Paper to be presented at the DRUID 2012

on

June 19 to June 21

at

CBS, Copenhagen, Denmark,

Once bitten, twice shy? ? Learning from experience in the context of R&D cooperation and copying of IP

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

Theresa Helena Veer
Technische Universität Berlin
Chair of Innovation Economics
theresa.veer@tu-berlin.de

Abstract

In this article we show how experience, learning, and, ultimately, knowledge influence a company?s strategic decision-making. We base our argumentation on learning from failure literature and the 4I framework. We test our hypotheses empirically using data from the German Mannheim Innovation Panel (Community innovation survey) in the context of R&D cooperation and copying and infringement of IP(R). Until now, research has not yet focused on how an organization?s own experience with copying of own non-protected intellectual property and infringement of own intellectual property rights (e.g., patents, trademarks, etc.) and learning from it affect the tendency to cooperate in R&D. We find that firms with experience regarding copying of IP are less willing to engage in research collaboration. In contrast, firms with experience regarding infringement of IPR are more likely to cooperate on R&D. Our findings have implications for management and policy. We find that companies should strive for unambiguous IP(R) ownership and invest into drawing contracts addressing these issues, especially if they want to cooperate with a partner who experienced copying of IP. Policy should strive for clear IP(R) ownership by providing reliable IPR regimes.

Jel codes: O32, O38

ONCE BITTEN, TWICE SHY? – LEARNING FROM EXPERIENCE IN THE CONTEXT OF R&D COOPERATION AND COPYING OF IP

Annika Lorenz
Technische Universität Berlin
School of Economics and Management; Department of Technology and Management
annika.lorenz@tu-berlin.de

Theresa Helena Veer
Technische Universität Berlin
School of Economics and Management; Department of Technology and Management
HARTING Graduiertenkolleg
theresa.veer@tu-berlin.de

June 2012

Acknowledgements: The authors wish to express their thanks to the ZEW Mannheim for sharing the data and for the numerous helpful comments of colleagues. The usual disclaimer applies.

Abstract

In this article we show how experience, learning, and, ultimately, knowledge influence a company's strategic decision-making. We base our argumentation on learning from failure literature and the 4I framework. We test our hypotheses empirically using data from the German Mannheim Innovation Panel (Community Innovation Survey) in the context of R&D cooperation and copying and infringement of IP(R). Until now, research has not yet focused on how an organization's own experience with copying of own non-protected intellectual property and infringement of own intellectual property rights (e.g., patents, trademarks, etc.) and learning from it affect the tendency to cooperate in R&D. We find that firms with experience regarding copying of IP are less willing to engage in research collaboration. In contrast, firms with experience regarding infringement of IPR are more likely to cooperate on R&D. Our findings have implications for management and policy. We find that companies should strive for unambiguous IP(R) ownership and invest into drawing contracts addressing these issues, especially if they want to cooperate with a partner who experienced copying of IP. Policy should pursue clear IP(R) ownership by providing reliable IPR regimes.

Keywords: organizational learning; learning from experience; copying; IPR infringement; R&D cooperation

"Among mortals many arts have been discovered empirically from experience. For it is experience which makes our life proceed by art, but lack of experience which reduces it to chance." - Plato

R&D cooperation as well as learning mechanisms inside organizations are both very well researched topics. Also the links between learning from success and better performance (Argote, Beckman, & Epple, 1990; Baum & Dahlin, 2007; Huber, 1991; Levitt & March, 1988) as well as between learning from success and higher survival (Baum & Ingram, 1998; Kim, Kim, & Miner, 2009) have been fairly well established in research. Our article complements and adds the large body of work emphasizing learning from success. It thus contributes to existing research on learning from failure (Baum & Dahlin, 2007; Chuang & Baum, 2003; Denrell, 2003; Haunschild & Rhee, 2004; Haunschild & Sullivan, 2002; Kim & Miner, 2000; Miner, Kim, Holzinger, & Haunschild, 1999) with regards to rare events. This stream of research has been relatively neglected for methodological and conceptual reasons. In general, more research is needed for rare and exceptional experiences' influence on decision-making. Prior research is mainly based on case studies of particular industries and focuses on different aspects of the experience concept such as learning from prior alliance experience, heterogeneity and recency of experience as determinants for companies' learning outcomes and vicarious learning from other companies' experiences. Furthermore, literature mainly emphasizes learning from and within R&D cooperation and does not explicitly take into account how an organization's prior experience influences the tendency to cooperate in R&D. In this article we establish this link by contributing to existing theory for the way experience, learning, and, ultimately, knowledge influence a company's decision making.

To test our hypotheses, we empirically investigate the relationship between a company's experience with infringement of intellectual property rights (IPR) and/or copying of intellectual property (IP)[1], respectively, and the likelihood to participate in R&D collaboration. We define infringement of IPR as the usage of IP protected by a legal exclusion right (e.g., patents, trademarks, etc.) and copying of IP as the usage of IP without protection of a legal exclusion right (e.g., a new idea to solve a technical problem which is not (yet) protected by a patent). We apply the 4I-framework to capture learning from experience by combining concepts of learning

[1] Referred to as infringement or copying [of IP(R)] hereafter.

from failure and rare events and organizational learning. By doing so, we contribute to the comprehension of a further driving factor of R&D cooperation. Rather than using alliance capability (derived from general and partner-specific alliance experience) as an indicator for cooperation we focus on a company's copying/infringement experience which does not necessarily have to stem from previous alliances or have to be associated with a certain alliance (partner) and thus is rather distinct from previous literature in that field. Hence, we argue that companies experienced with copying of their IP are less keen on cooperating in R&D. In contrast, we expect companies experienced with infringement of their IPR to cooperate even more, due to a potential, successful enforcement experience. This research design delivers an interesting and intuitive phenomenon for which we provide a first empirical investigation.

We test our hypotheses in the decision context of inter-firm research partnerships, i.e. R&D cooperation, which have become increasingly important as firms seek to access new knowledge, to speed up the pace of innovation and to quickly respond to market needs (Chesbrough, 2003; Hagedoorn, Link, & Vonortas, 2000; Miotti & Sachwald, 2003). Despite the advantages of R&D alliances, prior literature also analyzes general obstacles and risks associated with cooperating on R&D such as but not limited to knowledge spillover, distrust, sunk cost, opportunism, adverse selection, moral hazard and hold-up (Cassiman & Veugelers, 1998; Dess & Beard, 1984; Hamel, 1991; Krishnan, Martin, & Noorderhaven, 2006; Parkhe, 1993; Somaya, Kim, & Vonortas, 2011; Sutcliffe & Zaheer, 1998; Zaheer, McEvily, & Perrone, 1998). There are studies which predominantly deal with prior general (Hoang & Rothaermel, 2005; Kale, Dyer, & Singh, 2002; Sampson, 2005; Zollo, Reuer, & Singh, 2002) and partner-specific alliance experience (Gulati, 1995; van de Vrande, Vanhaverbeke, & Duysters, 2009; Vanhaverbeke, Duysters, & Noorderhaven, 2002; Villalonga & McGahan, 2005; Wang & Zajac, 2007) as explanatory variables for cooperation.

This article reports the findings of a systematic empirical investigation of experience with infringement and/or copying of IP(R). The data we use stem from the annual German MIP (Mannheim Innovation Panel; ZEW) which represents the German version of the Eurostat Community Innovation Survey (CIS). We use data from 2008-2009 in order to be able to track infringement experience and its effect on a company's likelihood to engage in R&D cooperation.

