0	1
Trademarks	0.396	0.489	0	1
Copyrights	0.201	0.401	0	1
OECD sectors				
High-tech	0.046	0.210	0	1
Medium high-tech	0.183	0.386	0	1
Medium low-tech	0.194	0.396	0	1
Low-tech	0.124	0.330	0	1
Knowledge-intensive services	0.354	0.478	0	1
Less-knowledge-intensive services	0.013	0.112	0	1
NACE sectors				
Manufacturing	0.584	0.493	0	1
Chemicals and pharmaceuticals	0.055	0.228	0	1

Plastics and rubber	0.037	0.188	0	1
Manufacturing of non-metallic mineral products	0.025	0.157	0	1
Manufacturing of food, beverages and tobacco	0.033	0.180	0	1
Metal processing	0.081	0.273	0	1
Electrical engineering	0.109	0.311	0	1
Mechanical engineering	0.127	0.333	0	1
Manufacturing of textiles, clothes and leather	0.030	0.170	0	1
Manufacturing of wood, paper and furniture	0.045	0.208	0	1
Printing and reproduction of recorded media	0.019	0.138	0	1
Other manufacturing	0.102	0.302	0	1
Services	0.416	0.493	0	1
Information and communication	0.077	0.268	0	1
Professional scientific and technical activities	0.112	0.315	0	1
Financial and insurance activities	0.047	0.213	0	1
Other services	0.145	0.352	0	1
Size				
Employees	2.133	1.323	0	4

Sectors	Abandon-ment	Cancel-lation	Invent around	Wait and see	In-licensing	Cross-licensing	Revo-cation	Out-of-court settlement
Chemicals and pharmaceuticals	10%	7%	27%	15%	32%	4%	21%	24%
Plastics and rubber	6%	4%	19%	15%	10%	7%	22%	17%
Manufacturing of non-metallic mineral products	11%	9%	33%	14%	21%	4%	30%	24%
Manufacturing of food, beverages and tobacco	3%	2%	12%	8%	15%	2%	16%	13%
Metal processing	4%	3%	17%	13%	14%	3%	12%	14%
Electrical engineering	6%	4%	30%	16%	24%	6%	17%	19%
Mechanical engineering	4%	2%	30%	15%	20%	7%	23%	21%
Manufacturing of textiles, clothes and leather	3%	0%	16%	9%	17%	2%	17%	13%
Manufacturing of wood, paper and furniture	3%	3%	8%	6%	17%	1%	4%	10%
Printing and reproduction of recorded media	2%	2%	7%	7%	5%	2%	3%	3%
Other	4%	3%	22%	13%	19%	1%	12%	13%

manufacturing								
Information and communication	3%	3%	13%	9%	29%	3%	7%	10%
Professional scientific and technical activities	3%	3%	15%	8%	15%	1%	6%	5%
Financial and insurance activities	0%	1%	6%	2%	27%	1%	1%	8%
Other services	1%	1%	4%	4%	13%	1%	5%	6%

TABLE 3. Incidences of defensive strategies across manufacturing sectors

TABLE 4. Frequencies of strategies appearing together – full sample (N=2,995)

	Abandonment	Cancellation	Invent around	Wait and see	In-licensing	Cross-licensing	Revocation	Out-of-court settlement
Abandonment	**115**							
Cancellation	49	**83**						
Invent around	82	63	**511**					
Wait and see	38	27	146	**305**				
In-licensing	56	37	209	98	**563**			
Cross-licensing	20	11	72	32	69	**100**		
Revocation	55	37	214	95	166	71	**362**	
Out-of-court settlement	54	36	209	106	188	73	216	**385**

TABLE 5. Frequencies of strategies appearing together – manufacturing (N=1,748)

	Abandonment	Cancellation	Invent around	Wait and see	In-licensing	Cross-licensing	Revocation	Out-of-court settlement
Abandonment	**91**							
Cancellation	37	**59**						
Invent around	65	47	**400**					
Wait and see	27	15	118	**232**				
In-licensing	42	28	162	76	**337**			
Cross-licensing	17	9	63	28	53	**81**		
Revocation	49	28	187	81	137	62	**299**	
Out-of-court settlement	46	29	177	88	145	61	184	**301**

TABLE 6. Frequencies of strategies appearing together – services (N=1,247)

	Abandonment	Cancellation	Invent around	Wait and see	In-licensing	Cross-licensing	Revocation	Out-of-court settlement
Abandonment	**24**							
Cancellation	12	**24**						
Invent around	17	16	**111**					
Wait and see	11	12	28	**73**				
In-licensing	14	9	47	22	**226**			
Cross-licensing	3	2	9	4	16	**19**		
Revocation	6	9	27	14	29	9	**63**	
Out-of-court settlement	8	7	32	18	43	12	32	**84**

TABLE 7. Revealed dimensions from multiple correspondence analysis (N=2,995)

	Principal inertia	Percent	Cumulative percent
Dimension 1	0.346	34,6%	34,58%
Dimension 2	0.154	15,4%	49,95%
Dimension 3	0.114	11,4%	61,35%
Dimension 4	0.098	9,8%	71,20%
Dimension 5	0.090	9,0%	80,20%
Dimension 6	0.075	7,5%	87,70%
Dimension 7	0.064	6,4%	94,10%
Dimension 8	0.059	5,9%	100,00%

