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Technological Acquisitions: The Impact of Geographic Distance On Post-Acquisition Innovative Performance

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Abstract

The extant literature on technological mergers and acquisitions is built upon the assumption that firms exist in an ?aspatial world?. Despite the fact that two literatures ? the transaction cost literature and the international business literature ? suggest that geography is likely to play a particularly important role to play in post-acquisition innovation performance of a technological acquisition, empirical insights remains. In this paper, therefore, and using a sample of 3,680 high-tech acquisitions, announced in the period 2008 to 2012, we explore the impact of ?distance? on post-acquisitions innovative performance. We measure post-acquisition innovation performance using a modified version of the ?event study?; using data on the pre-deal patenting behaviour of the target and the acquiring firm, we forecast their ?expected? performance, as two standalone firms, and compare this to their ?actual? performance in the year after the acquisition. Our results suggest that only 21.04% of deals lead the newly created firm to positively deviate from its innovation trajectory, while 65.41% do not improve their innovative position with a technological acquisition. We show too that distance matters. Looking at the international business literature, we show that neither cultural nor institutional distances impact the post-acquisition innovation performance of the firm. Interestingly, however, we find that international deals, all else equal, add to the performance of the firm, implying that ?foreignness? is more of an ?asset? than a ?liability?.

Jelcodes:R30,G34

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Keywords: Mergers and Acquisitions; Technological Acquisitions; Post-Acquisition Performance; Patenting; Event Study; Geographic Distance; Cultural Distance

JEL Classification: G3, G14, G34, L1, L25

INTRODUCTION

Technological acquisitions – that is, the acquisition of a firm for its technological capabilities (Ziedonis, 2004; Poon and MacPherson, 2005; Hung and Tang, 2008) – are common occurrences (Hitt et al.,1996; Makri et al. 2010; Karim and Mitchell, 2000; Larsson and Finkelstein, 1999; Graebner et al. 2010; Sears and Hoetker 2014).

Conceptually, this makes sense: technological acquisitions not only provide a firm with economies of scale and scope (Mowery et al., 1996; Hagedoorn and Duysters, 2002; Desyllas and Hughes, 2010), but increase a firms' capacity to absorb, develop, and recombine knowledge in new ways (Cohen and Levinthal, 1990). This contributes both to the firm's short-term innovative performance (Cloodt et al., 2006; Makri et al. 2010), and to the creation of a long-term competitive advantage (Barney, 1986; Schumpeter, 1934; Henderson and Clark, 1990; Kogut and Zander, 1992). Empirically, however, many acquisitions are described as failures (Moeller et al., 2004), and technological acquisitions in particular are known to be prone to complication and disappointment (Chaudhuri and Tabrizi, 1999; Kapoor and Lim, 2007; Desyllas and Hughes, 2010; Graebner et al. 2010). Studies looking at the effect of technological acquisitions on the R&D process (Danzon et al., 20007; Hitt et al., 1996), the output, (Prabhu et al., 2005; Cefis et al., 2009) as well as the financial performance of the firm (King et al., 2004; Cosh et al, 2005, 2008; Cosh and Hughes, 2008) consistently report poor results for deals aimed at developing the acquiring firm's technological capabilities. Technological acquisitions, hence, are somewhat of a paradox: theoretically, they should add value, but empirically they tend not to.

Two literatures – the transactions cost and the international business literature – suggest that geography may have a part to play in explaining this paradox. The first literature – the transaction cost literature -- suggests that geographic distance

increases transaction, monitoring, agency, and asymmetric information costs, while at the same time reducing the benefits of soft information (Grote and Umber, 2003; Böckerman and Lehto 2003; Hauptman and Hirji 1999; Cummings, 2007; Von Hippel, 1994; Morgan, 2004; Jaffe et al., 1993; Keller, 2002; Maurseth and Verspagen, 2002; Greunz, 2003; Storper and Venables 2004). These are what the literature describes as the 'liabilities of distance' or the 'costs of doing business far away' (Boe and Beamish, 2012). The second literature – the international business literature -- argues that national cultural and institutional distance complicate communication (Kaurent, 1983; Chevrier, 2003), reduces the quality of the information transferred (Jaffe et al., 1993; Kim, 2009), create uncertainty (Reus and Lamont, 2009), and leads to situations of 'them and us' (Huntington, 1993), which increases employee turnover (Krug and Hegarty, 1997). These are what the literature describes as the 'liabilities of foreignness' or the 'costs of doing business abroad' (Zaheer, 1995). Both sets of liabilities are play a role in most mergers and acquisitions. Because technological acquisitions are so dependent upon communication, integration, knowledge sharing and transfer, (Gertler 1995; Kranenburg et al. 2014), we argue that both will be especially important predictors of post-acquisition innovative performance in the context of high tech acquisitions. Surprisingly, however, empirical insights on the role of geography on post-acquisition innovative performance remains lacking (Prabhu et al., 2005; Cefis et al., 2009).

Drawing on both literatures, and arguing that because technological acquisitions require constant attention and a human touch if they are to succeed, we suggest that 'closer' targets are more likely to create the sorts of synergies forecasted by the theoretical literature, while 'distant' targets are more likely to run into difficulties observed by the empiricists. The conclusion, therefore, that 'most' technological acquisitions fail may merely be a statistical fact, arising from the reality that 'most'

technological targets are ‘distant’. We empirically test this assertion -- and explore the impact of ‘distance’ on the post-acquisition innovation performance -- using a sample of 3,680 high-tech acquisitions, announced in the period Jan 2008 to Dec 2012.