The remainder of this article is organized as follows. First, we provide an overview of the current state of the art. Next, we apply a theoretical framework based on learning from failure

and rare events literatures and the 4I framework to explain the influence of experience on company decisions. We exemplify whether a company having had experience with infringement and/or copying of IP(R) will engage in R&D cooperation. The subsequent section describes the data, explains the methodology and tests the hypotheses on the likelihood of R&D cooperation depending on IP(R) infringement or copying experience. The article concludes by describing and discussing the results of the empirical investigation and providing implications for management and policy.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

Although there is no overarching definition of organizational learning, yet, it is commonly understood as a "process whereby knowledge is created through transformation of experience" (Kolb, 1984: 38). According to (1988; Levitt & March organizations learn when they encode "inferences from history into routines that guide behavior". Hence, organizational learning bases on experience.

Organizational Learning from Experience

The 4I framework is a well-established framework for analyzing organizational learning (Crossan & Berdrow, 2003; Crossan, Lane, & White, 1999; Dutta & Crossan, 2005; Lawrence, Mauws, Dyck, & Kleysen, 2005; Vera & Crossan, 2004). According to Crossan et al. (1999) organizational learning is a process that occurs over three levels: learning initially begins with individual learning, that leads to group learning which eventually leads to learning at the highest level, the organization. As these levels are connected by bidirectional processes, knowledge is constantly created, applied and updated.

Particularly, the 4I-framework contains four related (sub)processes that link individual learning to organizational learning: intuiting, interpreting, integrating, and institutionalizing. Intuiting is associated with a personal stream of experience which is then shared and/or verbally communicated to other organizational members (interpreting). Integrating is the process of obtaining a mutual understanding which is necessary for joint and coordinated action. Institutionalizing is the formation of systems, structures, procedures, and strategy to embed learning that has occurred by individuals and groups into the organization.

We are using the 4I framework to explain that organizations learn from their members' subjective experiences and vice versa (Huber, 1991; March, 1991). This means, the company's knowledge base grows as the transfer of employees' objective and subjective experiences results in learning (Argyris, 1999; Kim, 2004; Simon, 1991). Furthermore, previous research defines organizations as knowledge repositories with an organizational memory storing past experiences and information (Moorman & Miner, 1998; Olivera, 2000; Simon, 1991; Walsh, 1995; Walsh & Ungson, 1991). Thus, we expect that an organization's concrete experience with infringement and/or copying of IP(R) will be stored in the organizational memory. Moreover, learning from infringement and copying experience exposes a company's strengths and weaknesses whether or not a company was able to successfully protect and enforce its IP(R), and may create skills that transform the company to a better and more effective organization.

Nonetheless, some scholars are doubtful about whether companies (e.g., airlines) can learn from their prior experiences (e.g., crashes and accidents) (Haunschild & Sullivan, 2002). Despite the fact that airlines are known to be hazardous systems, statistics derived from well-led safety records show that accident rates have significantly reduced in the past decades (Haunschild & Sullivan, 2002). This suggests that learning is, indeed, taking place, which makes airlines the safest mode of transportation (Roberts, 1993; Roberts, 1990) and underlines the ability of organizations to learn from experience.

There seems to be an increasing interest in studies about experiential learning from events that occur more frequently than rare events: Prior work on learning from managerial experience (Holman, Pavlica, & Thorpe, 1997; Kayes, 2002; Kolb, Lublin, Spoth, & Baker, 1986), learning from cooperation experience (compare (Gulati, 1995; van de Vrande et al., 2009; Vanhaverbeke et al., 2002; Villalonga & McGahan, 2005; Wang & Zajac, 2007; Zollo & Reuer, 2010), learning from acquisition experience (Haleblian & Finkelstein, 1999; Hayward, 2002; Zollo, 2009), learning from contracting experience (Mayer & Argyres, 2004; Vanneste & Puranam, 2010), and learning from experience regarding organizational change (Hendry, 1996) have received considerable attention.

Eggers' (2012) experience concept deals with longer term and deeper experience and thus does not compare to the rare, sporadic or exceptional type of experience we are focusing on by analyzing copying and infringement experience. A recent study by Shepherd, Patzelt, & Wolfe (2011) analyzes individuals' negative emotions they experienced over project failure

which is to a certain degree similar to our understanding. However, in this article we define a experience as a more neutral (cognitive) firm-level construct than an individual emotional (affective) phenomenon.

A deeper understanding of the concept of experience allows us to determine when experience has positive or negative effects on learning outcomes or analyze the consequences when experience is evaluated as being positive or negative (March, 2010). A growing amount of learning studies show that organizational failures, such as accidents and incidents are an important promoter of organizational learning and change (Greve, 1998; Miner & Anderson, 1999; Sitkin, 1992). Some studies use rare and severe disastrous events to show that organizational learning is taking place. Moreover, there is an increasing interest in experiential learning from incidences that occur more frequently than rare events (Argote & Miron-Spektor, 2011). This specific phenomenon is the focus of our study.

Organizational Learning from Success and Failure

In general, prior literature on organizational learning reveals that there is a large amount of studies on learning curves which indicates that companies either improve efficiency and productivity or decrease costs due to repeated tasks, the development of routines and/or increasing experience. Thus, learning curves usually associate with a positive monotonic relationship between the sum of experience and performance outcomes (Argote et al., 1990; Kim et al., 2009). In line with (2009; Kim et al., we focus more on learning from infrequent or rare events as “we explicitly consider the specific features of success and failure and propose that this assumption [of monotonicity] does not necessarily apply to learning from success and failure experience” (Kim et al., 2009: 958). A major stream of literature deals with companies learning from prior successes and failures. In many disciplines such as sciences and engineering, it is widely accepted that companies learn more and better from failures than from successes (Baum & Dahlin, 2007; Shepherd et al., 2011). Studies on organizational learning from experience deal with different types of experience (Argote & Miron-Spektor, 2011), e.g., homogenous vs. heterogeneous experience (Haunschild & Sullivan, 2002; Schilling, Vidal, Ployhart, & Marangoni, 2003) and recent vs. past experience (Argote et al., 1990; Baum & Ingram, 1998; Benkard, 2000). A relatively new stream of literature focuses on companies learning from prior successes and failures (Baum & Dahlin, 2007; Shepherd et al., 2011) while another emphasizes

learning from other companies' experiences (vicarious learning) (Baum & Dahlin, 2007; Haunschild & Sullivan, 2002; Kim & Miner, 2007). There are seminal works dealing with origins of failure in alliances (Ariño & de La Torre, 1998) as well as prior general alliance experience (Hoang & Rothaermel, 2005; Kale et al., 2002; Sampson, 2005; Zollo et al., 2002) and partner-specific alliance experience (Gulati, 1995; van de Vrande et al., 2009; Vanhaverbeke et al., 2002; Villalonga & McGahan, 2005; Wang & Zajac, 2007) as predictor of alliance performance and/or failure. In the context of airlines and their accidents, Haunschild & Sullivan (2002) show that companies acquire new knowledge from prior errors and incidents. Another study by Baum & Dahlin (2007) focusing on U.S. freight railroad industry leads to similar results.

Organizational Learning from Rare Events

Some studies use rare and severe disastrous events to show that organizational learning is taking place. However, as these events are so unusual they pose challenges for interpretation (Argote & Miron-Spektor, 2011). Therefore, few studies demonstrate how firms learn from rare events with severe or major consequences (Lampel, Shamsie, & Shapira, 2009) such as, e.g., the collapse of the roof of the Baltimore & Ohio Railroad Museum Roundhouse (Christianson, Farkas, Sutcliffe, & Weick, 2009), U.S. coal mining accidents (Madsen, 2009), and prior corporate acquisition success (Zollo, 2009). Rare events are discontinuities assumed to disrupt current routines, thus expose weaknesses and strengths of a company and eventually lead to new practices, structures and change (Lampel et al., 2009). Consequently, evaluating rare events creates opportunities to learn by transforming this experience into knowledge that can be stored in the organizational memory for future purposes (Zander & Kogut, 1995; Zollo & Reuer, 2010; Zollo & Winter, 2002). According to Lampel et al. (2009), learning from rare events triggers two reactions of companies: they either focus on forecasting, improvement and prevention of consequences when the event has a negative impact, and on repetition when the event has a positive impact.

