Long Range Planning xxx (2015) 1–9

Contents lists available at ScienceDirect

Long Range Planning

journal homepage: http://www.elsevier.com/locate/lrp

The Impact of M&A on Rivals' Innovation Strategy

Giovanni Valentini

We investigate the effect of M&A on the innovation strategy of merging firms' competitors. We argue that while merging firms may reduce their commitment to innovation in the period following the deal because of an increased focus on short-term M&A implementation and financial considerations, rival firms can on the contrary exploit this moment of inertia to broaden their research and outperform rivals, producing more impactful innovations. We suggest merging firms' competitors increase the breadth of their technological search, even though this may be risky: If their attempts do not achieve the desired results, the consequences are relatively less harmful, as also their competitors are slowing down their innovation pace in the aftermath of M&A. Using data from European firms in the pharmaceutical industry, we find evidence consistent with these hypotheses.

Introduction

Mergers and acquisitions (M&A) are a popular growth strategy. In just the full-year 2012, the value of global mergers and acquisitions totaled more than US$2.2 trillion, exceeding the GDP of countries like Canada or Italy. Therefore, and not surprisingly, management scholars have devoted tremendous efforts to examine the effects of M&A. Extant literature, however, is generally focusing on the firms directly involved in the deals, and says little about the *competitive effects* of M&A on rival firms in the market (Haleblian et al., 2009). This gap in the understanding of the full impact of M&A is problematic, precisely because M&A constitute such a widespread strategy, and because not considering the strategic effects of an organizational decision might provide a partial—or at times even an incorrect—picture of the real consequences of this decision. As a simple example, consider Amgen's recent acquisition of Onyx Pharmaceuticals. Robert A. Bradway, Chairman and CEO of Amgen commented: "Amgen's acquisition of Onyx fits perfectly with our commitment to advancing medicines for cancer patients around the world. … We look forward to working together with the talented staff at Onyx to make the most of our exciting oncology portfolio and pipeline."[1] However, the eventual success of Amgen in this therapeutical market will depend not only on its actions and new product development efforts but also on the moves of direct competitors, which will likely not rest inert, but actively react to Amgen's move. Hence, not considering the *strategic effects* of a decision — for the purposes of this paper, the acquisition of a firm — might lead to a dangerously incomplete analysis of the final impact of such decision.

However, extant literature has created only relatively small inroads into the domain of the strategic effects of M&A. Clougherty and Duso (2009) constitute a recent exception. They explore the impact of horizontal mergers on rival firms, and find that they generally experience positive abnormal stock price returns at the merger announcement date. The rationale proposed is that, on the one hand, mergers increase market power for *every* firm in a given market (and hence also for firms that do not merge, but at zero cost), and, on the other, to the extent that M&A might contribute destroying value for merging firms, rival firms can take advantage of this transitory distress. Building on this latter idea, the present study contributes to the debate on the competitive effects of M&A by investigating their impact on rivals' innovation strategy.

M&A have become increasingly frequent in technology-based industries (e.g., Heeley et al., 2006; Inkpen et al., 2000), and prior literature (e.g., Cassiman and Colombo, 2006; Hitt et al., 1996; Valentini, 2012) has shown that M&A change merging firms' innovation strategy. If in research-based industries firms decide their innovation strategy also on the basis of the expected or observed behavior of their competitors — that is, if strategic interactions in R&D exist (e.g., Lerner, 1997) — then we should expect that a change in merging firms' strategy should be associated with a shift in the

[1] http://www.amgen.com/media/media_pr_detail.jsp?releaseID=1860143 accessed in April 2014.

http://dx.doi.org/10.1016/j.lrp.2015.02.007
0024-6301/

strategy of merging firms' competitors, too. Exploring whether such a shift exists — and if so in which direction — is the goal of this study.

We posit that firms that observe competitors' M&A deals accelerate in their race towards innovation so as to take advantage of the temporary deceleration of merging firms, which in the immediate aftermath of the deal are engaged in the organizational integration process, and are more focused on achieving short-term results than on pursuing long-term objectives related to research and development. Although our data structure prevents us from fully establishing causal relationships, empirical results based on data from the European pharmaceutical industry indicate M&A are actually associated with an increase in competitors' technological performance, as assessed by patenting output weighted by forward citations. Furthermore, we show that this result is associated with a broader search in the technological space. These empirical results suggest that M&A carried out by rival firms change a firm's organizational incentives, shifting them towards the exploration of more impactful innovations.

Although we are aware that for the purposes of this study we have only considered a subset of all the possible reactions firms put in place to competitors' M&A activity, we believe our results contribute to the literature in multiple ways. First, in a recent and influential review of the M&A literature, Haleblian et al. (2009) highlight that very little is known about how acquisitions affect rival firms in the market, and recommend this as a relevant stream for future research. Focusing on post-acquisition innovation strategy, this study intends to make a modest contribution in this direction. Second, the implications of this study are useful for our understanding of the competitive dynamics of technology-based industries. Extant literature analyzing strategic interactions in R&D (e.g., Cabral, 2003; Grossman and Shapiro, 1987) is predominantly theoretical. This study adds to the still scarce empirical evidence on this phenomenon, providing a test of the interdependencies of strategies in R&D intensive environments. Third, we introduce the idea that when a firm's direct competitors engage in M&A, the firm's risk of pursuing novel R&D trajectories becomes relatively lower. Because of the deal, which distracts merging companies in the short-run, competitors witness a window of opportunity to engage in riskier projects, without the risk of falling behind the merging companies. Finally, our results contribute to a better comprehension of the drivers of technological performance. Understanding the factors that influence organizations' technological performance is a central issue for strategic management studies in an increasingly knowledge-based economy.