To consider if the acquisition lead the newly created firm to deviate from its innovation trajectory, the empirical design of our study is based on a modified version of the ‘event study’ (c.f Brown and Warner, 1980). Looking at the patenting behaviour of the target and the acquiring firm over the four years prior to the acquisition, we forecast their ‘expected’ behaviour, as two stand-alone firms. We then compare actual and expected performance in the year after the deal, to consider if the deal added to, or detracted from, the sum of the recently joint firms’ innovative performance. Effectively, therefore, we measure success and failure in terms of the number of new patent application it brings, either above or below expectation.

Using this measure we find, firstly, that only 21.04% of firms in the sample beat their forecast, and made more patent applications in the year after the acquisition than they should have produced alone. By contrast, 45.75% achieved their forecast, and 19.66% made fewer applications. In other words, 65.41% of deals in the sample did not improve their innovative position with the acquisition, which tallies nicely with the suggestions of financial scholars that 65-85% of acquisitions fail to add value.

Secondly, when including the impact of geography in the form of controlling for physical distance between acquisition partners, we find strong evidence to support ‘liability of distance’ as an underestimated aspect that needs to be taken into account in the design of a technologically oriented acquisition. Our empirical findings point out that each kilometre that geographically separates the headquarters of acquisition partners costs the firm 0.001 abnormal patents. For the average deal – in which the geographic between two firms is 1,745 km (or 1,084 mi) – this translates into a loss of 1.63 patents. For the 10% of acquirers that make acquisitions over 5,320 km (3305

miles), the loss rises to 16.8 lost patent applications. Looking at the 'liability of foreignness', we find that internationalisation increases the post-acquisition innovation performance of the firm: we find that, all else equal cross-border deals result in 2.64 abnormal patent applications. This supports the suggestion that foreignness may be more of an 'asset' than a 'liability' (Nachum, 2010) in technological acquisitions. Decomposing the 'liability' of foreignness into cultural and institutional distance, however, we find that neither has a directly significant effect. This may suggest that the sorts of problems that international business scholar predict are less relevant for high-tech mergers and acquisitions than they may be in the general case. We do report, however, that both cultural and institutional distance negatively moderates the performance of an already physically distant deal.

In doing so, we make a number of contributions to the literature. Firstly, we introduce a new measure for post-acquisition innovation performance, which allows us to describe performance in both positive and negative terms. Secondly, we systematically demonstrate the significance of geography-based measures of distance on the post-acquisition performance of a technological acquisition, and separate out the impact of the liabilities of distance and foreignness, which are typically lumped together (e.g. Zaheer, 1995; Larsson and Finkelstein, 1999; Qian et al. 2013). In doing so, and by demonstrating that conditions that impact the performance of technological acquisitions, we move the research one step closer to explaining the paradox of technological acquisitions, and offer insights to academics and practitioners.

PRIOR LITERATURE

On the Impact of Acquisitions on Innovation

A 'technological acquisition' is an acquisition in which a target firm is acquired for its technology, or technology-related knowledge, to increase the innovative capacity of

the acquiring firm (Kim and Ro, 1995; Lambe and Spekman, 1997; James et al., 1998; Lowe and Taylor, 1998; Cho and Yu, 2000; Ziedonis, 2004; Hemmert, 2004; Kiyota and Okazaki, 2005; Poon and MacPherson, 2005; Hung and Tang, 2008).

The literature tells us that technological mergers and acquisitions are common occurrences (Hitt et al.,1996; Makri et al. 2010; Karim and Mitchell, 2000; Larsson and Finkelstein, 1999; Graebner et al. 2010; Sears and Hoetker 2014). Conceptually, and for a number of reasons, this makes sense. Most importantly, and from a resource-based and organizational learning perspective, technological acquisitions are said to improve the innovative performance of the acquiring firm (Cloodt et al., 2006). A firm's innovativeness is a function of its knowledge base, and while the knowledge base can be extended internally, through investment, authors argue that grafting a 'knowledge rich' target onto the existing base can offer a higher benefit for a number of reasons. To begin with, knowledge acquisitions serve to enhance the firm's asset base and organizational capabilities (Chaudhuri and Tabrizi, 1999; Ahuja and Katila, 2001; Puranam et al., 2006; Kapoor and Lim, 2006), while avoiding the time-consuming internal accumulation of innovation enhancing resources (Dierickx and Cool, 1989; Barney, 1991; Teece et al., 1997; Desyllas and Hughes, 2010). Perhaps more importantly, by acquiring 'knowledge rich' firms, acquirers not only 'get what they buy' – that is, the 'explicit knowledge' that motivated the acquisition – but also the unseen and un-quantified 'tacit knowledge'. With this the firm can recombine itself to create new syntheses and can explore previously unknown and unimagined opportunities (Ahuja and Katila, 2001; Wry and Lounsbury, 2013). In doing so, and by actively developing the so-called 'perceptiveness' of the firm's knowledge base, the acquirer, it is argued, can enhance not only its current abilities, but its ability to absorb new knowledge in future (Cohen and Levinthal, 1990).

Empirically, however, many acquisitions are described as failures (Moeller et al., 2004), and technological acquisitions, in particular, are known to be prone to complication and disappointment (Chaudhuri and Tabrizi, 1999; Kapoor and Lim, 2007; Desyllas and Hughes, 2010; Graebner et al. 2010). Studies looking at the effect of technological acquisitions on the R&D process (Danzon et al., 20007; Hitt et al., 1996), the output, (Prabhu et al., 2005; Cefis et al., 2009) as well as the financial performance of the firm (King et al., 2004; Cosh et al,. 2005, 2008; Cosh and Hughes, 2008) consistently report poor results for technology-motived acquisitions.

