The curse of openness:

on external knowledge sourcing and the risk of litigation

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Abstract

In this paper, we study the relationship between the openness of a firm's innovation strategy and the likelihood of being involved in litigation about intellectual property right disputes. While recent literature on external knowledge sourcing, or in more nuanced form the open innovation literature, emphasizes the importance of exchanging ideas for successful innovation, it is not debated frequently that there may be potential cost associated with openness of the business strategy. Using a newly available database on German innovating firms, we find that firms engaging in external knowledge sourcing are more likely both to be sued by another party and to sue another party with respect to intellectual property disputes. In addition, we also find that firms using an open innovation strategy are also more likely to be involved in pre litigation settlements. Thus, there may be substantial cost involved with external knowledge sourcing. In conclusion, it is unclear whether the benefits of open innovation outweigh the cost when the higher risk of litigation is taken into account.

JEL-Classification: O31, O32, O34
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1 Introduction

Innovation is considered crucial for creating a sustainable competitive advantage by firms and – even more importantly – for generating growth and welfare in the national, European and global economy. However, many firms struggle with the successful organization of innovation.

On the one hand, there is mounting evidence that successful innovation depends more and more on the combination of new ideas and inventions. For instance, a growing share of firms adopt the so-called open innovation paradigm (Chesborough, 2006, Chesborough et al. 2006) where firms do not develop new technologies independently from other actors in the innovation systems, but open their innovation strategy towards more collaboration and external sourcing of knowledge (see e.g. Katila, 2002; Katila and Ahuja, 2002; Laursen and Salter, 2006). Open innovation can play an important part in the solution of knowledge adoption deficiencies. By breaking down traditional corporate boundaries, open innovation allows intellectual property, ideas, and people to flow freely both into and out of an organization.

On the other hand, firms have to manage their intellectual assets carefully. With the movement towards the knowledge economy, intellectual assets have become a much more important determinant of firm value than physical assets, especially in key industries such as pharmaceuticals, biotechnology and semiconductors (see, for instance, market value studies such as Hall et al., 2005, or Czarnitzki et al., 2006, for a survey). With the increasing trend towards open innovation, a further challenge for the innovation strategy of the firm arises: It is not sufficient to manage own intellectual assets only, but also maneuver through an increasingly dense landscape of intellectual property of other actors in the innovation system. For instance, the rights of patentees have been strengthened by several policy reforms in the last two decades (see Hall, 2007, for an overview). The most prominent example is possibly the creation of the U.S. Court of Appeals of the Federal Circuit (CAFC) in the 1980s. A pioneer case example for the strengthening of rights of patent holders is the Polaroid vs. Kodak case (1986/1991). Kodak was found guilty of having infringed some of Polaroid's patents in the 1970s concerning the development of instant cameras. In addition to a major damage award to Polaroid, Kodak was forced to shut down its entire instant camera business. As a result of the movement towards effective enforcement of IP, firms started to use intellectual property rights more strategically (see e.g. Shapiro, 2001, Ziedonis, 2004) which may result in hold-up problems and eventually in impediment of innovation. In the United States this threatening trend for technological hold-up has already been identified in the 1990s which led to intense government investigations (see Federal Trade Commission, 2003). If seen in perspective with the global trend towards open innovation, the management of IP consequently amounts to one of the most challenging quests for successful innovation strategy of companies. One part of this strategy is the enforcement of alleged infringed patents and the active litigation against intellectual property of other companies. Since the work of Lanjow and Schankerman (2001) and further work by Galasso and Schankerman (2010), the analysis

of patent litigation has been analyzed in a broad context of economic strategies. (see also Cremers, 2007 and 2009).

In this paper, we explore the relationship between the openness of a firm's innovation strategy and the risk of litigation with regard to intellectual property right disputes empirically. Following the implication of earlier research we expect that companies which organize their innovation strategy using external knowledge sources are more likely to be involved in disputes over intellectual property rights than companies which have no focus on external knowledge sourcing. We expect differences when we distinguish between formal and informal as well as active and passive means of litigation and settlement.

