Rent Appropriation and Competitor Blocking: The Two Faces of Technology Acquisition

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Abstract

Gaining access to technological assets has since long been a major motive and objective for firm acquisitions. Technologies may be used in combination with existing resources to enhance an existing technology portfolio. Patents underlying an acquired technology may, however, also be used to block competitors in technology markets. In this paper, we analyze the importance of these two faces of technology acquisition at the market for corporate control. Our empirical results for European firm acquisitions in the period from 1999 to 2003 indicate that acquiring firms pay a higher price for target firms with valuable patents and those with a blocking potential, especially if these are closely related to the patent portfolio of the acquirer. Value creation hence occurs not only through technological complementarities realized in the merged firm but also through a strategic use of patents.

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1 Introduction

Along with technology alliances (Teece, 1992; Hagedoorn, 1993; Mowery et al., 1996) and licensing agreements (Teece, 1986), the acquisition of innovative firms has been characterized as a major tool for accessing externally developed technologies (Capron et al., 1998, Graebner, 2004). Existing research suggests that value can be created through technology acquisitions if the merged entity succeeds in exploiting strategic similarities and complementarities (Singh and Montgomery, 1987; Barney, 1988; Harrison et al., 1991, 2001; Hitt et al., 2001): Such transactions can be used to reconfigure the acquirer's or target's business, in order to respond to changes in the competitive environment or enhance and improve existing operations (e.g., Bowman and Singh, 1993; Capron et al., 1998; Capron and Hulland, 1999). Reconfiguring the business goes along with a redeployment of resources which, in case of research and development (R&D), may involve intellectual property rights (IPR), personnel, laboratories and technical instruments being physically transferred to new locations or used in different R&D projects. These resource-based motivations for acquisitions have gained a lot of attention in the literature (see Veugelers, 2006, for a survey). Similarities of the resources employed hence enable efficiency gains through the exploitation of scale and scope economies in R&D (Kamien and Schwartz, 1982; Cohen and Levin, 1989).

Moreover, the combination of two product or technology portfolios provides an opportunity to exploit complementarities (Barney, 1988; Ahuja and Katila, 2001; Colombo et al., 2006) that result from a skilled unbundling and bundling of resources with the objective to enhance (technological) core competencies of the merged firm (Harrison et al., 1991, 2001; Cassiman *et al.*, 2005; Sorescu et al., 2007). Technology acquisition as a complement to in-house R&D activities has been shown to be vital to firm performance and economic growth (Kogut and Zander, 1992). By employing technology from external sources, firms aim to develop innovative products or services that lead to improved firm value (Griliches, 1981; Pakes, 1985). Roughly equating a technology with a patent, particularly a firm's patent portfolio can be assumed to have a direct influence on innovative capacities (Mansfield, 1986). After all, complementary acquired technologies can also be characterized as a decisive factor for post-merger innovation performance in technology motivated acquisitions (Ahuja and Katila, 2001; Cloodt et al., 2006; Colombo et al., 2006). In other words, technology acquisitions allow to appropriate returns from post-merger innovation activities.

However, existing literature seems to have largely overlooked another value creation trajectory: Firm acquisitions can also be used strategically leveraging control over key IPR to erect or disrupt barriers to entry and exert market power in technology markets (Reinganum, 1983; Chakrabarti *et al.*, 1994; Mukherjee *et al.*, 2004). Their strategic use may therefore result in "patent fences" that could block competitors in their innovation activities (Blind et al., 2006; Ziedonis, 2004; Heeley et al., 2007). Relatively little, however, is known about the strategic value of patents in M&A activities. Acquiring firms might either bear in mind to offensively or defensively block competitors in technology markets or they might be in a situation where the acquisition of a target firm would "unlock" an existing patent fence which – as a consequence – would enable the acquirer to continue or expand ongoing research and development (R&D) work (O'Donoghue *et al.*, 1998; Lerner *et al.*, 2003; Graff et al., 2003). Barney (1988) suggests that acquiring firms may create value when private and uniquely or inimitable valuable cash flows can be realized. Such cash flows are unique or inimitable when the acquirer benefits more than other potential acquirers from the strategic value of the target's IPR. Private refers to the fact that information concerning this advantage may only be available to the acquirer itself.

An example for an acquisition that was motivated by gaining access to a "blocked" technology is the case of the German optical instrument manufacturer Carl Zeiss that acquired the laser division of British BioRad (Competition Commission (UK), 2004). The merger has followed a number of patent disputes between Carl Zeiss and BioRad and its most important competitors, among them Leica and Cornell. Cornell invented and patented an outstanding multiphoton technology, which was the leading technology in the field and exclusively licensed out to BioRad. Hence, the acquisition of BioRad granted Carl Zeiss access to this highly valuable technology license. In summary, the BioRad acquisition might have been motivated by efficiency gains and resource complementarity, but also by the objective to "unlock" an existing patent fence established by other firms.