The remainder of the paper is organized as follows. First, we introduce our theoretical background. Next, we describe the empirical strategy and present the results of our econometric analyses. We conclude with a discussion of the implications of our study for theory and practice.

Background, literature review, and hypotheses

This study examines whether firms react to the M&A activity of their competitors by changing their innovation strategy. To this end, we rely upon two relevant premises. The first premise is that, in high-tech industries, M&A significantly affect the innovation strategy of the firms involved in the deal. M&A are clearly driven by a number of different motives, ranging from macroeconomic factors. to firm-level economies of scale and scope, to managers' self-interest (Trautwein, 1990). Increasingly, however, literature documents that, through M&A, companies are also attempting to obtain technical expertise and R&D skills, experienced personnel, and specific new technologies (e.g., Hagedoorn and Duysters, 2002; Inkpen et al., 2000; Ruckman, 2005). Yet the empirical analysis of the effects of M&A on the innovation strategy of the merging firms still presents mixed results, and highlights the need for nuanced considerations (e.g., Ahuja and Katila, 2001; Cassiman et al., 2005; Hitt et al., 1996).

On the input side, merging firms are generally expected to decrease their R&D expenditures (Hitt et al., 1991; Blonigen and Taylor, 2000). A possible reason for this reduction is that acquiring firms increase their leverage to finance the deal, and, as a consequence, when deciding resource allocation, assured debt interests compete directly with research activities characterized by risky outcomes (Hall, 1990). At the same time, firms may simply become more efficient and exploit economies of scale and scope in R&D (Cassiman et al., 2005). Several studies suggest that merging firms witness an increase in their patenting output (e.g., Ahuja and Katila, 2001; Valentini, 2012).

At the same time, prior literature also highlights that M&A may change the type of innovations pursued by merging firms, mainly because M&A change (i.e., increase) managers' risk aversion in the innovation process (Valentini and Di Guardo, 2012). Hitt et al. (1996) show that a firm's acquisition intensity is negatively associated with the use of organizational strategic controls — i.e., controls that employ long-term, strategic indicators — and positively related to rigid, short-term financial controls. After M&A, the market puts intense pressure on managers demanding immediate results, so managers will move quickly on projects with fast time to realization and back off from long-term innovation endeavors. As a consequence of this short-term pressure and increased risk-aversion, firms are less likely to search for, and actually find, original and breakthrough inventions (Valentini, 2012). As an example, consider the merger between HP and Compaq. After the deal, short-term objectives — which were conceived as absolutely critical given the publicity of the $2.5 billion cost-cutting target — were pursued at the expense of strategic, long-term objectives (Burgelman and McKinney, 2006).

The second premise upon which this study is built is that, on average, firms do not determine their strategy as if they were in isolation; i.e., without considering their rival firms' strategy. There is actually empirical evidence that firms can and will adopt a strategic behavior. Among others, Ghemawat and McGahan (1998) show that strategic interactions underlie price competition in the U.S. large turbine generator industry, and Gimeno (1999) illustrates how U.S. airlines use footholds in their rivals' important markets to reduce the competitive intensity of those rivals in the airlines' own important markets (i.e., their

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

hubs). With specific reference to M&A, Brito (2003, 1614) argues, "real world decisions illustrate that firms react to the announcement of mergers in their market."[2]

Interdependencies also affect firms' innovation strategies. In high-tech environments, where technological performance is key to organizational success, strategic considerations have been shown to play a significant role in explaining R&D-related decisions (e.g., Lerner, 1997). Furthermore, it has been shown that a firm's innovation strategy has an impact on rivals' payoff. In particular, McGahan and Silverman (2006) document that the patenting output of a given firm significantly affects the market value of its rivals. One of the possible mechanisms underlying this result is based on a market-stealing effect, whereby patenting by a competitor may generate property rights that give the competitor an advantaged position in the industry, thus reducing the focal firm's financial value.

Given these two premises — i.e., if interdependencies in R&D exist or else if firms decide their innovation strategy also on the basis of other firms' strategy — and if M&A modify merging firms' innovation strategy, it follows that M&A should also shift the innovation strategy of merging firms' competitors. The question then becomes: Is this actually the case? And, if so, in which direction?

The central claim of this article is that when firms observe competitors completing M&A deals, they can purposefully take advantage of merging firms' needed attention to the organizational integration challenges coupled with the possible short-range financial focus, to try to overcome them thanks to superior technological results.

As previously argued, prior literature has documented that merging firms might eventually witness an increase in their R&D efficiency, but at the same time, in the aftermath of the deal they change their risk attitude, engaging less in path-breaking research activities. The output of R&D, therefore, is expected to have a lower variance but also a lower average value. Merging firms' competitors — who observe or infer this slowdown due to the deal — react accordingly.

To better understand this reaction, it is important to observe that in most high-tech environments firms also value *relative* innovation performance, in that several markets exhibit winner-take-all features. A standard assumption in the literature on competitive dynamics in technology-based settings is that a firm's own success probability in R&D is negatively related to rivals' aggregate hazard of success; e.g., because of IP protection or due to customers' switching costs. This stream of literature has traditionally focused on so-called "patent races", which have received some empirical confirmation. In the simplest version of a model representative of this tradition, firms decide their R&D effort or expenditures, and then compete to develop innovations, receiving the so-called "leader's payoff" if they are the first to succeed or if they have a widely recognized better solution, and the "follower's payoff" otherwise, with the leader's payoff being greater than the follower's (e.g., Reinganum, 1982; Grossman and Shapiro, 1987).

