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The Goldilocks Effect: Industry-relatedness and M&A

M&A Research Centre – MARC

September 2017



MARC – Mergers & Acquisitions Research Centre

MARC is the Mergers and Acquisitions Research Centre at Cass Business School, City, University of London – the first research centre at a major business school to pursue focussed leading-edge research into the global mergers and acquisitions industry.

MARC blends the expertise of M&A accountants, bankers, lawyers, consultants and other key market participants with the academic excellence of Cass to provide fresh insights into the world of deal-making.

Corporations, regulators, professional services firms, exchanges and universities use MARC for swift access to research and practical ideas. From deal origination to closing, from financing to integration, from the hottest emerging markets to the board rooms of the biggest corporations, MARC researches the wide spectrum of mergers, acquisitions and corporate restructurings.

Overview

June 2017's announcement that Amazon was buying Whole Foods shook the market, sending the shares of traditional 'bricks and mortar' food retailers into freefall. This wasn't a deal for short-term cost saving synergies. Indeed there wasn't even a glossy PowerPoint for analysts to pore over and it wasn't really about a short-term boost to top line growth, given Amazon's own stellar performance. It was about innovation and long-term positioning.

Unlike a number of pieces produced by the MARC, this report does not focus on the short-term economic benefits of M&A but on the **post-M&A innovative performance of companies** which might have long-term strategic consequences and hopefully eventually lead to increased economic performance.

Using an global sample of 1,013 transactions with announcement dates between 2000 and 2015, this report researches the relationship between M&A and innovation performance of companies active in the information technology industry for up to three post-M&A years.

The acquirer's innovation performance is analysed by studying the impact of M&A on R&D-intensity. The main focus is on the deal-specific characteristics in terms of industry relatedness.

The research approach is based on the idea that R&D is a source for the creation of intangible intellectual capital that will create positive cash flows in the future. Therefore, it focuses only on the effects of innovation inputs, measured by R&D-intensity.

The three questions we attempted to address, and their answers:

1. Will industry relatedness be curvilinearly (inverse U-shaped) related to the post-M&A innovative activities of the acquiring firm?

Answer: Yes (Like Goldilocks. Best to be not too related, not too distantly related, just the right level of closeness)

2. Is there is a positive relationship between the acquirer's prior activity (experience) in industry related M&A and the post-M&A innovative activities (measured by a higher percentage change in R&D intensity) of the acquiring firm?

Answer: No

3. Is there is a negative relationship between the acquirer's leverage level at the time of acquisition and R&D-intensity post the deal?

Answer: Yes

So, there is a '**sweet spot**', that one might call 'adjacent M&A'. Acquire in an area where you know something about the risks and threats but where you don't yet have all the answers.

In rapidly changing areas, newly acquired knowledge has a limited shelf life in terms of setting you up for the next deal. As MARC has written in other reports, M&A needs to be part of a sequence of linked events and each deal not viewed in isolation.

Get your house in order first. If you are to take advantage of the technological opportunities granted by the acquisition, it's going to cost money to leverage them. If you are already heavily indebted you may end up not being able to spend that money.

Note that the research in this field is far from exhaustive. It isn't realistically possible yet to perform an assessment of other types of innovative activity, such as software development or internal human resources development, since this knowledge is rarely codified in R&D expenditure. So we hope this research is a step forward, but there are many areas still to probe.

Background (and a short maths lesson)

The motives for engaging in M&A have changed dramatically over the years and the period post-2000 is no exception. Whereas previously M&A motivation was dominated by drivers such as market-entry, market domination or simply the desire of a company to expand its product base, the last wave of mergers has seen the emergence of the Internet and rapid technological change. These factors, combined, with increased competition worldwide, have led to a much greater emphasis on exploring external market opportunities beyond the firm's boundaries.

So, given the increasing importance of innovation for company growth, and indeed survival, does M&A boost innovation or hinder it? And what types of M&A will send you down the boost path or the hinder path? But first there is a fundamental problem to tackle.