Technological assets in M&A activities like patents therefore seem to have "two faces" directed at the appropriation of rents from innovation activities and/or the (un-)blocking in technology markets. Similarity or complementarity as well as a high strategic value of a prospective target's patents should thus be reflected in the acquirer's willingness to pay as they open up unique and private value creation potentials. Comparative evidence on these two distinct faces of technology acquisition is however scarce. This paper is hence intended to elucidate our understanding of the motivation and objectives of acquiring firms with regard to technology. We argue that the prevailing focus on similarities and complementarities in technology acquisitions misses out a lot in explaining the prices paid at the market for corporate control. Instead, based on a sample of 479 European firms that were subject to horizontal acquisitions in the period from 1999 to 2003, we show that strategic considerations regarding the target's IPR are a major driver for the deal value. The willingness to pay is even higher when such technology is closely related to the acquirer's own technology portfolio. This serves as a hint that firm acquisitions are used to (un-)block ongoing R&D activities and thus create value. Moreover, in that we pay particular attention to the value of technology as a blocking instrument we contribute to the literature on patent indicators (Trajtenberg, 1990; Trajtenberg *et al.*, 1997; Trajtenberg *et al.*, 2000; Harhoff *et al.*, 2003; Harhoff et al., 2005a,b) by employing a new measure to assess the blocking potential of patents.

The remainder of the paper is organized as follows. The next section outlines our theoretical considerations and establishes a set of hypotheses. Section 3 introduces the data set we use and presents descriptive statistics. The empirical test of our hypotheses is provided subsequently. Section 5 discusses our results and provides policy implications. The last section concludes with a critical evaluation of the study and points out potential areas for further research.

2 The pricing of technological assets in M&A transactions

Financial market efficiency suggests that the market value of a firm reflects the available information that relates to its current and future profitability (Fama, 1970). Jensen and Ruback (1983) have argued that acquisitions typically involve a significant positive control premium over the market value of the target firm. Particularly the premium should reflect the acquirer's expectations on unique and private cash flows to be realized after the merger. Previous literature, however, fails to disentangle the different sources of value creation potential through technology acquisition. We hypothesize that two faces of acquired technology assets influence the price and hence also the premium paid for a target's technological assets: the *technological content* and the *blocking potential* of a target's technology. While the former refers to potential gains from exploiting similarity and complementarity, the latter focuses on the strategic value of technology.

2.1 Technological content and the value of technology

In order to realize similarity or complementarity gains from combining two technology portfolios, firm acquirers presumably screen technology markets carefully as they should be interested in those acquisition targets that allow for economies of scale and scope and that will most effectively complement their technology portfolio (Frey and Hussinger, 2006). They are hence interested in technologies and intellectual property with a particular *technological* *content*. Resource-based theory suggests that particularly complementarity effects between acquirer and target provide opportunities to create value as they result from bundling strategic resources into unique and valuable combinations (Barney, 1988; Barney, 1991; Conner, 1991; Harrison et al., 1991, 2001; Peteraf, 1993). An interesting example constitutes the “green” biotechnology industry where M&A transactions are extensively used to combine different complementary assets like patented genes and patented tools for genetic transformations of plants within one firm (Graff et al., 2003). Through the process of resource redeployment (Capron et al., 1998; Capron and Hulland, 1999), a merged entity may thus create a new or improved set of capabilities providing the basis for superior firm performance and competitive advantage (Penrose, 1959; Eisenhardt and Martin, 2000; Priem and Butler, 2001; Sorescu et al., 2007).

However, valuable resources of a target firm, which could provide complementarities, first need to be identified by the acquirer. The ability of an investor to judge the potential of externally available technologies and hence to value the innovation activities of a prospective target firm has been discussed from different theoretical perspectives. One of these perspectives has been summarized in the literature as the *absorptive capacity* of a firm (Cohen and Levinthal, 1989, 1990). Absorptive capacity is generally developed as a by-product of a firm’s own R&D activities. It is made up of three major components: the identification of valuable technological knowledge in the environment, its assimilation with existing knowledge stocks and the final exploitation for successful innovation. Absorptive capacities hence increase awareness for market and technology trends, which can be translated into pre-emptive actions (Bowman and Hurry, 1993). As a result, they enable firms to predict future developments more accurately (Cohen and Levinthal, 1994).

Acquirers who wish to realize complementarities have conducted R&D activities of their own, suggesting that they have also developed absorptive capacities in a particular technology field. Moreover, in the context of M&A transactions absorptive capacity might also be developed by successively engaging in such deals. In fact, the importance of experience in M&A transactions for post-acquisition performance has been highlighted in several studies (e.g., Gerpott, 1995; Birkinshaw et al., 2000; Hagedoorn and Duysters, 2002). Given prior acquisition experience, firm acquirers may be better able to judge whether a prospective target’s technology serves as a basis for value creation through complementarity effects.