Given the broadly recognized importance of *relative* performance, firms will thus exploit the distress that follows M&A, to try to advance them through a shift in their innovation strategy. In particular, we contend firms will be more prone to assume risk in their R&D process. If they are successful, they will be able to overcome merging firms. If they fail, the damage will be relatively low, as in any case merging firms are slowing their pace because of the deal they just completed.

For the purposes of this paper, we associate risk-taking with broader search in the technological space; i.e., firms rely upon a broader and more diverse set of knowledge when developing their own new patents. This idea is germane to a prevalent view that conceptualizes the inventive process as a recombinant search (e.g., Basalla, 1988; Fleming, 2001). This conceptualization has profound roots in the literature, as well as in the practice of R&D. Nelson and Winter (1982) state that the creation of novelty in art, science, or practical life consists of, to a substantial extent, a recombination of conceptual and physical materials that were previously in existence. And, Fleming and Sorenson (2004) describe how even inventions that resemble one unbreakable component might actually arise from the recombination of discrete components, as well. The knowledge components at the basis of the recombination are the result of a search process in the technological space, which can be more or less broad — and as a consequence more or less risky. In turn, the breadth of search has an effect on the output of the innovation process. Assuming more risk might lead to failure, but at the same time it might pay off, as it can more likely lead firms to achieve a breakthrough invention, an event which is generally rare. The distribution of the value of innovations is known to be very skewed, with most of the innovations having a value close to zero. In fact, breakthroughs account for most of the success of firms — just the top 10% of patents earn 48–93% of all inventions' financial payoffs (Scherer and Harhoff, 2000).

Consistent with the idea of broad search and its effects, Fleming (2001) has shown that experimenting with new components and combinations implies an increase in the variability of outcome that can result in failure, but also in breakthrough inventions. By the same token, firms' lack of innovation may be also explained by their tendency to always search among familiar and close components, whereby the refinement of familiar technologies is preferable to the exploration of new ones, as these are less risky (Ahuja and Lampert, 2001).

Thus, distant search, though risky, seems to be a condition that facilitates the achievement of technological breakthroughs. And, breakthroughs are precisely the type of inventions firm want, in order to win the competition of rival firms. Observing its competitors engaging in M&A, a firm will thus take advantage of this situation to search more broadly in its innovation

[2] Although we recognize that the competitive dynamics literature might at times overstate the actual extent of profit-motivated, strategic, rational behavior, it nonetheless provides a useful baseline for understanding the assumptions required for a theory of strategic interactions. A recent survey conducted by McKinsey Quarterly (2008) on 1,825 executives suggests that companies respond to competitors' moves, and, while their response might not fully adhere to some game theoretic assumptions (e.g., about half of the sample did not examine more than one round of countermoves by any competitor), the survey provides considerable evidence that strategic interactions do exist.

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

process, as it can more easily afford it. As previously discussed, M&A are usually followed by a high pressure on short-term results, which in turn might hinder firms' propensity to explore new domains and slow down their innovation pace. Merging firms' competitors might then increase the breadth of their search, because if their risky attempts do not achieve the desired results, the consequences are relatively less harmful, since their competitors are also slowing down their innovative efforts in the aftermath of M&A. By contrast, if they achieve a success, they might have the opportunity to overcome competitors,[3] which in turn can lead to a higher probability of achieving breakthroughs.

We can therefore hypothesize that, the higher rival firms' acquisition intensity, the more a focal firm will increase the breadth of its search in innovation, and this in turn should result in an enhanced technological performance. Stated formally:

Hypothesis 1. *A firm's technological breadth of search will be positively associated with rival firms' acquisition intensity.*

Hypothesis 2. *A firm's technological performance will be positively associated with rival firms' acquisition intensity.*

Methods

Data and sample

In this empirical investigation, we want to test whether a firm's innovation strategy is influenced by its rivals' acquisition intensity. To this end, we constructed a dataset comprising the M&A and patenting activities of firms in the European pharmaceuticals industry. This industry appears as a particularly suitable empirical context. First, over the last decades this industry has witnessed a significant share of global M&A transactions by value. Second, it is an industry where continuous innovation is crucial for firms to gain and sustain competitive advantage. Third, and relatedly, there is empirical evidence hinting at the fact that in this industry firms are reacting to each other's previous period R&D outlay (e.g., Ramrattan and Szenberg, 2006).

Eventually, the sample is comprised of all the companies reported in the Bureau van Dijk (BVD) Amadeus database, such that:

- They have 244 as primary 3-digit Nace Revision 1.1 code.
- There is full data availability for the years between 1998 and 2004. Financial data have been collected through the BVD Amadeus database, whereas data on R&D expenditures have been collected directly from companies' annual reports.
- They are EU 15 or Switzerland based companies.
- They are public companies.

This selection led to an unbalanced panel of 63 companies.

Data on M&A deals were retrieved from the BVD Zephyr database. We considered all the completed deals in the same period, where the acquirer had 244 as primary 3-digit Nace Revision 1.1 code.

We combined these data on firm M&A and organizational performance with data from the EPO-Kites dataset, which contains information on all patents granted at the European Patent Office.

