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How open is too open? The 'dark side' of openness along the innovation value chain

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Abstract

In this article, we aim at establishing a link between open innovation and the imitation of intellectual property (IP). Bivariate analyses of survey data concerning the open innovation orientation of 3956 German firms reveal that companies engaged in open innovation face imitation. Further, we find significant positive relations between imitation and every single innovation phase with the exception of the testing and marketing phase. Moreover, we show that all potential open innovation partner types are connected to the risk of imitation with the exception of competitors, which is a surprising result. While our results show these relationships, we are not able to test for a causal direction. However, the results of our work point at an interesting avenue in research quantitatively analyzing the influence of open innovation on imitation of IP. Further, our findings suggest that companies engaging in open innovation should be careful about an increased risk of imitation possibly induced by their openness.

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Abstract

In this article, we aim at establishing a link between open innovation and the imitation of intellectual property (IP). Bivariate analyses of survey data concerning the open innovation orientation of 3956 German firms reveal that companies engaged in open innovation face imitation. Further, we find significant positive relations between imitation and every single innovation phase with the exception of the testing and marketing phase. Moreover, we show that all potential open innovation partner types are connected to the risk of imitation with the exception of competitors, which is a surprising result. While our results show these relationships, we are not able to test for a causal direction. However, the results of our work point at an interesting avenue in research quantitatively analyzing the influence of open innovation on imitation of IP. Further, our findings suggest that companies engaging in open innovation should be careful about an increased risk of imitation possibly induced by their openness.

Keywords: open innovation; imitation; intellectual property; R&D cooperation

1 Introduction

Due to increasing complexity and the multi-disciplinarity of research and development (R&D) and innovation efforts, firms seek to access complementary assets and knowledge outside their boundaries (Miotti and Sachwald, 2003). Open innovation has increased awareness and aroused interest in the current management literature. Prior research associates an open innovation strategy with benefits and positive returns for companies organizing their R&D activities in an open framework. In general, literature emphasizes a positive relationship between openness and innovation (Laursen and Salter, 2006), while we currently have a limited understanding of the downside of openness (Dahlander and Gann, 2010; Knudsen and Mortensen, 2011). Moreover, an open innovation strategy is assumed to decrease the risk which is inherent to the innovation process at the same time may increase the risk and costs inherent to collaboration with different partners.

According to Huizingh (2011), more quantitative research is needed to test for context dependencies of open innovation. Consistent with prior research that highlights the need for more research on the costs and risks of openness (Vanhaverbeke et al., 2008), our study contributes to the understanding of a possible drawback of open innovation.

Research, however, neglects the risks of an open innovation framework, i.e., knowledge spillovers and imitation. This, we believe, may cause further drawbacks of an open innovation strategy which is the topic of this paper. Open innovation has, as yet, not been analyzed in the context of imitation and in particular, along the innovation value chain. The concept of an innovation value chain is part of a broader evolutionary dynamic perspective in which knowledge, ideas, and technologies are constantly redefined (Roper et al., 2008). In this paper, we show how companies' cooperation along the innovation value chain affects imitation. We analyze survey data consisting of 3956 German firms and identify the influence of a company's open innovation strategy on the imitation of its intellectual property (IP).

These results shed light on some new limitations of openness than the literature on the open innovation paradigm suggests.

We define imitation as the imitation of products or business models of companies, including technology, brands, and designs.

In this article, we do not challenge the benefits of openness with regards to reducing the innovation inherent risks but we raise awareness for the correlation between open innovation and imitation.

Next, we give an overview on open innovation literature to explain the influence of openness on imitation. We exemplify whether a company that is open along the innovation value chain is experiencing imitation of its intellectual property (IP). The subsequent section describes the data, explains the methodology and looks at the link between imitation and the company's openness along the value chain. The article concludes by describing and discussing the results of the empirical investigation and providing implications for management and policy.

2 Literature review

2.1 Open innovation

Open innovation has aroused enormous interest and become an en vogue topic for both research and management. In the last decades, innovative firms have shifted from the 'closed innovation' paradigm where companies rely on internal capabilities, towards the 'open innovation' model (Chesbrough, 2003) using a wide range of inter-organizational ties and sources (Laursen and Salter, 2006). According to Chesbrough et al. (2006, p.1) 'open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation'. In that sense, we understand open innovation as an interactive innovation process where innovators rely on collaboration with external partners (Hippel, 1986; Szulanski, 1996).

A large amount of literature on strategic alliances addresses the impact of inter-firm cooperation on innovation performance (for a review see Man and Duysters, 2005). Some scholars, argue that the impact on innovative performance depends on the nature of the partner(s) involved (Belderbos et al., 2004; Chen et al., 2011; Faems et al., 2005; Miotti and Sachwald, 2003), the intended type of innovation to be developed (radical vs. incremental) (Tether, 2002), the knowledge overlap (Mowery et al., 1996), or the absorptive capacity of the partnering companies, (Lane and Lubatkin, 1998; Lane et al., 2001; Zahra and George, 2002) and the sector (Tether and Tajar, 2008a, 2008b). In sum, a growing number of alliances have been formed during the past decades since R&D partnerships are an important strategic tool for organizational learning (Inkpen, 1998; Inkpen and Dinur, 1998).

Further, scholars have analyzed how the degree of openness affects companies. They differentiate two dimensions: breadth and depth (Katila and Ahuja, 2002; Laursen and Salter, 2004, 2006). Breadth refers to the number of external (knowledge) sources a company uses; depth means the extent to which a company uses these external sources, search channel (Laursen and Salter, 2006; Leiponen, 2012; Leiponen and Helfat, 2010), or existing knowledge (Katila and Ahuja, 2002; Laursen and Salter, 2004).

