Firm Acquisitions and Technology Strategy: Corporate versus Private Equity Investors

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Abstract

The role and importance of technology in firm acquisitions significantly differs depending on the motivation for the acquisition. Distinguishing between corporate and private equity investors we provide empirical evidence on the different role of technologies for a sample of European mergers and acquisitions (M&A) in the period from 1997 to 2003. Our results suggest that corporate investors are more interested in patent volumes and in rather valuable patents; especially in those patents with a blocking potential. Corporate M&A, hence, increase concentration in technology markets. For private equity investors, in contrast, patents serve primarily as signals. As private equity investors pay on average higher prices for their targets they might crowd-out corporate investors and hence prevent technology transfers to strengthen the innovative capabilities of the acquirer. Moreover, this result has implications for competition policy in that corporate M&A may decrease competition in technology markets.

Keywords: M&A, technology, patents, corporate and private equity investors

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1 Introduction

Gaining access to technological knowledge located worldwide has, for a number of years, been one of the top motives and objectives of mergers and acquisitions (M&A) (Graebner, 2004). In acquiring technology from external sources, firms aim at promoting innovations that will improve their own competitiveness (Brockhoff, 1997). Under the accelerating pressure of timing in innovation, M&A transactions give access to technology as a firm-specific resource enabling firms to pursue a resource-based strategy (Barney, 1991; Conner, 1991; Peteraf, 1993; Wernerfelt, 1984). This strategy aims at accumulating valuable technological assets combined with an ambitious intellectual property rights policy as a firm's patent portfolio is assumed to have a direct influence on innovative capacities (Mansfield, 1986), especially in case of technological complementarities between the target and acquiring firm (Cassiman *et al.*, 2005; Hussinger, 2005). These resource-based motivations for acquisitions have gained a lot of attention in the literature (see Veugelers (2006) for a survey), but they only capture one part of the firm acquisitions that take place. Another type of acquirers are private equity investors who aim at siphoning off the profits from financing the targets' activities. Private equity investors may be venture capitalists who typically invest in early stage inventions – rather than buying technologies in order to commercialize them (Wright and Robbie, 1998). Private equity also includes buyouts of undervalued or distressed companies to reap the profits from disentangling resources and stripping the assets (Kucher and Meitner, 2004). For private equity investors, the technology field is supposed to be of less

importance as it must not necessarily fit into an existing technology portfolio.[2] In fact, the literature on company ownership suggests that the type of acquirer has a considerable impact on objectives, corporate strategy and performance (Thomsen and Pedersen, 2000). This is assumed to be reflected in profit goals, dividends, capital structure and growth rates (Short, 1994).

We transfer this stream of literature to the context of mergers and acquisitions and draw a broad distinction between corporate and private equity investors. A corporate investor, on the one hand, typically represents a horizontal acquirer active in the same industry as the target company. Besides the acquisition of technology to complement own resources, corporate investors frequently aim at gaining market share, getting access to certain national markets and products, increasing efficiency as well as eliminating competition (Chakrabarti et al., 1994; Mukherjee et al., 2004). Private equity investors on the other hand are mainly motivated by financial success to be obtained in a relatively short time frame (Thomsen and Pedersen, 2000). This type of investor might supply private equity to the target firm in order to initiate often broad and widespread reorganization processes as well as to impose tight financial and operational controls with the objective to increase the target's competitiveness and value. Depending on the maturity of the target, private equity can take on the form of venture capital which is typically less risk averse (Gompers and Lerner, 2001; Wright and Robbie, 1998). Moreover, private equity can implicate significant benefits for the target, e.g. a better mobilization of research and commercial partners (Folta and Janney, 2004) or by providing management advice (Kaplan and Strömberg, 2003). In any case, the acquirer's engagement at the target is limited in time and is geared

[2] Exceptions are private equity investors that follow a buy-and-build strategy. Such acquirers sequentially acquire several firms to form a competitive firm portfolio.

towards a successful exit, e.g. in the form of an initial public offering (IPO) at the stock market, a trade sale to a corporate investor or a secondary purchase of another private equity firm (Brav and Gompers, 1997).