How do you measure innovation?

In the literature, R&D expenditure and R&D-intensity (R&D/sales) are two of the key indicators used to capture innovative performance, especially in R&D-intensive industries. They serve as an indicator of the firm's research capabilities and efforts, in terms of generating new ideas and new models, that might eventually lead to new patents or new product announcements. Aside from this, R&D inputs are also found to have an influence on the broader business of companies, and therefore on their future innovative performance, particularly in high-tech industries^{1,2}. Previously successful R&D expenditure is likely to increase the commitment to investing in R&D projects in the future. Therefore, the actual R&D expenditure reflects not only the current input but also a firm's previous successes.

Other measures of innovative performance that have been used heavily in previous research

are measures of R&D output: patent counts, patent citations and new product announcements. Although actually dominant in the literature, the disadvantages and limitations of patent statistics as an overall measure of innovative performance are well known³. To start with, patents are not able to measure all produced knowledge within the industry since some research outputs such as human knowledge are not patentable and some are kept as industrial secrets. Moreover, their impact on the productivity of further technological innovations is not the best measure to capture the long-term innovative capabilities of companies. However, most researchers still use them since patent counts are easily accessible and remain one of the better quantitative measures of performance.

The relationship between R&D and patents has been studied extensively in the past 30 years and researchers came to a general conclusion that there is a direct relation between R&D input and technological output. In their seminal studies, Pakes and Griliches mention a high correlation between R&D expenditure and the number of patents across industries⁴.

In 2002, Cloudt and Hagedoorn got together to find the definitive answer as to whether using multiple indicators to measure innovative performance is advantageous⁵. Their study, which covers a large sample of nearly 1200 companies in four high-tech industries, reports that there is a strong relationship between the indicators of innovative performance. They suggest that especially in the information technology industry, with sub-sectors such as computers, electronics and communications, the statistical overlap between R&D inputs and patents is so strong that future research might consider using any of these indicators to

¹ Hagedoorn, J., Duysters, G. Technology Analysis & Strategic Management, 2002

² Henderson, R., Cockburn, I. Journal of Economics, 1996

³ Griliches, Z. Journal of Economic Literature, 1990

⁴ Pakes, A. and Griliches, Z. Economics Letters, 1980

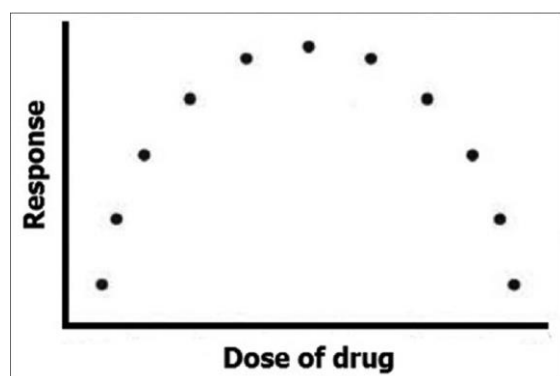
⁵ Hagedoorn, J., Duysters, G. Technology Analysis & Strategic Management, 2002

capture the innovative performance of companies.

Curvilinear

In this report you will see the word 'curvilinear' a lot. This refers to a situation where, when we are talking about the relationship between two variables, the data points increase together up to a certain point (like a positive relationship) and then as one increases, the other decreases (negative relationship) or vice versa. On a scatterplot, this develops an arch in which the data increase together up to a peak (or a U-shape). In other words, there is a 'sweet spot' that maximises (or minimises the result). In this report we are trying to find properties of an M&A programme that maximise changes in R&D intensity.

A classic (non-finance) example would be the usage of a drug. A certain amount of the drug must be used to gain any kind of positive response. But there is a point beyond which the use of the drug becomes harmful.



