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Is acquiring a high-tech firm a good deal for investors?

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IS ACQUIIRING A HIGH-TECH FIRM

A GOOD DEAL FOR INVESTORS?

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CONFIDENTIAL   No **X**   Yes ☐

This paper aims at exploring the takeover market focusing on the acquisition of high tech companies during the 2005-2015 decade. We investigate the relationship between two general strategic options available to managers – product diversification and geographic diversification – and market reaction. We found that acquirer investors react negatively to the announcement of a deal when the aim of the acquirer is buying a high-tech company to diversify the business and react positively when the objective is international expansion. Then we delve deeper into the relationship unveiling a more sophisticated pattern in which investor react positively to the announcement of acquisitions performed to expand in a new business if, simultaneously, the acquisition allows to expand geographically. Finally, assumed the primary role of R&D for high-tech firms, we found a level of investment after the acquisition profoundly influenced by the closeness of target and acquirer products and technology. When acquirer and target product market overlap, research and development function benefits of larger investment while when the product and technology are more complementary the investment is less consistent.

Cet article vise à explorer le marché de la prise de contrôle axé sur l'acquisition de sociétés de haute technologie au cours de la décennie 2005-2015. Nous étudions la relation entre deux options stratégiques générales disponibles pour les gestionnaires - la diversification des produits et la diversification géographique - et la réaction du marché. Nous avons constaté que les investisseurs acquéreurs réagissaient négativement à l'annonce d'un accord lorsque le but de l'acquéreur est d'acheter une entreprise de haute technologie pour diversifier les activités et réagir positivement lorsque l'objectif est l'expansion internationale. Ensuite, nous approfondissons la relation dévoilant un modèle plus sophistiqué dans lequel l'investisseur réagit positivement à l'annonce des acquisitions effectuées pour développer une nouvelle entreprise si, simultanément, l'acquisition permet d'étendre géographiquement. Enfin, a assumé le rôle principal de la R & D pour les entreprises de haute technologie, nous avons trouvé un niveau d'investissement après l'acquisition profondément influencé par la proximité des produits et des technologies cibles et acquéreurs. Lorsque l'acquéreur et le marché des produits ciblés se chevauchent, la fonction de recherche et de développement bénéficie d'investissements plus importants alors que le produit et la technologie sont plus complémentaires, l'investissement est moins cohérent.

LIST OF KEYWORDS

Mergers and Acquisitions

High-tech

Product Diversification

Geographic Diversification

Product complementarity

Product Substitution

1 TABLE OF CONTENTS

2 INTRODUCTION

Despite the financial and economic crisis, the high-tech industry has experienced a consistent activity in terms of mergers and acquisitions during the last ten years. Such interest seems still solid as deals continue to hit the headlines of business newspapers.

This paper aims at exploring the takeover market focusing on the acquisition of high tech companies during the 2005-2015 decade. We analyze the acquisition performed by incumbents competing in the same field, with those undertaken by companies coming from other sectors.

Companies willing to acquire or merge another company, are driven by different rationales: the securement of new skills to strengthen their offer and the improvement of efficiency of their internal processes belong respectively to the so called horizontal-merger and vertical-merger. An alternative purpose behind the decision to combine two entities lies in the company's intent to diversify its business, often identified in the literature as conglomerate-merger or diversification-merger.

Although managers have as ultimate objective the maximization of shareholders' value, when new information about the firm is released, as the case of the acquisition of a high-tech firm, the change of shareholder expectation triggers different market reactions.

While business diversification is generally considered an improper motive for takeovers, we see the necessity to delve deeper into this topic and assess how market reacts to the announcement of high-tech deals discerning amid different strategic intentions.

The specificity of high-tech firms and the primary role played by the research and development unit in shaping the success of the company, requires managers to preserve its ability to generate value.

Technology relatedness, product substitution and product complementarity between the target and acquirer will be analyzed, emphasizing the relationship between these variables and the level of acquirer research and development expenses after the acquisition.

Although literature presents several different viewpoints on this matter, we propose a comprehensive view to accommodate for different perspectives. Firms may opt for investing in a complementary product to compensate for a shortage of feasible idea to develop their own products. This lack of momentum for the research and development unit might than explain the reduction in performance and the departure of the corresponding key employees.

If a firm acquires a high-tech one to take advantage of a diverse field know-how or to gain new market share this theory would also accommodate for a decrease in the stake of investment in research and development show when acquirer and target share the same product and technology base. Likewise, it accommodates for a more consistent investment in research and development when the acquirer sees a close target as a precious resource to further develop its product.