Both corporate and private equity investors frequently show a high interest in the technologies of the target firm. Corporate investors typically aim at complementing their own technology portfolio and at enhancing technological core competencies (Ahuja and Katila, 2001; Cassiman et al., 2005; Hussinger, 2005; Frey and Hussinger, 2006). Often they necessitate the ownership of intellectual property held by the acquired firm in order to continue or expand ongoing research (O'Donoghue et al., 1998; Lerner et al., 2003). In contrast, the interest of private equity investors – and in particular venture capital investors – is mainly concentrated on bringing a new and prospective technology to the market or on leveraging technological assets at a later exit date. To a large extent, a firm's endowment with technological assets will hence determine the price that is paid by corporate or private equity investors at the market for corporate control. It has remained unexplored so far, however, what particular value both types of investors attach to a target's technological assets while accounting for the different motivations of the investors.

The contribution of this paper is to shed light on the question what particular importance acquired technologies have for different types of investors. Based on a sample of European firms that were subject to acquisitions in the period from 1997 to 2003 our results suggest that private equity investors systematically overvalue their targets not only relative to the market (Jensen and Ruback, 1983), but also relative to corporate acquisitions. With respect to the innovative assets we find that corporate investors rather invest in the future potential of the target's technologies. Digging deeper into the strategic dimension of technology acquisitions our results indicate that

corporate investors have a significant interest in patents with a potentially blocking character, whereas those do not matter for private equity investors. We contribute to the literature on patent indicators (Trajtenberg et al., 1997; Trajtenberg et al., 2000) by proposing a new measure to assess the blocking potential of patents, which is based on forward patent citations using detailed information on the patent application process at the European Patent Office (EPO).

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 shows descriptive statistics. The empirical test of our hypotheses is provided subsequently. Section 5 discusses our results and provides implications for management. The last section concludes with a critical evaluation of the study and points out potentials for further research.

2 Conceptual framework

2.1 Corporate versus private equity investors: differences in the financing of acquisitions

Over the last decade, M&A activity has increased sharply with only a short interruption after the year 2001 which has in total led to some kind of a new “merger wave”. Both the number of deals as well as the deal volumes climbed on new record highs in 2006 (Grimpe, 2007a). This development, however, was not only due to a growing number of “mega mergers” but also to increased investments aside the public equity market. Private equity, including its subtype venture capital, also leaped to a record level of €71.8 billion in 2005, more than two and a half times the amount of €27,5 billion raised the year before (EVCA, 2006). Among the institutions investing into private equity funds, pension funds were the largest contributor, followed by

banks. Particularly pension funds increased their investment allocation to private equity funds in the belief that the returns are largely uncorrelated with public markets (Gompers and Lerner, 2001). The assumption here is that firms receiving private equity remain privately held for a number of years. However, there appears to be a number of linkages between the public and private equity market that become apparent when the investor prepares its exit, e.g. through an initial public offering (Brav and Gompers, 1997).

Regarding the structure of private equity investments buyouts represented 68.2 percent of the total amount but only 22 percent of the total number of investments. Seed investments accounted for only 0.2 percent by amount and 4 percent by number while start-up investments represented 5 percent by amount and 29 percent by number. A share with 42 percent by number and 21.8 percent by amount is due to expansion investments. The remainder refers to replacement capital (EVCA, 2006). This distribution makes clear that the majority of private equity deals refers to venture capital investments (seed, start-up and expansion) which, however, only correspond to 27 percent of the total amount invested. The different types of private equity investments have implications for the financing methods of the deal. Private equity buyouts are typically structured as leveraged buyouts with a high share of debt while venture capitalists typically do not employ debt. In fact, venture debt can be a risky tool for early-stage start-ups. The loans need to be repaid over time, which can considerably burden a start-up if the business model does not yet generate revenue. Moreover, venture lenders as creditors have the first right to demand repayment, before equity investors.