In general, literature emphasizes a positive relationship between openness and innovation (Laursen and Salter, 2006), while potential drawbacks of openness are yet to be examined (Dahlander and Gann, 2010; Knudsen and Mortensen, 2011).

The 'bright side' of open innovation

To successfully develop and commercialize at least one innovation, a company diversifies risks and R&D investments across different knowledge sources or cooperation partners resulting in a portfolio strategy which aims at hedging the innovation inherent risk. Thus, innovators rarely innovate alone as they can benefit from access to a broad base of

complementary ideas, knowledge, skills, and expertise when cooperating (Dyer and Singh, 1998; Hamel, 1991; Laursen and Salter, 2006).

Usually studies find a positive relationship between cooperation and innovation activities (e.g., Belderbos et al., 2004; Hagedoorn, 2002; Sampson, 2007; Stuart, 2000). In a meta-analytic study, Wijk et al. (2008) discover a positive relationship between inter-organizational knowledge transfer and company performance (also: Lane et al., 2001; Szulanski, 1996) as well as innovativeness (also: Jansen et al., 2005; Powell et al., 1996).

In general, prior research associates essential positive returns with an open innovation strategy as well as breadth and depth of external information sources and objectives (Chen et al., 2011; Katila and Ahuja, 2002; Leiponen and Helfat, 2010; Tomlinson, 2010).

Lee et al. (2010) (also: Vrande et al., 2009a) find benefits of open innovation for small and medium-sized enterprises (SMEs). Another stream of literature addresses the advantages of open innovation practices in corporate venturing (Vanhaverbeke et al., 2008; Vrande et al., 2009b). Chesbrough and Rosenbloom (2002) and Dahlander and Gann (2010) suggest that companies may benefit from outside partners when commercializing inventions.

The 'dark side' of open innovation

An open innovation strategy aims at decreasing the risk inherent to the innovation process but at the same time it may increase the risk inherent to collaboration with different partners. According to Vanhaverbeke (2006), most companies do not feel at ease in open innovation settings because this process redefines and blurs the boundaries between the own firm and its environment (Laursen and Salter, 2006; McEvily et al., 2003).

An emerging stream of literature suggests that there are drawbacks associated with an open innovation strategy. Costs which are caused by coordination, management, and control and associated with too much openness (Enkel et al., 2009) may also be a burden for an open company. Using too many sources simultaneously generates an attention and a maintenance

problem (Ahuja, 2000). This means, implementing open innovation strategy can be associated with high transaction costs (Christensen et al., 2005). Enkel et al. (2009) show that difficulty in finding the right partner (also: Chesbrough and Appleyard, 2007), interference with the daily business, and insufficient time and financial resources are risks of carrying out open innovation activities.

Open innovation is usually associated with the risk of involuntary knowledge spillover (Cassiman and Veugelers, 2002), leakage of critical internal resources, and disclosure of core competencies to cooperation partners. In a recent study, Knudsen and Mortensen (2011) find that openness relates to slower product development projects with greater costs than usual. Furthermore, Lokshin et al. (2011) acknowledge that firms with negative collaboration experiences may also encounter negative innovative performance.

Our study contributes to the understanding of a possible drawback of open innovation. In general, the literature has emphasized a positive relationship between openness, but the downsides of openness can be detrimental in terms of imitation and performance (Dahlander and Gann, 2010; Knudsen and Mortensen, 2011).

2.2 Imitation

According to Teece (1986), innovators are likely to lose parts of their profit share to imitators if imitation is relatively easy. The ease of imitation is especially influenced by the degree of the codification of the relevant knowledge (e.g., the imitation enabling effect of patents Anton and Yao, 2004; Horstmann et al., 1985) and the way the knowledge is transmitted. Consequently, weak appropriability regimes or failure to protect knowledge or IP can induce imitation. Teece (1986) points out different cases in which the ‘lion’s share’ of the

innovation's profits eventually was reaped by imitators. In other words, without appropriate protection, a firm's innovation effort can be diluted if there is a serious threat of imitation.[1]

Especially in the open innovation context, knowledge is transmitted in a way that even tacit knowledge can spill over to the open innovation partner as open innovation aims at sharing tacit knowledge and IP which are inherent to the partners themselves. Consequently, appropriating the rents from IP and knowledge put into the open innovation partnership may be difficult as imitation may occur.

As prior literature in management (Wernerfelt, 1984) suggests that a firm must focus on the inimitability of its products to sustain a competitive advantage (for a recent literature overview, refer to Polidoro and Toh, 2011), firms engaging in open innovation contexts should be especially aware of the imitation threat open innovation poses.

Extant studies analyze factors that influence the likelihood of being imitated such as export intensity, company size, IP right stocks, etc. (Berger et al., 2012; Gulati and Singh, 1998). Further, scholars find that cooperation intensity reduces patent infringement while other IPR types are not affected (Berger et al., 2012).

In addition, we aim to analyze open innovation along the value chain as a further driver for imitation of IP.

2.3 Research question and contribution

Our literature review reveals that research lacks an empirical study that investigates the relationship between following an open innovation strategy and imitation of IP. We also find that the impact of openness along the innovation value chain on imitation remains relatively

[1] For an overview on legal and informal protection measures please refer to Teece (1986) and Cohen et al. (2002).

unclear. In this paper we show how companies' cooperation along the innovation value chain is related to imitation.

Hansen and Birkinshaw (2007) argue that especially in the idea generation phase many companies miss opportunities as they do not source knowledge from outside. Notwithstanding, Hansen and Birkinshaw (2007) do not find cooperation in the idea conversion phase as important, but argue that in the idea diffusion phase support from external partners (and not only customers) may be more beneficial.