There have been several reviews of the organizational learning literature (Fiol & Lyles, 1985; Huber, 1991; Levitt & March, 1988), and numerous studies show that organizations do learn from prior failure of other companies. However, the question whether companies also learn from prior (negative) experience remains unclear. As only few scholars have investigated the

importance of learning from experience in company context and since it is not in the focus of research, yet, we analyze how companies learn from their own failure or mistakes. Another problem in existing literature is that previous studies mainly analyze learning from experience within a single industry such as railroad, mining, airlines or banking industries. We close the gap by concentrating on learning from events that occur infrequently, but more frequently than rare disasters as there is increasing interest in these experiences (Argote & Miron-Spektor, 2011). Infringement and copying of IP(R) are relatively low-frequency events that represent significant and salient failures for the firm involved. As the descriptive results show, infringement and copying of IP(R) can be interpreted as an exceptional event as only 14% of the companies in the sample have experienced infringement or copying of IP(R) over a time span of 4 years, respectively. According to Argote & Miron-Spektor (2011), it is essential to learn from events that occur infrequently, although more frequently than rare disasters.

In sum, this leads to our assumption and conceptualization that companies do not only learn from rare accidents and incidents but also from more frequent, exogenous shocks or own (negative) experiences which can eventually impact an organization's decision-making. Thus, we argue that companies might actually be able to learn from error experience and are able to improve performance as well as decisions to reduce and avoid subsequent mistakes and failure. Moreover, we empirically test this in a wider industry context of inter-firm research partnerships.

Prior research mainly deals with explanations for failure and learning from other firms' failure. This study complements and adds the large body of work emphasizing learning from success and thus contributes to existing research on the learning from failure perspective (Baum & Dahlin, 2007; Chuang & Baum, 2003; Denrell, 2003; Haunschild & Rhee, 2004; Haunschild & Sullivan, 2002; Kim & Miner, 2000; Miner et al., 1999) with regards to rare events.

Experience as a Driver for R&D Cooperation

As organizations store knowledge obtained from learning and experiences in their organizational memory (Moorman & Miner, 1998; Olivera, 2000; Walsh, 1995; Walsh & Ungson, 1991), we argue that companies' decisions are influenced by their experience. FIGURE 1 shows the interdependencies between experience, learning, organizational memory and a company's decision making (e.g., R&D cooperation). Collaborative learning in inter-organizational relationships has often been described as a double-edged sword. On the one hand,

R&D partnerships are often suggested to be an appropriate way to acquire new knowledge, skills, and expertise (Hamel, 1991). Despite their advantages, alliances may also lead to unintended and undesirable knowledge drain. This can result in the loss of a firm's critical capabilities or skills to a partner without receiving any reimbursement in return and thus in the potential dilution of a competitive advantage. Since both partners can opportunistically take advantage of the cooperation, there is a potential for conflict between cooperation partners.

Moreover, they anticipate potential imitation and copying due to knowledge spillovers especially if they possess valuable resources or technologies (i.e., IP or IPR). In sum, companies have to analyze the risk by balancing incoming against outgoing spillovers depending on the type of research partner, their own absorptive capacity (Cassiman & Veugelers, 1998) and the value of the resources in question.

Insert FIGURE 1 about here

The risk of spillover and opportunism depends on particular characteristics such as the transferability (tacit vs. explicit knowledge) (Grant, 1996) as well as the partner's absorptive capacity (Cohen & Levinthal, 1990) and appropriability (Teece, 1986). At the same time, collaboration also induces risk to create new competitors and strengthen the existing competitors (Wang & Zajac, 2007). Referring to Harrigan (1985), a company needs to observe changes in the environment thoroughly and adapt the cooperation strategy accordingly.

Companies use formal and relational governance mechanisms to control and manage the above mentioned hazards (Somaya et al., 2011). As a result, firms with negative experience may either choose not to cooperate at all or to set tight contractual guidelines to protect their interests especially when their technological knowledge capital is very valuable (compare resource-based view). Trust can also help overcome transaction costs (Dyer & Singh, 1998; Poppo & Zenger, 2002) and appropriation concerns (infringement and/or copying of IP(R)) (Barney & Hansen, 1994). Trust also facilitates the assessment of each other's likely behavior and the enforcement of property rights (Gulati & Singh, 1998). In sum, there are three coping mechanisms: a detailed contract, trust or refraining from cooperating.

HYPOTHESES

We apply the 4I framework and refer to learning from failure literature to predict experience with infringement and/or copying of IP(R) as inhibitor or promoter of R&D cooperation. The 4I framework, and learning from failure as well as rare events provide important explanations for the above mentioned phenomenon. In the context of R&D cooperation, companies learn from failure to protect their IP (i.e., copying of IP) and reduce subsequent errors (i.e., cooperate on R&D).

A company whose IP has been copied has made a concrete experience and thus is sensitized. Once having made this experience, a company will engage in reflecting about it, look for causes and arrive at developing theories about its origin and action steps on how to cope with this experience. Hence, the company will learn from its prior failure to protect its IP. Consequently, companies with copying experience will be more prudent when it comes to entering a research partnership and thus will most likely cooperate with partners they know and trust. Alternatively, they could enter into collaboration with tight contractual obligations according to transaction cost theory for the participating companies. The most risk-averse companies could even withdraw from further collaboration as they might fear repeated copying. We expect only these solutions to happen when companies engage in reflection as the third potential solution "cooperation without protection" shows that an in depth learning process has not taken place. Thus, copying of IP is inherent to R&D cooperation as part of an open innovation strategy depending on the likelihood of involuntary knowledge spillover (Cassiman & Veugelers, 1998). This evaluation will then be stored in the organizational memory in connection with the evaluation of R&D cooperation as a major risk factor for copying. Ultimately, the process will eventually lead to a more reserved behavior towards potential collaboration partners (Gulati, 1995; Gulati & Singh, 1998). If now the company has to decide upon R&D cooperation, both aspects will negatively influence the likelihood of a positive decision. Companies experienced with copying of IP should be risk-averse preferring in-house R&D over external R&D with a partner. Thus, firms will engage in less R&D cooperation associated with the risk of knowledge spillover.

Hypothesis 1. A company's likelihood to cooperate in R&D decreases if the company has experienced copying of IP.

Nonetheless, a positive experience of being able to enforce IPR successfully also plays an important role for R&D cooperation. If a company has experienced that it is capable of enforcing its IPR[2] it should be more inclined to cooperate as it knows how to cope with infringement and this knowledge decreases the risks of involuntary spillover. If, however, the company was not able to enforce its IPR successfully, the outcome is less certain. On the one hand, the company could decide against R&D cooperation based on the same arguments we discussed for copying of IP. On the other hand, it could learn from the experience and incorporate this knowledge into the IPR management. This evaluation will then be stored in the organizational memory in connection with the evaluation of successful IPR enforcement. If this process of learning from success is evaluated correctly and, hence, fruitful, the company might feel safe enough to join R&D cooperation. Therefore, we expect firms to engage even more in R&D cooperation associated with a successful enforcement experience.