Although this theory needs deeper scrutiny and more extensive empirical evidence, with this study we aim to improve the understanding of market reaction to a diverse set of takeover motives, offering to those entrusted with the management of a firm a practical support to managerial decisions.

3 LITERATURE REVIEW

Within the panoply of M&A studies, we can distinguish two main schools of thoughts: economics and business studies. In turn, Economics literature's contributors may be divided into two categories: industrial economists and financial economists. (Rossi, Yedidida Tarba and Raviv 2013)

Industrial economists have analysed the reasons behind mergers and acquisitions from the perspective that market structure can shape and determine the success of a business. According to this view, M&As are considered a prominent form of corporate development especially when the firm faces difficult market conditions and the external growth become preferable to the internal one. This conditions are even more likely to occur in the mature phase of a business lifecycle, when companies fight for market share with their competitors and the timing in taking decision becomes a critical ingredient of the decision-making process. (Meglio 2004)

Thus, their studies focus mainly on the cost reduction, efficiency gain, market share improvements and profitability. However, the empirical evidence on this topic is inconsistent (Cloodt 2005) and leads to ephemeral general conclusions: (i) M&As have increased market concentration; (ii) the goal of M&As vary; and (iii) given the heterogeneity of measures and results the benefit for the economic system is uncertain. (Schrerer 1980)

As far as profitability is concerned, various researches argue that mergers may trigger the ability of producing additional profits. (Caves 1989). However, subsequent empirical analyses do not support such result demonstrating contrariwise that improved post-M&A performance is, on average, either non-existent or very limited. (Meeks 1977)

Further studies show that profitability increases slightly during the year of the M&A, but the same improvement decline in the further years, in some cases well below the pre-merger levels. Finally, others provide empirical evidence that mergers have neutral or negative effect on profitability and market share.

A different set of studies focus on the overall process of a business combination emphasizing the role of transaction costs in affecting the ultimate outcome. Additional difficulties may also come from the complexity of the process itself, the information asymmetry and the specificity of the assets controlled by the entities. The complexity of the operation is due, by a large extent, to the numerous actors participating in the process, such as lawyers, bankers and executives. Information asymmetry regard the capability of valuing and comparing different potential candidates for a merger or acquisition. Asset specificity addresses the problem of separating, selecting and recombining assets thereby modifying their ability to produce value.

Thereby, dealing with M&As, a substantial amount of resources is required to bear transaction costs and to deal with the other potential difficulties mentioned above, thus affecting the potential of profitability of the raw operation.

Financial Economists have focused on stock market data and other performance indicators. By a large extent, they focus on the stock price movements to the announcement of the deal.

Strategic management research has primarily addressed the problem of strategic fit, def the degree to which the acquired or merged firm . On this field, a consistent amount of literature deals with the comparison between related and unrelated M&As' performance. Most of the studies expect and confirm that related M&As are capable to deliver superior results thanks to the realization of economy of scale or scope, or increasing the market

share. Other researches show that performance of unrelated M&As does not distance significantly from performance of related M&As, suggesting that strategic fit might not be the main theme to explain M&As success, and to deliver superior post-MA&As performance.

Organizational behaviour theory mostly focuses on the post-M&A integration process of the organizations involved in a merger or acquisition. Such process, consisting in the creation of a new organization from two, has as ultimate outcome the combination of resources and competences to achieve the programmed objectives.

Such mixture of findings produce a collection of heterogenous results that has been defined in literature as a slow accumulation of knowledge rather than a comprehensive and exhaustive paradigm that would help explaining the M&A phenomenon. This lack of a shared framework for structuring analyses leads to at least two drawbacks. The first consists in the difficulty of comparing results among different researches. Incomparable results due to different timeframe choices, are exacerbates by the multiple definitions of performance measures used for the analysis. Furthermore, this inconclusive set of results might offer either legitimation to managers for taking actions, or a compelling justification to distance their responsibility in case of poor results.

3.1 MERGERS AND ACQUISITION IN HIGH-TECH INDUSTRIES

Since 1990 there has been a significant escalate in the number of deals involving high-tech companies. The large majority of mergers and acquisitions were undertaken with the aim of securing new skills and knowledge to improve competitive position. Such intense activity attracted the interest of many scholar who contributed to shed a light on the different facets of this phenomenon.

Despite the contradictions among high-tech M&As studies, an attempt to reconcile different findings has been put forward. In this section, we will present a general overview of the studies on high-tech M&As starting from a strategic decision making perspective. Subsequently, we will focus on the integration process and we conclude with the main contributions on acquisition performance. (Meglio 2009)

Following the strategic decision making approach, from the acquirer perspective, the reasons to merge or to acquire another entity are obtaining access to competitive technologies, starting or expanding diversification, or responding to the need of recombining existing and acquired resources.