Our results show that firms engaging in external knowledge sourcing are more likely both to be sued by another party and to sue another party with respect to intellectual property disputes. In addition, we also find that firms using an open innovation strategy are also more likely to be involved in out of court settlements. Thus, there may be substantial cost involved with external knowledge sourcing. In conclusion, it is unclear whether the benefits of open innovation outweigh the cost when the higher risk of litigation is taken into account. The results are more pronounced when we analyze small and large companies separately.

To the best of our knowledge it is the first attempt to analyze IP litigation behavior taking the general innovation strategies into account. All empirical analysis so far was started with the observation of patenting strategies (or partly the use of trademarks or utility patents) and analyze the litigation strategies in relation to the firm's patent portfolio. Other research results are based on analyses of the patent universe, sometimes all patents of a certain industry (e.g. Lanjouw and Schankerman, 2001 and Somaya, 2004, Ziedonis, 2003). (NEW LITERATURE TO BE INCLUDED). Additionally, this paper will add empirical evidence to the literature discussed before which assumes that openness in companie's innovation strategy leads to more risks of being involved in IPR litigation.

The rest of the paper is organized as follows. The next section

2 External knowledge sourcing and IP litigation

The general acknowledgement of external knowledge sourcing as causing ambiguous effects on the productivity of R&D efforts have been discussed widely in the literature.
Chesbrough (2003 indentifies several factors that are subsumed under open innovation strategies . these are the increasing availability and mobility of skilled workers, a venture capital market that endows entrepreneurs with the necessary capital to compete, external options for previously shelved ideas, and finally the increased capabilities of external suppliers. These factors are regarded as sources of knowledge spillovers which are still connected with a negative perception. As Grimpe and Sofka (2009) deeply discuss, tis negative perception is fading away as recent literature has pointed towards the merits of acquiring external knowledge (Tsang, 2000) and moving from 'research and develop' towards 'connect and develop' (Huston and Sakkab, 2006). External sources of knowledge have

become more significant in the innovation process in the shift towards 'open innovation' systems, and more readily available, for example as information and communication technologies have improved. Analyzing search patterns reveal that the usage of external knowledge from costumers and universities cause different patterns in those search strategies for knowledge.

Research on R&D spillovers suggests, however, sourcing knowledge from outside the company are strongly connected with e higher probability of losing knowledge. When knowledge flows easily but there are still protective means alive such as patents and trademarks, it is more likely to infringe some rights by using free floading knowledge (Chesbrough, 2009). Those means of protection new knowledge and intellectual property were previously associated with anti-competitive social welfare outcomes in traditional economic industrial organization theory. Now they are regarded as managerial actions that could enhance a firm's competitive strategy (Chesbrough and Appleyaard, 2007). However, it goes along with higher requirements on the design of those strategies. There are intellectual properties to be protected and license contracts to be designed. Stockwell (2003) argues that there can be a variety of sources which lead to contract failures, especially in licensing contracts.

Like Priest and Klein (1984) in their theoretical model and Lanjouw and Schankerman (2004) in the empirical analysis for patent litigation in the US. Stockwell also accents that differences and uncertainty in the expectations about the range of the contract and the success of the project cause infringing activities, intended or not. Failures or incomplete success occur in the result of business ventures and this will likely form a "fertile ground for disputes". Empirical analysis so far found that the history of IP management and IP enforcement has an impact on the likelihood of being involved in IP litigation (Somaya 2004, Lanjouw and Schnakerman (2004), Cremers (2007)). In these studies external knowledge sourcing was only implicitly included as the patents involved in litigation where weighted by their citations. Citations are regarded as value indicator as well as a measurement of knowledge spillovers. These spillovers create a higher probability of patent litigation. However, this paper will deal with explicit external knowledge sourcing.