A major advantage of debt financing is that it can be raised at significantly lower costs than equity, especially when interest rates are low as they have been worldwide

for a couple of years now. By employing a share of 70 to 80 percent of debt to finance an acquisition private equity investors have the chance to considerably leverage their internal rate of return (Arundale, 2002). In contrast to that, corporate investors tend to finance their transactions with a larger share of equity, e.g. by an exchange of stock. The higher costs of equity have in turn an impact on the evaluation of potential acquisition targets. Hence, the higher the expectations of the shareholders for the profitability of their equity the lower the price will be that the corporate investor can afford to pay for the target. Private equity investors will therefore presumably be able to afford a higher control premium until the net gain from the acquisition turns less favorable. Moreover, as the EVCA figures indicated, there has been an abundance of funds over the last years that private equity investors need to invest into prospective target companies. This abundance of funds might even crowd out corporate investors.

Another consideration is that private equity investors typically lack the knowledge to evaluate target firms with regard to their technological endowment. In other words, there are information asymmetries between private equity investors on the one hand and corporate investors as well as the vendors of the target firm on the other hand. The target's vendors might hence succeed in obtaining a higher price for the firm from private equity investors compared to a sale to a corporate investor, especially when the corporate investor comes from the same industry and, hence, possesses relevant technological knowledge. This leads to our first hypothesis:

Hypothesis 1: Private equity investors systematically pay a higher price for acquisition targets.

2.2 The role of innovative assets in M&A transactions

2.2.1 The value of technology in M&A transactions

The different acquisition objectives and financing conditions might also be reflected in the price at which the target's innovative assets are traded. Several acquisition motives can be summarized as the outcome of a search for external technologies. One important objective is the realization of *economies of scale* in R&D (Cassiman et al., 2005). In response to a technology acquisition R&D fixed costs can be spread over the larger post-acquisition R&D output of the merged entities and costs can be further decreased as duplicated inputs for the same output are eliminated. A second important factor in technology acquisitions are *economies of scope* in R&D (Cassiman et al., 2005). Post-acquisition R&D investments can be jointly optimized using the fact that costs can be spread over different R&D projects. Cost reductions can be realized because personnel, laboratories and technical instruments can (in parts) be used in different projects. A further important motivation for M&A transactions – that has received quite some attention in the past (see Veugelers (2006) for a survey) – are expected *synergy effects* from the combination of two technology portfolios. The target's technology portfolio often complements the technology stock of the acquiring firm (Ahuja and Katila, 2001) and enhances the technological core competencies of the merged entity (Cassiman et al., 2005; Hussinger, 2005). Through a close collaboration after the acquisition the *level of spillover effects* from R&D investments can increase (Arrow, 1962; D'Aspremont and Jacquemin, 1988). Further, *intellectual property rights* often play an important role for corporate M&A transactions because acquiring firms can necessitate the ownership of intellectual property held by the target firm in order to continue or expand ongoing research (O'Donoghue et al., 1998; Lerner et al., 2003). This leads to the conclusion that corporate investors carefully

screen technology markets as they are interested in acquisition targets that complement their technology portfolio most effectively (Frey and Hussinger, 2006).

In contrast, the interest of private equity investors – and in particular venture capital investors – is mainly concentrated on bringing a new and prospective technology to the market or on leveraging technological assets at a later exit date that could include a trade sale of the firm to a corporate investor. Whereas corporate investors presumably put a high value on technologies that reached their commercialization-stage, e.g. on already patented technologies, private equity investors often invest in early-stage technologies. In biotech for example many technologies would not have reached the market phase without the support of private equity investors because the necessary steps in order to get there, as for example expensive medical test series, are often unaffordable for small start-up firms (Folta and Janney, 2004). Particularly venture capital has thus been shown to considerably spur innovation (Fenn and Liang, 1998; Kortum and Lerner, 2000).