A number of explanations are put forward for this finding. For example, a some scholars suggest that acquisitions disrupt the established routines of the acquiring firm (Jemison and Sitkin, 1986, Haspeslagh and Jemison 1991), and because, in a technological acquisition, these sorts of disruptions are most likely to occur in the set of routines that are closest to the innovation area, technologically complex firms are particularly prone to complication (Pritchett, 1985; Hitt et al., 1991, 1996; Hoskisson et al., 1994; Ahuja and Katila 2001;). High tech acquisitions, in other words, are, by definition, a high risk form of acquisitions. Others suggest that technological acquisitions are prone to complication and failure for more human reasons. This literature suggests that the level of post-acquisition integration -- and the ease with which information flows from one firm to another (Haspeslagh and Jemison, 1991; Capron et al., 1998; Bresman et al., 1999) -- explains performance (Larsson & Lubatkin, 2001; Zollo & Singh, 2004; Bjorkman et al., 2007). Factors which complicate the integration – such as differences in the organisational cultures of the target and acquiring firm (Nahavandi and Malekzadeh 1988; Datta 1991; Cartwright and Cooper 1996; Weber et al. 1996; Morosini et al. 1998; Larsson and Finkelstein 1999; Kavanagh and Ashkanasy 2006; Birkinshaw et al., 2000; Larsson and Lubatkin, 2001; Stahl and Voigt, 2009) – complicate the deal, and require additional managerial

resources. The finding that most acquisitions fail, therefore, suggests that most managers do not sufficiently invest in the integration to create synergies.

HYPOTHESIS DEVELOPMENT

On the Impact of Distance on Acquisitions

If integration and managerial commitment explain the post-acquisition performance of a technological acquisition, then clearly any factor which interferes with the managers ability to integrate the target is likely to negatively impact performance. Much of the existing literature on the post-acquisition innovative performance of a technological acquisition is built upon the assumption that firms exist in an 'aspatial world' (Howells and Bessant, 2012), insofar as the distance between the target and acquiring does not matter. Geography, however, is known to play a role in merger performance (see e.g., Green & Cromley, 1984; Hannan and Rhoades, 1987; Capron, 1999; Chapman, 2003; Böckerman and Lehto, 2003; Rhodrigues-Pose and Zaemach, 2003; Schildt and Laamanen, 2006; Eun and Mukherjee, 2006; Ragozzino, 2009; Di Guardo et al., 2013; Paci et al., 2013; Ellwanger and Boschma, 2013; Chakrabarti & Mitchell, 2013), and two literatures, in particular, suggest that the impact of geography may even be amplified in the case of a technological acquisitions.

Physical Distance and Transactions Cost Theory

The transactions costs literature suggests that – even in the face of easier travel and ever more extensive telecommunications (Sorenson and Baum, 2003) – geographic distance creates a number of business challenges (e.g., Green & Cromley, 1984; Spiller, 1985; Hannan & Rhoades, 1987; Hauptman and Hirji, 1999; Schildt & Laamanen, 2006). In the context of mergers and acquisitions, a number of arguments suggest that the greater the geographic distance, the poorer the performance.

First, geographic distance increases transportation costs (Grote and Umber, 2003). Integrating an acquisition usually involves the exchange of goods and workers (Capron et al., 1998). The greater the distance between the target and the acquirer the more time consuming and the more costly these exchanges become (Grote and Umber, 2006). Geographic distance increases transportation costs, and therefore decreases performance, as acquirers are less likely to interact with their targets.

Second, geographic distance increases monitoring and agency costs. The managerial theories of mergers and acquisitions suggest that geographically distant acquisitions are often little more than hubristic (Roll, 1986), agency driven attempts to grow the firm beyond its optimal size, and are designed to maximize managerial power or prestige, or to build empires (Rhoades, 1983; Ravenscraft and Scherer, 1987). Indeed, several studies find that empire building plays at least some role in expansionary merger decisions (Rhoades, 1983, Ravenscraft and Scherer, 1987). This – the fact that distance may signal an intention to act in a self-serving manner – coupled with the fact that – even in the absence of an intention to act in a self-serving manner – it is easier to monitor a closer manager than it is to monitor a more distant one, means that geographic distance increases the threat of agency, and the necessity of monitoring. Or, put another way, geographical proximity improves monitoring or at least decreases the costs of monitoring (e.g. Green, 1990; Ashcroft et al., 1994). Empirically, Böckerman and Lehto (2003) support this reasoning, and find evidence that monitoring costs drive proximate mergers in Finland. This finding is in line with the observation that venture capital firms tend to prefer to invest locally (Lerner 1995; Zook 2002, Sorenson and Stuart 2001). Geographic distance increases monitoring costs, and therefore decreases the probability of a successful acquisition.

Finally, geographic distance reduces the benefits of so-called ‘soft information’ for three reasons. First, and in terms of efficient communication, research indicates that

distance increases communication difficulties (Hauptman and Hirji 1999; Cummings, 2007), as well as the costs of seeking, and of integrating relevant knowledge (Borgatti and Cross, 2003; Cummings and Ghosh, 2005). Efficient communication is critical, however, to deal performance (Yunker, 1983; Chakrabarti & Mitchell, 2013). Ghemawat (2001) and van Kraneburg et al 2014 show that, in the context of alliances, geographic distance is negatively related to the quality of information flows and the quality of knowledge transfers. Second, and in terms of tacit information – that is, information, for example, about the moods, and non-quantifiable feelings about the future – research indicates that tacit information is not easily transferable over distance (Coval and Moskowitz 1999; Polanyi 1958). The transmission of tacit knowledge presumes face-to-face contact or other mechanisms that require spatial proximity (Von Hippel, 1994; Morgan, 2004). Accordingly, there is a great amount of evidence that points out that knowledge and technology flows are dampened by geographical distance (e.g. Jaffe et al., 1993; Keller, 2002; Maurseth and Verspagen, 2002; Greunz, 2003). Third, and in terms of unrequested information, research indicates that distance matters because by being proximate to the deal, investors get information, without having to ask for it, just by, for example, bumping into people and chatting with them (Storper and Venables 2004). Geographically proximate acquirers are, therefore, in a better position to appraise a target firm, while remote acquirers are more likely to lack soft information. A number of studies support this reasoning, and shows how proximity, and the advantages conferred from 'soft information', impact investment decisions. Petersen and Rajan (2002), for example, observe that appraisals depend upon the processing of rich, soft information that necessitates local relationships, and in support of this Malloy (2005) finds that the accuracy of an analysts' forecasts decreases with distance. Coval and Moskowitz (1999) find that fund managers who invest in local companies post better returns. Grinblatt and Keloharju (2001) show that investors, consequently, prefer stocks of