Hypothesis 2. A company's likelihood to cooperate in R&D increases if the company has experienced infringement of IPR.

An overview of both hypotheses is given in FIGURE 2.

Insert FIGURE 2 about here.

---

[2] We analyze data on a company's infringement experience but we lack data on whether there was any attempt of enforcement and whether it was successful. We can provide argumentation and justification for the effect but we cannot test our argumentation itself. Therefore, we do not know whether there is any other underlying effect that we cannot observe. Please refer to the data section for a more detailed explanation.

EMPRIRICAL ANALYSIS

Sample

For our study we make use of the Mannheim Innovation Panel (MIP), ZEW, Mannheim which includes the core Eurostat CIS and additional topics for firms from Germany. The study is conducted every year and contains a random sample stratified by region, size and sector. The MIP survey includes questions on IP, innovation performance, R&D cooperation, and innovation expenditures and follows the recommendations contained in the OCED's Oslo Manual on innovation data collection (OECD & Eurostat, 2005). The MIP is a panel sample refreshed by adding new companies (observations) every second year to tackle panel mortality. European as well as international scholars (e.g.Belderbos, Carree, & Lokshin, 2004; Cassiman & Veugelers, 2002; Laursen & Salter, 2006; Leiponen & Helfat, 2011; Leiponen & Helfat, 2010; Mairesse & Mohnen, 2002; Miotti & Sachwald, 2003; Tether, 2002) have started to work with CIS data for two reasons: first, CIS data measure innovation performance and second, CIS data complement conventional patent data (Kaiser, 2002; Leiponen & Helfat, 2011; Mairesse & Mohnen, 2002) so that existing patent data drawbacks can be overcome. We merge two waves containing information regarding the infringement and unauthorized copying of IP(R) (MIP 2008) and information about R&D cooperation (MIP 2009). Moreover, information regarding patent stock, trademark stock and utility model stock is added to the data set. The matching of the two waves is done on a 1:1 basis by a variable (ID) identifying each company throughout the MIP waves with a distinctive number. The same holds true for the matching of the numbers of patents, community trademarks and utility models. The merged data set contains 2001 randomly chosen, innovative German companies of different size. The resulting data set is suitable for cross-section analyses regarding our employed dependent and independent variables as they are either contained in MIP 2008 (independent) or in MIP 2009 (dependent). Consequently, it is not possible to build a panel regarding the respective variables.

Measures

Dependent variable

We operationalize R&D cooperation with the binary variable "Cooperation". This variable comprises cooperation in R&D with all sorts of stakeholders, such as suppliers, customers, competitors, etc. The related question is present in the MIP 2009 questionnaire and refers to the years 2006-2008 and includes all types of cooperation in R&D.[3]

Independent variables

As determinants for infringement and copying of IP(R) we employ two binary variables: "Infringement" and "Copying". Infringement in this context refers to copying of IP which is protected by a legal exclusion right such as patents, trademarks, and the like. Copying instead refers to incidences in which no IPR has been granted for the respective IP. Hence, copying does not violate any IPR. This information is taken from the MIP 2008. The questionnaire refers to different types of IP (technical IP, whole products or business models, names or brands, and designs) and differentiates between unprotected IP without and protected IP with legal exclusion right (i.e., IPR). This makes it possible to operationalize copying of unprotected IP and infringement of IPR in two different variables. The question refers to the years 2005-2007.[4]

Control variables

In our estimations, we control for size effect using the number of employees as natural logarithm (Employees (ln)). Moreover, we control for exports (Exports (%)) and innovation expenditures (Innovation expenditures (%)), both measured as ratio of turnover. Furthermore, we include IPR stocks (No. of patents; No. of utility models; No. of trademarks) in our models. Last but not least, we control for sector influence by employing the OECD classification of manufacturing industries based on R&D intensities (High-tech; Medium-high-tech; Medium-low-tech; Low-tech) and of knowledge-intensive service (KIS) industries and less knowledge-

[3] The exact question is „Did your company conduct any R&D cooperation in the years 2006-2008?"

[4] The exact question is „Has IP of your company been adversely affected in the years 2005-2007 (…) and was the respective IP legally protected?"

intensive service (LKIS) industries.[5] We choose the mentioned control variables on the basis of previously conducted studies regarding influencing factors on R&D cooperation (Arranz & de Fdez. Arroyabe, 2008; Becker & Dietz, 2004; Fritsch & Lukas, 2001; Miotti & Sachwald, 2003; Tether, 2002). All employed control variables with the exception of the IPR stocks are directly taken from the MIP 2009 questionnaire and the operationalization is straightforward. For an overview of the employed variables please refer to TABLE 1.

Insert TABLE 1 about here.

Statistical Method

In this paper, we analyze the influence of infringement and copying of IP(R) on the likelihood to cooperate on R&D. As our dependent variable (cooperation) is binary, we employ logistic regression, computing the odds-ratio to estimate the likelihood of cooperation in percentage. By employing odds-ratios, we can exactly tell how strong the influence is in lowering or increasing the likelihood (in percentage) of cooperating. This enables us to derive interpretable and comprehensive evidence for economic implications and to give recommendations for management.

However, the effect we aim to estimate is a classic treatment effect. The fact that a company has been copied or infringed upon IPR can be interpreted as a treatment that influences the likelihood of cooperation. As our sample may be imbalanced with regard to certain, unobservable variables, endogeneity becomes an issue (Guo & Fraser, 2010). We tackle this using propensity score analysis (Rosenbaum & Rubin, 1983). We use a three step approach: first, we identify variables with influence on copying/infringement to choose the variables with a significant influence (at least at the 10% level) to estimate the propensity score. We derive those variables from t-tests and stepwise logistic regressions. Second, we use the propensity score to execute a nearest neighbor matching with caliper (0.25*SD of the propensity score; compare Rosenbaum & Rubin, 1985) without replacement as suggested by literature (Guo & Fraser, 2010) resulting in a balanced sample with 50% treated and 50% untreated items. This reduces the

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

size of our dataset to 366 entities. In the third and last step, we run logistic regressions on the balanced sample, leading to fairly unbiased results regarding unobservable variables (Rosenbaum & Rubin, 1983). We estimate propensity scores for both variables infringement and copying, and run independent logistic regressions on the balanced sample afterwards.

Another possibility to correct for bias is to use a Heckman-type selection approach (Heckman, 1979). However, this approach tackles sample selection bias which is not present in our sample as it was randomly selected and contains treated and untreated subjects. The bias we have to correct for stems from the fact that becoming part of the treatment group versus not becoming part of it is not random but induced by certain, observable characteristics of the firms. Therefore, we apply propensity score instead of a Heckman-type analysis to correct for this bias.

Results

As we strive to estimate the influence of copying and infringement of IP(R), it is worthwhile to have a look at descriptive statistics to find out to what extent companies affected by those incidences tend to cooperate in R&D (FIGURE 3). A lot of innovative companies cooperate in R&D and most companies cooperating have not experienced copying or infringement, yet. Less than half of the companies affected by infringement cooperate, whereas the opposite is true for copying. Summing up, the descriptive analysis gives a first overview on cooperation and copying and infringement of IP(R). Notwithstanding, the results are ambiguous and a straight interpretation is not possible. The multivariate analyses explained above form a clearer picture. The results are reported in the following paragraphs.

Insert FIGURE 3 about here.

For the purpose of our research, we estimate three different logistic estimation models (TABLE 2) with cooperation as dependent variable. The first model (M1) is a simple logistic regression, whereas the second model (M2) is a logistic regression on a balanced sample regarding copying, and the third one (M3) a logistic regression on a balanced sample regarding infringement. The balancing is achieved by propensity score analysis.