Figures

FIGURE 1. Incidences of defensive strategies over firm size

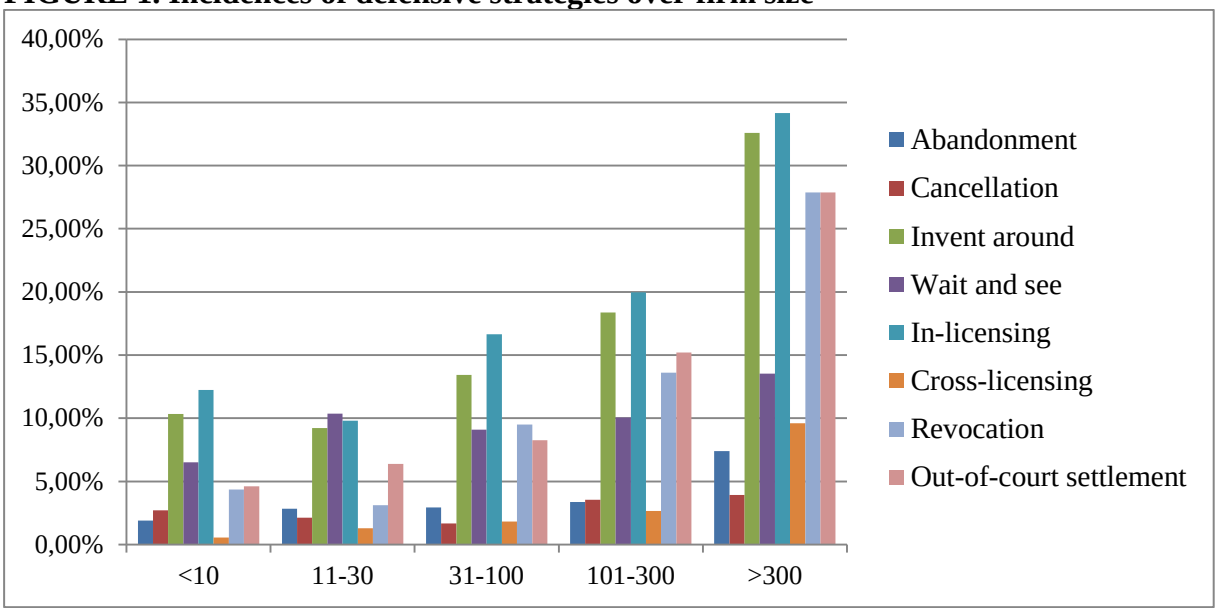


FIGURE 2. Incidences of formal protection mechanisms over firm size

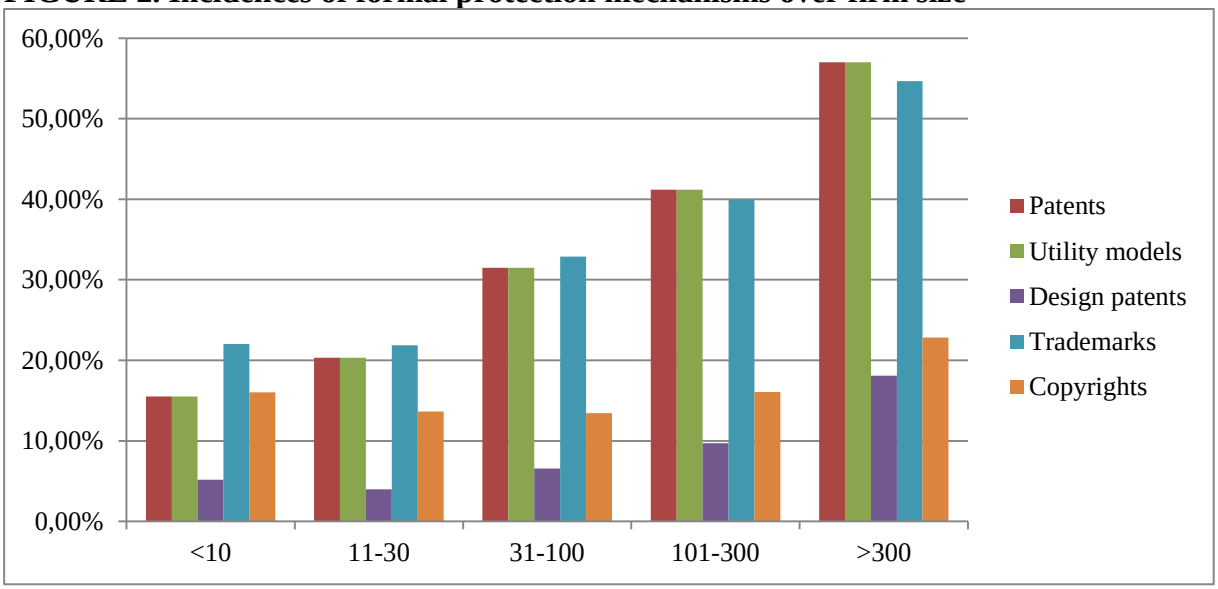


FIGURE 3. Number of observations by firm size and industry affiliation