A research study shows that skills and experience gained through company alliances, play a pivotal role in the acquisition process, and both the target and acquirer benefit from it. The fact that an acquirer has already obtained experience in the high-tech area, is also considered as a key factor for the success of the post-integration. High-tech acquirers seem to benefit from the acquisition of those resources that can be integrated in a timely fashion and that are owned and entirely controlled by their target. Differently, low-tech companies seem not to be influenced by the same variables. The reason relies on the fact that low-tech acquirers are less exposed to the risk of being excluded from technological trends if they are not capable of keeping the pace and are less dependent on the

proprietary nature of target resources. The resulting implication for management who envision the opportunity of taking advantage from a strategic use of M&As is that being alliance experience positively correlated with the value creation potential deriving from the integration, the alliance experience will also affect the acquirer's valuation, selection, and integration of target. (Porrini 2004)

Other studies combining the strategic decision-making approach and the integration process perspective, investigated on the role played by technological resources in creating opportunities for differentiation and on its consequences in terms of performance. Results from longitudinal data on 227 high-tech firms, which diversified between 1980 and 1992, reveal that prior to diversification, sample firms invested less in R&D and a had a greater breadth of technology than their competitors. Acquiring firms may also show lower performance because accounting entries are treated differently. However, results might be biased by firms that diversified less without being involved in any merger and acquisition. (Miller 2004)

From an integration process perspective, several scholars have contributed on shedding a light on the post-M&A phases. Being R&D a quintessential element of high-tech firms, a study focused on the post-acquisition integration of R&D function. From a sample of 92 acquisitions between German firm in 1988, the relationship between acquisition management intervention and strategic acquisition context, on one hand and degree of success of R&D function on the other has been investigated. Results show that pre- and post-acquisition management may significantly increase the probability of achieving organizational integration for the R&D function within three years after the deal. In addition, the success of organizational integration of the R&D process is positively related with the degree to which strategic R&D decisions for both partnering are centralized in the hands of the acquirer. Furthermore, the friendliness degree of the

acquisition seems to be positively related to the extent to which acquisition management promoted and facilitated learning process among employees. Thereby, a failure of R&D function integration does not stem by the hostility nature of the deal per se, but rather depends on the acquirer's ability to promote and support an effective human resources integration. The managerial implication for acquirer's management is that, in the event of an unfriendly or hostile takeover, they should embrace a 'counter-cyclical' approach with the aim of neutralizing the negative effects of the unfriendly transaction and pay even more attention to the programs designed to achieve successful R&D integration. (Gerpott 1995)

Another study focused on the post-acquisition integration process in three foreign acquisitions made by Swedish firms. The study split the integration into two distinct sub-processes: the management of task and the management of human integration. The former is defined as the identification and realization of operational synergies, while the latter is defined as the creation of positive attitudes towards the integration of among employees on both sides. The first counterintuitive finding is that the greater the problem encountered during the integration process, the lower the level of task integration sought in the medium term. However, dissatisfaction due to a degree of task-integration below expectations will in the medium-long-term, lead to a renewed effort to achieve full task integration and greater task integration is facilitated by a more developed stage of human integration process. The conclusion is twofold. First, the relationship between the overall task integration process and acquisition success is mediated by the current performance level of the individual operating units. Second, the relationship between the task integration process and acquisition success is mediated by the level of human integration already in place. Thereby, a very low level of performance in the individual operating units or a very low level of human integration will limit the effectiveness of task integration as a driver of acquisition success. (Birkinshaw, Bresman and Hakanson 2000)

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Following the same strand of studies though, acquisition integration plays a fundamental factor in determining whether the objectives of an acquisition are achieved. A study on the pharmaceutical industry examined the effect of acquisition integration on the productivity of acquired employees. Particularly, it focused on the productivity of those employees responsible for creating value through their day-to-day task, namely scientific investors. Within the pharmaceutical industry, acquisitions are usually undertaken with the goal of taking advantage of the technological core residing in the target firms. Thereby, if the technology capacity is undermined due to integration, then the acquirer's goal can't be accomplished. However, the degree to which employees suffer from the acquisition depends on how they are distinctive integrated in their social context. Employees that have more stature and centrality before the acquisition suffered more than those with less social embedded before the acquisition. Moreover, among those experiencing the most negative effects there are also target employees whose expertise differs more from the acquirer's one.