Consistent with Roper et al. (2008), we are especially interested in the process through which firms generate ideas, transform and exploit new knowledge into inventions to capture value. The concept of an innovation value chain is part of a broader evolutionary dynamic perspective in which knowledge, ideas, and technologies are constantly redefined (Roper et al., 2008). There is evidence for a positive relationship between the idea generation phase and innovation outcome (Roper et al., 2008). However, the innovation value chain has, as yet, not been investigated in the context of open innovation and imitation.

Despite the advantages of open innovation it may also lead to an unintended and undesirable knowledge drain, without receiving any benefits in return. This knowledge drain may result in the imitation of the own technology, products or services.

In this paper, we emphasize open innovation as a threat of appropriability of IP as imitation imposes a risk to capture the benefits from innovation investments (Teece, 1986). This is a potential drawback of an open innovation strategy.

To address the risk of imitation, firms usually use combinations of different means of protection using both formal methods (such as patent, trademark or copyright protection, etc.) and informal methods (lead time, first mover advantage, lock-in, complementary assets, etc.) within their appropriability strategies (Arora and Ceccagnoli, 2006; López and Roberts, 2002;

Pisano, 2006; Pisano and Teece, 2007). Especially in the context of informal protection measures, open innovation is a risky strategy as critical knowledge may spillover to outsiders.

In this paper we answer how open innovation along the value chain connects to the imitation of IP and, thus, may nurture an obsessiveness with ownership as pointed out by Dahlander and Gann (2010). This way we contribute to literature investigating hybrid strategies between the purely open or purely proprietary extremes (West, 2003).

In this paper we aim to shed light on the relationship between orientation of openness (Chen et al., 2011), openness along the innovation value chain and the company's appropriability of its innovation investments. Therefore, we focus on specific dimensions of open innovation. We do not claim causal relationships between the mentioned variables but try to establish a link between them. Hence, we refrain from hypothesizing causal links but instead focus on possible connections between the different variables as indicated by previous research.

First, we take a look at the breadth of open innovation by considering specific types of cooperation partners (i.e., competitors, B2B customers, B2C customers, suppliers, and universities). This is consistent with current research which defines breadth of open innovation as the number of external (knowledge) sources a company uses (Laursen and Salter, 2006). Second, we define scope of open innovation as the extent to which firms cooperate in different phases along the innovation value chain. Third, we investigate how breadth and scope connect to imitation and establish a non-causal link between the two. Fourth, we focus on open innovation along the value chain (i.e., idea generation; R&D; design and configuration; testing, marketing, and production preparations; market introduction and implementation) and investigate which phases jointly appear with imitation.

In the following, we derive argumentations for correlations between imitation and the mentioned concepts of breadth and scope, and the different phases along the innovation value chain.

Open innovation cooperation enables the partners to make use of the IP brought into the cooperation. Therefore, a company operating in an open innovation setting might also experience imitation. A company shares knowledge more intensely across the innovation value chain if it openly cooperates in many different phases, i.e., if the scope of open innovation is high. Therefore, critical knowledge is shared more deeply. Furthermore, a company sharing knowledge with many different partners in a broader open innovation setting creates more potential imitators. We fairly assume that the breadth and scope both positively correlate with imitation. .

Further, companies cooperating with competitors might also be more affected by imitation. If a firm enters an open innovation setting with a competitor, the product portfolio of both partners is very similar. This overlap might positively influence the partner's absorptive capacity regarding IP or knowledge revealed within the open setting, eventually facilitating imitation.

As aforementioned, we assume that a greater risk of imitation is associated with an open innovation strategy. We further take a look at the different phases along the innovation value chain which might be more prone to imitation of certain IP. We focus on the imitation of technology and design as these are – in contrast to brands, trademarks, and copyrights – typical and crucial IP for innovation while the latter are not necessarily part of innovations.

During the idea generation and R&D phases, the company mainly reveals its critical technological capabilities to its open innovation partner(s). Hence, we especially expect imitation of technology to be correlated with these phases of the innovation value chain. Moreover, we expect imitation of technology to be connected with the implementation phase of the innovation value chain. During this phase, the companies exchange complex IP and knowledge on the optimal production process of the innovation. For the production process,

critical technological knowledge needs to be shared to ensure an optimal outcome of the cooperation.

Contrasting, in the design phase of the innovation value chain, the close-to-optimal design of the innovation is developed and critical design components are shared within the open innovation setting. Hence, imitation of design should be correlated with companies that open up within the design and configuration phase of their innovation value chain. Empirical analyses

2.4 Sample

We use data from the Mannheim Innovation Panel (MIP), ZEW, Mannheim, which is the German version of the Eurostat Community Innovation Survey (CIS). Moreover, it includes additional alternating questions. The MIP is sent out every year to a random sample (stratified by size, region, and sector) of German companies. It addresses topics such as IP, innovation performance, cooperation, etc. To address mortality, new companies (observations) are added every other year. 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. First, the data provide indicators for innovation performance, and second, 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 imitation and about open innovation activities along the value chain. 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 3956 observations and is cross-sectional.

2.5 Measures

The focal variable in our analyses is ‘Imitation’. The operationalization derives from the question ‘Has IP of your company been negatively affected by other companies in the years 2005-2007’[2]. Hence, the dependent variable is binary, 1 coding imitation, and 0 coding no imitation. We further differentiate between imitation of technology and imitation of design. Both technology and design are crucial IP for innovation. Contrasting, brands and copyrighted material do not necessarily represent core parts of an innovation and are, consequently, no integral part of open innovation activities. The only exception to this is copyrighted software which we cannot disentangle from other copyrighted material (such as technical manuals, photographs, pictures, etc.). Both variables ‘Imitation of technology’ and ‘Imitation of designs’ are binary and their coding resembles the one of imitation.

The other variables in focus are ‘Breadth of open innovation’ and ‘Scope of open innovation’. Both are ordinal variables with a scale from 0 to 5.