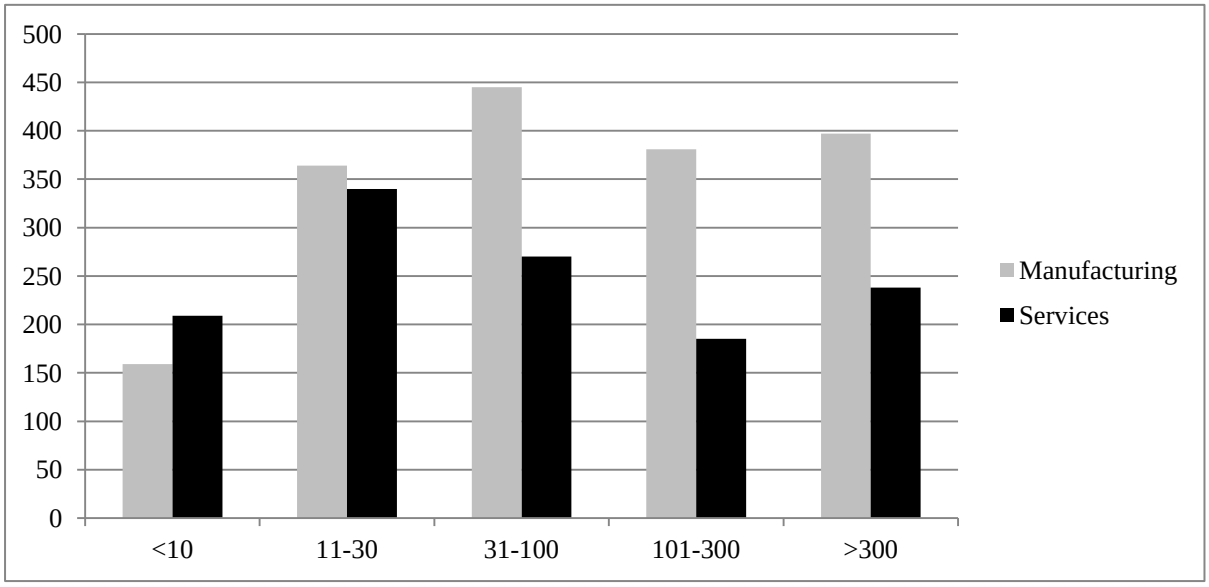


FIGURE 4. Incidences of defensive strategies over industry affiliation

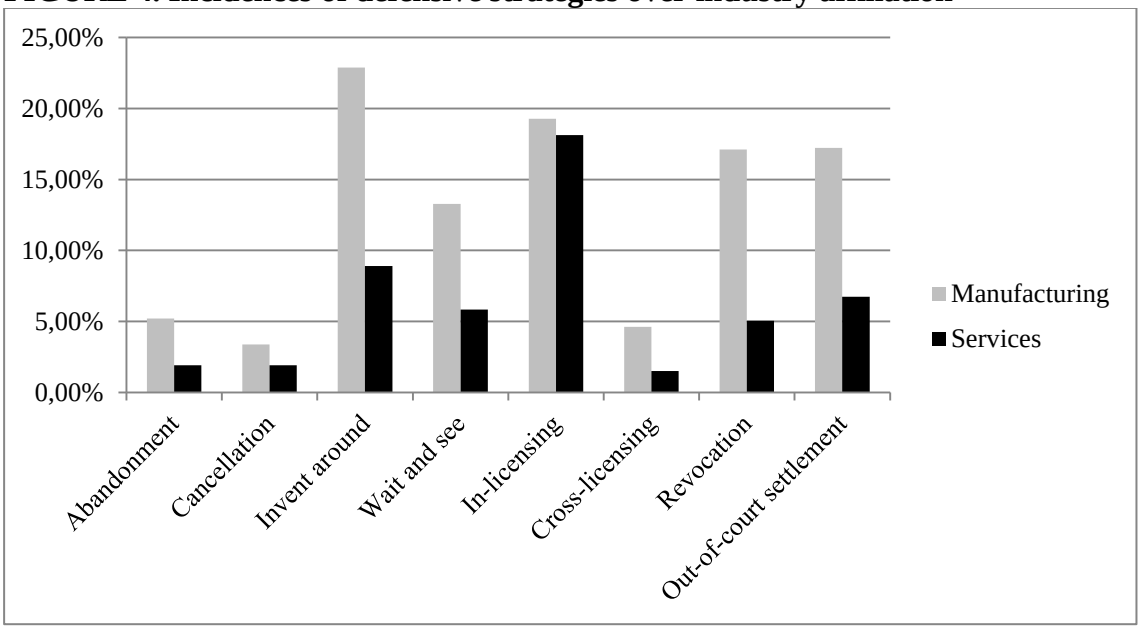


FIGURE 5. Number of observations by formal protection instruments and industry