Therefore, if acquirer's management is interested in securing key productive employees, and keeping them productive after the acquisition, they should prepare an integration plan considering apprehension and fears of the most valuable subgroups of employees. (Paruchuri, Nerkar and Hambrick 2004)

A relevant problem to which many scholars have devoted their attention, concerns the level at which post-M&A integration process is carried out. High-level of post-acquisition integration may be necessary to exploit the synergistic potential arising from the combination of acquirer and target firms. However, the threat for the target of losing autonomy, might jeopardize the essential conditions needed to make such synergies arise. Such question is even more important in a contest like the high-tech industry where acquisitions are usually triggered by the need of securing tacit and socially complex

knowledge-based resources. (Ranft 2006) The delicate nature of these forms of knowledge in fact, make them extremely hard to move. A post-acquisition process, carried out at high-level may increase the likelihood of realizing the expected benefits. Yet high-level post-integration process, may weaken the knowledge-based resources that the acquirer aim to secure, especially when the integration process contemplates a turnover of key employees or a major alteration of organizational routines. (Puranam, Singh and Zollo 2006) (Puranam, Singh and Chaudhuri 2009) (Puranam, Singh and Zollo 2003) (Puranam and Srikanth 2007)

A consistent number of empirical findings suggest that the influence of culture on integration process is pivotal. Former contributions on this field investigated culture under several perspectives and proposed various integration approaches and mode of acculturation but left the relationship between integration approach and M&A performance as an exogenous factor. Later, scholars devoted their attention to more comprehensive frameworks and revised them to encompass new understandings on the relationship between integration approach cultural dimension and M&A performance. One of these frameworks considers the integration approach as a dependent variable influenced by three elements, namely, synergy potential, cultural differences and cultural-specific dimensions either national or organizational. Moreover, the model defines three possible integration approaches: *absorption* is carried out at high level and is recommended for exploiting synergies when the level of cultural differences is low. *Preservation*, which implies low level of integration and it is optimal when the level of potential synergies is low and *Symbiosis*, which is appropriate when level of synergies and cultural differences are moderate. The authors suggest that, in choosing the appropriate integration approach, acquirers should consider not only the synergy potential and the implementation difficulties due to cultural differences, but also the preference with respect to the level of integration based on their cultural dimension and

traits. Thereby, in the hypothesis of two acquirers, each with different cultural characteristics, although they might choose the same integration approach, they are likely to differ in the level of integration chosen since it depends on their own national dimension and preferences. Thereby, the managerial implication of this finding is that, to maximize the performance of M&As, the decision regarding the integration process should be twofold and split the choice of the integration approach from the choice about the level at which such process will be carried out. (Weber, Tarba and Reichel 2009) (Weber and Tarba 2011)

Another research study on the post-M&A integration process, investigated a sample of 35 M&A transactions. The article distinguishes between the strategic approach to the integration and the practical instruments and measures that managers employ to carry out the process. Empirical evidence reveals that, depending on the need for strategic interdependence or organizational autonomy, firms typically revert to three distinct strategic approaches: *Symbiosis, Absorption, and Adjustment.* By means of seemingly unrelated regression models, the author linked the integration strategies to both integration instruments and measures like process redesign, system standardization, and culture building. The outcome obtained prove that the technological favorable results and new development product capabilities are maximized when symbiosis and absorption strategy is chosen. (Grimpe 2007)

On the same strand of literature, other authors studied the link between company financial performance and resource integration process. The research study relies on an OLS regression model with dependent variable the acquirer's Jensen's alpha as measure for the acquirer's abnormal return, and several measures for R&D investments and other firm characteristics as independent variables.

Hypothesis are developed and tested considering two possible kinds of relationship between acquirer's and target's resources, substitution and complement. Resource substitution occurs when the marginal benefit of each resource decreases in the level of the other resource, while resource complements implies a situation where the marginal benefits of each resource increase with the level of the others. Although the sample of 312 high-technology firms shows that, on average, acquisitions do not deliver higher performance, there are significant factors that are capable to lead to both higher and lower performance. The negative interaction between acquirer and target R&D expenditure supports the hypothesis that target R&D substitutes for the acquirer R&D, or that the acquisition of a target with substantial R&D expenditure produces higher value for an acquirer with modest R&D expenditure. Hence, results are consistent with the argument that acquirers may earn abnormal return when inimitable assets or skills are exchanged because of the increase competitiveness obtained by the acquiring firm with respect to its competitors. Nevertheless, results confirm that complementary resources between acquirer's marketing resources and target's R&D expenditure is positively related to positive abnormal returns.