Breadth codes 0 for open innovation with no partner type and, hence, codes a company not engaging in open innovation at all. A value of 5 represents open innovation with all five possible partner types. Scope is coded 0 if the company does not conduct open innovation in any phase along the innovation value chain and, hence, does not engage in open innovation at all. Contrasting, 5 codes open innovation within all phases along the innovation value chain.

Further variables capture the open innovation activities regarding the different phases of the value chain and the different open innovation partners. The operationalization is straight forward: If the company conducted cooperation with any partner within a certain phase of the value chain, we code this phase 1 and 0 if otherwise. The same is true for the cooperation

[2] Original question in German: “Ist intellektuelles Eigentum Ihres Unternehmens in den Jahren 2005-2007 durch andere Unternehmen beeinträchtigt worden?“

partners: If the company cooperated with a certain cooperation partner in any phase of the value chain, we code this partner 1 and 0 if otherwise.

In our estimations, we control for variables which scholars found to influence the likelihood of imitation. Hence, we include the size of the company (Employees (ln)), the intensity of exports (Export Intensity (%)) and of R&D (R&D Intensity (%)), both measured as a ratio of sales. Furthermore, we control for sectorial differences[3] and the influence of patent and trademarks stock (Patent Stock (ln); Trademark Stock (ln)).

For an overview of all employed variables, please refer to TABLE 1.

Insert TABLE 1 about here.

2.6 Statistical method

We cannot directly investigate whether the company faced infringement within an open innovation setting. However, we argue that the decision to open up the innovation process is a conscious, long-term decision that emphasizes a company's engagement in openness on a general scale, making it more prone to imitation. The exact wording of the question ('In which phases of the innovation process does your company cooperate with innovation partners') reflects this viewpoint. However, we do not claim causality for any of these regressions but rather use them as controlled correlations.

We use logistic regression analysis computing coefficients and odds-ratios as the dependent variable is binary. The odds-ratio enables us to interpret the strength of the explaining variables' connection with imitation.

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

As the estimated regressions miss out on roughly 35% of observations contained in the data set, we also conduct a non-response analysis (t-tests) to make sure that companies who did not give particulars about their imitation experience or open innovation behavior significantly differ from the ones who did. The t-tests do not reveal any significant differences.

2.7 Results

The descriptive statistics in FIGURES 1-4 reveal some interesting results. Imitation is connected to all phases of the innovation value chain, most frequently in the idea generation phase and least frequently in the market introduction phase. Particularly, the R&D phase is prone to imitation of technology. Additionally, imitation of design occurs together with the idea generation, R&D, and design and configuration phases.

Imitation coincides in open innovation settings with all partner types but most frequently with B2B customers and suppliers while less frequent regarding cooperation with competitors.

While the descriptive statistics already shed some light on the incidences of imitation along the value chain, only the bivariate analyses reveal significant correlations between the variables. The results of these analyses are reported herein. As stated beforehand, we make use of logistic regressions and will report these results. However, we do not claim causality but rather interpret them as correlations while controlling for other factors.

Insert FIGURES 1-4 about here.

With regard to the base model (TABLE 2), our results show a strong correlation between the breadth and scope of open innovation and imitation. Both positively and significantly correlate with imitation. If the open innovation breadth increases by one category (i.e., one additional partner type), the likelihood the same company faces imitation at the same time

rises by 66%. Likewise (i.e., one additional innovation phase), it rises by 45% with regard to scope. Both effects remain stable if we include both variables into the regression.

Insert TABLE 2 about here.

The further models differentiate between imitation types (imitation of technology, imitation of design), phases along the value chain (TABLE 3), and partner types (TABLE 4).

The estimations show that imitation is connected to different phases along the innovation value chain. Collaboration in the idea generation phase (94%), the R&D phase (59%), the design and configuration phase (65%), and the market introduction and implementation phase (40%) significantly and positively correlate with imitation. The only phase not correlating with imitation is the testing and marketing phase. The imitation of technology is significantly and highly correlated with open innovation in the idea generation (161%) and R&D phases (171%), while the market introduction and implementation phase (41%) correlates to a lesser degree with imitation. The imitation of design is predominantly coinciding with open innovation in the design and configuration phase (214%).

Regarding the influence of different open innovation partners, all partner types are significantly and positively related to imitation. The only exceptions are competitors who are the only partner type which is not significantly connected to imitation. Furthermore, we controlled for interaction effects between phases and partners. However, these effects did not reveal any interesting results and are not reported herein.

The employed control variables export intensity and patent stock both reveal a positive and significant connection with imitation as expected and also predicted by literature. We do not find any sectorial influence on imitation, nor does the R&D intensity or the number of employees correlate with imitation.

Insert TABLE 3 and TABLE 4 about here.
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3 Discussion and implications

The findings of our empirical analyses partly correspond to our expectations. Our expectation that imitation correlates with broad or widely scoped open innovation setting are confirmed by our findings. Thus, our theoretical prediction holds in this event. Our results regarding correlations between partner types and imitation are counterintuitive in that the cooperation with competitors is not significant while all other partner types reveal a positive correlation with imitation. The question, why competitors are not correlated with imitation while all other partner types or external sources do is difficult to answer as we do not possess information about the open innovation contract regimes companies employ. We assume that companies cooperating with competitors are more aware of the potential risks of knowledge spillover and imitation and, thus, cooperate less with competitors in general (cf., FIGURE 4 suggesting that cooperation with competitors is less common), set tight contractual guidelines before entering collaboration with competitors or require formal IPR in place before working together (Dahlander and Gann, 2010). Our data suggest all partner types but competitors are connected to imitation. Managers should be aware of this risk when entering an open innovation strategy. They should be prudent and expect an imitation risk across all sources they use and, thus, establish stronger and standard contractual guidelines.