Another theoretical perspective for analyzing the ability of an acquirer to judge the potential of externally available technologies has emerged from the literature on *information* *asymmetries* in investment decisions (e.g., Aboody and Lev, 2000; Cohen and Dean, 2005; Heeley et al., 2007). Generally speaking, acquiring firms face the challenge of determining the value of a potential target's innovation activities in the absence of detailed information on every single innovation project. Each innovation project has its own specific attributes which are generally kept secret by a firm to ensure the appropriability of the returns from innovation activities. Acquirers may hence use publicly available information sources like patent data to assess the quality of a firm's innovation activities (Heeley *et al.*, 2007). In order for a patent to be granted and offered protection, the technological content of the patent needs to be disclosed by the applicant to the patent office. As it is highly technical information, providing only those "skilled in the art" with relevant knowledge about the true content, there is a substantial information asymmetry between informed and uninformed acquirers. This difference becomes even more pronounced when technological complexity increases, as is typical for high-technology industries (Hagedoorn and Duysters, 2002).

Given the previous discussion on absorptive capacity, acquiring firms with a technological background should be in a favorable position to value technology based on patent data. They are used to dealing with patents in their own R&D activities and they need to consider other patents when they decide to file a patent application. The value of technology can then be split up into the number of technologies to be acquired and the quality of each technology. A patent acts, first of all, as a positive *signal* as it shows that the prospective target firm has already proven its technological expertise and capabilities and that it has a well-functioning laboratory and inventor team (Ndofor and Levitas, 2004; Levitas and McFadyen, 2006; Heeley *et al.*, 2007). This holds also for firms that lack technological background. Moreover, patents can be sold individually after the acquisition. Lastly, patents have an additional value from a combination with existing knowledge stocks, creating a new a valuable combination of technologies. Hence, our first hypothesis reads:

Hypothesis 1: The price paid for an acquisition target increases with the target's patent stock.

Given the discussion on absorptive capacity that stems either from own R&D activities or prior acquisition experience and acquired technological knowledge, we argue that acquiring firms will also be able to identify valuable technological resources, i.e. high-quality patents. Our second hypothesis hence reads:

Hypothesis 2: The price paid for an acquisition target increases with the value of the target's patents.

In the next section, we turn to the second factor in the valuation of technology which is the blocking potential of acquired technology.

2.2 Competitor blocking as strategic value of patents

Besides the acquisition of valuable technological assets that might complement the existing technology portfolio or that serve as a basis for revenue creation, another objective for M&A transactions has been identified as to enhance the position of the merged entity in technology competition (Cassiman *et al.*, 2005). By pooling technological assets the merged entity is in a position to create significant barriers to entry into particular technology lines or to disrupt existing patent fences. In other words, patents can be used to block competitors from developing a competing alternative technology (Heeley *et al.*, 2007) or to unlock existing patent barriers. This section therefore shifts the emphasis to the second face of technology acquisition. Besides the rent appropriation character of patents, patents can block successive patent applications by threatening their novelty requirements (Scotchmer, 1991; Shapiro, 2001; Jaffe and Lerner, 2004; Ziedonis, 2004). Against the background of a surge in patent applications worldwide over the past decade that was not accompanied by a proportional increase in R&D investment but by an increase in the number of legal disputes over patent rights (Lanjouw and Schankerman, 1997), survey evidence for the US and Europe has shown that the protection of intellectual property, i.e. what patents were originally conceived for, in order to stimulate incentives to innovate by granting the inventor a temporary monopoly on her invention, is not what makes them attractive in the first place (Arundel *et al.*, 1995; Cohen *et al.*, 2000). The value of patents is often determined instead by their importance in licensing and M&A negotiations and by their capability to block the inventions of competitors. A recent survey for Germany shows that more than 40 percent of patenting firms apply for patents in order to block competitors (Blind *et al.*, 2007). Blind et al. (2007) find particularly striking evidence of "defensive blocking" through patenting. They define this as a forward-looking protection strategy directed at protecting the firm's position in technology markets. Such a strategic use of patents leads to a complicated network of overlapping intellectual property rights, which has been characterized as a "patent thicket" (Shapiro, 2001). It bears many legal pitfalls for patent applicants and there is a considerable risk of underinvestment in the commercialization of downstream technologies in situations where too many licenses from different patent owners would be required in order to do so (Heller and Eisenberg, 1998). In fact, as a possible way out of the patent thicket Graff et al. (2003) propose to acquire firms with blocking patents.

Obviously, acquiring firms will have a substantial interest in those technologies that have a blocking potential. On the one hand, acquirers might find themselves in a situation where their own R&D activities are hindered as they are confronted with existing patent fences. The strategic importance of being able to continue with these R&D activities will presumably be higher when considerable (sunk) investments have already been made in a particular technology line, when major products or services offered by the firm depend on further development of a particular technology or when firms want to diversify into a promising product market. On the other hand, acquirers might want to build up their own blocking potential against undesired competition. Both situations impact the value creation potential as they promise unique and private cash flows to be realized by the acquirer after the merger. Our third hypothesis hence reads:

Hypothesis 3: The price paid for an acquisition target increases with the blocking potential of the target's patents.