The results of M1 tell us about a significant influence of both, infringement and copying experience. While the copying's influence is negative, infringement is positive: if a company has experience with copying of IP it is ~32% less likely to engage in R&D cooperation, whereas experience with infringement of IPR increases the likelihood of cooperation by ~52%. Other influences are, as expected, contained in the control variables. Especially, expenditures for innovation draw the attention towards their odds-ratio. The odds-ratio means that with each increase of innovation expenditures by 1% the likelihood of engaging in cooperation rises by roughly 9500%. This seems overwhelmingly high. However, TABLE 1 reveals a mean 0.08% and a maximum value of 3.9%. This shows that an increase by 1% is rather substantial and the high odds-ratio is just consistent. The sector variables do not reveal a systematically influence on the likelihood to cooperate on R&D.

Insert TABLE 2 about here.

As the results of M1 could be influenced by certain variables we do not observe, our sample may not be balanced regarding our explaining variables infringement and copying. Therefore, we estimate two models with balanced samples regarding copying (M2) and infringement (M3). Both models underline the findings of M1. For both explaining variables, the coefficients remain significant and consistent; the degree of influence, however, is slightly more pronounced. All models are highly significant and have a satisfying degree of explanation.

The following chapter explains and discusses our results with implications for management and policy.

DISCUSSION AND IMPLICATIONS

The findings of our empirical analyses correspond to our expectations which rest upon our theoretical considerations. Hypothesis 1 stating a decrease of the likelihood of R&D cooperation in case of prior experience with copying of IP is confirmed by our findings. Our theoretical prediction holds for Hypothesis 1. Also, Hypothesis 2 is verified: Companies who experienced infringement do have a higher tendency to cooperate on R&D. Our assumption that infringement experience is connected with enforcement experience is likely as suggested by our results.

However, we cannot provide conclusive proof for this relationship as we lack data for IPR enforcement. This gives room for further research on IPR enforcement.

Our results show that experience with copying of IP influences the likelihood to cooperate on R&D. Copying experience's negative influence shows the importance of IP to companies and the vulnerability of companies with unprotected IP in R&D cooperation. Managers should therefore thoroughly analyze their current IP(R) position and the advantages and disadvantages (such as unexpected copying of IP) before entering R&D cooperation. In order to mitigate the negative effect of experience with copying of IP, companies can employ methods such as contracts with adequate governance modes and structure, enlargement of their IPR portfolio and detailed evaluations of possible partners. The respective contracts should explicitly address IP(R) issues such as using and accessing rights, ownership of IPR flowing in and out of the R&D cooperation, joint use of research results, and division of profits. These contracts should give enough incentives to share the results of research and to act in mutual interest so that the cooperation leads to a „win-win" situation for *both* partners. Apart from that, companies aiming at cooperating on R&D with a particular partner (e.g., a company whose resources ideally complement the own resources) may face severe obstacles in case this particular partner has experienced copying of IP. As a consequence, the company might have to substantially invest in trust building mechanisms before the cooperation might actually be possible.

We have demonstrated the drawbacks and pitfalls of experience with copying of IP as well as R&D cooperation and the causal connection between the two. Nonetheless, R&D alliances are an important tool to develop new products and ideas in a timely and efficient manner while sharing costs and risks. Because of the public good effect of research, governments are interested in providing enough incentives for doing research at all and for sharing the results in particular. Therefore, governments often subsidize R&D cooperation. However, experience with copying of IP may jeopardize incentives set for entering R&D cooperation. Therefore, policy makers should strive to allow for unambiguous ownership of IP (e.g., with strong and enforceable IPR) and especially underline the importance of strong IPR portfolios for R&D cooperation. The same applies to Public-Private Partnerships: in this case, clear IPR ownership and contracts addressing this issue appropriately could serve as selection criteria for suitable partners. Summing up, a strong IPR regime and a solid legal base are required and an efficient legal enforcement is necessary to provide enough incentives and protection for companies to cooperate in R&D.

CONCLUSION AND FURTHER RESEARCH

In this article we provide substantial extensions to previous theories by applying a framework of the way experience, learning, and, ultimately, knowledge influence a company's decision. We use the framework for explaining the interdependency of copying and infringement experience with R&D cooperation. This study provides important empirical evidence of the effects of infringement and copying of IP(R) experience on R&D cooperation. Companies having had experience with copying of IP(R) clearly see R&D collaboration as a risk factor and thus shy away from this governance mode while experience with infringement reveals a positive influence. These results have clear implications for R&D alliance management, policy and future research and the importance of the increasingly common R&D alliance management offices (Sampson, 2005) within companies. Nonetheless, firms must be aware of the benefits and pitfalls of R&D cooperation especially when having had copying of IP experience. Moreover, missing or unclear IPR causes ambiguity over the proprietary of knowledge (Grant, 1996) which can especially be a problem in R&D cooperation. Therefore, companies need to set up good contracts as well as clear IPR when cooperating on R&D.

Future research should address the question why infringement experience reveals a positive influence. Our paper gives some intuitive reasons; however, we are not able to test our argumentation empirically. Still, such research is very valuable as it reveals information about the operational reliability of IPR regimes, especially regarding enforcement, and about the role of IPR in R&D cooperation. If our argumentation of positive experience with enforcement of infringed IPR holds, enforcement mechanisms are crucial to foster R&D cooperation. Moreover, we encourage scholars to further investigate the origins of infringement or copying experiences to better understand the influence of the infringing or copying party and of different IPR regimes across various countries on the propensity to cooperate on R&D. Furthermore, we expect companies with experience with copying of IP(R) to increase their "armory", i.e., to enlarge their IPR portfolio, yet, time-lagged. It would be interesting to empirically analyze whether this is truly the case.

Moreover, our results challenge the current viewpoint of the open innovation paradigm leading to more innovation per se. Our findings suggest that a certain restriction (i.e., existence and usage of IPR) in the openness actually leads to more cooperation and, consequently, to more innovation or at least more efficient innovative processes. As copying of IP leads to less

cooperation, a completely open innovation setting leads to discouragement of R&D cooperation. Instead, IPR infringement leads to more cooperation. This means that ceteris paribus a restricted open innovation setting eventually leads to more cooperation in R&D.

Our research provides first insights into this phenomenon. While we must take care generalizing the findings here, the evidence presented is a step towards understanding the importance of experience with infringement and/or copying of IP(R), here captured via learning from experience, on inter-organizational R&D cooperation.

While this work has many interesting implications, several limitations exist. It is not possible to draw any conclusions about the prevalent IPR regime the companies in the sample face. We cannot make any assumptions about the legal enforcement and the exact circumstances of the experience. Furthermore, we can draw no inferences about the origins and reasons for the infringement and/or copying of IP(R) experience. We can only observe whether a company has had experience with infringement and/or copying of IP(R) or not. Taking into consideration the theoretical framework we have applied, we argue that the source of the experience is not of major importance as the reflection about the experience reveals cooperation as a potential risk factor of infringement/copying.

REFERENCES

Argote, L., & Miron-Spektor, E. 2011. Organizational Learning: From Experience to Knowledge. ***Organization Science***, 22(5): 1123–1137.

Argote, L., Beckman, S. L., & Epple, D. 1990. The Persistence and Transfer of Learning in Industrial Settings. ***Management Science***, 36(2): 140–154.

Argyris, C. 1999. ***On organizational learning*** (2nd ed.). Oxford: Blackwell.

Ariño, A., & La Torre, J. de 1998. Learning from Failure: Towards an Evolutionary Model of Collaborative Ventures. ***Organization Science***, 9(3): 306–325.