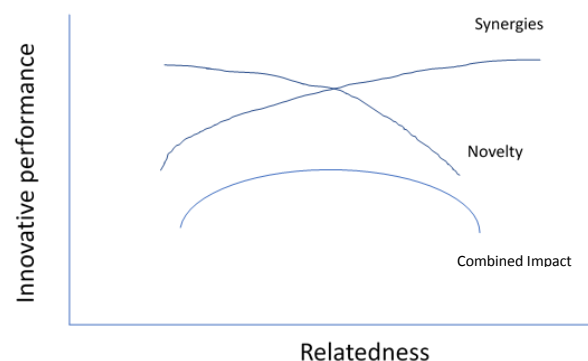
The link to M&A

According to the theory of industrial organisation, acquirers, by becoming larger, can benefit from R&D-related economies of scale⁶. M&A, by reducing running costs, can increase the overall R&D budgets of the merging companies which, in turn, enable them to carry out multiple R&D projects simultaneously and operate more efficiently. Merged companies can also benefit from economies of scope by the reduction of the

duplication of efforts and costs, primarily because of the joint production capabilities and the consolidation of R&D projects, which are now done in the same 'house'.

M&A theory suggests that synergy is a crucial element for successful value creation. Synergetic effects can be found primarily within the following five areas: economies of scale, economies of scope, diversification, market power and coinsurance⁷. Economies of scope and scale are usually associated with related industry mergers⁸, while diversification and coinsurance are connected to unrelated mergers. Therefore, there are different benefits acquirers can gain from M&A with respect to the level of relatedness. Figure 2 illustrates the different potential effects of relatedness and the inverted U-shaped innovative performance outcomes that result when we sum the synergy benefit with the novelty benefit.

Figure 2: Innovation vs. relatedness relationship
Source: Cass Business School



On the one hand, a high level of industry-relatedness between M&A partners will make it easier to transfer knowledge because of easier communication and learning between employees. And 'traditional' cost saving opportunities will abound. As this distance increases, companies need to invest more effort and time in the integration process, because of a lack of shared common routines and harder knowledge transfer. Hence, as companies tend to focus on the integration and

⁶ Desyllas, P. and Hughes, A. Research Policy, 2010

⁷ Seth, A. Strategic Management Journal, 1990

⁸ Harrison, J.S., Hitt, M.A., Hoskisson, R.E. & Ireland, R.D. Journal of Management, 1991

not on the R&D activity, the impact on post-M&A innovation can become negative⁹.

On the other hand, acquisition of a target with too closely related product/market resources will leave a company with little new input that can stimulate new learnings and hence, innovation. Through acquisitions, acquirers gain access to new products, ideas and practices that in turn enable them to increase their own innovative capabilities in the longer term. By acquiring firms in different industry domains, acquirers become aware of new market opportunities which facilitate opportunities for expansion. This is in addition to the financial benefits such as lower bankruptcy risk and the lower cost of capital that results from diversification.

⁹ Hitt, M.A., Hoskisson, R.E., Johnson, R.A., Moesel, D.D.
Academy of Management Journal, 1996

Previous studies

The first wave of studies on this topic focused only on the direct impact of M&A on innovative performance, without taking into account the conditions under which M&A might affect this performance. Studies measuring the direct impact of M&A on the acquirers' R&D input (which is measured by R&D expenditure and R&D-intensity) report either a neutral effect or a negative impact. Similarly, studies that focused on the M&A impact on the acquirers' R&D output (measured by patent intensity and new products) also report a neutral effect or a negative effect¹⁰.

The second type of study around M&A and innovation are more recent studies that focus on the deal-specific characteristics of the acquirer and the target, such as their market relatedness or technological similarities in terms of their knowledge assets¹¹. Having taken these factors into consideration, results from these studies offer a more positive outlook on post-M&A innovation performance.