Thus, the research illustrates the importance of understanding the underlying relationships between acquirer's and target's resource. Firms that lack specific technological resources are likely to screen for target firms that possess such resources. However, the potential for positive abnormal returns is affected by acquirer's resources and, if the objective is taking advantage of interactions with target's resources, the acquirer has first to develop a sound understanding of its own resources. Although the value creation is unlocked in the process of integration, an acquisition's potential value may be limited from the start by acquirer and target firm resource profiles. (King, Slotegraaf and Kesner 2008)

In the same line of the integration process method, other studies focused on human resourced with the aim of shedding a light on the relationship between human capital and effectiveness of the integration process.

Numerous studies aim at understanding the impact of key employees of the R&D function on the outcome of the post-M&A integration process. A research study on this topic, which consider key employees as those with the highest contributions in terms of patenting activity, analyzed the acquisition of 43 German companies operating in chemical and many engineering industries. The study focuses on how inventors in these firms, changed their behavior in terms of effort and performance, after the acquisition. Results show that more than one-third of the key employees left the company after the completion of the deal and half of those who remained changed their position. Key employees that remained also displayed reduced inventive performance both in terms of quantity and quality, with a diminishing of the latter more intense.

When the inventor-portfolio for each company is considered, in almost all the acquisitions analyzed, three out of four of those key employees who decided to remain, lost their status as key inventor.

Recalling the findings of the other studies on this strand of literature, the threat of key employees leaving the company or significantly reducing their performance, poses a danger to the achievement of the acquirer's objectives.

Moreover, the study highlights some factors that have the ability to influence the behavioral response of key employees after the acquisition as size of the acquired company, cultural differences between target's and acquirer's R&D department and complementarity of technological positions. A strong reduction in the effort was observed in those cases where key employees perceived large cultural differences

between acquirer and target's R&D departments. However, such negative response was less intense when key employees perceived high technological proximity and potential synergies likely to be realized. Finally, in small firms key employees are both less likely to leave and more likely to increase their inventive performance. On the contrary, the likelihood that key employees leave the company or limit their activity in research and patenting, increase with the size of the company itself. (Ernst and Vitt 2000)

As far as the human capital is considered, a different study focuses on the role played by the managers of the acquired firm and to what extent they can affect the outcome of a post-M&A integration process. Authors found that acquired firm's managers are instrumental in creating two types of value, expected and serendipity.

Expected values refers to those benefits that motivated the buyer to undertake the acquisition while serendipity refers to windfall that were not anticipated by the buyer, prior to the deal (i.e. new strategic ideas, improved product development techniques and unexpectedly useful techniques). The drivers for the two kind of values are different and managers' attitude play a pivotal role. Expected value is realized preserving the momentum of the acquired firm. Differently, serendipity value is realized when acquired personnel take on *cross-organizational responsibilities* encompassing both acquirer and target firms.

Thus, thanks to these cross-organizational roles, acquired leaders have the chance to find out and eventually sense unusual synergies. In doing so, the most valuable acquired leaders are able to convey a wide range of changes. This includes to ensure the success of acquired technology, completion of synergies and discover unpredictable extent. Indeed, the idea of different types of value coexisting is consistent with two widely accepted lines

of thoughts of change, which are both essential for organizational survival in dynamic markets: exploration and exploitation. (Graebner 2004)

Another contribution on this area focuses on the transfer of knowledge across 15 industries. Knowledge transfer is found to be associated with several variables.

The first element influencing the process is a shared understanding between the two entities involved in the transaction, of where the desired knowledge resides within the source.

Then, another relevant variable is weather the two entities share the same awareness bases or not. Eventually, as far as the communication between the two parties is concerned, the authors identified two sub-variables both necessary for the completion of the transfer, the interactions meant to transfer the knowledge itself, and the interactions aiming at creating an articulation process through which the source's knowledge is made accessible to the recipient.(Cummings and Teng 2008)

Concentrating on the biotech and pharmaceutical industries, widely considered among the most representative high-tech sectors due to the relevance of the R&D function and the substance of the corresponding investments, a research study analyzed the consequences for knowledge transfer/ shift and organization of R&D after the acquisition of a biotech company from a pharmaceutical company. The article links the different strategic reasons for acquisition with different post-acquisition integration approaches, to the specific relationships between pharmaceutical and biotech companies.

 The result is a hybrid post-acquisition integration approach that simultaneously combines rapid and slow integration with different degrees of integration to successfully integrate the acquired company. In order to realize the short-term and long-term motives

linked with acquisition (Propositions 1a, 1b), it is necessary to focus on the rapid integration of all non-R&D-related portions of an acquired business, while the R&D-related portion retains a high degree of autonomy that protects specific biotech know-how and designates the specific biotech culture as a capability worth preserving. (Schweizer 2005)

The strand of literature on acquisition performance focuses on the maximization of the potential value exploitable after the business combination completion and how different key characteristics interact.