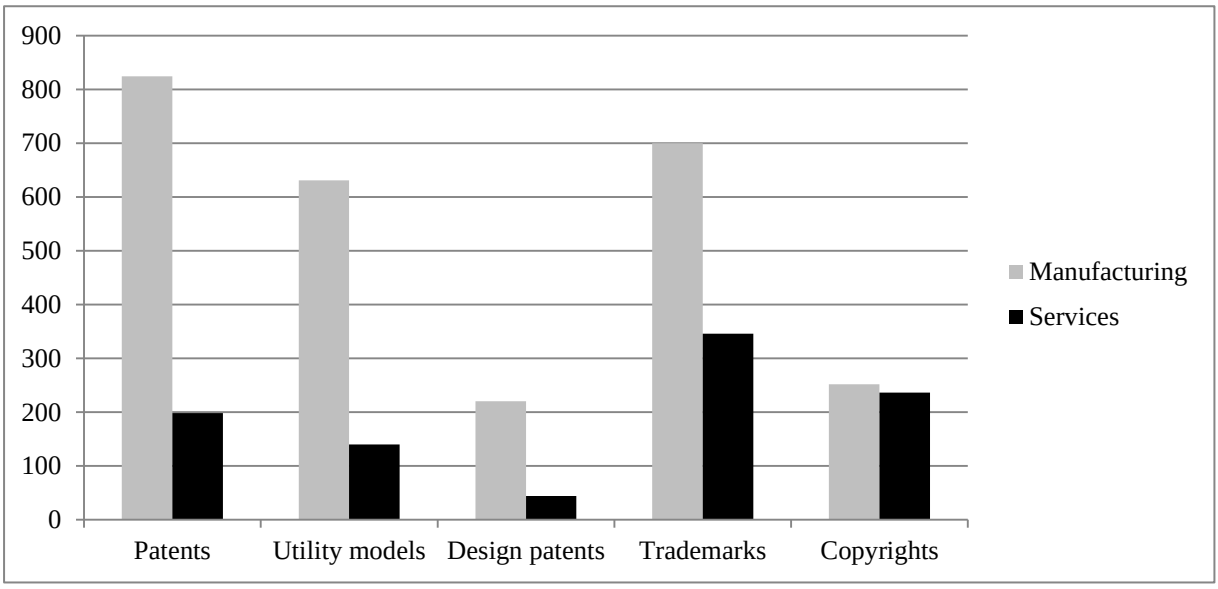


FIGURE 6. Identifying associations of defensive strategies in the full sample

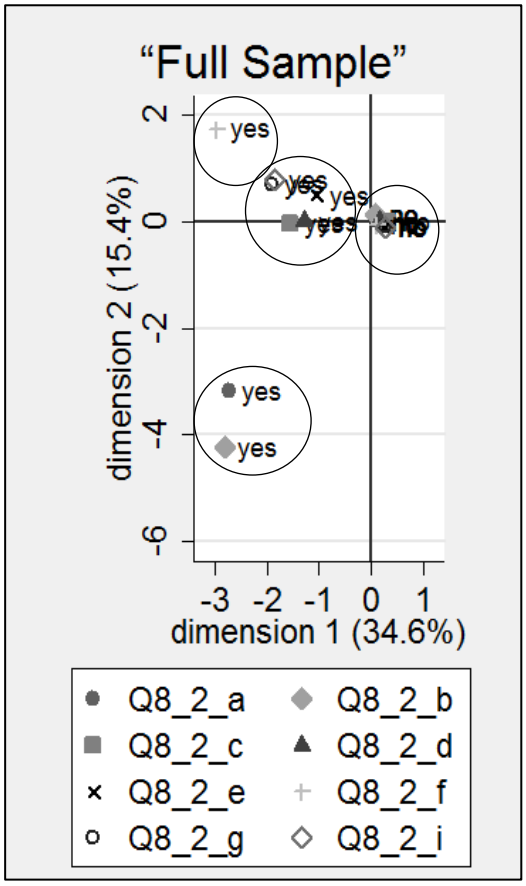


FIGURE 7. Identifying associations of defensive strategies – manufacturing and service sectors