Dependent variables

Following a relatively established tradition across multiple fields, we characterize firms' innovation strategy through patent measures. Patents have significant strengths as indicators of innovation strategies. They represent an externally validated measure of technological novelty with a clear economic significance, and they have been shown to correlate very well with other possible measures of technological performance, such as new products or innovation counts (Hagedoorn and Cloodt, 2003). Nonetheless, the use of patent might also present some limitations. In particular, some inventions are non-patentable and others are not patented. Moreover, patented inventions vary greatly in their characteristics and economic value, and some of these are pursued for offensive reasons, others for a merely defensive strategy. In this study, we tackle these limitations in two ways. First, as patenting patterns are to a great extent dependent on industry characteristics, we focus on a single industry. The external factors affecting the propensity to patent are likely to be stable within the same context (Ahuja and Katila, 2001). Furthermore, in the pharmaceutical industry, patents have been repeatedly shown to constitute an effective and valuable way of appropriating the returns from R&D (e.g., Arora et al., 2008). Second, to address the heterogeneity of characteristics across different patents, following prior literature (e.g., Argyres and Silverman, 2004; Sampson, 2007; Valentini and Di Guardo, 2012) we use some statistics based on patent citations.

More specifically, firms' breadth of search in the technological space is based on the following formula: the breadth of a given patent i is such that $Breadth\ of\ search_i = 1 - \sum_{j=1}^{n_i} t_{ij}^2$ where t_{ij} indicates the proportion of the citations made by patent i to patents that belong to patent class j. Then, for instance, if a patent cites previous patents that belong to a narrow set of

[3] This general intuition has also been formally derived with respect to general effort in the innovation process. Chowdhurya and Sheremetab (2010) show that if a firm's probability of winning an R&D contest equals the ratio of its effort to the sum of all players' efforts (i.e., relative R&D effort matters), for firms with relatively high levels of effort, the optimal response to a decrease of a competitors' effort is an increase in effort.

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

technologies, this measure will be low (zero, if it cites patents form one single technological class). Conversely, if a patent cites previous work that belongs to a wide set of technologies, the score will be high. We therefore calculated the average breadth of search of all the patents sample firms applied for in every year of the timeframe we examined.

Firms' technological performance, following Sampson (2007), is measured assessing firms' patenting output weighted by the citations they received by later patents (i.e., forward citations). A patent awards inventors the right to exclude others from the unauthorized use of the disclosed invention for a given period of time. The front page of a patent document contains information on a number of issues (e.g., the inventor and the assignee), including citations to previous patents. These citations serve an important legal function, as they delimit the scope of the property rights awarded by the patent. Thus, if patent *a* cites patent *b*, it implies that patent *b* represents a piece of previously existing knowledge upon which patent *a* builds, and over which patent *a* cannot have a claim. The applicant has a legal duty to disclose any knowledge of the prior art, but the decision regarding which citations to include ultimately rests with the patent examiner. Just as citations between journal articles disclose the transmission of ideas between papers, patent citations trace technological ancestries. Highly cited patents represent highly influential, pathbreaking innovations. What is more, there exists empirical evidence that the number of citations a patent receives by subsequent patents is an indicator not only of the importance of the underlying innovation, but also of its economic value (Gambardella et al., 2008; Trajtenberg, 1990), and a firm market value is positively related to its citation-weighted patent stock (Hall et al., 2005). Hence, to assess firms' technological performance, we use patenting output (i.e., number of successful patent applications) weighted by their forward citations.[4] As the number of citations a patent receives might depend on its application year, with more recent patents possibly having a lower probability of being cited, we also calculated the same measure with the number of citations normalized by the average value of citations per year/technological class.

Independent variable

The key covariate of this study is rival firms' acquisition intensity. To be sure, firms do not experience the same level of rivalry with all the other firms. To evaluate whether a firm is a rival of a given firm, we assess their technological proximity on the basis of their patenting stock. The assumption we make is that firms holding patents in similar technological classes will have similar products, and therefore will be rivals in product markets. Although this assumption might be relatively strong in some sectors, it is more plausible in the pharmaceutical industry, where firms compete in the final product market in specific therapeutical areas, and these map closely onto technological classes.

To measure the proximity of two firms, following Jaffe (1986), we characterize the technological position of firm i as a vector $F_i = (F_{1i}, F_{2i}, \ldots, F_{ki})$, where F_{ji} represents the proportion of patents belonging to technological class j that firm i has successfully applied for in the five years preceding the deal. Technological proximity between any two firms A and T is then measured as the uncentered correlation of the technological vectors of the two firms A and T, that is, $F_A F_T' / [(F_A F_T)\,(F_{AT})]^{1/2}$. This measure is bounded between zero and one, and a value close to one indicates a high proximity of technological resources. For each focal firm then, rival firms' acquisition intensity is calculated as the sum of other sample firm deals weighted for their technological proximity to the focal firm.

Control variables

We also build upon extant literature to control for a number of additional variables that might influence our dependent variables. In particular, in the regression having technological performance on the left-hand side we also include control for firm size — measured through the logarithm of assets — as well as for firms' own M&A deals (e.g., Ahuja and Katila, 2001). An additional natural control variable is (the logarithm of) R&D expenditures, which is a key determinant of patenting output. R&D expenditures data are not available in the Amadeus database for European firms. We collected these data from companies' official report, although we were not able to find figures for all the firm-year observations. In the regressions, we include the logarithm of R&D expenditures. We also control for past firms' profitability — as assessed by their ROA — to account for potential slack resources (Bourgeois III, 1981). Finally, in all regressions we insert year dummies. Table 1 reports summary statistics of the main variables.