Arranz, N., & Fdez. Arroyabe, J. C. de 2008. The choice of partners in R&D cooperation: An empirical analysis of Spanish firms. ***Technovation***, 28(1-2): 88–100.

Barney, J. B., & Hansen, M. H. 1994. Trustworthiness as a source of competitive advantage. ***Strategic Management Journal***, 15: 175–190.

Baum, J. A. C., & Dahlin, K. B. 2007. Aspiration Performance and Railroads' Patterns of Learning from Train Wrecks and Crashes. ***Organization Science***, 18(3): 368–385.

Baum, J. A. C., & Ingram, P. 1998. Survival-Enhancing Learning in the Manhattan Hotel Industry, 1898-1980. ***Management Science***, 44(7): 996–1016.

Becker, W., & Dietz, J. 2004. R&D cooperation and innovation activities of firms—Evidence for the German manufacturing industry. ***Research Policy***, 33(2): 209–223.

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

Benkard, C. L. 2000. Learning and Forgetting: The Dynamics of Aircraft Production. ***The American Economic Review***, 90(4): 1034–1054.

Cassiman, B., & Veugelers, R. 1998. R&D cooperation and spillovers: Some empirical evidence. ***SSRN Electronic Journal***.

Cassiman, B., & Veugelers, R. 2002. R&D cooperation and spillovers: Some empirical evidence from Belgium. ***The American Economic Review***, 92(4): 1169–1184.

Chesbrough, H. 2003. ***Open innovation: The new imperative for creating and profiting from technology:*** Harvard Business School Press.

Christianson, M. K., Farkas, M. T., Sutcliffe, K. M., & Weick, K. E. 2009. Learning through Rare Events: Significant Interruptions at the Baltimore & Ohio Railroad Museum. ***Organization Science***, 20(5): 846–860.

Chuang, Y.-T., & Baum, J. A. C. 2003. It's All in the Name: Failure-Induced Learning by Multiunit Chains. ***Administrative Science Quarterly***, 48(1): 33–59.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: A new perspective on learning and innovation. ***Administrative Science Quarterly***, 35(1): 128–152.

Crossan, M. M., & Berdrow, I. 2003. Organizational learning and strategic renewal. ***Strategic Management Journal***, 24(11): 1087–1105.

Crossan, M. M., Lane, H. W., & White, R. E. 1999. An organizational learning framework: From intuition to institution. ***The Academy of Management Review***, 24(3): 522–537.

Denrell, J. 2003. Vicarious Learning, Undersampling of Failure, and the Myths of Management. ***Organization Science***, 14(3): 227–243.

Dess, G. G., & Beard, D. W. 1984. Dimensions of organizational task environments. ***Administrative Science Quarterly***, 29(1): 52–73.

Dutta, D. K., & Crossan, M. M. 2005. The Nature of Entrepreneurial Opportunities: Understanding the Process Using the 4I Organizational Learning Framework. ***Entrepreneurship Theory and Practice***, 29(4): 425–449.

Dyer, J. H., & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. ***The Academy of Management Review***, 23(4): 660–679.

Eggers, J. P. 2012. All experience is not created equal: learning, adapting, and focusing in product portfolio management. ***Strategic Management Journal***, 33(3): 315–335.

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

Fiol, C. M., & Lyles, M. A. 1985. Organizational learning. ***The Academy of Management Review***, 10(4): 803–813.

Fritsch, M., & Lukas, R. 2001. Who cooperates on R&D? ***Research Policy***, 30(2): 297–312.

Grant, R. M. 1996. Toward a knowledge-based theory of the firm. ***Strategic Management Journal***, 17: 109–122.

Greve, H. R. 1998. Performance, Aspirations, and Risky Organizational Change. ***Administrative Science Quarterly***, 43(1): 58–86.

Gulati, R. 1995. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. ***The Academy of Management Journal***, 38(1): 85–112.

Gulati, R., & Singh, H. 1998. The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. ***Administrative Science Quarterly***, 43(4): 781–814.

Guo, S., & Fraser, M. W. 2010. ***Propensity score analysis***: ***Statistical methods and applications***. Thousand Oaks, Calif: Sage Publications.

Hagedoorn, J., Link, A. N., & Vonortas, N. S. 2000. Research partnerships. ***Research Policy***, 29(4-5): 567–586.

Haleblian, J., & Finkelstein, S. 1999. The Influence of Organizational Acquisition Experience on Acquisition Performance: A Behavioral Learning Perspective. ***Administrative Science Quarterly***, 44(1): 29–56.

Hamel, G. 1991. Competition for competence and interpartner learning within international strategic alliances. ***Strategic Management Journal***, 12(S1): 83–103.

Harrigan, K. R. 1985. Exit barriers and vertical integration. ***The Academy of Management Journal***, 28(3): 686–697.

Haunschild, P. R., & Rhee, M. 2004. The Role of Volition in Organizational Learning: The Case of Automotive Product Recalls. ***Management Science***, 50(11): 1545–1560.

Haunschild, P. R., & Sullivan, B. N. 2002. Learning from Complexity: Effects of Prior Accidents and Incidents on Airlines' Learning. ***Administrative Science Quarterly***, 47(4): 609–643.

Hayward, M. L. A. 2002. When do firms learn from their acquisition experience? Evidence from 1990 to 1995. ***Strategic Management Journal***, 23(1): 21–39.

Heckman, J. J. 1979. Sample Selection Bias as a Specification Error. ***Econometrica***, 47(1): 153–161.

Hendry, C. 1996. Understanding and creating whole organizational change through learning theory. ***Human Relations***, 49(5): 621–641.

Hoang, H., & Rothaermel, F. T. 2005. The effect of general and partner-specific alliance experience on joint R&D project performance. ***The Academy of Management Journal***, 48(2): 332–345.

Holman, D., Pavlica, K., & Thorpe, R. 1997. Rethinking Kolb's theory of experiential learning in management education: The contribution of social constructionism and activity theory. ***Management Learning***, 28(2): 135–148.

Huber, G. P. 1991. Organizational learning: The contributing processes and the literatures. ***Organization Science***, 2(1): 88–115.

Kaiser, U. 2002. Measuring knowledge spillovers in manufacturing and services: An empirical assessment of alternative approaches. ***Research Policy***, 31(1): 125–144.

Kale, P., Dyer, J. H., & Singh, H. 2002. Alliance capability, stock market response, and long-term alliance success: The role of the alliance function. ***Strategic Management Journal***, 23(8): 747–767.

Kayes, D. C. 2002. Experiential learning and its critics: Preserving the role of experience in management learning and education. ***Academy of Management Learning & Education***, 1(2): 137–149.

Kim, D. H. 2004. The link between individual and organizational learning. In K. Starkey, S. Tempest & A. McKinlay (Eds.), ***How organizations learn. Managing the search for knowledge***: 29–50 (2nd ed.). London [etc.]: Thomson.

Kim, J.-Y., & Miner, A. S. 2000. Crash Test Without Dummies: A Longitudinal Study of Interorganizational Learning from Failure Experience in the U.S. Commercial Banking Industry, 1984-1998. ***Academy of Management Proceedings & Membership Directory***: G1.

Kim, J.-Y., & Miner, A. S. 2007. Vicarious Learning from the Failures and NEAR-Failures of Others: Evidence from the U.S. Commercial Banking Industry. ***Academy of Management Journal***, 50(3): 687–714.

Kim, J.-Y., Kim, J.-Y., & Miner, A. S. 2009. Organizational Learning from Extreme Performance Experience: The Impact of Success and Recovery Experience. ***Organization Science***, 20(6): 958–978.

Kolb, D. 1984. ***Experiential learning: Experience as the source of learning and development:*** Prentice-Hall.