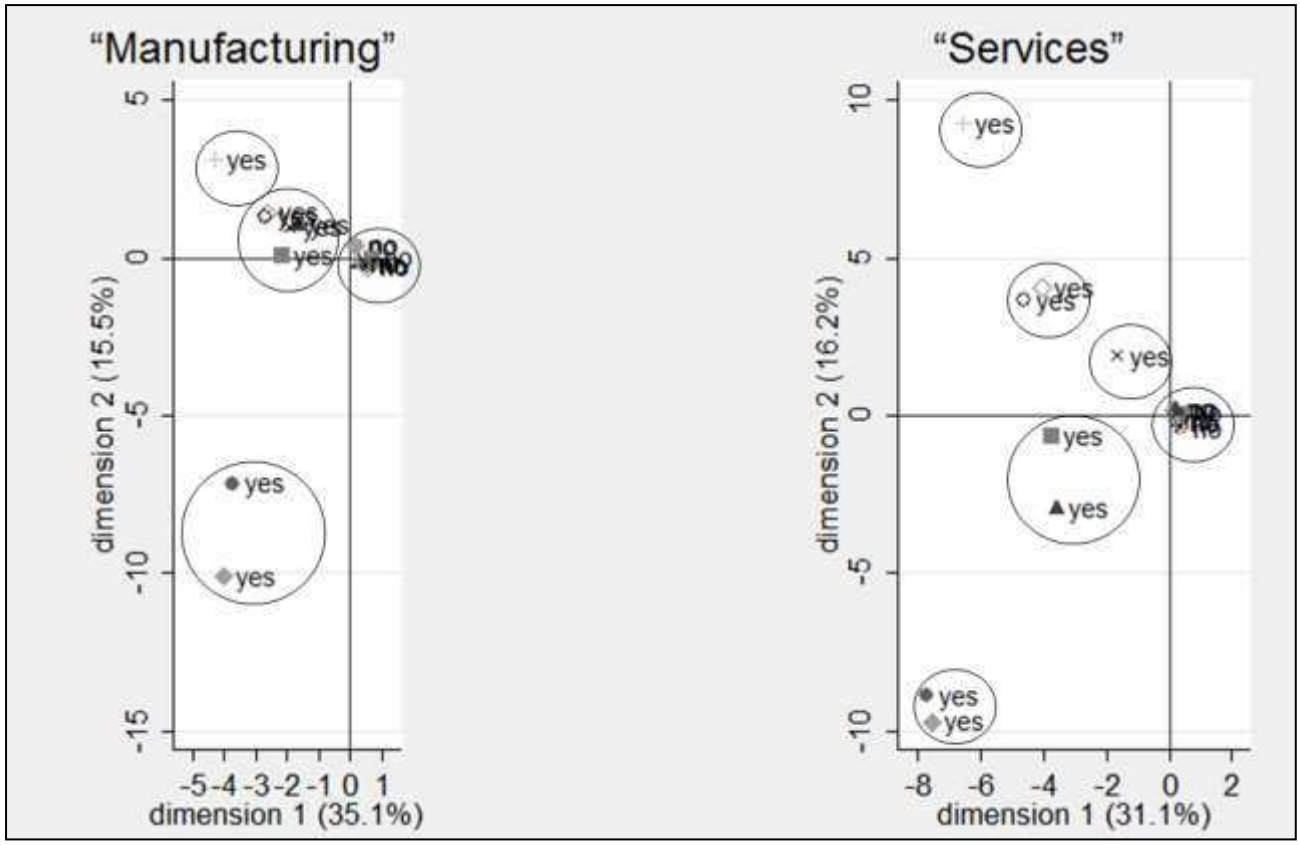
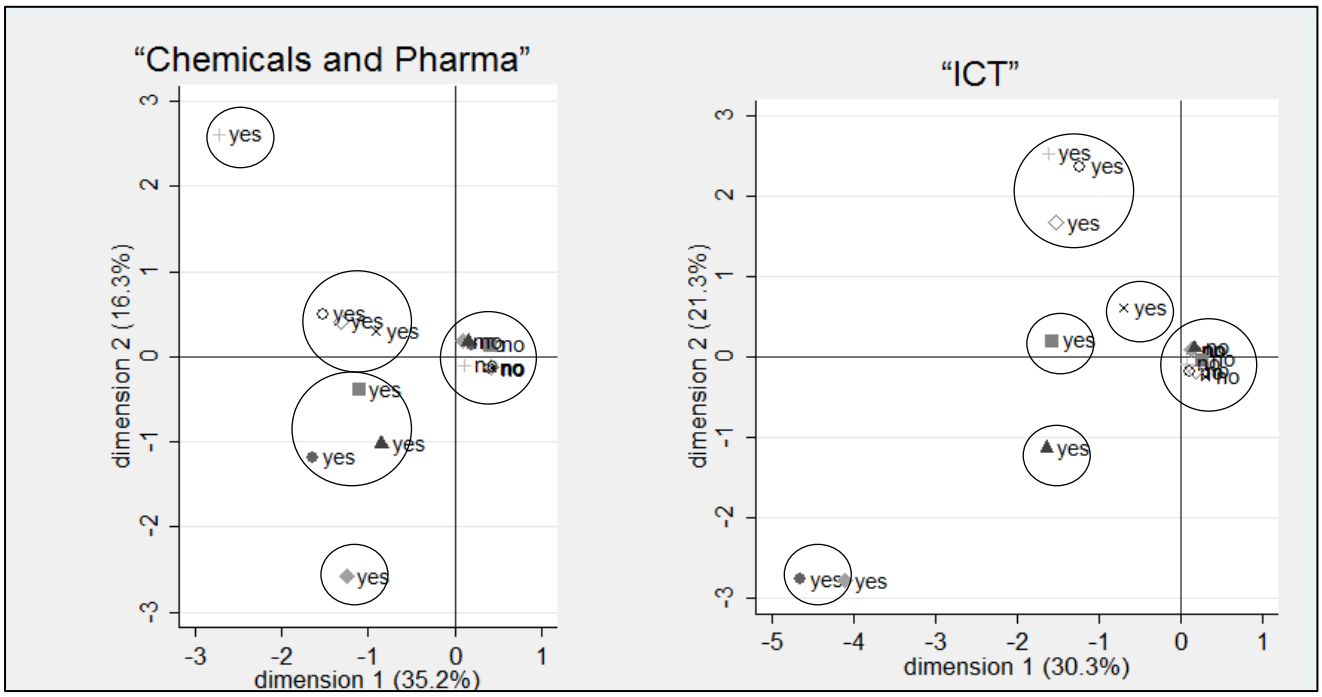