firms that are headquartered in spatially close locations. These 'informational advantages' have been identified as main drivers of what has been termed, consequently, as the 'home bias' (Gehrig 1993; Dvorák 2005; Ahearne et al. 2004; Strong and Xu 2003; Chan et al. 2005; Lewis 1999; Portes et al. 2001). Geographic distance, in other words, decreases the benefits of soft-information, and therefore decreases the probability that an acquisition will end successfully.

Taken together – because geographic distance increases transaction, monitoring, agency, and asymmetric information costs, while reducing the benefits of soft information, we argue that distance matters. The resulting suggestion is that 'closer' technological deals will outperform 'distant' ones. In other words:

H1 – The distance between the target and the acquirer, in a physical sense, impacts the post-acquisition innovation-based performance of the firm.

Cultural Distance and International Business Theory

The international business literature suggests that – even in the face of cultural convergence (Jenkins, 2006) – cultural and institutional distance creates various challenges (e.g., Krug & Hegarty, 1997; Simonin 1999; Dhanaraj et al., 200; Reus and Lamont, 2009). In the context of mergers and acquisitions, a number of arguments suggest that the greater the cultural distance, the poorer the performance of the deal.

Firstly, cultural and institutional distance is likely to influence the ex-ante negotiation process. Individuals, who share a national cultural background tend to share certain frames of reference, shaping their ways of communicating, making decisions, and resolving conflicts (Kaurent, 1983; Chevrier, 2003). Negotiating the way in which an acquisition will be concluded is likely, therefore, to be more difficult when negotiators do not share such frames of reference (Walsh, 1989). The more

uncertainty that the negotiation process creates, the more likely that the key people will leave, and therefore cultural distance is likely to impact acquisition performance.

Secondly, and from, an ex-post perspective, cultural distance impacts the extent to which acquisition partners communicate with each other. Several studies report that national culture has an important influence on how people interact with others. For example, Singelis & Brown (1995) report that mothers from collectivistic cultures tend to encourage listening and empathy in their children, whereas mothers from individualistic cultures tend to teach self-expression, and Hofstede (2001) explains that cultures characterized by large power distance tend to have centralized communication, whereas cultures characterized by low-levels of power distance tend to have decentralized communication. These differences are lead to very distinct communication styles and expectations from communication. This, coupled with the fact that people prefer, and therefore create more greater opportunities, to communicate with other members from similar cultures rather than with members from distant cultures (Lane et al., 2004), means that cultural distance makes it more difficult for workforces to come together, interact, and share ideas, and, as a result, impedes communication (Reus and Lamont, 2009). Cultural distance, in other words, increases the costs of communicating, and decreases the probability success.

Third, cultural distance is said to influence the way in which groups work together. Cultural differences lead to situations of ‘‘us versus them’’ (Huntington, 1993), and restricts the extent to which organization develop strong relationships (Luo, 2001). This becomes particularly important in the context of a technological acquisition, where people from different cultures may be required to work together closely. The differences in national cultures between merging groups can lead to considerable clashes about what is considered appropriate behavior, increasing the likelihood of conflict and mistrust among acquisition partners (Cartwright & Cooper, 1992; Datta

& Puia, 1995; Reus and Lamont, 2009). Ex-post, research also suggests that cultural and institutional distance increases the costs of monitoring the cooperation (Davidson and McFetridge, 1985; van Kranenburg et al. 2014). Cultural distance, in other words, creates a barrier to cooperation, which decreases the probability of a successful acquisition. Active involvement and frequent interaction is particularly important when the technology or knowledge is complex (Teece, 1986), and when the transfer is to occur across national and cultural boundaries (Contractor et al., 2011). Lack of such involvement and such interaction may lead to innovative potential leaking away.

Finally, and because cultural distance creates uncertainty, ex-ante, and creates barriers and sub-groups ex-post, cultural distance also impacts the acquirers ability to retain key personnel in the target firm. Research shows that the employees of the acquired firm, likely to feel threatened by the acquisitions (Krug & Hegarty, 1997), and will be less willing to adjust to, or accept practices of culturally an institutionally distant acquirers that show very different values and norms (Reus and Lamont, 2009). This leads, at best, to inefficiency, or dysfunction, and at worst to a loss of the key talent that motivated the acquisition. Cultural and institutional distance, in other words, decreases performance by increasing the challenges of retaining key working.

Taken together – because cultural and institutional distance complicates communication, and leads to situations of 'them and us' in the work place, which increase the turnover – the suggestion is that both culturally and institutionally 'closer' technological acquisitions will outperform technologically 'distant' ones:

H2a – The distance between the target and the acquirer, in a cultural sense, impacts the post-acquisition innovation-based performance of the firm.

H2b – The distance between the target and the acquirer, in a institutional sense, impacts the post-acquisition innovation-based performance of the firm.