Moreover, we hypothesize that acquiring firms will have a particular interest in those target patents that have a blocking potential *and* that are closely related to the technology employed by the acquirer. This interaction represents the situation that, on the one hand, acquirers might want to "un-block" their own R&D activities or that, on the other hand, acquirers might want to create a particularly strong patent fence. Both motivations should presumably directly translate into a higher willingness to pay for such patents. This leads to our final hypothesis:

Hypothesis 4: The price for an acquisition target with blocking patents that are closely related to the acquirer's technology is higher than for a target without these patents.

In conclusion, we argue that technological assets of a potential target firm are a major driver for the price paid in the market for corporate control. In the following, we empirically disentangle the importance of the different faces of technology in firm takeovers. The next section outlines our empirical model to test our theoretical considerations.

3 Methods

3.1 Empirical Model

In our empirical model we explain the deal value of the acquisition, i.e. the price paid by the acquirer, by the target firm's assets and characteristics. As outlined above, our main focus is on the contribution of the two functions of patents for the deal value paid by the acquiring firm. We define the acquired company in a hedonic way as a bundle of its characteristics and assets X (Hall, 1988; Gompers and Lerner, 2000). The deal value of the target V is a function of those characteristics *X*. In the presence of efficient markets and full information *V(X)* would equal the price at which the target firm's assets are traded. Our empirical model then shows how the deal value is decomposed with respect to the target firm's characteristics and assets:

$$V(X) = f(X) + u \qquad (1)$$

where *u* is the error term of the empirical model which can be estimated using ordinary least squares (OLS). The target's bundle of characteristics *X* is defined as its total assets, return on assets, total liabilities and firm age. To test our hypotheses on the value of technologies we introduce different measures for the target's technological assets: the patent stock, the forward citations that its patents received in a five-year window and a measure of the patents' capability to block other patents. Moreover, we include a measure of technological relatedness that is subsequently interacted with the measure for blocking patents. Their definitions will be detailed in the following section. Finally, measures for prior acquisition experience as well as industry and year dummies are included to control for the different economic conditions and stock market levels during the period from 1999 to 2003. All continuous variables reflect the target's assets and characteristics in the year prior to the completion of the acquisition; they are all measured in logarithms to take account of their skewed distributions.

3.2 Data sources and measures

Our main source of data is the merger and acquisition database ZEPHYR from Bureau van Dijk Electronic Publishing. We identified firms located in Europe that were subject to an acquisition by a corporate or private equity investor in the five-year period from 1999 to 2003. Moreover, only targets from the manufacturing sector were included as patents are of minor importance for services. Our sample consists of 479 target firms with known deal values. Financial information on the firms is taken from Bureau van Dijk Electronic Publishing's Amadeus database. As our main focus is on innovative assets, we linked the acquisition targets to their patent history as patent applicants at the European Patent Office (EPO). Based on a computer supported text based search algorithm, target firms and patent applications were linked to each other using firm names and addresses in both databases. Each potential match proposed by the search engine was checked manually.

Focusing on the target's technological assets, we use three variables to capture different aspects of the target companies' innovative activities. In line with several recent papers all measures are based on the EPO patent data. First, we use the patent stock (*PS*) to proxy the number of technologies the firm owns, which is calculated as follows:

$$PS_t = PS_{t-1}(1-\delta) + patent\ applications_t \qquad (2)$$

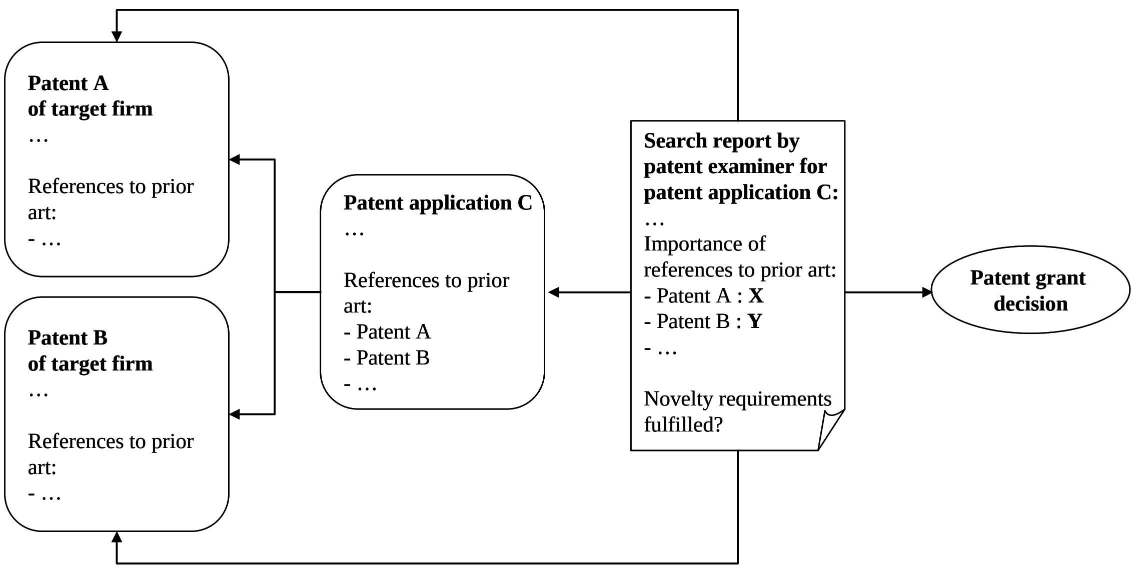
where δ represents the constant knowledge depreciation rate, which is set to 15 percent as is standard in the literature (e.g. Hall, 1990).[1] This variable is used to test the importance of the quantity of patents held by the target company for the acquirer (Hypothesis 1). The second variable is the citation rate, which describes the value of the acquired firm's patent portfolio proxied by the sum of citations the patents received in a five-year window after the patent publication date (Hypothesis 2). Patent citations have frequently been shown to be a reliable measure of patent quality and value (Trajtenberg, 1990; Harhoff *et al.*, 2003; Harhoff et al., 2005b). Patents receive citations when subsequent patents make reference to relevant prior art during the patent application process. The more frequent a patent is cited by other patents, the higher is its presumable importance in a particular technology field. The citations are hence called "forward citations". As the citations a firm receives are highly correlated with its patent stock, we divide the number of citations by the number of patents for our empirical specification. The estimated coefficient can be interpreted as the premium an acquiring firm pays for the value of the target's patents on top of the price paid for the patented technologies themselves.

The third technology measure we use is a proxy for the potential of patents to block other patents (Hypothesis 3). The blocking potential measure we propose is also based on forward citations, making particular use of the citation system at the EPO. For each EPO patent the patent examiner prepares a so-called "search report" that lists all important documents which are considered as prior art. Based on the search report a decision is made as to whether a patent application is novel enough to be granted. An interesting feature of the EPO search reports as opposed to search reports at the United States Patent and Trademark Office (USPTO) is that references to prior art are classified according to their importance for the patent filing. Prior art which threatens the novelty requirement of the patent application is thus made visible. In the search report, references made for individual claims in the patent application are marked with an "X" if the invention cannot be considered to be novel or

[1] Dating patents according to their application date as opposed to the granting date conforms with common practice (e.g. Griliches, 1981). The application date has the advantage of being closer to the actual completion of the invention.

cannot be considered to involve an inventive step when the referenced document alone is taken into consideration. References are marked with a “Y” if the invention cannot be considered to involve an inventive step when the referenced document is combined with one or more other documents of the same category, such a combination being obvious to a person skilled in the art (Harhoff and Reitzig, 2001; Harhoff et al., 2005a,b). A patent can still be granted (although this is less likely) if it has many references classified with X or Y. This can be the case for patent applications with many claims. X and Y references may only pertain to single claims and the remaining claims can be strong enough to get a (modified) application granted. All forward citation measures are constructed based on the EPO/OECD patent citation database. Patent equivalents, i.e. if a particular invention is patented at two different patent offices, are taken into account. If patent equivalents were ignored, the number of forward citations a patent receives would be significantly underestimated (Harhoff et al., 2005b). Figure 1 gives an overview of the patent application procedure at the EPO.

Figure 1: Patent application procedure at the EPO



We assume that patent A and patent B are held by a potential target firm. Both patents are cited by an incoming patent application C as prior art. In the search report, the patent examiner evaluates the importance of the references made for a particular claim by assigning a code letter “X” and “Y”, respectively (for a full description of all EPO code letters see Harhoff et al., 2005a,b). We use the sum of X and Y citations that patent A and patent B receive in a five-year window to proxy their value as blocking patents. To account for the high correlation between citations received and the subset of X or Y citations received we normalize this measure by the total number of forward citations. Hence we use the percentage of X and Y citations in order to represent the threatening power of the patents. Again, the estimated coefficient depicts the premium that acquiring firms pay for the blocking potential of the target company's patents on top of what they pay for the patented technologies and their value as measured by citations.

To control for technological proximity of the patent portfolios of acquiring and target firm we use the proximity measure introduced to the patent literature by Jaffe (1986). In order to calculate this measure we determined patent stocks for each firm, categorized into 2-digit technology classes according to the International Patent Classification (IPC). This yields a technology vector F for each target i and acquirer j, which can be interpreted as their technology portfolio. Using these vectors (as a percentage of the total patent stock) technological proximity T is now calculated as:

$$T_{ij} = \frac{F_i F_j}{\sqrt{(F_i' F_i)(F_j' F_j)}}; \qquad 0 \leq T_{ij} \leq 1. \qquad (3)$$

Prior literature suggests an inverted U-shaped relationship between the relatedness of the acquirer's and target's technology portfolio and innovation performance (Ahuja and Katila, 2001; Cloodt et al., 2006). On the one hand, new acquired knowledge may provide additional stimuli and information to the acquirer's knowledge base. On the other hand, acquired knowledge that is too closely related to the existing knowledge is presumably of limited benefit. This pattern should be reflected in the price that acquiring firms pay for their purchase, as the deal price is supposed to capture the expected value of the innovative assets for the acquiring firm. To allow for such a non-linear relationship between deal value and technological proximity, we also use a squared term of the proximity measure in our empirical model.