The fact that private equity acquirers invest in more risky projects as compared to corporate investors who are interested in rather de-risked technological assets illustrates the different nature of technological assets in acquisitions for both types of investors. Corporate investors are interested in technologies and intellectual property with a particular *technological content* in order to complement their own innovation processes (Cassiman et al., 2005) and technology portfolio (Hussinger, 2005; Frey and Hussinger, 2006). In contrast, private equity investors are typically not interested in specific technologies and their technological knowledge is often limited. Hence, for private equity investors patents and the innovation history of the acquisition target in general are supposed to rather serve as *signals* in the first place (Ndofor and Levitas, 2004; Levitas and McFadyen, 2006). A patent acts as a positive signal as it shows that

the firm in question has already proven its technological expertise and capabilities and that it has a well-functioning laboratory and inventor team. Patents, thus, reduce the uncertainty associated with the acquisition for potential investors. This leads us to the assumption that the signalling value of patents is larger for private equity investors than for corporate investors that often aim at complementing their own technology portfolios. In line with this assumption we expect that the stock of patents is of less importance for the private equity investors because one patent already has a signalling character and it should not matter for private equity investors whether the target firm has a patent stock of two or of 20 patents, whereas this should be important for corporate investors.[3]

Hypothesis 2a: The price paid for an acquisition target with a patent is ceteris paribus higher than for a target without a patent.

Hypothesis 2b: Corporate investors pay, on average, more for a target's patent stock than private equity investors.

Referring to the argumentation above, corporate investors are more interested in rather de-risked patents and their value in complementing the own patent portfolio or in future licensing and M&A negotiations than private equity investors. We thus hypothesize:

Hypothesis 3a: There is a positive premium due to highly cited, i.e. more valuable, patents.

Hypothesis 3b: Corporate investors pay, on average, more for valuable patents than private equity investors.

[3] We use the patent stock as a measure that proxies also technological assets. Hussinger (2006) has shown that there is a high correlation between patents and the market sales with new products indicating that this variable is appropriate to capture the fact that corporate investors are interested in rather de-risked assets.

2.2.2 The strategic/blocking value of patents

Another objective for M&A transactions is to enhance the position of the merged entity in technology competition (Cassiman et al., 2005; Williamson, 1975). Through the pooling of technological assets the merged entity is in a position to create significant barriers to entry into particular technology lines. This section therefore shifts emphasis on a third function of patents. Besides the knowledge protection character of patents and their signalling effect for potential investors, patents can block other patents by threatening the novelty requirements of successive patents (Scotchmer, 1991; Shapiro, 2001; Jaffe and Lerner, 2004).[4] In fact, survey evidence for the US and Europe has shown that the protection of intellectual property, i.e. what patents are originally made 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 rather determined 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 (see Blind et al., 2007). The authors investigate patenting strategies and how they relate to the actual patent portfolio of firms comparing traditional patenting aiming at the protection of knowledge and competitive patenting strategies as the blocking of competitors. They conclude that there is significant evidence for "defensive blocking" through patenting what they define as a forward-looking protection strategy directed at protecting the firm's position in technology markets. Private equity investors, however, presumably lack

[4] There is a huge body of theoretical literature on the optimal "patent breath", i.e. the degree of the patent protection, from a welfare perspective. The more "narrow" a patent is the easier it is to "invent around" the patent. Surveys on this particular literature are provided by Denicoló (1996) and Takalo (2001).

the necessary in-depth knowledge on technology markets and their future development in order to predict which patents might reduce future technology competition.

Hypothesis 4: Corporate investors pay, on average, more for patents with the capability to block competitors in technology markets, whereas these patents have no value for private equity investors.

3 Data and descriptive statistics

3.1 Construction of the sample

Our main source of data is the merger and acquisition database ZEPHYR of 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 period from 1997 to 2003. Moreover, only targets from the manufacturing sector were included as patents should be of minor importance for services. Our sample consists of 1,445 target firms with known deal values. Financial information on the firms is taken from the Amadeus database of Bureau van Dijk Electronic Publishing. 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.