METHODS

Sample

We use Thomson SDC to build our sample. We refine this to include all: (1) acquisitions; (2) between January 1, 2008 and December 31, 2012; (3) which do not involve a recapitalization, repurchase of own shares, or a spin-off to existing shareholders. We only include deals by: (4) publicly listed acquirers; (5) seeking to buy 100% of the target shares at announcement; (6) in high-tech industries. Following Cloodt et al., (2006), we define high tech industries to mean the aerospace and defense (SIC-codes 372 and 376), computers and office machinery (SIC-code 357), pharmaceuticals (SIC-code 283) and electronics and communications (SIC-code 36) industries. In doing so, we create an initial sample of 4,731 acquisitions.

Dependent

We use a modified version of the 'event study method' -- which is commonly employed to describe merger performance in finance and strategy (see Zollo and Miere, 2008) -- to consider if the acquisition led the newly created firm to deviate from its innovation trajectory. We create a measure of 'abnormal innovative performance' -- which we term Abnormal_Patents -- to measure the number of patents applications made by the newly created firm, above or below expectation of the two stand-alone firms. We calculate it as follows. First, we collect the number of patent applications for both the target and the acquiring firm around the acquisition date. Next, and using the pre-acquisition number of patent applications, we make a forecast of the expected number of patents in the years after the deal, for both the target and the acquirer. This is an estimate of how innovative the firm should have been, in the absence of the acquisition, based on its prior innovative performance. For this, we look at the patenting behaviour of the two firm over the 4 years prior to the

deal. Then, looking at the actual number of patent applications, to both the target and the acquirer, post-acquisition, we contrast actual with expected performance, to estimate abnormal innovative returns. Because it is not possible to attribute abnormal performance to one deal as opposed to another in the case of repeat acquirers, we exclude repeat acquirers that have more than one acquisition with a two year window. We calculate Abnormal_Patents for each of the first four years after the deal.

Independents

We use Thomson SDC to identify the address of both the target and the acquiring firms. We collect data at the city- and country-levels. Dropping those deals for the location of either partner could not be identified reduces the sample to 3,683. Using the location of the target and the acquiring firm, we create the following variables:

Kilometer Distance: We identify the GPS coordinates of both the target and the acquirer, using GPS Visualizer[1]. Then, using the haversine formula , we calculate the greater-circle distance between the target and the acquirer, in kilometers.

International: We programme a dummy variable to distinguish domestic and cross-border deals. We use this test the liability of foreginess on deal performacne.

Cultural Distance: We calculate cultural distance using the Hofstede (1984) cultural dimensions. We retrieve the value for each dimension, for each country, and follow Kogut and Singh's (1998) in calculating a cultural distance.

Institutional Distance: We calculate institutional distance using the Globe institutional measures. We retrieve the value for each dimension, for each country, and follow Salomon (2012) in calculating a measure of institutional distance.

[1] http://www.gpsvisualizer.com/

-- Table 1 Here --

Performance Controls

We control for a number of factors known to impact innovation performance: (1) Target Industry, which we measure using the target firms Standard Industrial Classification (SIC) codes, because the propensity to patent varies per industry; (2) the Levels of Related between the target and the acquiring firm, which we measure as the difference between the SIC codes of the target and acquiring firm; (3) target public / private status (Private Target), which we identify using a dummy variable set equals to one if the target was private and otherwise zero; (4) Acquirer Prior Performance, for which we computed industry-adjusted performance by subtracting the median industry ROA value, from firm-level ROA measured at the end of the year before an acquisition year, because Morck et al. (1990) shows that firms with better financial performance make better acquisitions; (5) the Percentage Acquired, because the percentage acquired is likely to impact the levels of collaboration, and thus the level of innovative output; (6) Acquirer R&D Expenditure, in millions of dollars, because the levels of investment made in innovation by the target and acquiring firm is likely to impact the innovation; (7) Acquirer Number of Employees, in thousands of employees, as a measure of firm size, and therefore deal complexity, because Moeller et al (2005) shows that larger deals underperform; (8) Cash Flow to the acquiring firm – which we calculate by dividing the operating profits over the last twelve months by the market value four weeks prior to the announcement – because innovation requires a 'cushion of liquidity'; (9) an indicator of deal attitude (Hostile), which we identify with an indicator variable, set equal to 1 if the deal was hostile or unsolicited, because hostility impacts performance, and is especially likely to impact collaboration. All the necessary data is collected from Datastream, and winsorized to remove outliers. In our analysis, we cluster by acquirer industry, and control for year effects. Table 1

report the correlation, the mean and standard deviation of our key variables.

RESULTS

Acquisitions and Innovation

Table 1 reports that the average acquisition in the sample resulted in +2.16 abnormal patent applications. This rises to +3.06 in the second year, +5.09 in the third year, and +6.89 in the fourth year. In other words, the average acquirer produced more patents, after the acquisition, than it and the target had been forecast to make alone.

Looking at the abnormal patents distribution, however, we see that this is was certainly not true of all the firms in the sample. We report that only 21.04% of firms beat their forecast, and therefore made more patent applications in the year after the acquisition than was expected, 45.75% of firms achieved their forecast or, put another way, had no effect, positive or negative, from the acquisition, and 19.66% of firms made fewer applications than forecast. In other words, 65.41% of deals in the sample did not improve their innovative position with the acquisition. This tallies with the suggestions of financial scholars, who suggest that between 65-85% of acquisitions fail to add financial value (e.g., McCarthy and Dolfsma, 2012). Interestingly, we note that that percent of firms that beat their forecast in the second year rises from 21 to 22%. This rises further to 24% in the third year, and to 26% in the fourth year, leading credence to the suggestion that innovation takes time. Table 2 summarises.

-- Table 2 Here --

We also note industry specific effects: in the aerospace and defence (n=249) and pharmaceuticals (n=1,467), industries, only 15% and 16% of firms respectively beat their forecast. In the electronics and communications (n=1,279) and computers and office machinery (n=688) industries 24% and 26% of firms beat their forecast.