3 Data

3.1 Sample description

The analysis is based on the Mannheim Innovation Panel (MIP), an annual survey which focuses on the innovative activities of German companies. Every second year the survey is part of the Community Innovation Survey (CI)S. The target population of the MIP covers legally independent firms in Germany with at least five employees and covers both the manufacturing and the service sector. For our analysis we use information from the survey wave conducted in 2008 using the observation for manufacturing. A total of 6,110 companies answered the survey. We restrict the regression sample to companies with innovative activities, i.e. companies which introduced a new product or process in the three years preceding the survey, abandoned an innovation project or are still working on an unfinished

innovation project. After excluding the service sector we have full information on 1497 companies with innovative activities. To control for forgone IP strategies we included information from earlier MIP data in from 2005. For all companies included we matched information from the OECD patent database PATSTAT.

3.2 Variable description

As dependent variable we study the incidence of three types of litigation which are closely related to each other. They are derived from the MIP questionnaire of 2008 where a dummy indicates whether a firm is involved in litigation or opposition procedures. The three variables are

(i) the likelihood that a firm sues another company via annulment suit or opposition (**Active Litigious behavior**),

(ii)) the likelihood that a firm is sued by a third party via annulment suit or opposition (**Passive Litigious behavior**)

(iii) the likelihood of settlement about intellectual property right disputes out of court (Active **Pre trial negotiations**)[1]

Note that these variables comprise the litigious actions which are inherent within the European system provided by the EPC and the German patent system rather than "litigation" in the sense of filing disputes before court.[2] The distinction between formal ((i), (ii)) and informal litigious actions (iii) stresses the strategic component enforcing intellectual property right. Additionally, we can separately observe active ((i), (iii)) and passive litigious actions (ii).

Our explanatory variable of main interest is a dummy variable indicating that the firm is engaged in external knowledge sourcing, that is, conducting external R&D (fueext). It is a general indicator of external knowledge sourcing as well as seeking for cooperation or buying external capacities. In our sample 40 % of all companies are engaged in external R&D.

As control variables we applied a measure of internal R&D is available as R&D intensity (fueint) with a very skew distribution. The mean is 2.9 % while the median is 0.01 %. Further control variables are the size of the companies in terms of employees. We defined classes

[1] In the questionnaire the companies were asked: "Did your company faced in the period of 2005to 2007 one of the following occurrences in respect to the access to intellectual property rights? (i) Opposition or Annulment suits filed against an IP of an other company? (ii) Opposition or Annulment suits filed against an IP of your company? (iii) Negotiations or pre-trial settlements to avoid formal litigation before court

[2] Research on patent litigation has dealt mainly with litigation actions which follow a detected potential infringement of the property right.

from 1-19, 20-99, 100-499, more than 500 employees (gkk1-gkk4). The age of the companies covers a range between 2 and 431 years with a mean of 37 years and a median of 44 years.

The history of IP strategies is included in patent stock, trademark and utility patent stock variables. The stocks are calculated up to 2004 and weighted by the size of the companies. The utility patent stock is surprisingly high compared to the patent stock which is due to the sample of German firms which often chose utility patent as the first attempt to achieve an IP with lower requirements of novelty and inventive step.
Within our sample 5.5 % (83 companies) could be identified as active opposers until 2004 while 3.5 % of the companies encountered an opposition of one of their IPs.

Table 1: Descriptive statistics

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	Max.
Dependent variable					
Active Litigious behavior	1497	.183	.386	0	1
Passive Litigious behavior	1497	.158	.365	0	1
Active Pre trial negotiations	1497	.184	.387	0	1
Explanatory variables					
External R&D (fueext)	1497	.400	.490	0	1
Internal R&D (fueinten)	1497	2.965	6.470	0	82.840
Size (Number of employees	1497	1077	11830	2	400000
gkkl1	1497	.198	.398	0	1
gkkl2	1497	.331	.471	0	1
gkkl3	1497	.318	.466	0	1
gkkl4	1497	.154	.361	0	1
Age of Companies (age in years)	1497	37.99	44.151	2	293
Patent stock up to 2004 (ps)	1497	1.659	5.504	0	51.157
Utility stock up to 2004 (gs)	1497	5.580	14.228	0	123.075
Trademark stock up to 2004 (ts)	1497	1.851	6.821	0	65.250
Opposition until 2004 (opp)	1497	.032	.176	0	1
Active opposing (ichoppose)	1497	.055	.229	0	1