Moreover, to test hypothesis 4 we define a binary variable that equals 1 if technological proximity between the M&A partners is larger than zero and the target firm owns patents with a blocking potential. For all other constellations the dummy equals zero. Sticking to a binary variable is necessary in order to avoid multicollinearity in the presence of multiple technology measures. The estimated coefficient of the dummy shows whether blocking patents are more important for acquiring firms which are active in technology areas related to the acquisition target.

Regarding the non-technological assets, we include the following: the total assets; the return on assets, defined as the sum of profits earned by the firm and the capital gains of assets over the market value of assets in the year prior to the acquisition; the total liabilities of the target over total assets; and the age of the target, measured in years. Finally, besides industry and year dummies, our regressions control for prior acquisition experience. We include a dummy variable that is set to 1 if the acquiring firm acquired at least one firm in the three years before the focal transaction.

4 Results

4.1 Descriptive statistics

Table 1 presents the descriptive statistics for the sample of target firms, divided by patent holders and non-patent holders. All continuous variables except for the deal value refer to the year prior to completion of the acquisition. First of all, the descriptive statistics show that, on average, firms with EPO patents are significantly larger than those without patents. Significant differences can also be found for the totals assets, the return on assets as well as the liabilities over assets while no significant differences can be found for the age of the firm or the acquisition experience of the acquiring company. In this respect, it is particularly remarkable that patent holding firms are on average unprofitable compared to those firms without patents.

Regarding the technological assets of the target, Table 1 shows that acquisition targets have a patent stock of almost 42 patents. Moreover, every patent receives on average 0.8 citations within a five-year window after publication. 17 percent of the firms with a patent portfolio receive no citations at all. Further, the descriptive statistics show that the share of blocking citations (i.e., X and Y citations) over total citations is almost 30 percent. Technological proximity is on average 0.021, which means that the "technology vectors" of the average target and acquiring firm span an angle of 0.021 degree. Table 1 further shows that 30 percent of the acquisitions that involve patenting targets are related to each other in terms of their patent portfolio. Lastly, Table 1 shows that 22 percent of those acquisitions involve target patents with a blocking potential as measured by a dummy that equals one if the target firm's patent portfolio has blocking potential.

Table 1: Descriptive statistics

	Target Firms with EPO patents		Target Firms without EPO patents		T-Tests	
	90 observations		389 observations		H0: means are significantly different	
	Mean	St. dev.	Mean	St. dev.	Mean difference	
deal value	300.748	601.752	72.807	217.68	-216.187	***
total assets	190.533	368.428	92.335	278.731	-97.363	***
return on assets	-6.425	24.672	0.758	18.080	5.909	***
liabilities/assets	0.513	0.265	0.604	0.262	0.073	***
age of firm (years)	23.048	23.904	22.892	24.101	-0.458	
acquisition experience of acquiring firm	0.244	0.432	0.193	0.395	-0.043	
patent stock	41.981	114.729				
patent stock/assets	0.950	2.875				
# citations /# patents	0.849	0.761				
# XY citations /# citations	0.280	0.273				
technological proximity	0.021	0.070				
technological proximity > 0	0.300	0.461				
# XY citations * technological proximity	0.222	0.418				

***, **, * indicate statistical significance at the 1%, 5%, 10% level.

To further explore the relationships between the variables, Table 3 in the appendix reports the bivariate correlations. It turns out that both the technological and the non-technological assets are positively correlated with the deal value. Besides the total assets which drive the deal value all three technology measures are positively and significantly correlated with the deal value. Based on these findings our first three hypotheses receive support. The relationships will be further explored in the following section.

4.2 Multivariate analysis

Table 2 shows the results from the OLS estimation in three different model specifications. Focusing on the value of technologies, the first specification, which includes the volume and value of technological assets, suggests that both volume and value drive the deal value which confirms our first and second hypothesis. This result remains robust across the three specifications. Apparently, patents have a technological value that can be exploited in the merged company or through selling the patents after the acquisition. Moreover, patents work as a signal for the technological fitness of a potential target company. In addition, firm acquirers will have the opportunity to redeploy resources and realize the benefits from technology complementarities.

Model 2, which takes the value of blocking patents into account, shows that acquiring firms are highly interested in securing or enhancing their position in technology markets through firm acquisitions. Therefore, hypothesis 3 receives support. Our third model shows a positive and significant interaction term, which means that acquiring firms are highly interested in those patents that have a blocking potential and that are closely related to their own technology base. Hypothesis 4 hence receives support. The interaction term takes over the separate effects from the blocking citations and technological proximity measures. Including the interaction term in the regression does not alter the coefficients discussed above. Results turn out to be robust across the three model specifications.