3.2 Definition of variables and descriptive statistics

Focusing on the importance of technologies we use three different variables to capture different aspects of the innovative activities of the target companies. In line with

many 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:

$$PS_t = PS_{t-1}(1-\delta) + patent\_applications_t$$

where δ represents the constant knowledge depreciation rate, which is set to 15 percent as is standard in the literature (e.g. Hall, 1990). This variable is used to test the importance of the quantity of patents held by the target company for the acquirer (Hypotheses 2a, 2b). Table 1 shows that the average difference in patent volume between both types of acquisition targets, i.e. targets of corporate and private equity investors, is not too big. The difference even diminishes when the average patent value is considered as proxied by the sum of citations the patents received in a five-year window after the patent priority date (Harhoff et al., 2003; Harhoff et al., 2005) (Hypotheses 3a, 3b). It turns out that 79 percent of the patents owned by the targets of corporate and private equity investors receive no citations at all, which indicates a highly skewed distribution of patent value.

The third technology measure we use is a proxy for the potential of patents to block other patents (Hypothesis 4). The measure we propose is based on forward citations, i.e. the citations the patent receives by later patents, making use of the citation system at the EPO. For each EPO patent a search report exists that lists all important documents, which are considered as prior art. Based on the search report it is decided 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 made visible in that way. In the search report those references are marked with an “X” if the invention cannot be considered to be novel or cannot be considered to involve an inventive step when the referenced document is taken into consideration alone. 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 (Schneider, 2006). We use the sum of X and Y citations that a patent receives in a five-year window to proxy its value as a blocking patent. 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 depict the threatening power of the particular patents. Interestingly, the descriptive statistics show that the patents of targets involved in deals with a private equity investor have, on average, twice as many XY citations relative to total citations than the patents acquired from targets of corporate investors.

- Table 1 about here -

Looking at the further differences in between both types of acquisition targets Table 1 shows mean values and standard deviations for the variables of interest. All continuous variables except for the deal value refer to the pre-completion year of the acquisition. First of all, the descriptive statistics show that corporate investors pay, on average, a much higher price for their targets than private equity investors. This is related to the average size of the targets as targets of private equity investors are significantly smaller than firms being subject to horizontal acquisitions in terms of pre-acquisition total assets. Furthermore, targets of private equity investors are, on average, less profitable as indicated by the returns on assets, defined as the sum of the

profits earned by the firm and the capital gains of assets over the market value of assets in the year prior to the acquisition. For both types of acquisition targets the average return on assets is negative. Regarding the short and long term debt of the targets, the liabilities of firms involved in a deal with a corporate investor exceed on average those with a private equity investor which indicates a higher risk associated with such targets. Table 1 further indicates the importance of private equity financing for relatively young firms by showing that targets of private equity investors are on average 10 years younger than those bought by corporate acquirers. The descriptive statistics thus already hint at a considerably different firm profile in which corporate and private equity investors are interested. The findings suggest that private equity investors – in comparison to corporate investors – tend to prefer rather distressed firms or younger firms with unstable revenue and earning flows.

4 Model

4.1 Empirical specification

In our empirical model we explain the deal value of the acquisition by the target firm's assets and characteristics in order to get insights on the role and value of technologies for different types of acquirers. We define the acquired company in a hedonic way as a bundle of its characteristics and assets X. The deal value of the target V is a function of X. In the presence of efficient markets and full information $V(X)$ equals the price at which the target firm's assets are traded. Acquisitions, however, take place at a significant positive premium over pre-announcement stock value (Jensen and Ruback, 1983) indicating that the acquiring firm puts a higher value on the firm's assets than the market does. Our empirical model shows how the deal value is decomposed with respect to the target firms characteristics and assets. As