4 Econometric regression results

We assume that the issues of litigation do not occur independently. And the error terms of the single estimation equations are correlated. We chose a multivariate probit estimation to take the correlation of error terms into account (see Table 2). The results are more precisely estimated compared to independent probit estimations for each issue of litigation.[3]

[3] The independent probit regressions are included in appendix 1.

Our results in column (1) to (3) show that firms which conduct external knowledge sourcing are more frequently involved in litigation incidences about intellectual property violations and their validity. This would point to substantial cost of openness which might reduce the profitability of an open innovation regime. Additionally, we can observe that internal R&D has no effect on probability of litigious behavior of either kind. Neither has age of the company a significant effect on the involvement into litigation.

We can see that the size of the company is important for explaining the probability of litigious behavior. Smaller firms have lower probability of being a party in IP litigation negotiations. These results are different to those found by Schankerman and Lanjouw (2001 and 2004) and Cremers (2007) which found a strong negative correlation between size and the likelihood of litigation. These can be explained by a different measurement of the litigation behavior.

IP experience variables are included into the multivariate regressions in column (4) to (6). Former IP experience measured by the stock variables of patents and utility patents have significant positive effects on the formal kinds of litigious behavior (colums 4 and 5) while the trademark applications play only a role for the active behavior. In cases where the company was encountered by oppositions against their own patents the likelihood of litigious behavior is much higher.[4] Surprisingly, active opposing (ichoppose) has no effect on active pretrial litigious behavior but on active formal litigious behavior.

[4] We only include opposition until 2004 into „opp“ to avoid any endogeneity of these varaible.

Table 2: Multivariate Probit regression

	(1) Active litigation	(2) Passive litigation	(3) Active pretrail litigation	(4) Active litigation	(5) Passive litigation	(6) Active pretrail litigation
fueext	0.357***	0.253***	0.335***	0.290***	0.205**	0.293***
	(0.090)	(0.092)	(0.088)	(0.093)	(0.095)	(0.090)
fueinten	0.035*	0.016	0.012	0.029	0.009	0.006
	(0.018)	(0.016)	(0.016)	(0.019)	(0.017)	(0.016)
fueinten2	-0.001*	-0.000	-0.000	-0.001	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
lnage	0.049	0.022	-0.015	0.018	-0.003	-0.052
	(0.047)	(0.048)	(0.046)	(0.048)	(0.049)	(0.047)
gkk1	-1.461***	-1.340***	-1.073***	-1.370***	-1.295***	-0.992***
	(0.170)	(0.170)	(0.152)	(0.176)	(0.175)	(0.156)
gkk2	-1.120***	-1.137***	-1.026***	-1.120***	-1.150***	-1.035***
	(0.127)	(0.131)	(0.126)	(0.135)	(0.138)	(0.132)
gkk3	-0.709***	-0.636***	-0.584***	-0.688***	-0.642***	-0.573***
	(0.112)	(0.113)	(0.110)	(0.117)	(0.117)	(0.113)
east	-0.304***	-0.283**	-0.380***	-0.258**	-0.259**	-0.351***
	(0.111)	(0.115)	(0.108)	(0.115)	(0.117)	(0.111)
ps				0.016**	0.020***	0.000
				(0.007)	(0.007)	(0.007)
gs				0.011***	0.009***	0.012***
				(0.003)	(0.003)	(0.003)
ts				0.011*	-0.002	0.012**
				(0.006)	(0.007)	(0.006)
opp				0.509**	0.484**	0.891***
				(0.201)	(0.197)	(0.199)
ichoppose				0.162***	0.059*	0.022
				(0.049)	(0.033)	(0.016)
Constant	-0.546**	-0.653**	-0.464*	-0.497*	-0.579**	-0.397
	(0.271)	(0.283)	(0.267)	(0.278)	(0.288)	(0.273)
Observations	1,497	1,497	1,497	1,497	1,497	1,497