A company engaging in an open innovation setting with a lot of partner types should focus on certain critical partners or have a clear idea about the different partners' behavior and intentions. Managers should bring to mind whether they can manage, maintain and control all their open innovation partners at the same time. It might be more difficult to handle two partners of different types (e.g., a university and a competitor) than just more than two partners of one type (e.g., three competitors).

As with regard to the scope of the open innovation setting, companies should know in which phase of the innovation value chain they want to cooperate. We find evidence that imitation of technology correlates with all phases of the innovation value chain but the testing as well as the design phase. We find that the R&D phase is strongly correlated with imitation, which is why we propose to enter the R&D phase with a clear idea about IP ownership (e.g., update the patent portfolio beforehand) and to draft clear contracts. The empirical analyses reveal that design imitation correlates with open innovation in the design phase. Therefore, managers should protect designs when entering this kind of open innovation collaboration.

Open innovation is associated with the idea to jointly develop new IP at the cost of revealing firm-internal critical IP to partners who may use that IP for imitation of products and services not related to the cooperation. Consequently, companies should be aware of their core competencies and capabilities and know which of these are critical for their company performance and competitive advantage. These are the ones that should be kept secret and should not be shared while cooperating in a phase where these may be revealed. Firms should choose a suitable partner whom and an innovation phase in which they can offer less critical resources and capabilities that are valuable for the partner and thus, gain valuable capabilities in return. As a result, we expect companies to analyze the innovation process with regard to the most beneficial phase and partner to cooperate in and with and, hence, to optimize their open innovation strategy.

Firms should neither play their cards at too many partners nor phases as this behavior connects to imitation. Moreover, they should not overestimate the benefits and underestimate the risk induced by breadth and scope of the open innovation setting.

In sum, this study shows that there is a trade-off between risk hedging (a lot of partners and phases enable a lot of different innovations and increase the probability of at least one

successful innovation) and risk inducing effects (breadth and scope connect to imitation and hence risk).

4 Conclusion and further research

In this article, we provide extensions to previous open innovation studies by showing a potential ‘dark side’ of an open innovation strategy, which has, as yet, not been in the focus of research. We explain the interdependency between open innovation and imitation of IP and provide first empirical evidence of the relation between openness along the innovation value chain and imitation. We disentangle open innovation along the different phases of the innovation value chain and give recommendations for managers on how to leverage an open innovation strategy. In sum, our results give first indication that open innovation exposes companies to the risk of imitation.

Particularly, open innovation relies on mutual sharing of resources, e.g., releasing some IP (e.g., by licensing) to receive some in return. There is no access to new knowledge sources without being regarded a potential source of knowledge. However, these sources might be accessed and used outside the open innovation collaboration without permission.

Some firms may even purposefully enter open innovation settings to acquire new IP or knowledge not in the focus of the collaboration from suppliers or customers to diversify vertically. This may not only increase the risk of imitation but also bread future competitors. We raise awareness for the fact that managers should be as cautious about other partners as they are about direct competitors and should therefore consider the aforementioned risk which might seem farfetched in the first place.

This study highlights the tradeoff between transaction and protection costs and the benefits of open innovation: Transaction costs decrease if contracts are less tight; however, the risk of imitation increases at the same time. While we cannot measure the transaction costs of open

innovation, our results show that companies engage in a significant number of open innovation partnerships while at the same time experiencing imitation suggesting a lack of protection against imitation.

Addressing potential pitfalls in contracts in advance may limit the possibility of a rude awakening. Moreover, IPR might mitigate the effects we detect; however, we find evidence that IPR might even enable them (i.e., patents enable imitation). We discover a positive relation between patent stock and imitation which leaves room for further research. We further encourage research on how companies cope with imitation and how this affects further collaboration in the future.

In general, we raise the question whether open innovation is a win-win or more a win-lose game assuming that one firm wins the IP another firms 'looses' and vice versa. Hence, the questions of how strong the effect of imitation directly induced by open innovation is (we cannot control for that) and how this is out-weighted by the benefits (new IP and innovation, etc.) remain and offer an interesting avenue for further research.

Concluding, we do not challenge the benefits of openness but we raise awareness for the risks of imitation companies face simultaneously.

Our contribution has clear limitations. The causal relationship between imitation and open innovation is not entirely transparent as we lack information about who imitates. This may not necessarily be the open innovation partner. Consequently, the measured imitation could be caused by other factors which are yet to be found by scholars. More research may reveal further insights.

Furthermore, we did not include IP value in our analyses as there is no clear and convincing concept on how to capture the real IP value as existing concepts (e.g., patent citations, IP transactions, etc.) are very limited in their explanation power. Hence, IP value is difficult to control for and represents a classic limitation in this context.

Our results find evidence for a negative relationship between open innovation and imitation. Imitation, however, might also induce positive effects such as increasing the diffusion of innovations (e.g., in network goods). This opens up an interesting area for further research disentangling the effects of imitation on companies.

The relationship we assume and provide evidence for is based on a sample of German companies, only. Thus, we may encounter a country bias here. Hence, we encourage further research in a more international context to check for robustness of these results.

We lack data with regard to the quality of partnership which might moderate the imitation effect. We encourage further research to test this effect. Prior research reveals that roughly 60% of alliances and inter-firm cooperation fail (Hoang and Rothaermel, 2005; Sampson, 2005). We argue that negative experience within the collaboration or open innovation setting might increase the likelihood of termination of the same. Therefore, companies that experience imitation of their IP caused by an open innovation strategy are also more likely to resolve these ties. This leaves room for further research as we are unable to test this relationship within the limits of our data.