The idea of a curvilinear relationship between international diversification and performance is developed / stated by a following study. To be more specific, the slope and the shape of this non-linear relationship varies with the degree of product diversification. Therefore, while performance is positively related with international diversification in firms with high product differentiation, the same relation becomes insignificant with a low degree of product diversification. In the same vein, international diversification is negatively related to performance in non-diversified firms.

As far as the link between R&D function, international diversification and product differentiation is concerned, the study suggests the R&D intensity is positively related to international diversification, but negatively related to product diversification. (Hitt, Hoskisson and Ireland, Effect of acquisition on R&D inputs and outputs 1991)

Thereby, given that companies offering a well-differentiated range of products may achieve higher performance thanks to international diversification firm's decision makers should consider the attenuation of the positive effects of international diversification in designing governance approaches and incentive programs. (Hitt, Hoskisson and Kim 1997)

Following a different approach, a research study investigated the main cause of failure in internalizing external knowledge during the integration of technology intensive acquisitions. Eight case studies were taken in consideration. The analysis concludes that technology intensive acquisition are likely to be unsuccessful because there is a shortage of integrative decision-making, systemic process, designed and holistic change.

Strategic technology management are responsible for the decision of which technologies trend should be complied, strengthen in-house or acquired, and how and when they should benefit from it. (Brodbeck and Birkenmeier 1997)

However, technology management is hardly involved process early and deeply enough in the integration planning, and decision making is entitled to financial, legal and strategy experts. Such lack of integrative decision-making causes an incorrect definition, prioritization and management of technology integration processes.

Authors found that a recurrent pattern among the case studies was the lack of clear responsibility, poor leadership, disorientation and lack of communication.

All these problems can be seen as a signal that the integration process was not understood as a systemic process, where all phases were planned and prepared in advance, conducted, continuously reviewed and orientated towards the same direction. Similar lack of active systemic management of the integration process hinders the ability of the acquiring firm of exploiting the value creation potential arising from the acquisition.

Once the integration process is completed, both acquirer and target count on a changed, broad set of technological abilities. However, to fully understand the possibly synergies corporate culture, organizational structure, processes and the strategic direction need to

be changed too. Empirical evidence show instead that integration practices rarely follow a holistic approach and the companies involved perceive the integration process as a mutual adaptation of individual aspects rather than a global fusion into a new organization. The risk was that integration was understood as part of the day-to-day routine and, as a consequence, only slightly adjustments were made.

When decision maker inside a firm do not follow a shared strategic pattern, the process aiming at merging the two entities is likely to fail. The acceptance that both the target and the acquirer has to change is essential, otherwise, critical parts of the comined entity might be significatively affect and harm the survival of the organization. (Bannert and Tschirky 2004)

Another contribution on this theme, analyzed 31 M&A deals with the aim of identifying meaningful relations, at the level of R&D process, between target and acquirer firms. The study reveals that technological relatedness, defined as….. between the two combining firms, directly affects both the input and the organizational structure of the R&D process.

Data show that firms operating in the same technological field, thus technologically substitutes, tend to reduce and rationalize their R&D effort after the integration is finalized. As a result, such firms are likely to face less technological competition, but the reduced effort that is applied afterward at R&D level may represent a threat for the firm in the mid-, long-term. In contrast, M&As between firms with ex-ante complementary technologies result in more active and even more efficient R&D performance.

Regarding market relatedness, namely…, it shows comparable effect on R&D process at aggregate level but affect different dimensions of R&D in different ways. When the combining firms operate in two distinct competitive arenas, the joint forces result in increased R&D productivity. Conversely, when combining firms are competitors they

are less likely to increase R&D effort to expand into new fields or to employ the combined technological resources and competences.

4 METHODOLOGY AND DATA DESCRIPTION

We test the hypotheses on a sample of M&A deals as recorded in the Thomson One database, provided by Thomson Reuters. We select transactions in which the target company belongs to the high-tech macro-industry regardless the industry of the acquirer.

Macro-industry is represented by Thomson Financial macro-industry code, defined as "Thomson Reuters proprietary macro-level industry classifications based on SIC Codes, NAIC Codes and overall company business description." (Thomson Reuters 2000)[1]

Number of acquirer by macro industry			
CPS	93	MATERLS	22
ENERGY	16	MEDIA	68
FINANCE	43	REALEST	4
GOVAGY	1	RETAIL	16
HEALTH	20	STAPLES	8
HT	858	TELECOM	93
IND	107	TOTAL	1287

The sample includes M&As announced between 1/1/2005 to 31/12/2015. We consider only transactions for which the value is officially disclosed and is higher than 100 million US dollars. Moreover, the transaction must be for the majority of the shares or the ownership stake of the acquirer after the transaction above 50%.