Econometric specification

Technological outcome (TO) of firm i at time t is modeled as follows:

$$TO_{it} = f(RAI_{it-2}, X_{it-1}; \beta)$$

In essence, technological outcome (for the purposes of this study, technological performance and technological breadth of search) is set to depend upon rival firms' acquisition intensity (RAI), as well as on a number of control variables X; β is a vector

[4] Recently, it has been shown that the fact that some citations that are added by patent examiners may make citations a biased measure of knowledge flows. However, a priori there is no reason to think that this should not bias the reliability of patent citations to indicate the *quality* of patents. Consistently, through a recent extensive survey concerning some 8,000 patents, Gambardella et al. (2008) find that the economic value of patents is well-correlated to the number of forward citations they receive.

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

Table 1
Descriptive statistics and correlations

		Mean	Std. Dev.	1.	2.	3.	4.	5.
1.	Technological performance	6.55	32.23	1				
2.	Rival firms acquisition intensity	2.56	2.26	0.13	1			
3.	Profitability	−2.23	25.49	0.11	009	1		
4.	Own deals	0.25	0.73	0.30	0.12	0.12	1	
5.	Size	6.20	2.65	0.34	0.30	0.52	0.29	1
6.	R&D intensity	0.37	0.60	−0.09	−0.07	−0.18	−0.11	−0.48

of coefficients to be estimated. The variable representing rival firms' acquisition intensity is two-years lagged; two years is a timeframe long enough to assess change in technological performance due to the reaction to competitors' M&A (recall we are assessing firms' reactions as indicated by their patenting activity), but short enough to minimize possible confounding effects. Two additional considerations are relevant in this respect. First, the M&A date we use is that of the *completion* of the deal, yet the announcement of the deal is usually made well before (not to consider potential rumors). Second, as Hall et al. (1986, 281) stated, "there is a rather strong contemporaneous relationship between R&D expenditures and patenting, which does not disappear when we control for the size of the firm, its permanent patenting policy, or even the effects of its R&D history." Most R&D carried out in a given year leads to a patent application soon thereafter, with a very short lag between R&D activities and patent applications. Hence, a two-year lag between M&A activity and rival firms' reaction appears suitable.

When estimating the model having breadth of search as the dependent variable, we use a Tobit model (as the dependent variable is bounded between 0 and 1 by construction) with random effects, because a Tobit conditional fixed-effects model cannot be estimated, as there is not a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood and unconditional. For the model having technological performance as the dependent variable, we estimate a (log-log) fixed-effects model, with robust standard errors.

Results

In this study, we are interested in examining whether a firm's innovation strategy is influenced by its competitors M&A deals. In particular, we contended that a firm will increase its breadth of technological search to overcome its competitors — temporarily distracted by the acquisition — and that this will result in better technological results.

Table 2 reports the results of the model having breadth of search as the dependent variable. Column (2.1) is our base model, which includes only the control variables. Column (2.2) reports the model that also includes rival firms' acquisition intensity. As hypothesized, rival firms' acquisition intensity exerts a negative and significant impact on firm technological performance ($p < 0.1$), thus providing some support to Hypothesis 1. It is interesting to note that, *ceteris paribus*, profitability exerts a significant and negative effect — possibly, firms also start searching more broadly when their results are below their aspirations.

Table 3 reports the results of the model estimating the effect of competitors M&A on a firm's technological performance. Column (3.1) is our base model, which includes only the control variables. Column (3.2) reports the model that also includes rival firms' acquisition intensity. As hypothesized, rival firms' acquisition intensity exerts a negative and significant impact on firm technological performance ($p < 0.05$), thus supporting Hypothesis 2. Conversely, a firm's own M&A deals do not show a significant effect on technological performance. This might be due to the specific measure of technological performance we adopt in this study; i.e., patenting output weighted for forward citations. Valentini (2012) has shown that M&A increase the merging firms patenting output, but decrease the number of citations received: the net effect might then be nullified. In separate regressions we do not report for the sake of conciseness, we actually observe a negative effect (although it is marginally statistically significant) of a firm's own deal on its *average* forward citations. Model (3.3) considers the dependent variable with normalized citations, and provides qualitatively similar results.

Our results therefore show that an increase in rival firms' acquisition intensity is associated with an increase in a focal firm's breadth of search in the technology space and technological performance. We suggested that this is due to the fact that

Table 2
Results of random effects Tobit regression. Dependent variable: breadth of search

	(2.1)	(2.2)
Rival firms' acquisition intensity		0.063† (0.035)
Own deals	−0.023 (0.045)	−0.062 (0.053)
Firm size	0.059*** (0.010)	0.059*** (0.012)
Profitability	−0.002** (0.001)	−0.003*** (0.000)
Constant	−0.926*** (0.143)	−1.211*** (0.180)
Year dummies	Included	Included
Wald Chi^2	48.55***	50.30***
N of observations	311	252

Standard errors in parentheses.
†p < .10; *p < .05; **p < .01; ***p < .001.

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

Table 3
Results of fixed-effects model. Dependent variable: technological performance

	(3.1)	(3.2)	(3.3)
Rival firms' acquisition intensity		0.404* (0.184)	0.685* (0.335)
Own deals	0.535* (0.248)	0.244 (0.195)	0.670 (0.423)
Firm size	−0.587* (0.273)	−0.209 (0.288)	−0.199 (0.384)
Profitability	0.010 (0.006)	0.012** (0.004)	0.013* (0.005)
R&D expenditures	0.034 (0.193)	0.307† (0.183)	0.138 (0.237)
Constant	7.878* (3.834)	3.287 (3.560)	2.173 (4.840)
Year dummies	Included	Included	Included
F	4.50***	4.36***	4.58***
Overall R^2	0.18	0.48	0.26
N of observations	209	178	178

Robust standard errors in parentheses.
†p < .10; *p < .05; **p < .01; ***p < .001.

a firm wants to take advantage of the temporary myopic behavior that characterizes merging firms in the aftermath of the deal, and lead firms to accelerate in their technological trajectories.