FIGURE 8. Identifying associations of defensive strategies – chemical and pharmaceutical and information and communication sectors



Appendix

Table A.1: Contingency tables: firm size and usage of defensive strategies

Abandonment

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	98.1	[97%, 99%]	1.9	[1%, 3%]	100.0
11-30 (n = 704)	97.2	[96%, 98%]	2.8	[2%, 4%]	100.0
31-100 (n = 715)	97.1	[96%, 98%]	2.9	[2%, 4%]	100.0
101-300 (n = 566)	96.6	[95%, 98%]	3.4	[2%, 5%]	100.0
>300 (n = 635)	92.6	[91%, 94%]	7.4	[6%, 9%]	100.0
Total (n = 2988)	96.2	[96%, 97%]	3.8	[3%, 4%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 29.5738$
Pearson: design-based $F(4, 11948) = 14.4647$

Cancellation

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	97.3	[96%, 98%]	2.7	[2%, 4%]	100.0
11-30 (n = 704)	97.9	[97%, 98.5%]	2.1	[1.5%, 3%]	100.0
31-100 (n = 715)	98.3	[97.5%, 99%]	1.7	[1%, 2.5%]	100.0
101-300 (n = 566)	96.5	[95%, 97%]	3.5	[3%, 4%]	100.0
>300 (n = 635)	96.1	[95%, 97%]	3.9	[3%, 5%]	100.0
Total (n = 2988)	97.3	[97%, 98%]	2.7	[2%, 3%]	100.0

Pr = 0.068
Pearson: uncorrected $\chi^2(4) = 8.7438$
Pearson: design-based $F(4, 11948) = 4.2766$

Invent around

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	89.7	[87%, 92%]	10.3	[8%, 13%]	100.0
11-30 (n = 704)	90.8	[89%, 92%]	9.2	[8%, 11%]	100.0
31-100 (n = 715)	86.6	[85%, 88%]	13.4	[12%, 15%]	100.0
101-300 (n = 566)	81.6	[79%, 84%]	18.4	[16%, 21%]	100.0
>300 (n = 635)	67.4	[65%, 70%]	32.6	[30%, 35%]	100.0
Total (n = 2988)	82.9	[82%, 84%]	17.1	[16%, 18%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 157.9294$

Pearson: design-based F(4, 11948) = 77.2442

Wait and see

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	93.5	[91%, 95%]	6.5	[5%, 9%]	100.0
11-30 (n = 704)	89.6	[88%, 91%]	10.4	[9%, 12%]	100.0
31-100 (n = 715)	90.9	[89%, 92%]	9.1	[8%, 11%]	100.0
101-300 (n = 566)	89.9	[88%, 92%]	10.1	[8%, 12%]	100.0
>300 (n = 635)	86.5	[84%, 88%]	13.1	[12%, 16%]	100.0
Total (n = 2988)	89.8	[89%, 90.5%]	10.2	[9.5%, 11%]	100.0

Pr = 0.007
Pearson: uncorrected $\chi^2(4) = 14.1679$
Pearson: design-based F(4, 11948) = 6.9296

In-licensing

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	87.8	[85%, 90%]	12.2	[10%, 15%]	100.0
11-30 (n = 704)	90.2	[88.5%, 92%]	9.8	[8%, 11.5%]	100.0
31-100 (n = 715)	83.4	[81%, 85%]	16.6	[15%, 19%]	100.0
101-300 (n = 566)	80.0	[78%, 82%]	20.0	[18%, 22%]	100.0
>300 (n = 635)	65.8	[63%, 68%]	34.2	[32%, 37%]	100.0
Total (n = 2988)	81.2	[80%, 82%]	18.8	[18%, 20%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 148.4874$
Pearson: design-based F(4, 11948) = 72.6261

Cross-licensing

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	99.5	[98.5%, 100%]	0.5	[0%, 1.5%]	100.0
11-30 (n = 704)	98.7	[98%, 99%]	1.3	[1%, 2%]	100.0
31-100 (n = 715)	98.2	[97%, 99%]	1.8	[1%, 3%]	100.0
101-300 (n = 566)	97.3	[96%, 98%]	2.7	[2%, 4%]	100.0
>300 (n = 635)	90.4	[89%, 92%]	9.6	[8%, 11%]	100.0
Total (n = 2988)	96.7	[96%, 97%]	3.3	[3%, 4%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 101.1817$
Pearson: design-based F(4, 11948) = 49.4886

	Revocation				
Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	95.7	[94%, 97%]	4.3	[3%, 6%]	100.0
11-30 (n = 704)	96.9	[96%, 98%]	3.1	[2%, 4%]	100.0
31-100 (n = 715)	90.5	[89%, 92%]	9.5	[8%, 11%]	100.0
101-300 (n = 566)	86.4	[84%, 88%]	13.6	[12%, 16%]	100.0
>300 (n = 635)	72.1	[70%, 74.5%]	27.9	[25.5%, 30%]	100.0
Total (n = 2988)	88.0	[87%, 89%]	12.0	[11%, 13%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 229.2156$
Pearson: design-based F(4, 11948) = 112.1107