Since acquisitions in R&D-intensive industries are more likely to be technology motivated, the existing literature on post-M&A innovative performance has largely emphasised the technological relatedness between merging companies and the complementarity of their technology assets¹². However, recent research has indicated that acquisitions also offer opportunities for market-related innovation¹³. Acquisitions are not only a means for accessing new technological knowledge but companies can also gain access to industry-specific resources, such as customer demand or market trend information. Despite these positive

theoretical predictions, it was found that market relatedness has a negative impact on the R&D process when the merging firms are rivals (competing in the same industry).

Therefore, in light of these sometimes-contradictory results, we believe there is a need for further research on the impact of product/market relatedness on post-M&A innovation.

Financial capacity

Further recent research has emphasised the impact of acquirers' financial characteristics as a key determinant of innovation input, over and above other factors that motivate acquisitions¹⁴. According to these studies, the ability of the acquirer to exploit opportunities from M&A might be influenced more by the leverage level and leverage growth than an acquirer experiences at the time of acquisition than by the deal-specific characteristics of the acquirer and the target. The theoretical explanation behind this is that the high levels of leverage force firms to put aside a significant amount of cash for debt repayments and therefore companies end up having less capital to fund necessary post-M&A R&D investments. Moreover, companies that experience high leverage levels have to deal with tighter financial constraints, imposed by investors who persuade executives to avoid risky investments in long-term projects (i.e., R&D) in the post-M&A period.

So, alongside our 'relatedness' work we also consider the financial capacity issue.

¹⁰ Hitt, M., Ireland, R., Harrison, J. and Hoskisson, R. *Academy of Management Journal*, 1991

¹¹ Ornaghi, C. *International Journal of Industrial Organisation*, 2009

¹² Makri, M., Hitt, M.A. and Lane, P.J. *Strategic Management Journal*, 2010

¹³ Fabrizio, K.R. & Thomas, L.G. *Strategic Management Journal*, 2012

¹⁴ Vyas, V., Narayanan, K. and Ramanathan, A. *Innovation and Development*, 2013

Our approach

Therefore, based on the discussion above, we theorise that while some level of relatedness between the acquirer and the target is seen as advantageous for post-M&A integration and performance, but too much overlap might limit the benefits of an extended and renewed resource base. The study hypothesises that acquiring a target with a moderate level of industry relatedness will lead to better post-M&A innovative performance than will acquiring too unrelated or too similar a target. A target with a moderate level of industry relatedness will provide new market and product inputs for post-M&A innovation while not incurring a significant net cost related to the integration. So our first investigation was centred around the following question:

Question One: Will industry relatedness be curvilinearly (inverse U-shaped) related to the post-M&A innovative activities (measured by a percentage change in R&D intensity) of the acquiring firm?

The second question relates to the impact of experience in related industry M&A.

Question Two: Is there is a positive

relationship between the acquirer's prior activity (experience) in industry related M&A and the post-M&A innovative activities (measured by the percentage change in R&D intensity) of the acquiring firm?

And finally, we tackle the financing issue.