outlined above, our main focus is on the contribution of different variables capturing the target's innovative assets. We use a flexible specification that allows deals with private equity investor (PEI) involvement to differ from horizontal acquisitions in their intercept as well as in their slope coefficients:

$$V(X) = c + (1 - PEI) * f(X) + PEI * f(c_{PEI}, X) + u \,.$$

u is the error term of the empirical model which can be estimated using ordinary least squares (OLS). c refers to the intercept of the model and c_{PEI} depicts the deviation from the general intercept for private equity investors. c_{PEI} can hence be interpreted as the general premium or discount that private equity investors attach to the target firm. The target's bundle of characteristics (X) is defined as a function f of its total assets, its return on assets, liabilities and firm age. To test our hypotheses on the value of technologies for different acquirers we introduce the target's patent stock, the forward citations that its patents received in a five-year window and a measure for the capability of patents to block other patents into the empirical model. Further, industry and year dummies are included to control for the different economic conditions and stock market levels during the period from 1997 to 2003. All continuous variables reflect the target's assets and characteristics in the pre-completion year of the acquisition; they are all measured in logarithms to take account of the skewness of their distributions.

4.2 Estimation results

Table 2 shows the results from the OLS estimation in three different model specifications. Regarding the intercept, the results indicate that private equity investors pay, on average, significantly more than corporate investors confirming our first hypothesis. Given that the deal value consists of the market value of the

respective target plus a merger premium this shows that private equity investors systematically overvalue their targets not only relative to the market, but also relative to corporate investors.

Focusing on the value of technologies the first specification, which controls for the volume of technological assets only, suggests that patents are valuable for both types of investors (Hypothesis 2a) and that corporate investors valuate patents much higher than private equity investors (Hypothesis 2b). When citations as a measure for the value of the technological assets are taken into account (specification 2) it turns out that much of the attractiveness of patents is explained by their value rather than by the patent stocks (Hypothesis 3a). Further, more valuable patents are more important for corporate investors (Hypothesis 3b). Part of this can be attributed to the different meaning patents have in acquisitions. On the one hand, patents have a technological value. On the other hand, patents work as a signal for the technological fitness of a potential target company. The signaling function is supposed to be the more important feature of patents for private equity acquirers as their acquisitions are supposed to be less content driven in technological acquisitions.

Accounting for the value of blocking patents specification 3 shows that corporate investors are highly interested in securing or enhancing their position in technology markets through the acquisition, whereas there is no such evidence for private equity investors (Hypothesis 4). This most complete specification shows that the major difference between private equity and corporate investors in technologies relates to their different valuation of blocking patents. Including this measure shows that the coefficients of the patent stock and the citation measure are in the same range now and that the only significant difference is in the investors' attitude towards patents that

potentially help to secure their future position in technology markets through their blocking potential. To sum up, all hypotheses can be confirmed by the data.

- Table 2 about here -

Apart from the key variables on patents and citations Table 2 shows some interesting results regarding the other 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. The magnitude moreover indicates that corporate investors attach a higher importance to the target's assets which would confirm our assumption that corporate investors prefer rather de-risked assets. Referring to the return on assets there tends to be a rather small positive effect for private equity investors in the second and third specification which should, however, not be overemphasized. Furthermore, there is a positive significant effect of the liabilities on deal value for corporate investors. This finding should be interpreted relative to the private equity investors. As private equity investors employ a high share of debt to finance the acquisition which is subsequently transferred to the target to pay for the interest they will presumably choose those targets that can bear a higher amount of debt relative to equity in order to reach the desired internal rate of return. Finally, we could not observe an effect of the target's age on deal value neither in case of corporate nor private equity investors. This proves that private equity investors do not generally pay a higher price for younger targets with possibly prospective business models or technologies.