Acquisitions, Innovations and Distance

Table 3 reports on the impact of distance on post-acquisition innovation performance. These models are estimated using the number of abnormal patents in the year after the deal. The results are robust when the other Abnormal_Patents variables are included.

Before interpreting the results, we check multi-collinearity. A variance inflation factor (VIF) test reveals that the highest VIF for a single variable is 1.38, for Cash Flow, with a mean VIF of 1.13. These values are well below the established cut-offs (Hair et al., 1992; Studenmund and Cassidy, 1992) used to indicate multi-collinearity.

-- Table 3 Here --

Model 1 presents the base set of control variables. Positive significance in terms of target industry, market-to-book ratios, and R&D expenditure, and negative significance in terms of the levels of relatedness and the levels of hostility, demonstrates that certain firm- and deal-level characteristics impact the post-acquisition innovative performance of the newly merged firm. The direction of the significance, in most cases, fits with our expectations. The scale of the impact of the hostility flag is, however, noteworthy: the results of Model 1 suggest all else equal, hostility costs a technological acquisition 33.78 patent applications on its forecast.

To this base specification, Model 2 adds the distance between the target and acquiring firm, in kilometers. A negative and significant coefficient suggests that each kilometer reduces performance: one kilometer costs -0.001 abnormal patents. Because the average distance between the target and the acquirer is 1,745 km (1,084 mi) – which is equivalent to the distance between New York and Miami, or Berlin and Istanbul – this translates, all else equal, into an abnormal loss of -1.63 patent applications. We find (but do not report) that the costs of distance are nonlinear: targets within 143 km of the acquiring firm (that is, within the first quartile of the distance distribution,

where n=921) gain, on average, +5.34 abnormal patents. Deals above 2,541 km (that is, within the fourth quartile of the distance distribution, n=921) lose, on average, -15.2 abnormal patents. In the furthest 10% of deals (n=369), in which the target and the acquirer are more than 5,320 km apart, the loss rises to -16.88 abnormal patents.

-- Figure 1 Here --

Because 35% of the deals in the sample were international, and therefore subject to the liability of foreignness, Model 3 adds an international dummy to the base specification. A positive and significant coefficient suggests that, all else equal, international, cross-border deals, result in 2.64 patents more than the average deal. This supports the suggestion that foreignness may be more of an asset than a liability (Nachum, 2010). Model 4 and 5 decompose the concept of foreignness into cultural and institutional distance respectively. Insignificant coefficients, in both cases, suggest that neither has an impact on the post-acquisition innovative performance of the combined firm. Model 6 tests the combined, cultural and institutional distance measures, and again reports an insignificant effect. Model 3 to 6 suggest, in essence, that it pays to go abroad, and cultural and institutional distance doesn't matter.

Finally, Models 7 and 8 combine the various distance measures in a single model. They differ insofar as Model 7 reports the separate effects of cultural and institutional distance, and Model 8 reports the combined effects. Both demonstrate that geographic distance is a robust predictor of post-acquisition innovation performance.

-- Table 4 Here --

Because distance is the most robust predictor of performance, Table 4 explores if the various foreignness measures moderate the impact of geographic distance. Model 9 considers if the 'assets of foreignness', described in Model 3, can moderate the direct costs of geographic distance. A positive direct effect for the international dummy

confirms the benefits of internationalization, or the asset of foreignness, but an insignificant moderating effect suggests that the direct effect of distance cannot be reduced through internationalization. This, of course, makes conceptual sense. Model 10 considers the impact on performance when cultural distance is added to an already geographically distant acquisition, and Model 11 considers how institutional distance alters the equation; negative and significant coefficients on the moderators in both situations suggest that complicating an already geographically distant deal with cultural and/or institutional costs further reduces performance. Finally, Model 12 reports that the single measure for institutional and cultural distance does not significantly moderate the performance of a geographically distant acquisition.

DISCUSSION & CONCLUSION

Key Findings & Contributions

Much of the existing discussion on the performance of technological mergers and acquisitions is built upon the assumption that firms exist in an 'aspatial world': the benefits of a technological acquisition – in terms of new knowledge, innovation, and increased absorptive capacity – are assumed to be directly realizable, irrespective of where the target firm is located. The paradox that emerges then is why do so many technological acquisitions fail? Our starting point in this paper was not only to suggest that geography matters – insofar as the location of the target and acquiring firms in space impacts the realizability of the synergies -- but that the costs implied by geography – as highlighted in the transactions cost and international business literatures – may even be amplified in the case of a technological acquisition. Testing these propositions, using a sample of 3,680 high-tech acquisitions, we find that:

1. Most technological acquisitions end unspectacularly

We report that only 21.04% of firms in the sample beat their forecast and made more

patent applications in the year after the acquisition than they were expected to make as standalone firms. Some 45.75% achieved their forecast or, put another way, had no effect, and 19.66% of firms made fewer applications than forecast. In other words, 65.41% of deals did not improve their innovative position with the acquisition.

2. Distance impacts the innovative performance of a technological acquisition

Our results suggest that the physical distance between the target and acquiring firm, in kilometers, predicts the post-acquisition innovation performance of the firm. Here, however, two findings, in particular, are interesting. Firstly, and looking at the general effect of distance, we report that one additional kilometer between the target and acquiring firms costs 0.001 abnormal patents. Because the average distance between the target and the acquirer is 1,745 km (1,084 mi), this translates, all else equal, into an abnormal loss of -1.63 patent applications. With an average patent worth $1.25 million[2], the implication is that technological acquisitions costs more than $2 million in lost innovation. Secondly, we find that the costs of distance are nonlinear: the closest 25% of deals – that is, those for which the target is within 143 km of the acquiring firm – gain, on average, +5.34 abnormal patents, while the furthest 25% of deals – that is, those for which the target is more than 2,541 km from the acquiring firm – lose, on average, -15.2 abnormal patents. In furthest 10% of deals, in which the target and the acquirer are more than 5,320 km apart, this rises to -16.88 abnormal patents. In dollar terms, this is a loss of $21 million. Both findings fits with our expectation, and the suggestions of the literature that distance increases transaction, monitoring, agency, and asymmetric information costs, while at the same time reducing the benefits of soft information. For managers the implications are obvious.