	Out-of-court settlement				
Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	95.4	[94%, 97%]	4.6	[3%, 6%]	100.0
11-30 (n = 704)	93.6	[92%, 95%]	6.4	[5%, 8%]	100.0
31-100 (n = 715)	91.7	[90%, 93%]	8.3	[7%, 10%]	100.0
101-300 (n = 566)	84.8	[83%, 87%]	15.2	[13%, 17%]	100.0
>300 (n = 635)	72.1	[70%, 74.5%]	27.9	[25.5%, 30%]	100.0
Total (n = 2988)	87.1	[86%, 88%]	12.9	[12%, 14%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 192.7266$
Pearson: design-based F(4, 11948) = 94.2637

Table A.2: Contingency tables: firm size and usage of protection measures

	Protection measures: patents				
Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	82.6	[79%, 85%]	17.4	[15%, 21%]	100.0
11-30 (n = 704)	77.4	[75%, 80%]	22.6	[20%, 25%]	100.0
31-100 (n = 715)	65.5	[63%, 68%]	34.5	[32%, 37%]	100.0
101-300 (n = 566)	54.8	[51.5%, 58%]	45.2	[42%, 48.5%]	100.0
>300 (n = 635)	40.2	[37%, 43%]	59.8	[57%, 63%]	100.0
Total (n = 2988)	62.7	[61%, 64%]	37.3	[36%, 39%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 261.6275$
Pearson: design-based F(4, 10932) = 118.3323

Protection measures: utility models

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	83.2	[80%, 86%]	16.8	[14%, 20%]	100.0
11-30 (n = 704)	81.6	[79%, 84%]	18.4	[16%, 21%]	100.0
31-100 (n = 715)	73.2	[70.5%, 76%]	26.8	[24%, 29.5%]	100.0
101-300 (n = 566)	63.3	[60%, 66.5%]	36.7	[33.5%, 40%]	100.0
>300 (n = 635)	53.0	[50%, 56%]	47.0	[44%, 50%]	100.0
Total (n = 2988)	70.2	[69%, 72%]	29.8	[28%, 31%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 155.9126$
Pearson: design-based $F(4, 10348) = 67.5935$

Protection measures: design patents

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	93.7	[91%, 95.5%]	6.3	[4.5%, 8%]	100.0
11-30 (n = 704)	95.1	[93.5%, 96%]	4.9	[4%, 6.5%]	100.0
31-100 (n = 715)	91.8	[90%, 93%]	8.2	[7%, 10%]	100.0
101-300 (n = 566)	87.4	[85%, 90%]	12.6	[10%, 15%]	100.0
>300 (n = 635)	77.3	[74%, 80%]	22.7	[20%, 26%]	100.0
Total (n = 2988)	89.0	[88%, 90%]	11.0	[10%, 12%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 104.8958$
Pearson: design-based $F(4, 9564) = 43.0773$

Protection measures: trademarks

Firm size	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	74.9	[71%, 78%]	25.1	[22%, 29%]	100.0
11-30 (n = 704)	75.0	[72%, 77.5%]	25.0	[22.5%, 28%]	100.0
31-100 (n = 715)	62.9	[60%, 66%]	37.1	[34%, 40%]	100.0
101-300 (n = 566)	54.0	[51%, 57%]	46.0	[43%, 49%]	100.0
>300 (n = 635)	39.2	[36%, 42%]	60.8	[58%, 64%]	100.0
Total (n = 2988)	60.4	[59%, 62%]	39.6	[38%, 41%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 200.4845$
Pearson: design-based $F(4, 10532) = 88.0678$

Protection measures: copyrights

Firm size	No	Yes	Total

	Row (%)	95% CI	Row (%)	95% CI	Row (%)
<10 (n = 368)	81.0	[77%, 84%]	19.0	[16%, 23%]	100.0
11-30 (n = 704)	83.4	[81%, 86%]	16.6	[14%, 19%]	100.0
31-100 (n = 715)	83.5	[81%, 86%]	16.5	[14%, 19%]	100.0
101-300 (n = 566)	79.2	[76%, 82%]	20.8	[18%, 24%]	100.0
>300 (n = 635)	72.0	[69%, 75%]	28.0	[25%, 31%]	100.0
Total (n = 2988)	79.9	[79%, 81%]	20.1	[19%, 21%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(4) = 30.1014$
Pearson: design-based $F(4, 9708) = 12.4826$

Table A.3: Contingency tables: sector affiliation and usage of defensive strategies

Abandonment

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	98.1	[97.5%, 98,5%]	1.9	[1.5%, 2.5%]	100.0
Yes (n = 1748)	94.8	[94%, 95.5%]	5.2	[4.5%, 6%]	100.0
Total (n = 2995)	96.2	[96%, 97%]	3.8	[3%, 4%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 21.2234$
Pearson: design-based $F(1, 2994) = 41.6152$