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Likelihood ratio test of rho21 = rho31 = rho32 = 0: chi2(3) = 554.715 Prob > chi2 = 0.0000
Likelihood ratio test of rho54 = rho64 = rho65 = 0: chi2(3) = 502.168 Prob > chi2 = 0.0000

Separate regressions of small and large firms were conducted in order to pronounce the importance of firm size for company behavior in the sense of enforcing IP. We separated the sample at the median of 86 employees into small or large firms. The estimation supports the results of the full sample estimations.

Table 3: Separate Multivariate Probit regression for small and large firms

	small			**large**		
	(1) Active litigation	(2) Passive litigation	(3) Active pretrail litigation	(4) Active litigation	(5) Passive litigation	(6) Active pretrail litigation
fueext	0.466***	0.323*	0.471***	0.215*	0.111	0.165
	(0.165)	(0.168)	(0.153)	(0.117)	(0.117)	(0.114)
fueinten	-0.003	-0.034	-0.022	0.151***	0.049	0.110**
	(0.027)	(0.026)	(0.023)	(0.045)	(0.043)	(0.045)
fueinten2	0.000	0.001	0.001	-0.009***	-0.002	-0.008**
	(0.001)	(0.001)	(0.000)	(0.003)	(0.003)	(0.003)
lnage	0.039	-0.142	-0.123	0.003	0.008	-0.055
	(0.102)	(0.105)	(0.099)	(0.057)	(0.058)	(0.056)
gkk1	-0.222	-0.221	0.004			
	(0.173)	(0.171)	(0.152)			
gkk2				-0.744***	-1.316***	-0.891***
				(0.282)	(0.345)	(0.308)
gkk3				-0.711***	-0.651***	-0.568***
				(0.121)	(0.121)	(0.117)
ost	-0.139	-0.257	-0.179	-0.370**	-0.313*	-0.602***
	(0.165)	(0.169)	(0.151)	(0.168)	(0.170)	(0.173)
ps	-0.000	0.015	-0.005	0.032***	0.022**	0.005
	(0.012)	(0.010)	(0.011)	(0.012)	(0.011)	(0.011)
gs	0.013***	0.006	0.012***	0.010**	0.012***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
ts	0.012	0.000	0.009	0.014	-0.005	0.018*
	(0.008)	(0.008)	(0.008)	(0.010)	(0.011)	(0.010)
opp	0.266	2.487***	1.857***	0.393*	0.273	0.761***
	(0.712)	(0.834)	(0.661)	(0.223)	(0.216)	(0.216)
ichoppose	0.851	-1.956	0.755	0.159***	0.055	0.021
	(0.690)	(1,332.265)	(0.621)	(0.051)	(0.035)	(0.017)
Constant	-1.974***	-1.219**	-1.294**	-0.371	-0.518	-0.330
	(0.568)	(0.540)	(0.510)	(0.323)	(0.333)	(0.328)
Observations	750	750	750	747	747	747

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Likelihood ratio test of rho21 = rho31 = rho32 = 0: chi2(3) = 176.1 Prob > chi2 = 0.0000
Likelihood ratio test of rho54 = rho64 = rho65 = 0: chi2(3) = 319.563 Prob > chi2 = 0.0000

For small companies the effect of external R& D sourcing is more pronounced. External knowledge sourcing in small firms is related with a higher likelihood of being involved in litigious actions than for large companies. This is even more relevant when we take into account that only 29 % of the small companies source for external knowledge compared to 52 % of the large companies. For small firms there is no difference whether there location is in the former east German part. For large firm there is a negative correlation.