2. Crossing borders boosts post-acquisition innovation

[2] Based on the 2012 acquisition of AOLs 800 patents by Microsoft.

The international business literature suggests that foreignness is a liability, and looking at financial performance indicators finance scholars have confirmed that domestic deals outperform cross-border deals (see e.g., Chatterjee and Aw, 2000; Eckbo and Thorburn, 2000; Moeller and Schlingemann, 2005). Looking at the post-acquisition innovation performance, however, our results suggest the opposite to be the case: we find that, all else equal, international, cross-border deals, result in 2.64 abnormal patents more than the average deal. This supports the suggestion that foreignness may be more of an asset than a liability (Nachum, 2010). It seems that crossing borders, and entering new markets, with new knowledge and new information, adds to the post-acquisition innovative performance of the deal. The implication is that while managers should be careful about the liability of foreignness, in the case of the average deal, and when describing performance in financial terms, managers shouldn't fear borders when the objective is to enhance innovation.

3. Cultural and institutional distances do not impact innovative acquisitions

The literature led us to suggest that cultural and institutional distance complicates communication, creates uncertainty, and leads to situations of 'them and us' in the work place, which increases employee turnover. We hypothesised, therefore, that cultural and institutional distance would damage deal performance, but failed to support this suggestion. Our results suggest that neither construct predicts post-acquisition innovation. This may suggest that the sorts of problems that international business scholar predict – in terms of cultural and institutional distance – are less relevant for high-tech mergers and acquisitions than they may be in the general case. We do report, however, that both cultural and institutional distance negatively moderates the performance of an already physically / geographically distant deal: making a physically and culturally distant acquisition, for example, implies a loss of 3.49 applications. The implication for managers is that crossing borders, and creating

cultural and institutional distance, should not be feared when the objective is enhance the firms innovative capacity, unless the target firm is physically distant.

In sum, we make a number of contributions to the literature. Firstly, we systematically demonstrate the significance of geography-based measures of distance on the post-acquisition performance of a technological acquisition. In doing so, and by demonstrating that conditions that impact the performance of technological acquisitions, we move the research one step closer to explaining the paradox of technological acquisitions, and offer insights to academics and practitioners. Secondly, we empirically separate the liability of distance and foreignness, which are typically lumped together (e.g. Zaheer, 1995; Larsson and Finkelstein, 1999; Qian, Li, Rugman, 2013). Thirdly, we empirically separate the liability of distance and foreignness, which are typically lumped together (e.g. Zaheer, 1995; Larsson and Finkelstein, 1999; Qian, Li, Rugman, 2013). We show that neither cultural nor institutional distances impact the post-acquisition innovation performance of the firm. And lastly, as a methodological contribution, we introduced a new measure for post-acquisition innovation performance, which allows us to describe performance in both positive and negative terms. The benefit of this measure over the standard 'total patents' measure is that we can not only describe the innovative gains generated by the acquisitions, but also the innovative loses incurred by the deal.

Limitations & Future Research

As with all empirical research, ours has its limitations. Firstly, we only consider the case of once off acquirers. We do so because, in the case of a repeat acquirers, it is impossible to attribute a new patents to one deal or another. It maybe, however, that repeat acquirers behave differently, in terms of their post-acquisition performacen, by virtue of the fact that they have experience of technological mergers and acquisition.

We hope that future researchers will pick up on this question. Secondly, we do not consider the value of the patents generated after the deal, but only the number. It may be, however, that while the number of patent applications increases after a deal, the quality, or the financial value of the patent decreases. We hope that future researchers will pick up on this question, to consider not only if technological acquisitions lead to more patents, but if technological acquisitons lead to more valuable patents too. Thirdly, we only consider the performance of the deal one year after the acquisition. We do so because the longer the gap between the event, and the point of measurment, the more likely the error. For some firms this may be too short a period. We hope, therefore, that researchers will investiate the temporal side of this story too.

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Table1 – Descriptive Statistics

		Mean	**S.D.**	**Min**	**Max**	1	3	4	5	6	7	8	9
1	Abnormal Patents	2.16	47.13	-494	1365.8	1.000							
3	Market-to-Book	5.94	1.03	-0.96	14.42	0.030 -0.220	1.000						
4	Prior Performance	-18.16	424.47	-12441	615.52	0.000 -0.870	0.020 -0.480	1.000					
5	Percentage Acquired	97.16	10.34	3.33	100	0.010 -0.530	0.000 -0.990	0.000 -0.960	1.000				
6	R&D Expenditure	6063.62	38158.6	0	564781	0.140 0.000	0.040 -0.090	0.010 -0.740	-0.130 0.000	1.000			
7	Number of Employees	44024.82	93323.69	1	475000	0.050 -0.060	-0.110 0.000	0.030 -0.250	0.030 -0.160	0.190 0.000	1.000		
8	Cash Flow	-2.88	0.93	-8.83	0.3	-0.040 -0.170	-0.410 0.000	0.170 0.000	0.080 0.000	-0.120 0.000	0.110 0.000	1.000	
9	Hostile	0.98	0.13	0	1	-0.040 -0.020	0.010 -0.640	-0.010 -0.720	0.110 0.000	-0.040 -0.160	-0.020 -0.530	0.040 -0.130	1.000