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[1] Thomson Reuters industry classification available in the appendixes

The number of deals per country is presented in the following table. Only completed M&A deals are included in the sample. We consider both domestic and cross-border deals in the following countries: USA, China, Japan, UnitedKingdom, France, Taiwan, Canada, Germany, India, Israel,Netherlands, South Korea, Switzerland, Norway, Australia, Singapore, Sweden.

The number of deals per country is summarized by the following table.

Number of deals by country

USA	787	Israel	14
China	133	Netherlands	13
Japan	100	South Korea	13
UK	58	Switzerland	12
France	33	Norway	10
Taiwan	29	Australia	9
Canada	23	Singapore	9
Germany	22	Sweden	8
India	14	TOTAL	1287

The number of deals per year is displayed in the folowing table

Number of deals by year			
2005	121	2011	92
2006	123	2012	98
2007	140	2013	113
2008	90	2014	152
2009	89	2015	159
2010	110	TOTAL	1287

Target	WG	US	UK	TW	TH	SZ	SW	SK	SG	NT	NO	JP	IS	IN	FR	CH	CA	AU	Total
Acquirer																			
WG	11	7	2			1									1				22
US	13	665	25	2		7	6	1	2	5	1	5	13	3	7	3	22	7	787
UK	1	27	23			1	2							1	1	1		1	58
TW		4		24				1											29
SZ		8					1				1				2				12
SW		5					1										1		7
SK								13											13
SG		4			1				3										8
NT	2	5					1			4	1								13
NO		2	1				2				4				1				10
JP		14	2		1	1		1	1	2		77						1	100
IS		5	1									1	7						14
IN		6	1						1					5			1		14
FR	1	17	1							3					10		1		33
CH	1	1	1										2			128			133
CA		14	1														8		23
AU			2															7	9
Total	29	785	60	26	2	10	14	16	7	14	7	85	20	10	21	132	33	16	1287

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To perform the analysis, for each deal we consider a set of variables including, *deal number, deal announcement date, acquirer Datastream code, acquirer name, acquirer country, acquirer macro-industry, acquirer micro-industry, acquirer total assets, acquirer price to book ratio, acquirer leverage, acquirer research and development expenses, acquirer's revenues, target name, target SIC code, target nation.* The whole data is from Thomson Reuters Datastream platform.

Deal number is the "unique nine digit number assigned to every individual transaction" (Thomson Reuters 2000). It represents the primary key of the database.

Acquirer Datastream code is an alphanumeric value defined as the "unique Datastream code of the acquiring entity". (Thomson Reuters 2000)

Deal announcement date is, given a deal number, the "Announcement date of the related M&A deal" (Thomson Reuters 2000)

Acquirer name is proxied by the AN variable, defined as the "Acquiring company's short name on 1 line, up to 30 characters" (Thomson Reuters 2000). In Datastream, other variables are available to ensure the full name of the company is retrievable, however, for this study we opt for the short one, since the main identifier for acquirer is represented by the Datastream code and this is just a description.

Acquirer country is represented in our database from two different variables. The first is the variable ANAT, that consists on the full name of the acquiring company Nation. The other is ANATC, which is the Datastream nation code of the acquirer company and it is the one on which we base the further analysis from a geographic perspective.

In the same vein, the acquirer macro-industry is represented in our database from two variable of Datastream database. ATF_MACRO_CODE is defined as "Thomson Reuters

proprietary macro-level industry classifications based on SIC Codes, NAIC Codes and overall company business description. There are 14 macro-level classifications comprised" (Thomson Reuters 2000). In order improve the readability of the database, the variable ATF_MACRO_DESC is added to easily reconnect to the full name of the industry. As for acquirer country, further analyses on macro industry rely on ATF_MACRO_CODE.

As proxy for the micro industry we rely on the Standard Industrial Classification (SIC) codes. Such classification, developed by the US government with the aim of identifying a company's main line of business at establishment, is now a popular classification adopted by private and public institutions around the world. Company's primary SIC code is the code corresponding to the company's line of business that generates the highest revenue in the previous year. There are 11 main economy divisions, divided into 83 2-digit major groups, further split into 416 3-digit and 1005 4-digit subgroups. For this study, we rely on the 2-digits code as proxy for micro-industry. Datastrea, with the ASICP variable provides "the SIC code for acquiror's primary line of business". (Thomson Reuters 2000). Although such variable consists on the 4-digits code, thanks to the hierarchical structure of the codification system, the corresponding 2-digits one can be easily obtained extracting the first and the second left digits from the full 4-digits code.