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Appendix

FIGURE 1 : Frequency of imitation across the innovation value chain

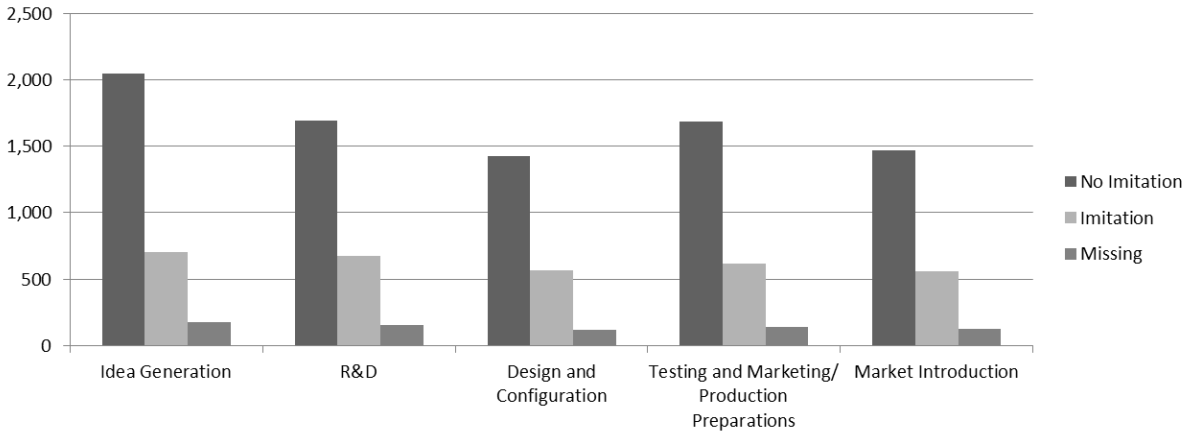

FIGURE 2: Frequency of imitation of technology across the innovation value chain

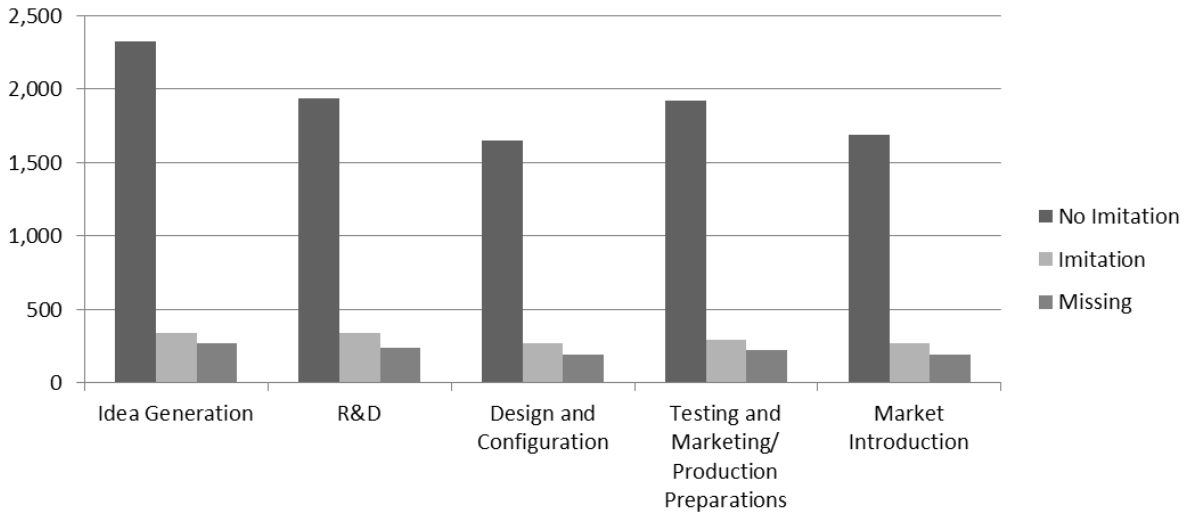

FIGURE 3: Frequency of imitation of design across the innovation value chain

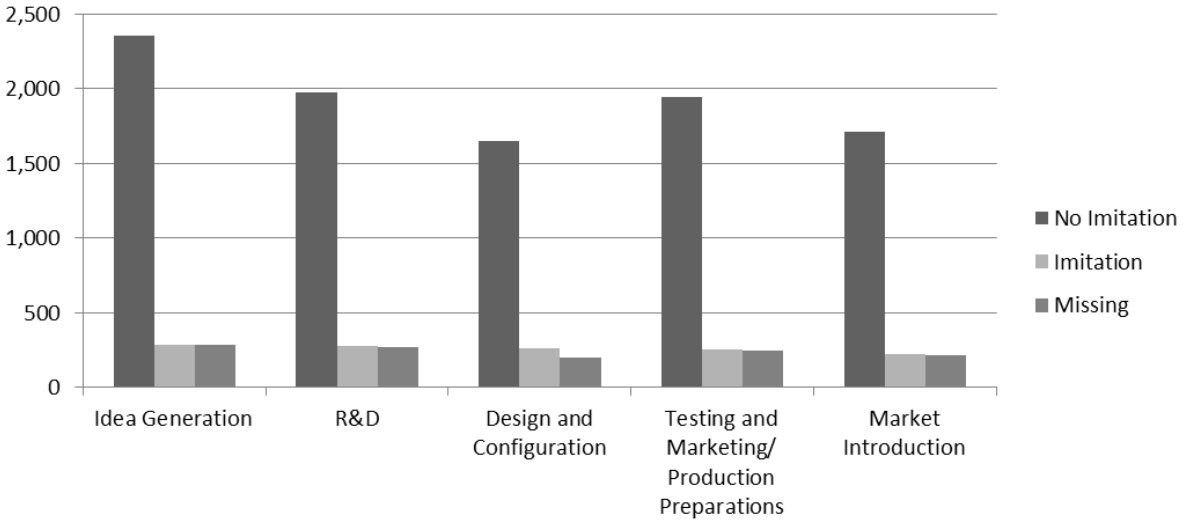

FIGURE 4: Frequency of imitation for different partner types

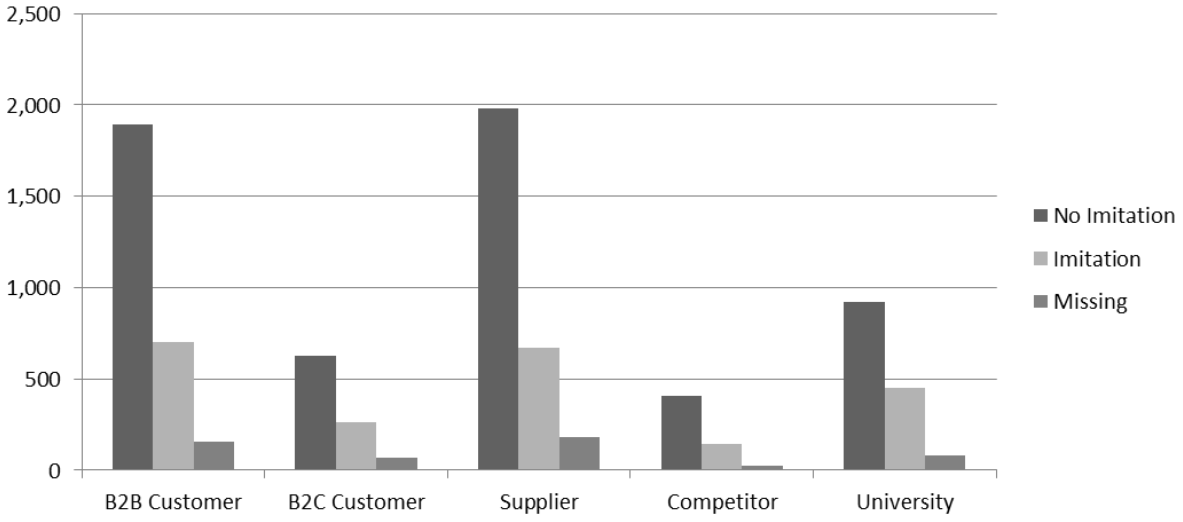

TABLE 1: Overview of variables

Dependent Variables	**Measurement**	**Mean**	**S.D.**	**Min**	**Max**
Imitation	Dummy	0.20	0.40	0	1
Imitation of Technology	Dummy	0.10	0.30	0	1
Imitation of Design	Dummy	0.09	0.28	0	1
Independent Variables					
Breadth of Open Innovation	Ordinal	1.71	1.45	0	5
Scope of Open Innovation	Ordinal	2.50	2.03	0	5
Idea Generation	Dummy	0.58	0.49	0	1
R&D	Dummy	0.53	0.50	0	1
Design and Configuration	Dummy	0.45	0.50	0	1
Testing and Marketing/ Production Preparations	Dummy	0.50	0.50	0	1
Market Introduction/ Implementation	Dummy	0.45	0.50	0	1
B2B Customer	Dummy	0.54	0.50	0	1
B2C Customer	Dummy	0.19	0.39	0	1
Supplier/ Service Provider	Dummy	0.55	0.50	0	1
Competitor	Dummy	0.12	0.33	0	1
University	Dummy	0.31	0.46	0	1
Control Variables					
Employees (ln)	Integer	3.88	1.72	0	12.16
R&D Intensity (%)	Integer	0.02	0.09	0	1.34
Export Intensity (%)	Integer	0.17	0.25	0	1.00
Patent Stock (ln)	Integer	0.25	0.64	0	6.92
Trademark Stock (ln)	Integer	0.11	0.42	0	4.98
High-Technology	Dummy	0.05	0.21	0	1.00
Medium-High-Technology	Dummy	0.18	0.38	0	1
Medium-Low-Technology	Dummy	0.17	0.38	0	1
Low-Technology	Dummy	0.13	0.33	0	1
Knowledge-Intensive Services	Dummy	0.35	0.48	0	1