Table 2 – Abnormal Patenting by Year

Dependent Variable	Years After the Deal	Observations			Mean	SD	Min	Max
		N	Abnormal Patent					
			>1	<1				
Abnormal_Patents1	1	3683	743	2908	2.16	47.13181	-494	1365.8
Abnormal_Patents2	2	3608	798	2741	3.06	66.01664	-558	2015.8
Abnormal_Patents3	3	3499	848	2637	5.09	92.72059	-773	3111.8
Abnormal_Patents4	4	3393	887	2478	6.89	110.1005	-844	3367.8

Table 3 – Distance and Abnormal Patenting

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Distance_Kilometres		**-0.001*** **					**-0.003** **	**-0.002** **
		0.000					**0.000**	**0.000**
International			**2.641***				3.028	**8.494** **
			-1.530				-3.380	**-3.260**
Distance_Cultural				2.169			3.944	
				-2.170			-4.000	
Distance_Institutional					-6.327		0.644	
					-25.410		-23.220	
Distance_IB						11.705		12.706
						-9.320		-8.880
Target Industry	**0.972** **	**0.951** **	**0.984** **	**0.987** **	**1.010** **	**1.029** **	**0.989** **	**0.996** **
	-0.450	**-0.440**	**-0.450**	**-0.470**	**-0.460**	**-0.470**	**-0.460**	**-0.480**
Levels of Relatedness	**-0.010** **	**-0.010** **	**-0.010** **	**-0.010***	**-0.010** **	**-0.011** **	**-0.010***	**-0.010***
	0.000	**0.000**	**0.000**	**-0.010**	**0.000**	**-0.010**	**-0.010**	**-0.010**
Private Target	5.177	5.120	5.320	5.728	5.047	5.103	5.745	5.519
	-5.560	-5.620	-5.610	-5.870	-5.870	-5.810	-6.170	-5.900
Market-to-Book Ratio	**4.203***	4.095	**4.305***	**4.433***	**4.355***	**4.286***	**4.529***	**4.403***
	-2.410	-2.510	**-2.380**	**-2.340**	**-2.590**	**-2.310**	**-2.600**	**-2.450**
Prior Performance	-0.134	-0.128	**-0.141***	**-0.141***	-0.129	**-0.132**	**-0.132** **	**-0.138** **
	-0.080	-0.080	**-0.070**	**-0.080**	-0.080	**-0.080**	**-0.060**	**-0.060**
Percent Acquired	0.037	0.053	0.036	0.054	0.041	0.074	0.117	0.111
	-0.160	-0.160	-0.160	-0.160	-0.180	-0.170	-0.180	-0.170
R&D Expenditure	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **
	0.000	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Number of Employees	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cash Flow	0.006	0.015	0.150	0.116	0.168	0.047	0.663	0.580
	-0.840	-0.770	-0.740	-0.820	-0.700	-0.510	-1.170	-1.060
Hostile Deal Flag	**-33.782** **	**-34.601** **	**-33.392** **	**-37.622*** **	**-35.911*** **	**-39.342*** **	**-41.456*** **	**-39.310*** **
	-13.110	**-13.470**	**-13.800**	**-12.820**	**-13.310**	**-12.090**	**-11.620**	**-11.440**
Constant	-25.266	-22.872	-27.198	-26.436	-24.942	-25.959	-25.375	-26.738
	-45.290	-46.560	-45.440	-45.120	-47.240	-47.530	-44.720	-46.520
R_Square	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Obs	3,683	3,683	3,683	3,683	3,683	3,683	3,683	3,683

Table 4 – Distance and Abnormal Patenting (Cont)

	Model 9	Model 10	Model 11	Model 12
Distance_Kilometres	**-0.001*** **	**-0.001** **	**-0.001** **	**-0.001* ***
	0.000	**0.000**	**0.000**	**0.000**
INT_Distance_Internationall	-0.004			
	0.000			
International	**16.250*** **			
	-5.830			
INT_Distance_Cultural		**-0.001** **		
		0.000		
Distance_Cultural		7.174		
		-3.220		
INT_Distance_Institutional			**-0.019***	
			-0.010	
Distance_Institutional			86.460	
			-56.210	
INT_Distance_IB				-0.004
				-0.010
Distance_IB				35.634
				-39.320
Target Industry	**1.029** **	**0.999** **	**0.959** **	**1.017** **
	-0.440	**-0.500**	**-0.450**	**-0.470**
Levels of Relatedness	**-0.011** **	**-0.010***	**-0.010** **	**-0.010** **
	0.000	**-0.010**	**0.000**	**-0.010**
Private Target	5.524	5.916	5.283	5.125
	-5.770	-6.050	-6.040	-5.790
Market-to-Book Ratio	**4.179***	**4.078***	4.465	**4.101***
	-2.470	**-2.450**	-2.970	**-2.310**
Prior Performance	**-0.152** **	**-0.142***	-0.128	-0.128
	-0.070	**-0.080**	-0.080	-0.080
Percent Acquired	0.060	0.104	0.070	0.112
	-0.160	-0.170	-0.160	-0.180
R&D Expenditure	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **
	0.000	**0.000**	**0.000**	**0.000**
Number of Employees	0.000	0.000	0.000	0.000
	0.000	(0.000)	0.000	0.000
Cash Flow	0.550	0.368	0.358	0.074
	-1.120	-1.080	-1.080	-0.650
Hostile Deal Flag	**-33.924*** **	**-38.019*** **	**-35.268*** **	**-38.056*** **
	-12.380	**-11.960**	**-12.710**	**-12.860**
Constant	-29.779	-27.304	-26.360	-27.897
	-42.540	-43.240	-47.550	-52.020
R_Square	0.060	0.060	0.060	0.060
Obs	3,683	3,683	3,683	3,683