5 Discussion

Our results have shown that technology considerably matters in firm acquisitions – but to a varying extent and depending on the acquirer's identity. First of all, private equity acquirers systematically pay more for a target while controlling for the target's

assets and characteristics. This result can be attributed to a number of reasons: First of all, private equity investors are able to pay a higher price than horizontal acquirers as these transactions are typically structured as leveraged buyouts with a high share of debt while horizontal transactions tend to be financed with equity (Arundale, 2002). Debt can be raised at significantly lower costs than equity which is why private equity investors can afford a higher merger premium. Moreover, private equity investors tend to expect higher returns from their investment in a shorter time. In fact, the results on the target's return on assets confirm that private equity investors attach a higher importance on this financial ratio than corporate acquirers. To achieve this objective, private equity investors can usually take more rigorous steps in the reorganization of the target than a corporate acquirer as the target is still a legally independent firm and – besides a buy-and-build strategy – there are no plans for integration into the parent. In contrast to that, corporate acquirers have to cope with significant integration efforts when they try to integrate the target's technology portfolio into their own portfolio (Grimpe, 2007b). Apart from the high failure rate of such transactions (Miles and Snow, 1984) it is not clear at the time of the acquisition whether the integration of technology portfolios proves to be beneficial for innovative capacities. Corporate acquirers presumably take this risk into account when they decide on the acquisition price. Together with the higher cost of equity this could lead to a higher merger premium of private equity acquisitions relative to corporate acquisitions.

Our results also indicate that signaling using patents has a high importance in M&A transactions. Patents indeed serve as a signal to exhibit technological capabilities which reduces the uncertainty associated with the acquisition for the investors (Ndofor and Levitas, 2004; Levitas and McFadyen, 2006). This seems to be

particularly true for private equity investors as they should typically lack the technological expertise to evaluate a potential target's patent portfolio. What is more, private equity investors should not normally have certain considerations how the acquired technology fits into an existing technology portfolio. This facet is, however, of great importance for corporate investors as they deliberately strive to complement their own technology portfolio in order to increase own innovative capabilities (Cassiman *et al.*, 2005; Hussinger, 2005). Corporate investors, hence, attach a higher value to patents than private equity investors.

But corporate investors also seem to be more successful in securing those targets whose patents exhibit a high value as indicated by the patent citations. Obviously, corporate investors are able to constantly monitor technical change in their industry and identify those patents that are of particular relevance for future innovation trajectories. This result is confirmed when the blocking potential of acquired patents is taken into consideration. Here as well, corporate investors deliberately identified targets with such patents that could, on the one hand, be used to extend present R&D activities into areas that were previously blocked by competitors. On the other hand, these patents provide a basis to protect and secure own technology domains. Patents in corporate acquisitions therefore always seem to serve a technological but also a strategic objective in technology markets (Blind et al., 2007). This has a significant impact on the allocation of technological assets in the market as it hints at a concentration of key technologies in technological markets through acquisitions. This links our results with an important implication for competition policy in that M&A transactions, to a large extent, are meant to create barriers to entry in specific technology driven markets and, hence, decrease competition.

Finally, our finding makes clear that it is necessary to split up the acknowledged but broad merger motive of technology acquisition into different notions. The blocking potential of patents must not necessarily go along with their genuine technological importance. Instead, this particular feature constitutes an independent justification for a higher price paid by the acquirer.

6 Limitations and future research

The paper has shown for a sample of European firm acquisitions with the involvement of corporate and private equity investors that technology matters in firm acquisitions but to a varying extent and in different ways when the acquirer's identity is taken into account. Our results, however, provide no indication whether there is an effect of acquirer identity on innovation performance following the deal. Thomsen and Pedersen (2000) provided evidence that private equity investor ownership leads to higher shareholder value. It is questionable though whether such an effect also holds in the context of technology. Previous studies have indicated that the interpretation of the post-merger developments in R&D is not that straightforward. A decrease in technological engagement after an acquisition might correspond to post-merger integration difficulties (as the integration of two firms' R&D departments) that hinder the exploitation of the joint capacities (Ahuja and Katila, 2001; Grimpe, 2007b). 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. In such cases that infer a decrease in technology activities, an independent advancement of the technology portfolio in a firm owned by a private equity investor might lead to a superior technological outcome. Future research should hence try to generate empirical evidence on the

longitudinal performance of firm acquisitions with respect to different acquirer identities.