To be seen that internal R&D has a positive impact for the likelihood of active litigious actions for large companies. (In fact there is a u-shaped relationship Formal litigious behavior is significantly correlated with a stock of patents or utility patents in large firms.

5 Conclusion

In the empirical analysis, we carefully control to what extent the firm has made use of different intellectual property rights in the past. We control for the firms' patent stock, and also include variables measuring whether the firms made use of trademarks, copyrights and industrial design. In addition, we collected data on opposition cases at the European Patent office and include whether a firm filed patents that were opposed in the past, or whether the firm opposed a patent by a third party.

We also control for innovation input as measured by the firms' R&D intensity, firm size, firm age and unobserved heterogeneity across industries.

When estimating probit models as well as multivariate probit models, we find strong evidence that firms pursuing an open innovation strategy are more subject to the risk of litigation. When knowledge is sourced externally firms are more likely to be sued, to sue a third party themselves, and also the incidence of a settlement is much higher for such firms. Thus, we conclude that an open innovation may incur substantial cost that, to a large extent, will be unknown to the firm before engaging in external knowledge sourcing but should well be taken into account when the decision of whether or not opening up that innovation strategy has to be taken.

We also find expected results concerning the control variables, i.e. firms that have a higher propensity to use means of intellectual property right protection are more likely to be involved in litigation. However, the impact of different kind of IP such as trademarks and industry designs, patents and utility patents vary among the different litigation types.

This is an ongoing research project, and currently a number of robustness tests are conducted. Finally, limitation of the study and possible extensions for further research will be elaborated.

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Appendix

Table 4: Probit regression

	Active litigation	*Passive litigation*	*Active pretrail litigation*	*Active litigation*	*Passive litigation*	*Active pretrail litigation*
fueext	0.354***	0.253***	0.336***	0.286***	0.196**	0.292***
	(0.091)	(0.093)	(0.088)	(0.094)	(0.096)	(0.091)
fueinten	0.038*	0.014	0.009	0.031	0.005	0.004
	(0.021)	(0.015)	(0.015)	(0.022)	(0.016)	(0.015)
fueinten2	-0.001*	-0.000	-0.000	-0.001	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
lnage	0.044	0.005	-0.020	0.017	-0.018	-0.052
	(0.048)	(0.049)	(0.046)	(0.049)	(0.051)	(0.048)
gkk1	-1.420***	-1.320***	-1.085***	-1.328***	-1.267***	-1.002***
	(0.168)	(0.168)	(0.151)	(0.174)	(0.174)	(0.155)
gkk2	-1.104***	-1.156***	-1.028***	-1.095***	-1.166***	-1.043***
	(0.128)	(0.132)	(0.126)	(0.136)	(0.140)	(0.132)
gkk3	-0.723***	-0.664***	-0.586***	-0.696***	-0.664***	-0.580***
	(0.112)	(0.114)	(0.110)	(0.118)	(0.118)	(0.114)
east	-0.314***	-0.289**	-0.364***	-0.261**	-0.262**	-0.329***
	(0.113)	(0.116)	(0.108)	(0.116)	(0.119)	(0.111)
ps				0.017**	0.020***	-0.001
				(0.007)	(0.007)	(0.008)
gs				0.011***	0.009***	0.012***
				(0.003)	(0.003)	(0.003)
ts				0.011*	0.000	0.013**
				(0.006)	(0.006)	(0.005)
opp				0.512**	0.496**	0.919***
				(0.207)	(0.202)	(0.203)
ichoppose				0.143***	0.059	0.022
				(0.052)	(0.040)	(0.016)
constant	-0.548**	-0.594**	-0.430	-0.505*	-0.532*	-0.374
	(0.277)	(0.290)	(0.270)	(0.282)	(0.295)	(0.276)
Observations	1,497	1,497	1,497	1,497	1,497	1,497
PSeudo-R-squared	0.197	0.173	0.137	0.237	0.201	0.177
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						