Apart from the variables used to test the hypotheses the results show that the relatedness of the target firm's technology portfolio is of high importance for the acquiring firm. As expected, the coefficients hint at an inverted U-shaped relationship between the relatedness of the technology portfolios and the deal value. Acquiring firms are hence willing to pay for technological assets that provide opportunities for cross-fertilization. However, the deal value is negatively affected when the technology portfolios are too closely related. Similar results for the relationship between technology relatedness and innovation performance (Ahuja and Katila, 2001; Cloodt et al., 2006) can therefore be extended to the market for corporate control. In fact, the price paid for a target should reflect the future innovation potential of the merged entity.

Furthermore, Table 2 shows some interesting results regarding the remaining variables that refer to the target's characteristics and assets. Focusing on total assets, the coefficients for both types of investors are positive and significant across all three models. Referring to the return on assets, there is only a rather small positive effect on the deal value. Apparently, the higher the profitability of the target the higher also the deal value which makes intuitively sense as those targets provide more opportunities to recover the acquisition price. All other firm characteristics as well as the acquisition experience of the acquiring firm turn out to be insignificant. Finally, industry and year dummies are jointly significantly different from zero as LR-Chi^2 -tests show (Table 2).

Table 2: Ordinary least squares regression for the deal value

	(1) Coefficient (standard error)		(2) Coefficient (standard error)		(3) Coefficient (standard error)	
patent stock/assets	0.174	***	0.152	**	0.155	**
	(0.066)		(0.068)		(0.067)	
# citations /# patents	0.143	***	0.118	**	0.125	**
	(0.054)		(0.049)		(0.050)	
# XY citations /# citations			0.792	**	0.614	
			(0.395)		(0.405)	
technological proximity	8.430	***	7.320	**	3.110	
	(3.015)		(3.046)		(3.740)	
$(\text{technological proximity})^2$	-18.471	***	-15.657	**	-8.378	
	(6.337)		(6.576)		(8.064)	
# XY citations * technological proximity					0.704	**
					(0.338)	
log(total assets)	0.526	***	0.513	***	0.502	***
	(0.045)		(0.045)		(0.046)	
return on assets	0.012	***	0.012	***	0.012	***
	(0.003)		(0.003)		(0.003)	
liabilities/assets	0.016		0.030		0.027	
	(0.280)		(0.279)		(0.278)	
log(age of firm)	0.087		0.088		0.087	
	(0.076)		(0.076)		(0.076)	
acquisition experience of the acquiring firm	0.135		0.100		0.109	
	(0.188)		(0.184)		(0.186)	
constant	4.680	***	4.792	***	4.914	***
	(0.616)		(0.619)		(0.622)	
8 industry dummies	$\text{LR-Chi}^2 = 14.13$*		$\text{LR-Chi}^2 = 14.17$*		$\text{LR-Chi}^2 = 15.38$**	
4 year dummies	$\text{LR-Chi}^2 = 16.84$***		$\text{LR-Chi}^2 = 17.89$***		$\text{LR-Chi}^2 = 18.16$***	

***, **, * indicate statistical significance at the 1%, 5%, 10% level.

We use heteroscedasticity-consistent Huber/White standard errors, which are clustered to account for multiple acquisitions by the same acquirer.

5 Discussion

Our results have shown that technology acquisitions clearly have two faces: one directed at acquiring valuable technology that can be used in combination with existing technology to appropriate the returns from innovation activities; and another that is directed at improving the position of the acquiring firm in technology markets through accumulating those technologies that have a potential to block competitor technologies. Acquiring firms obviously succeed in identifying the technology employed by a target company. They are found to pay higher prices for targets with valuable technological assets. In other words, acquirers seem to have developed the necessary absorptive capacity for identifying valuable technologies. Our results have demonstrated that the technological content and the opportunity to exploit protected knowledge in combination with one's own knowledge stocks are of great importance. Acquirers deliberately strive to complement their own technology portfolio by redeploying technological resources in order to increase their own innovative capabilities (Cassiman *et al.*, 2005; Hussinger, 2005; Sorescu et al., 2007).

Moreover, patents with a blocking potential are particularly interesting for acquirers. This result becomes more pronounced when the blocking potential is interacted with the technology relatedness of the acquiring and target firms. Acquiring firms deliberately identify targets with patents that could, on the one hand, be used to extend their present R&D activities into areas that were previously blocked by competitors and, on the other hand, provide a basis to protect and secure the firm's own technology domains. Patents in those acquisitions therefore always serve not only a technological but also a strategic objective in technology markets (Graff et al., 2003; Blind *et al.*, 2007). Both provide opportunities for unique and private post-merger cash flows.