Concluding remarks

In this study, we integrated the M&A and innovation literatures to examine and explain the changes that the quality of inventive activity may witness in the aftermath of rivals' M&A. From the M&A literature, we drew on the notion that M&A change firms' innovation strategy because of an increased focus on the short-term, and of the energy absorbed by the integration process. From the innovation literature, we drew on the idea that firms respond strategically to rivals' competitive moves shaping their innovation strategy accordingly. We then discussed how a firm's technological performance will be positively associated with rival firms' acquisition intensity, and we found empirical evidence consistent with this hypothesis. Furthermore, we showed that this change is also associated with an increase in firms' breadth of technological search.

Limitations

This study is characterized by a number of limitations that warrant attention. First and foremost, because of our data structure, we have only highlighted conditional correlations and cannot infer causality. Second, for data availability reasons, the study was limited to publicly owned firms. The extent to which the results are generalizable to private firms is open to question. Moreover, our sample is composed by European firms from a single industry, analyzed for a specific and relatively short period of time. Again, the usual caveats on generalizability apply. Third, we assessed firms' innovation strategy using patent statistics. Although patents are a usually reliable indicator in the pharmaceutical industry — and, for the purposes of this study are perhaps even a better indicator than new products, as in the pharmaceutical industry there is a considerable lag between R&D activities and product introduction, due to both product development and regulations, which might make the empirical analysis quite complicated — opportunities exist to capture firm reactions through more fine-grained measures of firm behavior and outcomes. Fourth, like most of the research in this stream, we could not assess the actual purpose for which M&A deals were conducted. We could speculate that deals sought to exploit economies of scale and to cut redundancies in R&D can have a different effects on competitors with respect to deals pursued to explore new technological domains. Similarly, deals requiring a conspicuous integration effort — which therefore can possibly slow down merging firms' innovativeness — may be different from deals that leave the two firms virtually independent. Finally, but importantly, in this study we only observed the effect of rival firms' M&A activity on a firm's innovation strategy. We did not make the further step of identifying the impact of this shift on financial performance — which is what mostly matters, in the end. Future research would therefore be well served by a careful empirical investigation on the impact of this shift in firms' innovation strategy on their profitability. At the same time, we could investigate if similar strategic effects also hold for other interfirm agreements, like strategic alliances.

Contributions to the literature

Notwithstanding the aforementioned limitations, this study contributes to the literature in multiple ways. First, it contributes to a better understanding of the consequences of M&A in the pharma industry. Despite the large amount of research work generated over the last decades, we are still far from reaching a satisfactory understanding of the drivers of M&A performance (see the meta-analysis of King et al. (2004)). Nonetheless, management scholars have directed their efforts in theoretical developments and empirical testings focusing on a relatively restricted set of variables (Zollo et al., 2011). New avenues should be opened. In this respect, Haleblian et al. (2009, 490) conclude in their recent review of the literature: "We also recommend that researchers focus on deepening our knowledge of several outcomes of interest. For example, little is known about how acquisitions affect rival firms in the market." In this study, we move forward in this direction, and examined the effect of M&A on rival firms' innovation strategy. Prior literature that has explored the effect of M&A on rival firms (e.g.,

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

Chatterjee, 1986; Clougherty and Duso, 2009) usually assumed firms can benefit passively from others' deals, profiting by the increased consolidation and by the value destruction consequent to the deal. We showed how firms can also play an *active* role to take advantage of the temporary distress of merging firms, considering in particular their innovation strategy. This assumes particular salience if we consider the increasingly relevant role of M&A in high-tech environments. Also, given the importance of the relationship between a firm's inventive activity and its long-term viability, evidence uncovered concerning the factors that shape M&A impact on firms' inventive activity will also produce new evidence on the long-term effects of M&A.

Furthermore, with this study we add to the scarce empirical literature on competitive dynamics in R&D. Most of the empirical literature on interdependencies in strategic decisions has focused either on pricing (e.g., Ghemawat and McGahan, 1998; Gimeno, 1999) or on entry (e.g., Anand et al., 2009). Conversely, the literature on competitive dynamics in R&D has provided mostly theoretical insights (e.g., Cabral, 2003; Grossman and Shapiro, 1987; Reinganum, 1982). We thus provide an empirical contribution to this stream of literature. At the same time, the relationship we uncovered between M&A and rival firms' patenting activity is relevant for the growing literature on the organizational determinants of technological performance, which has rarely adopted a competitive dynamics perspective.

Implications for practice

This study also presents some implications for practice. Merging firms should consider that a possibly significant share of the potential value created in a deal can actually be absorbed by competitors. Prior literature had already highlighted that competitive interactions may divert part of the value created in an M&A to competitors; for instance, because of increased market concentration, or because of the departure of key executives and employees due to the uncertainty surrounding the deal. This study shows that this process might materialize also through firms' innovation strategy, which might temporarily slow down in merging firms and allow rivals to increase the breadth of their technological search, even though this may be risky. This, in turn, increase their technological performance.