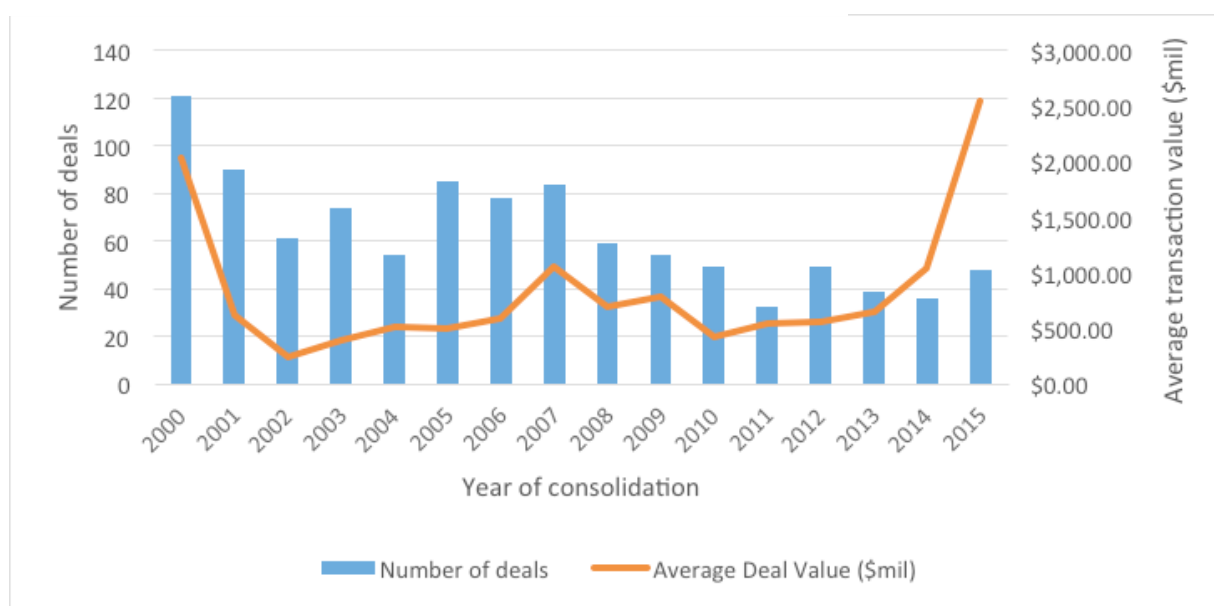
Question Three: Is there is a negative relationship between the acquirer's leverage level at the time of acquisition and R&D-intensity post the deal?

Our dataset

The questions were addressed over a large global sample of publicly-traded companies during the period from 1 January 2000 to 31 December 2015. The sample encompassed 1,013 deals.

Besides the need for an updated investigation, this period is chosen as it presents an interesting time to research because it includes periods of fundamental change in the overall M&A environment, including the highs and lows of the market i.e. the collapse of the information technology bubble, the M&A boom of 2006-2007, the financial crisis of 2007-2008 and the subsequent more recent merger wave.

Figure 3. Yearly distribution and average transaction value of M&A deals in the sample
Source: Cass Business School



The sample includes high technology firms which have their primary activity in:

- Industrial and Commercial Machinery and Computer Equipment (SIC code 35),
- Electronic and other Electrical Equipment and Components (SIC code 36), and
- Computer Programming, Data Processing and other Computer Related Services (SIC code 737).

This context was selected as the primary group for the analysis for the following reasons. First, for firms in these high-tech industries, acquisitions are an important means of strategy development and implementation, so they generally heavily engage in M&A activity¹⁵. Second, these industries are characterised by uncertainty, caused by rapid technological change and the dependence on technological developments. Third, companies operating in these industries are facing heavy levels of technological competition so there is a pressure to innovate. In such an R&D-intensive environment, innovation activities and outcomes are expected to be key performance indicators. Therefore, these high-tech industries provide an ideal context for examining post-M&A innovation performance.

Our methodology

This study measures innovative performance using the percentage change in R&D-intensity. R&D-intensity is defined as the ratio of R&D expenditure to total sales. The percentage change of R&D-intensity is calculated and the average R&D-intensity for the periods one year prior to the deal and up to three years following the deal. A review of the literature indicates that scholars studying the M&A effect on R&D-intensity employ a minimum of one-year period and a maximum of three year periods¹⁶. Post-M&A three year analysis is useful as it allows time for firms to integrate targets effectively.

Experience in industry-related M&A is measured by the number of industry-related M&A transactions made during the five-year period before the acquisition. As is standard, industry-related deals were identified using the first three digits (i.e., the first three digits must be identical to be classified as related M&A) of the unique Standard Industrial Classification (SIC) code for each acquisition. However, this study also takes into account 'level of relatedness' by analysing the relationship between target and acquirer in M&A deals at both the 2-digit and 4-digit level. We describe 2-digit matched SIC codes as 'loosely related', 3-digit matched as 'moderately related', and 4 digit-matched as 'highly related'.