Cancellation

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	98.1	[97.5%, 98.5%]	1.9	[1.5%, 2.5%]	100.0
Yes (n = 1748)	96.6	[96%, 97%]	3.4	[3%, 4%]	100.0
Total (n = 2995)	97.2	[97%, 98%]	2.8	[2%, 3%]	100.0

Pr = 0.0009
Pearson: uncorrected $\chi^2(1) = 5.6842$
Pearson: design-based $F(1, 2994) = 11.1457$

Invent around

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	91.1	[90%, 92%]	8.9	[8%, 10%]	100.0
Yes (n = 1748)	77.1	[76%, 78.5%]	22.9	[21.5%, 24%]	100.0
Total (n = 2995)	82.9	[82%, 84%]	17.1	[16%, 18%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 100.5464$

Pearson: design-based F(1, 2994) = 197.1536

Wait and see

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	94.1	[93%, 95%]	5.9	[5%, 7%]	100.0
Yes (n = 1748)	86.7	[85.5%, 88%]	13.3	[12%, 14.5%]	100.0
Total (n = 2995)	89.8	[89%, 91%]	10.2	[9%, 11%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 43.7882$
Pearson: design-based F(1, 2994) = 85.8608

In-licensing

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	81.9	[80%, 83%]	18.1	[17%, 20%]	100.0
Yes (n = 1748)	80.7	[79%, 82%]	19.3	[18%, 21%]	100.0
Total (n = 2995)	81.2	[80%, 82%]	18.8	[18%, 20%]	100.0

Pr = 0.2639
Pearson: uncorrected $\chi^2(1) = 0.6368$
Pearson: design-based F(1, 2994) = 1.2487

Cross-licensing

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	98.5	[98%, 99%]	1.5	[1%, 2%]	100.0
Yes (n = 1748)	95.4	[95%, 96%]	4.6	[4%, 5%]	100.0
Total (n = 2995)	96.7	[96%, 97%]	3.3	[3%, 4%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 21.8140$
Pearson: design-based F(1, 2994) = 42.7734

Revocation

Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	94.9	[94%, 96%]	5.1	[4%, 6%]	100.0
Yes (n = 1748)	82.9	[82%, 84%]	17.1	[16%, 18%]	100.0
Total (n = 2995)	87.9	[87%, 89%]	12.1	[11%, 13%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 99.5051$

Pearson: design-based F(1, 2994) = 195.1119

	Out-of-court settlement				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1247)	93.3	[92%, 94%]	6.7	[6%, 8%]	100.0
Yes (n = 1748)	82.8	[81.5%, 84%]	17.2	[16%, 18.5%]	100.0
Total (n = 2995)	87.1	[86%, 88%]	12.9	[12%, 14%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 71.4031$
Pearson: design-based F(1, 2994) = 140.0088

Table A.4: Contingency tables: sector affiliation and usage of protection measures

	Protection measures: patents				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1120)	82.3	[81%, 84%]	17.7	[16%, 19%]	100.0
Yes (n = 1619)	49.1	[47%, 51%]	50.9	[49%, 53%]	100.0
Total (n = 2739)	62.7	[61%, 64%)	37.3	[36%, 39%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 312.2897$
Pearson: design-based F(1, 2738) = 565.8242

	Protection measures: utility models				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1081)	87.0	[85.5%, 88.5%]	13.0	[11.5%, 14.5%]	100.0
Yes (n = 1512)	58.3	[56%, 60%]	41.7	[40%, 44%]	100.0
Total (n = 2593)	70.3	[69%, 72%]	29.7	[28%, 31%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 249.9276$
Pearson: design-based F(1, 2592) = 434.0257

	Protection measures: design patents				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1045)	95.8	[95%, 97%]	4.2	[3%, 5%]	100.0
Yes (n = 1352)	83.7	[82%, 85%]	16.3	[15%, 18%]	100.0
Total (n = 2397)	89.0	[88%, 90%]	11.0	[10%, 12%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 87.4945$
Pearson: design-based F(1, 2396) = 143.9182

	Protection measures: trademarks				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1138)	69.6	[67.5%, 72%]	30.4	[28%, 32.5%]	100.0
Yes (n = 1502)	53.4	[51.5%, 55%]	46.6	[45%, 48.5%]	100.0
Total (n = 2640)	60.4	[59%, 62%]	39.6	[38%, 41%]	100.0

Pr = 0.000
Pearson: uncorrected $\chi^2(1) = 71.0302$
Pearson: design-based F(1, 2639) = 125.0230

	Protection measures: copyrights				
Manufacturing	No		Yes		Total
	Row (%)	95% CI	Row (%)	95% CI	Row (%)
No (n = 1086)	78.3	[76%, 80%]	21.7	[20%, 24%]	100.0
Yes (n = 1348)	81.3	[80%, 83%]	18.7	[17%, 20%]	100.0
Total (n = 2434)	80.0	[79%, 81%]	20.0	[19%, 21%]	100.0

Pr = 0.063
Pearson: uncorrected $\chi^2(1) = 3.4602$
Pearson: design-based F(1, 2433) = 5.7489