Kolb, D., Lublin, S., Spoth, J., & Baker, R. 1986. Strategic management development: Using experiential learning theory to assess and develop managerial competencies. ***Journal of Management Development***, 5(3): 13–24.

Krishnan, R., Martin, X., & Noorderhaven, N. 2006. When does trust matter to alliance performance? ***Academy of Management Journal***, 49(5): 894–917.

Lampel, J., Shamsie, J., & Shapira, Z. 2009. Experiencing the Improbable: Rare Events and Organizational Learning. ***Organization Science***, 20(5): 835–845.

Laursen, K., & Salter, A. 2006. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. ***Strategic Management Journal***, 27(2): 131–150.

Lawrence, T. B., Mauws, M. K., Dyck, B., & Kleysen, R. F. 2005. The Politics of Organizational Learning: Integrating Power into the 4I Framework. ***The Academy of Management Review***, 30(1): 180–191.

Leiponen, A., & Helfat, C. E. 2010. Innovation objectives, knowledge sources, and the benefits of breadth. ***Strategic Management Journal***, 31(2): 224–236.

Leiponen, A., & Helfat, C. E. 2011. Location, decentralization, and knowledge sources for innovation. ***Organization Science***, 22(3): 641–658.

Levitt, B., & March, J. G. 1988. Organizational learning. ***Annual Review of Sociology***, 14(1): 319–338.

Madsen, P. M. 2009. These Lives Will Not Be Lost in Vain: Organizational Learning from Disaster in U.S. Coal Mining. ***Organization Science***, 20(5): 861–875.

Mairesse, J., & Mohnen, P. 2002. Accounting for innovation and measuring innovativeness: An illustrative framework and an application. ***The American Economic Review***, 92(2): 226–230.

March, J. 2010. ***The ambiguities of experience:*** Cornell University Press.

March, J. G. 1991. Exploration and exploitation in organizational learning. ***Organization Science***, 2(1): 71–87.

Mayer, K. J., & Argyres, N. S. 2004. Learning to Contract: Evidence from the Personal Computer Industry. ***Organization Science***, 15(4): 394–410.

Miner, A. S., & Anderson, P. (Eds.) 1999. ***Population-level learning and industry change:*** Advances in Strategic Management, vol. 16; Stamford, Conn. and London; JAI Press.

Miner, A. S., Kim, J.-Y., Holzinger, I. W., & Haunschild, P. 1999. Fruits of Failure: Organizational Failure and Population-Level Learning. In A. S. Miner & P. Anderson (Eds.), ***Population-level learning and industry change***: 187–220: Advances in Strategic Management, vol. 16; Stamford, Conn. and London; JAI Press.

Miotti, L., & Sachwald, F. 2003. Co-operative R&D: Why and with whom?: An integrated framework of analysis. ***Research Policy***, 32(8): 1481–1499.

Moorman, C., & Miner, A. S. 1998. Organizational improvisation and organizational memory. ***The Academy of Management Review***, 23(4): 698–723.

OECD, & Eurostat 2005. ***Oslo manual***: ***Guidelines for collecting and interpreting innovation data*** (3rd ed.). Paris.

Olivera, F. 2000. Memory systems in organizations: An empirical investigation of mechanisms for knowledge collection, storage and access. ***Journal of Management Studies***, 37(6): 811–832.

Parkhe, A. 1993. Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. ***The Academy of Management Journal***, 36(4): 794–829.

Poppo, L., & Zenger, T. 2002. Do formal contracts and relational governance function as substitutes or complements? ***Strategic Management Journal***, 23(8): 707–725.

Roberts, K. 1993. ***New challenges to understanding organizations:*** Macmillan.

Roberts, K. H. 1990. Some Characteristics of One Type of High Reliability Organization. ***Organization Science***, 1(2): 160–176.

Rosenbaum, P. R., & Rubin, D. B. 1983. The central role of the propensity score in observational studies for causal effects. ***Biometrika***, 70(1): 41–55.

Rosenbaum, P. R., & Rubin, D. B. 1985. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. ***The American Statistician***, 39(1): 33–38.

Sampson, R. C. 2005. Experience effects and collaborative returns in R&D alliances. ***Strategic Management Journal***, 26(11): 1009–1031.

Schilling, M. A., Vidal, P., Ployhart, R. E., & Marangoni, A. 2003. Learning by Doing Something Else: Variation, Relatedness, and the Learning Curve. ***Management Science***, 49(1): 39–56.

Shepherd, D. A., Patzelt, H., & Wolfe, M. 2011. Moving Forward From Project Failure: Negative Emotions, Affective Commitment, and Learning From the Experience. ***Academy of Management Journal***, 54(6): 1229–1259.

Simon, H. A. 1991. Bounded rationality and organizational learning. ***Organization Science***, 2(1): 125–134.

Sitkin, S. B. 1992. Learning through Failure: The Strategy of Small Losses. In B. M. Staw & L. L. Cummings (Eds.), ***Research in organizational behavior. Volume 14***: 231–266: An Annual Series of Analytical Essays and Critical Reviews; Greenwich, Conn. and London; JAI Press.

Somaya, D., Kim, Y., & Vonortas, N. S. 2011. Exclusivity in licensing alliances: using hostages to support technology commercialization. ***Strategic Management Journal***, 32(2): 159–186.

Sutcliffe, K. M., & Zaheer, A. 1998. Uncertainty in the transaction environment: An empirical test. ***Strategic Management Journal***, 19(1): 1–23.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. ***Research Policy***, 15(6): 285–305.

Tether, B. S. 2002. Who co-operates for innovation, and why: An empirical analysis. ***Research Policy***, 31(6): 947–967.

van de Vrande, V., Vanhaverbeke, W., & Duysters, G. 2009. External technology sourcing: The effect of uncertainty on governance mode choice. ***Journal of Business Venturing***, 24(1): 62–80.

Vanhaverbeke, W., Duysters, G., & Noorderhaven, N. 2002. External technology sourcing through alliances or acquisitions: An analysis of the application-specific integrated circuits industry. ***Organization Science***, 13(6): 714–733.

Vanneste, B. S., & Puranam, P. 2010. Repeated Interactions and Contractual Detail: Identifying the Learning Effect. ***Organization Science***, 21(1): 186–201.

Vera, D., & Crossan, M. 2004. Strategic Leadership and Organizational Learning. ***The Academy of Management Review***, 29(2): 222–240.

Villalonga, B., & McGahan, A. M. 2005. The choice among acquisitions, alliances, and divestitures. ***Strategic Management Journal***, 26(13): 1183–1208.

Walsh, J. P. 1995. Managerial and organizational cognition: Notes from a trip down memory lane. ***Organization Science***, 6(3): 280–321.

Walsh, J. P., & Ungson, G. R. 1991. Organizational memory. ***The Academy of Management Review***, 16(1): 57–91.

Wang, L., & Zajac, E. J. 2007. Alliance or acquisition? A dyadic perspective on interfirm resource combinations. ***Strategic Management Journal***, 28(13): 1291–1317.

Zaheer, A., McEvily, B., & Perrone, V. 1998. Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. ***Organization Science***, 9(2): 141–159.

Zander, U., & Kogut, B. 1995. Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test. ***Organization Science***, 6(1): 76–92.

Zollo, M. 2009. Superstitious Learning with Rare Strategic Decisions: Theory and Evidence from Corporate Acquisitions. ***Organization Science***, 20(5): 894–908.

Zollo, M., & Reuer, J. J. 2010. Experience Spillovers Across Corporate Development Activities. ***Organization Science***, 21(6): 1195–1212.