Leverage level is defined as the ratio of the total debt of the firms to the total assets one year prior to the consolidation.

Figure 4: Deal distribution by primary industry SIC codes
Source: Cass Business School

Industry SIC code	# of Deals	% of Total	Total Deal Value (\$mil)	Average Deal Value (\$mil)	Median Deal Value (\$mil)
737	562	55.48%	\$381,161.59	\$678.22	\$94.32
36	353	34.85%	\$362,593.85	\$1,030.10	\$216.96
35	98	9.67%	\$136,444.02	\$1,392.29	\$409.39
Total	1013	100.00%	\$880,199.46	\$3,100.61	\$720.66

¹⁵ Cloudt, M., Hagedoorn, J., Van Kranenburg, H, Research Policy, 2006

¹⁶ Desyllas, P. and Hughes, A. Research Policy, 2010

Our findings

The table on the following page shows the relevant findings from our analysis. As well as analysis to answer our three questions, a number of other variables were tested in a full multiple regression analysis, without providing outcomes that influenced our conclusions. For a full discussion of the outcomes please see the Appendix.

Analysis suggests that there is some evidence that the acquirer's activity in loosely-related M&A one year prior to the M&A event has a negative impact on post-M&A innovative activities two and three years after the acquisition. However, this impact is rather small.

On the other hand, acquisition of moderately related targets one year prior to the M&A event results in significant and positive correlation with post-M&A innovative activities two and three years after the acquisition. There is even evidence that this positive correlation gradually increases, given that a one-unit increase in activity in related deals one year prior to the M&A event leads to a 9.9% increase in R&D-intensity in the second year, and 13.6% increase in the third year.

However, if the acquirer's activity is too related (4-digit SIC code relatedness), then M&A one year prior to the event is negatively correlated to the post-M&A innovative activities in all years after the acquisition. The results from regression suggest that a unit increase in overly related acquisitions one year prior to the M&A event leads to a 9.7% decrease in the second year, and even to a 15.0% decrease in the third year.

These findings give strong support for an affirmative answer to Question 1, suggesting a curvilinear pattern, as they suggest that to increase innovative activities through M&A, companies have to target firms which are moderately related, avoiding targets that are either too unrelated or too related. The explanation for this might be that in the latter situations the acquirer has to spend heavily on restructuring, without any relevant enrichments of its existing knowledge base.

The data does not, however, offer strong enough evidence to be able to answer yes to Question 2, which asked if there was a positive relationship between the acquirer's prior activity in industry related M&A and the post-M&A innovative activities of the acquiring firm.

No significant correlation between serial activity in any year before t-1 and R&D-intensity in the post-M&A period was found. This might be attributed to fast knowledge depreciation and the environmental turbulence that characterise the IT industry. In high-tech industries, the value of knowledge tends to depreciate faster because of the rapid rates of replacement and obsolescence.

In the case of previous M&A experience, one study observed that more frequent acquirers perform better than the less frequent in a long-term period of 10-13 years¹⁷. This implies that it takes some time for serial acquirers to accumulate their acquisition experience and that there is a chance that they would have performed better than the less active ones if we analysed them for a longer period, or indeed in a non 'tech' universe sample.

¹⁷ Laamanen, T. and Keil, T. Strategic Management Journal, 2008

Figure 5: Change in R&D intensity (and statistical significance) between one year prior to the deal and in the following three periods

Source: Cass Business School

	Time from Acquisitions (years)			Average over 3 years
	1 year	2 years	3 years	
M&A Experience 2 digit related SIC (t-1)	Positive very weak	Negative very weak	Negative very weak	Negative very weak
M&A Experience 3 digit related SIC (t-1)	Positive very weak	Positive moderate	Positive moderate	Positive moderate
M&A Experience 4 digit related SIC (t-1)	Negative weak	Negative strong	Negative strong	Negative very weak
Leverage	N/A	Negative moderate	Negative strong	Negative strong