Thus, each decision a firm takes not only has a direct effect on its results, but also a *strategic* effect through the reactions of its competitors. Foregoing the analysis of the strategic effects of a decision like M&A in high-tech contexts can possibly lead to a paradox — firms might buy other firms to overcome competitors, but at the same time competitors might react and nullify the potential advantages obtainable though M&A.

On a related note, this study indicates a possible reaction strategy to merging firms' rivals. Often, firms react to other firms' deals in an isomorphic fashion (Auster and Sirower, 2002; Tseng and Chou, 2011)—feeling challenged by the growth of competitors, they also engage in M&A. This study suggests rival firms' may also profitably react by enlarging the breadth of search of their innovation strategy. In proximity of a competitors' deal, firms enjoy a window of opportunity in which they can pursue riskier R&D strategies — since merging firms are distracted by the financial and organizational consequences of the deal, and paying less attention to long-term projects — making the case of a failure relatively less damaging. The window of opportunity firms can exploit to this end might depend on the magnitude of the deal competitors are involved in, hence continuous attention is essential. Of course, this attention should be devoted to all firms' actions that may influence their behavior at the advantage of rivals — in this paper, we considered just one of those particular actions.

More generally, while strategic interdependencies exist and are acknowledged, in reality, responses to competitors' moves are often straightforward and relatively slow (McKinsey Quarterly, 2008). Hence, improving the ability to anticipate a rival's moves and formulate better responses gives managers new ways to think about how they might gain competitive advantage.

The results of this study can carry relevant implications for public policy, as well. This study points out that merger policy should take into account the overall effect of M&A, not only under a “product market” perspective, but also considering the “innovation market” (Davis, 2003). Traditionally, merger policy has focused its attention on static efficiency, analyzing whether a proposed transaction would lead to higher or lower prices. This study shows that, while M&A may eliminate product market competition between the merging parties, they also change the incentives for competitors, potentially shifting them towards more radical innovations. To what extent this is beneficial under a dynamic efficiency perspective can constitute an important matter for future research.

Conclusion

To conclude, in this study we have advanced and tested the idea that M&A alters rival firms' innovation strategy. Much remains to be done to unearth fully this complex topic, but we hope this paper will be able to stimulate future research that will continue to enhance managerial theory and practice in this area.

References

Ahuja, G., Katila, R., 2001. Technological acquisitions and the innovation performance of acquiring firms: a longitudinal study. Strategic Management Journal 22 (3), 197–220.

Ahuja, G., Lampert, C.M., 2001. Entrepreneurship in the large corporation: a longitudinal study of how established firms create breakthrough inventions. Strategic Management Journal 22 (6–7), 521–543.

Anand, J., Mesquita, L., Vassolo, R., 2009. The Dynamics of Multimarket Competition in Exploration and Exploitation Activities. Academy of Management Journal 52 (4), 802–821.