In this respect, our results extend existing knowledge on the motivation for firm acquisitions. For the first time, the two key functions of patents – as monopoly rent devices and as blocking instruments – are shown to be reflected in the market for corporate control. In particular, the deliberate acquisition of patents with a blocking potential by acquiring firms has a significant impact on the allocation of technological assets in the market. It hints at a concentration of key technologies in technology markets through acquisitions. This links our results with an important implication for competition policy. M&A transactions, to a large extent, are carried out in the intention of creating barriers to entry in specific technology markets and, hence, decreasing competition. Merger control authorities should therefore have an eye on the concentration of key technologies in the market. This would, however, also require the competition authorities to develop a set of criteria defining a concentration of key technologies along the lines of the guidelines for critical market shares in product markets. These could actually be based on an assessment of the intellectual property held by the then merged entity. In case such a concentration is detected a possible remedy would be to commit the merging firms to allow competitors to get a license on the respective technology. An example for this is the merger of Pfizer and Pharmacia that was only allowed under significant remedies and divestures including compulsory licensing of their patenting technologies to third parties (Commission of the European Communities, 2003).

The tendency towards concentration in technology markets also needs to be reflected in the technology strategy of firms that do not merge. It is an important managerial implication that firms need to keep a careful eye on the key technologies in their industry and identify the underlying intellectual property. They need to understand that reorganization in the industry through M&A transactions could be directed at a concentration of key technologies and that, through redeployment resulting in a new combination with other technological assets, these technologies might serve as a basis to threaten the novelty requirements of future patent applications. Firms should however also consider taking a pro-active approach in technology acquisitions. This would argue for deliberately identifying relevant acquisition targets whose IPR may be used as a strategic weapon in technology markets. Moreover, market entry strategies could be prepared by acquiring key IPR first to deter competitors from entering before acquisitions focused on gaining market share are made. In this regard, a complementary strategy would be to secure important IPR early on through licensing agreements.

6 Conclusion and future research

This paper has examined a sample of European firm acquisitions and shown that technology matters considerably in firm acquisitions in that it proves to be a major driver for the deal value. Our results, however, provide no indication of how innovation performance in the merged entity develops following the deal. Previous studies have indicated that the interpretation of the post-merger developments in R&D is not that straightforward. A decrease in innovation activity after an acquisition might correspond to post-merger integration difficulties (such as problems in the integration of two firms’ R&D departments) that hinder the exploitation of the joint capacities (Ahuja and Katila, 2001; Grimpe, 2007). However, a post-merger decrease in technology outcome can also be the response to a dominant position of the merged entity in technology markets (market power effect), which reduces the incentives to innovate. A critical prerequisite for that, however, would be the ability to track the post-merger development of the target company, whether it is subsequently integrated and – if so – to what extent and what consequences this has for the once legally independent entity. Future research should hence aim at providing a picture of the value creation processes that refer to the exploitation of similarities, complementarities or the strategic value of patents. Particularly the last aspect requires further investigation. To narrow down the managerial implications that arise from the blocking potential of patents and their role in technology acquisitions, it would be helpful to provide evidence on how the position of the firm in technology markets can actually be improved and how the process of value creation from exploiting the technological content and the blocking potential can be harmonized. In other words, the interactions of the different motivations for technology acquisitions need to be explored further. Case studies might, in this situation, provide useful insights. The disadvantages of case studies notwithstanding, most prominent the limited number of cases that can be focused on, at this early stage of research about the two faces of technology acquisition case study approaches could provide helpful guidelines for data collection for further large-scale research, on the one hand, and would allow managers more discretion to detail the actual post-merger efforts and implication for the R&D process within the merged entity.

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Appendix

Table 3: Bivariate correlations

Variables	1.		2.		3.		4.		5.		6.		7.		8.		9.		10.
1. log(deal value)	1.000																		
2. log(total assets)	0.501	***	1.000																
3. return on assets	0.066		-0.128	***	1.000														
4. liabilities/ assets	-0.087	*	-0.026		-0.158	***	1.000												
5. log(age of firm)	0.086	*	0.053		0.111	**	-0.069		1.000										
6. patent stock/ assets	0.111	***	-0.106	**	0.100	**	-0.049		0.044		1.000								
7. # citations/# patents	0.188	***	0.122	***	-0.041		-0.030		0.107	**	0.061		1.000						
8. #XY citations/# citations	0.213	*	0.183	***	-0.085	*	-0.104	**	0.033		0.194	***	0.236	***	1.000				
9. technological proximity	0.084		0.084	*	-0.106	**	-0.089	**	-0.013		-0.010		0.178	***	0.111	***	1.000		
10. (technological proximity)^2	0.036		0.052		-0.077	*	-0.079	*	-0.008		-0.007		0.156	***	0.056		0.922	***	1.000
11. acquisition experience	0.015		0.006		-0.116	***	-0.004		-0.003		0.005		-0.037		0.093	**	0.046		0.069

***, **, * indicate statistical significance at the 1%, 5%, 10% level.