Acquirer's Financial Capacity and R&D-intensity

Focusing on the impact of acquirers' financial characteristics on the percentage change in R&D-intensity, a statistically significant negative relationship between acquirer's leverage level and post-M&A R&D-intensity is confirmed for the second and third years following the deal and for the average of three post-acquisition years, as can be seen in the above table. This can be attributable to cash flows being used for debt repayments instead of investing in new R&D projects. The results from regression show that a unit increase in leverage level at the time of acquisition leads to approximately a 1% decrease in R&D-intensity for the different periods. Although the total impact is rather small, these findings provide strong support to be able to answer yes to Question 3.

Conclusions and implications

This report focuses on whether industry relatedness between companies engaged in M&A has a significant impact on the innovation performance of acquirers. It also examines the role of acquirer's characteristics in terms of financial capacity and previous M&A experience in order to find whether some acquirers will perform better than others in this context. Analysis of the full dataset from an international high-tech environment from 2000 to 2015 suggests both positive and negative effects of acquisitions.

The results suggest that acquisition of loosely-related targets results in a slight negative impact on R&D-intensity but a significant positive relationship if companies are moderately related. This finding implies that relatedness promotes technological complementarities and closeness of ideas which lead to enhanced R&D investments. However, as the degree of relatedness increases, the impact on R&D-intensity becomes gradually negative. Therefore, it is beneficial to the acquirer to obtain knowledge in areas that are somewhat related to its existing activities, but neither too related nor too unrelated. This finding adds additional support to much of the previous empirical evidence as it confirms a positive curvilinear relationship between industry relatedness and post-M&A innovation performance.

In the case of related acquisitions, the results suggest that acquisition brings no significant impact on R&D-intensity in the first post-acquisition year but significantly positive impact in the years after. Therefore, integration of common but not too similar ideas and resources between two companies takes time and might only be visible over time.

Interestingly, there is no clear evidence of a positive link between the experience of companies in related M&A in the past and R&D activity. A high number of M&A transactions in the five years prior to the deal do not seem to improve the innovative performance of

companies. These findings indicate that it is not possible to observe much just from the quantity of previous M&A deals as there are other more significant factors that need to be taken into account that overwhelm the learning/experience factor. What this finding does indicate is that, if there is an experience effect regarding M&A, the effect probably wears off after some time especially in highly turbulent industries characterised with fast knowledge depreciation such as IT. Further research could, look at the quality of experience in terms of the effective learning of acquirers, over and above the total number of acquisitions in the past.

Regarding the role of an acquirer's financial capacity, results confirm that high leverage levels impact negatively the post-deal R&D-intensity of the acquirer. High leverage levels inhibit acquiring firms from investing cash flows in R&D projects in the post-M&A period as they need to provide funds for, amongst other things, debt repayments.

Recommendations and implications:

Note that the analysis above was carried out in the tech sphere but there is likely a high degree of read across to all industries where disruption is both the greatest threat and the greatest opportunity. Therefore we conclude:

1. There is a 'sweet spot', that one might call 'adjacent M&A'. Acquire in an area where you know something about the risks and threats but where you don't have all the answers.
2. In rapidly changing areas, newly acquired knowledge has a limited shelf life in terms of setting you up for the next deal. As MARC has said in other reports, M&A needs to be part of a sequence of linked events and each deal not viewed in isolation.
3. Get your house in order first. If you are to take advantage of the technological opportunities granted by the acquisition you will need to spend to leverage them. If you are already heavily indebted you may end up not being able to spend that money

Appendix

To gather the merger data, this study uses Thomson One Banker's Database for M&A transactions. The initial acquisition announcement must occur between 1 January 1995 and 31 December 2015. The annual R&D expenditure data and financial information are downloaded from DataStream. In total, 26,449 M&A events from high-tech industries were identified. However, it is further imposed that all deals are required to satisfy the following conditions to be included in the final sample:

Figure 6: Condition requirements for study

Source: Thomson One Banker

Conditions	Number of deals
The acquirer is a publicly listed firm	17,458
The transaction is completed	12,934
The disclosed transaction value is greater than \$10 million	5,178
SIC codes and Datastream codes of both acquirers and targets are available	1,456
The acquirers are selected based on the industry information provided in SIC codes which cover one of the three information technology industries as mentioned above	1,328

After imposing these aforementioned restrictions, the sample is reduced to 1,328 M&A deals. The period 1995-2015 is chosen to obtain annual R&D expenditure data for the five years period prior to the M&A event as the same methodology was employed in previous studies. The final panel for the regression analysis amounts to 16 years from 2000 to 2015 and includes 1,013 M&A deals.

Figure 7. Yearly distribution of deals according to transaction value

Source: Thomson One Banker

Year	# of Deals	% of Total	Total Deal Value (\$mil)	Average Deal Value (\$mil)	Median Deal Value (\$mil)
2000	121	11.94%	\$246,070.14	\$2,033.64	\$276.27
2001	90	8.88%	\$55,089.68	\$612.11	\$83.79
2002	61	6.02%	\$14,440.89	\$236.74	\$73.30
2003	74	7.31%	\$29,230.82	\$395.01	\$85.40
2004	54	5.33%	\$27,668.13	\$512.37	\$91.40
2005	85	8.40%	\$41,881.64	\$492.73	\$138.74
2006	78	7.70%	\$45,572.34	\$584.26	\$236.26
2007	84	8.29%	\$88,445.27	\$1,052.92	\$216.29
2008	59	5.82%	\$41,037.59	\$695.55	\$73.41
2009	54	5.33%	\$42,726.70	\$791.24	\$115.04

Year	# of Deals	% of Total	Total Deal Value (\$mil)	Average Deal Value (\$mil)	Median Deal Value (\$mil)
2010	49	4.84%	\$20,671.53	\$421.87	\$184.32
2011	32	3.16%	\$17,223.67	\$538.24	\$57.98
2012	49	4.84%	\$27,510.84	\$561.45	\$171.81
2013	39	3.85%	\$25,529.14	\$654.59	\$180.00
2014	36	3.55%	\$37,310.10	\$1,036.39	\$370.77
2015	48	4.74%	\$119,790.99	\$2,548.74	\$398.76
Total	1013	100.00%	\$880,199.46	\$13,167.84	\$2,753.54

Robustness Checks

There is little correlation between the main control variables, with the expected exception of relatedness among SIC codes. Although no statistically significant correlation is observed, there is a high negative relationship between percentage change in R&D-intensity and liquidity, as well as a high positive correlation between percentage change in R&D-intensity and profitability. However, no highly significant correlation ($r > 0.7$ or $r < -0.7$) is observed which implies that the problem of multicollinearity should not be a concern with this sample.

Notes on Authors

Zana-Ljubica Krsticevic, Undergraduate student at Cass Business School

Dr Valeriya Vitkova, MARC Research Fellow, who recently completed a PhD on *Topics in Mergers and Acquisitions* at Cass Business School.

Scott Moeller, Director of MARC and Professor in the Practice of Finance. His research and teaching focuses on the full range of mergers and acquisitions activities.

Contact: cassmarc@city.ac.uk

M&A Research Centre

Cass Business School

106 Bunhill Row

London EC1Y 8TZ

T: +44 (0)20 7040 5146

E: CassMARC@city.ac.uk

www.cass.city.ac.uk/marc



Cass Business School

In 2002, City University's Business School was renamed Sir John Cass Business School following a generous donation towards the development of its new building in Bunhill Row. The School's name is usually abbreviated to Cass Business School.

Sir John Cass's Foundation

Sir John Cass's Foundation has supported education in London since the 18th century and takes its name from its founder, Sir John Cass, who established a school in Aldgate in 1710. Born in the City of London in 1661, Sir John served as an MP for the City and was knighted in 1713.