Zollo, M., & Winter, S. G. 2002. Deliberate Learning and the Evolution of Dynamic Capabilities. ***Organization Science***, 13(3): 339–351.

Zollo, M., Reuer, J. J., & Singh, H. 2002. Interorganizational routines and performance in strategic alliances. ***Organization Science***, 13(6): 701–713.

APPENDIX

FIGURE 1: Learning from Experience and Company Behavior (non-observable aspects are indicated by a dotted line)

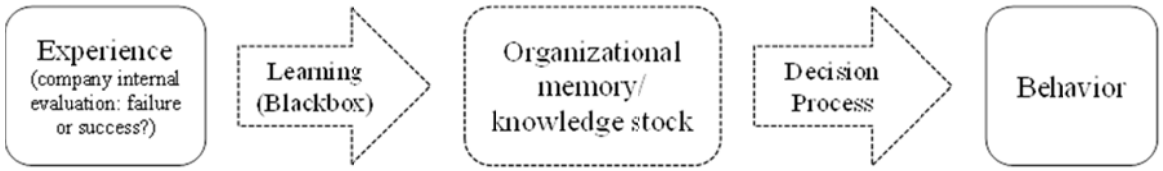

FIGURE 2: Model for Hypothesis-Testing

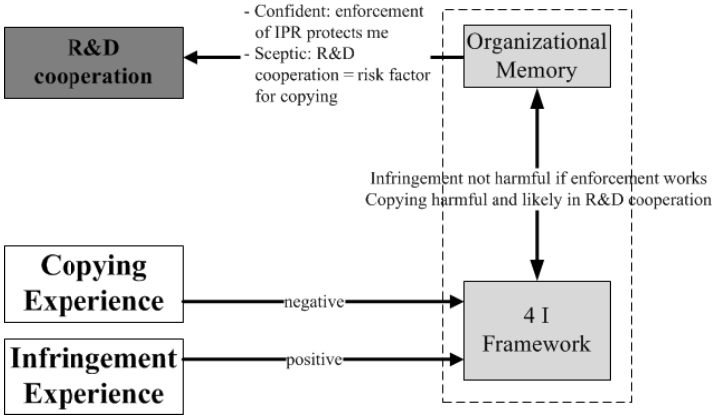

TABLE 1: Overview Variables

Dependent Variable	**Measurement**	**Mean**	**S.D.**	**Min**	**Max**
Cooperation	Dummy	0.37	0.48	0	1
Independent Variables					
Copying	Dummy	0.14	0.35	0	1
Infringement	Dummy	0.14	0.35	0	1
Control Variables					
No. of patents	Integer	0.28	1.9	0	46.97
No. of utility models	Integer	1.28	6.48	0	107.55
No. of trademarks	Integer	0.40	1.72	0	21.91
Employees (ln)	Integer	4.28	1.67	0.69	12.55
Exports (%)	Dummy	0.22	0.28	0	1
Innovation expenditures (%)	Integer	0.08	0.20	0	3.94
Sector Types					
High-tech	Dummy	0.05	0.22	0	1
Medium-high-tech	Dummy	0.21	0.41	0	1
Medium-low-tech	Dummy	0.18	0.38	0	1
Low-tech	Dummy	0.14	0.35	0	1
KIS	Dummy	0.32	0.47	0	1
LKIS	Dummy	0.01	0.11	0	1

FIGURE 3: Descriptive Analyses - Cooperation and Copying/Infringement

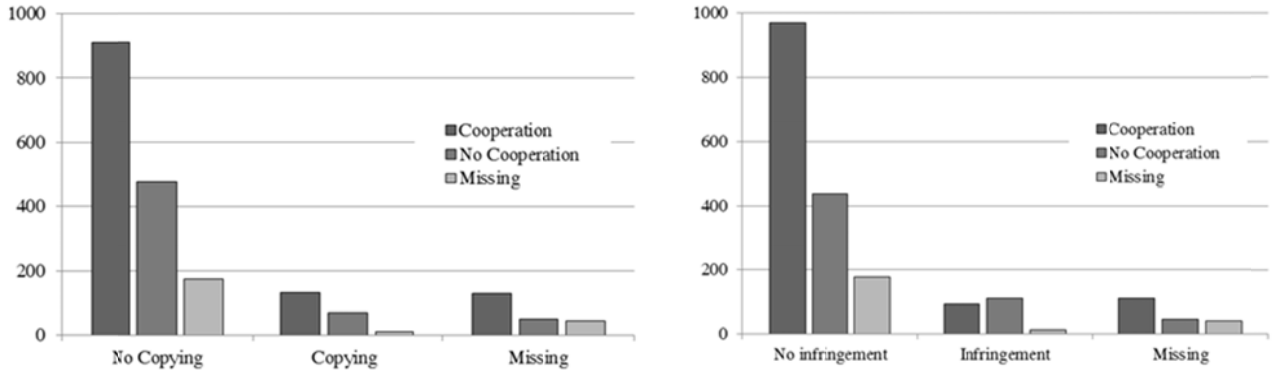

TABLE 2: Logistic Regression – Dependent Variable Always Cooperation

	M1		M2		M3	
	Coeff.	Odds-Ratio	Coeff.	Odds-Ratio	Coeff.	Odds-Ratio
Copying	-0.38*	0.68*	-0.59**	0.56**		
	(0.20)	(0.14)	(0.25)	(0.14)		
Infringement	0.42**	1.52**			0.59*	1.80*
	(0.19)	(0.29)			(0.32)	(0.58)
No. of patents	-0.01	0.99	-0.02	0.98	0.02	1.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
No. of utility models	0.02	1.02	0.01	1.01	-0.00	1.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
No. of trademarks	0.02	1.02	0.08	1.08	0.12	1.12
	(0.04)	(0.04)	(0.10)	(0.11)	(0.15)	(0.17)
Employees (ln)	0.27***	1.31***	0.27***	1.31***	0.24**	1.27**
	(0.05)	(0.06)	(0.09)	(0.12)	(0.10)	(0.13)
Exports (%)	0.57**	1.77**	0.37	1.45	0.11	1.12
	(0.28)	(0.49)	(0.49)	(0.71)	(0.52)	(0.58)
Innovation expenditures (%)	4.56***	95.86***	9.27***	10,593.80***	8.09***	3,251.55***
	(0.89)	(85.71)	(2.38)	(25,167.80)	(2.26)	(7,338.16)
High-tech	0.15	1.16	0.23	1.26	0.76	2.13
	(0.35)	(0.41)	(0.77)	(0.97)	(0.82)	(1.75)
Medium-high-tech	0.36	1.43	0.82*	2.27*	1.13**	3.09**
	(0.25)	(0.35)	(0.48)	(1.08)	(0.56)	(1.74)
Medium-low-tech	0.59**	1.81**	0.78	2.18	0.77	2.16
	(0.25)	(0.46)	(0.49)	(1.06)	(0.58)	(1.25)
Low-tech	0.07	1.08	0.68	1.97	0.82	2.28
	(0.27)	(0.29)	(0.51)	(1.00)	(0.62)	(1.42)
KIS	0.25	1.29	0.76	2.13	0.72	2.05
	(0.25)	(0.32)	(0.51)	(1.09)	(0.63)	(1.29)
Constant	-2.50***	0.08***	-2.78***	0.06***	-3.24***	0.04***
	(0.31)	(0.03)	(0.61)	(0.04)	(0.78)	(0.03)
Observations	1,130		316		285	
Log Likelihood	-664.52		-186.82		-163.43	
Chi^2	99.10		38.83		32.07	
Pseudo R^2	0.11		0.12		0.11	
Prob > chi2	0.00		0.00		0.00	

Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1