Less-Knowledge-Intensive Services	Dummy	0.03	0.17	0	1

TABLE 2: Base model: Logistic regression – breadth and scope of open innovation

	Imitation		Imitation		Imitation	
	Coeff	Odds Ratio	Coeff	Odds Ratio	Coeff	Odds Ratio
Breadth of Open Innovation	0.51***	1.66***			0.32***	1.37***
	(0.04)	(0.07)			-0.06	-0.08
Scope of Open Innovation			0.37***	1.45***	0.22***	1.25***
			(0.03)	(0.04)	-0.05	-0.06
Employees (ln)	0.04	1.04	0.04	1.04	0.02	1.02
	(0.04)	(0.04)	(0.04)	(0.04)	-0.04	-0.04
R&D Intensity (%)	-0.76	0.47	-0.38	0.69	-0.91	0.4
	(0.67)	(0.31)	(0.61)	(0.42)	-0.69	-0.28
Export Intensity (%)	1.37***	3.92***	1.29***	3.65***	1.33***	3.77***
	(0.22)	(0.87)	(0.21)	(0.75)	-0.22	-0.83
Patent Stock (ln)	0.56***	1.75***	0.54***	1.71***	0.55***	1.73***
	(0.10)	(0.18)	(0.09)	(0.16)	-0.1	-0.17
Trademark Stock (ln)	-0.04	0.96	0.01	1.01	-0.03	0.97
	(0.15)	(0.14)	(0.13)	(0.13)	-0.14	-0.14
High-Technology	-0.18	0.84	-0.35	0.71	-0.23	0.8
	(0.30)	(0.25)	(0.29)	(0.21)	-0.3	-0.24
Medium-High-Technology	-0.06	0.94	-0.04	0.96	-0.05	0.95
	(0.21)	(0.20)	(0.20)	(0.19)	-0.21	-0.2
Medium-Low-Technology	0.19	1.21	0.28	1.32	0.2	1.22
	(0.21)	(0.25)	(0.20)	(0.26)	-0.21	-0.25
Low-Technology	0.00	1.00	0.02	1.02	-0.02	0.98
	(0.22)	(0.22)	(0.21)	(0.21)	-0.22	-0.21
Knowledge-Intensive Services	-0.23	0.80	-0.21	0.81	-0.19	0.83
	(0.20)	(0.16)	(0.19)	(0.15)	-0.2	-0.16
Constant	-3.00***	0.05***	-3.13***	0.04***	-3.21***	0.04***
	(0.23)	(0.01)	(0.23)	(0.01)	-0.24	-0.01
Observations	2,616	2,616	2,892	2,892	2615	2615
Log Likelihood	-1071.82	-1071.82	-1183.81	-1183.81	-1059.89	-1059.89
Chi^2	403.13	403.13	432.49	432.49	405.78	405.78
Pseudo R^2	0.19	0.19	0.18	0.18	0.2	0.2
p	0.00	0.00	0.00	0.00	0	0