Moreover, the still heterogeneous composition of private equity investors and their objectives requires further clarification. First of all, it seems reasonable to differentiate between venture capital investors, i.e. those investors engaging in rather early stages of firm development, and other private equity investors as their motivations and objectives, especially in case of leveraged buyouts, should be different. Furthermore, it would be desirable to identify buy-and-build strategies that private equity investors execute to create a new and integrated company. In that case, motivations regarding the acquired technologies should also differ as the acquired firms are expected to fit together technologically. More valuable patents and those with a blocking character should hence also receive more importance for private equity investors.

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Tables

Table1: Descriptive Statistics

	Targets of private equity investors	**Targets of corporate investors**
	# 784	# 661
	Mean	Mean
	(st.dev.)	(st.dev.)
Deal value (TEUR)	39,196.93	243,849.40
	(153,098.10)	(2,773,373.00)
Total assets (TEUR)	189,790.00	308,909.20
	(1,536,109.00)	(2,489,083.00)
Return on assets (%)	-11.05	-2.09
	(24.20)	(18.18)
Liabilities (TEUR)	126,021.90	189,353.30
	(1,141,654.00)	(1,429,620.00)
Age (years)	10.89	21.31
	(19.51)	(23.84)
Patent stock	2.10	2.87
	(10.47)	(20.43)
Citations/patents	0.41	0.48
	(0.93)	(1.37)
% of XY citations	0.14	0.07
	(0.28)	(0.17)

Table 2: Ordinary least squares regression for the deal value

	Model 1 Coefficient (st. err. [A])	**Model 2** Coefficient (st. err. [A])	**Model 3** Coefficient (st. err. [A])
Private equity investors			
intercept	1.694***	1.588***	1.451***
	(0.515)	(0.515)	(0.510)
Log(patent stock)	0.439***	0.345***	0.376***
	(0.115)	(0.126)	(0.127)
Log(citation stock/patent stock)		0.027***	0.050***
		(0.010)	(0.018)
Log(blocking citations/citations)			-0.033
			(0.020)
Log(total assets)	0.173***	0.171***	0.175***
	(0.043)	(0.042)	(0.042)
Log(return on assets)	0.023	0.028*	0.028*
	(0.017)	(0.017)	(0.017)
Log(liabilities)	0.047	0.043	0.040
	(0.045)	(0.044)	(0.044)
Log(age)	0.033	0.018	0.017
	(0.060)	(0.060)	(0.060)
Corporate investors			
Log(patent stock)	0.705***	0.517***	0.431***
	(0.143)	(0.151)	(0.163)
Log(citation stock/patent stock)		0.064***	0.034**
		(0.013)	(0.016)
Log(blocking citations/citations)			0.056**
			(0.026)
Log(total assets)	0.265***	0.229***	0.216***
	(0.072)	(0.068)	(0.067)
Log(return on assets)	-0.008	-0.001	-0.000
	(0.133)	(0.013)	(0.015)
Log(liabilities)	0.151**	0.167**	0.175***
	(0.064)	(0.061)	(0.059)
Log(age)	0.032	0.022	0.019
	(0.063)	(0.061)	(0.060)
constant	5.516***	6.72***	7.033***
	(0.448)	(0.489)	(0.555)
8 industry dummies	LR-Chi^2 = 15.84**	LR-Chi^2 = 18.35**	LR-Chi^2 = 18.65**
6 year dummies	LR-Chi^2 = 53.66***	LR-Chi^2 = 49.98***	LR-Chi^2 = 51.47***
Number of observations		1,445	
F (25,1419)	18.00***	19.11***	17.99***
R-squared	0.28	0.30	0.30

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

[A] Standard errors are based on the Huber/White estimator to account for heteroscedasticity.