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007

Argyres, N.S., Silverman, B., 2004. R&D, organization structure, and the development of corporate technological knowledge. Strategic Management Journal 25 (8–9), 929–958.
Arora, A., Ceccagnoli, M., Cohen, W., 2008. R&D and the Patent Premium. International Journal of Industrial Organization 26 (5), 1153–1179.
Auster, E., Sirower, M., 2002. The Dynamics of Merger and Acquisition Waves: A Three-Stage Conceptual Framework with Implications for Practice. Journal of Applied Behavioral Science 38 (2), 216–244.
Basalla, G., 1988. The Evolution of Technology. Cambridge University Press, Cambridge, MA.
Blonigen, B.A., Taylor, C.T., 2000. R&D Intensity and Acquisitions in High Technology Industries: Evidence from the U.S. Electronic and Electrical Equipment Industries.
Bourgeois III, L.J., 1981. On the Measurement of Organizational Slack. Academy of Management Review 6 (1), 29–39.
Brito, D., 2003. Preemptive mergers under spatial competition. International Journal of Industrial Organization 21 (10), 1601–1622.
Burgelman, R.A., McKinney, W., 2006. Managing the strategic dynamics of acquisition integration: Lessons from HP and Compaq. California Management Review 48 (3), 6–27.
Cabral, L., 2003. R&D Competition When Firms Choose Variance. Journal of Economics & Management Strategy 12 (1), 139–150.
Cassiman, B., Colombo, M., 2006. Mergers and Acquisitions. The Innovation Impact. Edward Elgar Pub.
Cassiman, B., Colombo, M.G., Garrone, P., Veugelers, R., 2005. The impact of M&A on the R&D process: An empirical analysis of the role of technological- and market-relatedness. Research Policy 34 (2), 195–220.
Chatterjee, S., 1986. Types of Synergy and Economic Value – The Impact of Acquisitions on Merging and Rival Firms.
Chowdhurya, S.M., Sheremetab, R.M., 2010. Multiple Equilibria in Tullock Contests. Working paper.
Clougherty, J., Duso, T., 2009. The Impact of Horizontal Mergers on Rival Firms: Gains to Being Left Outside a Merger. Journal of Management Studies 46, 1365–1395.
Davis, R., 2003. Innovation Markets and Merger Enforcement: Current Practice in Perspective. Antitrust Law Journal 71 (2), 677–703.
Fleming, L., 2001. Recombinant Uncertainty in Technological Search. Management Science 47, 117–132.
Fleming, L., Sorenson, O., 2004. Science as a Map in Technological Search. Strategic Management Journal 25, 909–928.
Gambardella, A., Harhoff, D., Verspagen, B., 2008. The Value of European Patents. European Management Review 5, 85–89.
Ghemawat, P., McGahan, A., 1998. Order backlogs and strategic pricing: the case of the U.S. large turbine generator industry. Strategic Management Journal 19 (3), 255–268.
Gimeno, J., 1999. Reciprocal threats in multimarket rivalry: staking out 'spheres of influence' in the U.S. airline industry. Strategic Management Journal 20 (2), 101–128.
Grossman, G.M., Shapiro, C., 1987. Dynamic R&D Competition. The Economic Journal 97, 372–387.
Hagedoorn, J., Cloodt, M., 2003. Measuring innovative performance: is there an advantage in using multiple indicators? Research Policy 32 (8), 1365–1379.
Hagedoorn, J., Duysters, G., 2002. External Sources of Innovative Capabilities: The Preferences for Strategic Alliances or Mergers and Acquisitions. Journal of Management Studies 39 (2), 167–188.
Haleblian, J., Devers, C.E., McNamara, G., Carpenter, M.A., Davison, R.B., 2009. Taking Stock of What We Know About Mergers and Acquisitions: A Review and Research Agenda. Journal of Management 35, 469–502.
Hall, B., 1990. The Impact of Corporate Restructuring on Industrial Research and Development. In: Brookings Papers on Economic Activity.
Hall, B., Griliches, Z., Hausman, J., 1986. Patents and R&D ? Is There a Lag? International Economic Review 27, 265–283.
Hall, B., Jaffe, A., Trajtenberg, M., 2005. Market Value and Patent Citations. RAND Journal of Economics 36 (1), 16–38.
Heeley, M.B., King, D.R., Covin, J.G., 2006. Effects of Firm R&D Investment and Environment on Acquisition Likelihood. Journal of Management Studies 43, 1513–1535.
Hitt, M.A., Hoskisson, R.E., Ireland, R.D., Harrison, J.S., 1991. Effects of Acquisitions on R&D Inputs and Outputs. Academy of Management Journal 34 (3), 693–706.
Hitt, M.A., Hoskisson, R.E., Johnson, R.A., Moesel, D.D., 1996. The Market for Corporate Control and Firm Innovation. Academy of Management Journal 39 (5), 1084–1119.
Inkpen, A.C., Sundaran, A.K., Rockwood, K., 2000. Cross-Border Acquisitions of U.S. Technology Assets. California Management Review 42 (3), 50–71.
Jaffe, A., 1986. Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits, and Market Value. American Economic Review 76 (5), 984–1001.
King, D., Dalton, D., Daily, C., Covin, J., 2004. Meta-analyses of post-acquisition performance: indications of unidentified moderators. Strategic Management Journal 25 (2), 187–200.
Lerner, J., 1997. An Empirical Exploration of a Technology Race. The RAND Journal of Economics 28, 228–247.
McGahan, A., Silverman, B., 2006. Profiting from Others' Technological Innovation: The Effect of Competitor Patenting on Firm Value. Research Policy 35, 1222–1242.
Nelson, R., Winter, S., 1982. An Evolutionary Theory of Economic Change. Belknap Press of the Harvard University Press, Cambridge, MA.
Quarterly, McKinsey, 2008. How Companies Respond to Competitors. McKinsey Global Survey.
Ramrattan, L., Szenberg, M., 2006. Global Competition and the United States Pharmaceutical Industry. The American Economist 50 (2), 65–82.
Reinganum, J.F., 1982. A Dynamic Game of R and D: Patent Protection and Competitive Behavior. Econometrica 50 (3), 671–688.
Ruckman, K., 2005. Technology Sourcing Through Acquisitions: Evidence from the US Drug Industry. Journal of International Business Studies 36 (1), 89–103.
Sampson, R., 2007. R&D Alliances and Firm Performance: The Impact of Technological Diversity and Alliance Organization on Innovation. Academy of Management Journal 50 (2), 364–386.
Scherer, F.M., Harhoff, D., 2000. Technology policy for a world of skew-distributed outcomes. Research Policy 29 (4–5), 559–566.
Trajtenberg, M., 1990. A Penny for Your Quotes: Patent Citations and the Value of Innovations. RAND Journal of Economics 21 (1), 172–187.
Trautwein, F., 1990. Mergers motives and merger prescriptions. Strategic Management Journal 11 (4), 283–295.
Tseng, J.-J., Chou, P.-H., 2011. Mimetic isomorphism and its effect on merger and acquisition activities in Taiwanese financial industries. The Service Industries Journal 31 (9), 1451–1469.
Valentini, G., 2012. Measuring the effect of M&A on patenting quantity and quality. Strategic Management Journal 33 (3), 336–346.
Valentini, G., Di Guardo, M.C., 2012. M&A and the profile of inventive activity. Strategic Organization 10 (4), 384–405.
Zollo, M., Valentini, G., Meier, D., 2011. What Explains M&A Performance?. CROMA Working Paper.

Biography

Giovanni Valentini is an Associate Professor of Strategy at Bocconi University, Milan. He holds a PhD in Management from IESE Business School. His research has examined the effects of M&A on technological performance, the relationship between innovation and export, and the organization of R&D. His research has appeared on a number of outlets, including *Journal of International Business Studies, Long Range Planning, Organization Science, Research Policy, Strategic Management Journal*, and *Strategic Organization*. E-mail: giovanni.valentini@unibocconi.it

Please cite this article in press as: Valentini, G., The Impact of M&A on Rivals' Innovation Strategy, Long Range Planning (2015), http://dx.doi.org/10.1016/j.lrp.2015.02.007