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE 3: Logistic regression – innovation phases

	Imitation		Imitation of technology		Imitation of designs	
	Coeff	Odds Ratio	Coeff	Odds Ratio	Coeff	Odds Ratio
Idea Generation	0.66***	1.94***	0.96***	2.61***	0.33	1.39
	(0.18)	(0.35)	(0.30)	(0.78)	(0.26)	(0.36)
R&D	0.47***	1.59***	1.00***	2.71***	0.33	1.39
	(0.17)	(0.28)	(0.30)	(0.82)	(0.25)	(0.35)
Design and Configuration	0.50***	1.65***	0.12	1.13	1.14***	3.14***
	(0.14)	(0.22)	(0.18)	(0.20)	(0.21)	(0.66)
Testing and Marketing/ Production Preparations	-0.03	0.97	0.13	1.14	0.01	1.01
	(0.15)	(0.15)	(0.21)	(0.24)	(0.21)	(0.22)
Market Introduction/ Implementation	0.33**	1.40**	0.34*	1.41*	0.05	1.06
	(0.14)	(0.20)	(0.19)	(0.26)	(0.19)	(0.20)
Employees (ln)	0.04	1.04	-0.04	0.96	0.05	1.05
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
R&D Intensity (%)	-0.36	0.69	0.59	1.80	-1.86	0.16
	(0.62)	(0.43)	(0.70)	(1.25)	(1.14)	(0.18)
Export Intensity (%)	1.28***	3.59***	1.77***	5.88***	1.86***	6.44***
	(0.21)	(0.74)	(0.26)	(1.53)	(0.26)	(1.65)
Patent Stock (ln)	0.52***	1.68***	0.68***	1.98***		
	(0.09)	(0.16)	(0.10)	(0.20)		
Trademark Stock (ln)	0.01	1.01				
	(0.13)	(0.13)				
High-Technology	-0.34	0.71	-0.41	0.67	-0.54	0.58
	(0.29)	(0.21)	(0.38)	(0.25)	(0.40)	(0.23)
Medium-High-Technology	-0.04	0.97	-0.08	0.92	-0.31	0.73
	(0.20)	(0.19)	(0.25)	(0.23)	(0.25)	(0.18)
Medium-Low-Technology	0.28	1.32	-0.45*	0.64*	0.00	1.00
	(0.20)	(0.26)	(0.26)	(0.17)	(0.24)	(0.24)
Low-Technology	0.03	1.03	-0.43	0.65	-0.15	0.86
	(0.21)	(0.21)	(0.28)	(0.18)	(0.26)	(0.22)
Knowledge-Intensive Services	-0.22	0.80	-0.76***	0.47***	-0.79***	0.45***
	(0.19)	(0.15)	(0.28)	(0.13)	(0.26)	(0.12)
Constant	-3.20***	0.04***	-4.36***	0.01***	-3.90***	0.02***
	(0.23)	(0.01)	(0.37)	(0.00)	(0.29)	(0.01)
Observations	2,892		2,836		2,811	
Log Likelihood	-1177.88		-678.90		-701.60	
Chi²	436.88		359.97		246.34	
Pseudo R^2	0.19		0.26		0.16	
p	0.00		0.00		0.00	

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

TABLE 4: Logistic regression – partner types

	Imitation	
	Coeff	Odds Ratio
B2B Customer	1.02***	2.77***
	(0.16)	(0.44)
B2C Customer	0.29**	1.34**
	(0.13)	(0.17)
Supplier/ Service Provider	0.60***	1.83***
	(0.15)	(0.27)
Competitor	0.22	1.24
	(0.16)	(0.19)
University	0.28**	1.33**
	(0.12)	(0.16)
Employees (ln)	0.04	1.04
	(0.04)	(0.04)
R&D Intensity (%)	-0.77	0.46
	(0.67)	(0.31)
Export Intensity (%)	1.27***	3.55***
	(0.22)	(0.80)
Patent Stock (ln)	0.57***	1.76***
	(0.10)	(0.18)
Trademark Stock (ln)	-0.01	0.99
	(0.15)	(0.15)
High-Technology	-0.27	0.76
	(0.30)	(0.23)
Medium-High-Technology	-0.11	0.89
	(0.21)	(0.19)
Medium-Low-Technology	0.16	1.17
	(0.21)	(0.25)
Low-Technology	-0.05	0.95
	(0.22)	(0.21)
Knowledge-Intensive Services	-0.22	0.80
	(0.20)	(0.16)
Constant	-3.21***	0.04***
	(0.24)	(0.01)
Observations	2,616	
Log Likelihood	-1061.41	
Chi^2	407.00	
Pseudo R^2	0.20	
p	0.00	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1