Acquirer total asset is available in Dastastream under the symbol WC02999 and is computed as "the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets." (Thomson Financial 2007)

Acquirer price to book ratio is also available in Datastream under the symbol PTBV which in turn, includes two different Worldscope items: WC05476 for the price to book value of

non Us-companies and WC05491 for US companies. The description of the variable in Datastream defines the ratio as "the share price divided by the book value per share" (Thomson Reuters 2000)

Acquirer leverage is available under the symbol WC0821 in Datastream and is defined as the sum of long-term debt, short-term debt and current portion of long-term debt over the sum of total capital, short term debt and current portion of long-term debt. Such ratio is subsequently multiplied by 100.

The amount of acquirer research and development expenses is available in Datastream under the symbol WC01201 and it is defined as the sum of "all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities". (Thomson Financial 2007)

Acquirer net sales or revenues is available in Datastream under the symbol WC01001 and represents the "gross sales and other operating revenue less discounts, returns and allowances." (Thomson Financial 2007)

4.1   CUMULATIVE ABNORMAL RETURN

To estimate the impact of an event on the stock performance, we need to measure the abnormal return over the event window. (MacKinley 1997)

To test the first strand of hypothesis, our event is represented by the day in which the deal is announced. Since we are interested in measuring the stock performance around the days of the announcement, our event window will be the (-1, +1) period around the announcement date.

Abnormal return is the difference between the actual ex-post return of the stock and the expected return of the stock over the event window. (MacKinley 1997) Our estimation of the expected return relies on the Capital Asset Pricing Model (Sharpe and Litner 1992).

 Thereby, the daily expected return for each stock is calculate as follows:

$$E(R_{i,t}) = rf_t + \beta_{i,t}(Rm_t - rf_{t)}$$

Where:

rf_t is the risk free rate at time t

$\beta_{i,t}$ represents the factor by which the stock amplifies and lessen the market movements

$(Rm_t - rf_t)$ is the excess of return of the market portfolio.

For each stock, the abnormal return on any day τ in the event window (τ_1, τ_2) is computed as follows:

$$AR_{i,\tau} = R_{i,\tau} - (rf_\tau + \beta_{i,\tau}(Rm_\tau - rf_\tau))$$

While the actual market return and risk-free rate of return are available, we need to estimate the historical beta. Such estimation has been performed by means of an OLS regression over the estimation window (-150,-50) days from the announcement date. The historical excess return of the stock has been regressed against the market risk premium. For each stock, the estimated coefficient of the market risk premium resulting from the regression is the beta coefficient to compute the expected return for each day in the event window.

To obtain the cumulative abnormal return, for each stock, we eventually aggregate the daily abnormal returns as follows: (MacKinley 1997)

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau_1}^{\tau_2} AR_{i,\tau}$$

4.2   OLS REGRESSION MODEL

We test the hypothesis with a set of univariate and multivariate OLS regression.

For the first strand of hypothesis, to investigate the relationship between the cumulative abnormal return and a set of other characteristics of interest we run a cross-sectional OLS regression on the cumulative abnormal return.

Thereby, considering a sample of cumulative abnormal return observations and M characteristics of interest, the resulting OLS regression model is as follows:

$$CAR = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \cdots + \delta_M x_M + \omega$$

$$E(\omega) = 0$$

We are interested in the estimation of both the coefficients associated to the different characteristics and to their level of significance. A coefficient is significant if the corresponding p-value is lower than 0.10. Hence, when the coefficient for a specific characteristic is significant, its sign and magnitude provide a measure of the relationship between such characteristics and the dependent variable.

With the aim of assessing the robustness of our model, we run a set of OLS regressions progressively including other characteristics that might explain the dependent variable

and that might reduce the explanatory power of the characteristics relevant for hypothesis' test.

Although considering other variables a decrease in the level of significance is likely, we expect the coefficients to remain significant, thereby displaying a p-value below 0.1

As far as the second strand of hypotheses is concerned, the set of multivariate OLS regressions aim at shedding a light on the relationship between the level of the research and development expenses in the year after the event with a different set of characteristics of interest.

In the same vein of the model adopted for the cumulative abnormal return, the associated OLS regression is

$$level\ of\ R\&D\ expenses = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \cdots + \delta_M x_M + \omega$$

$$E(\omega) = 0$$

The heteroskedasticity issue has been considered in both set of regressions and the results adjusted accordingly.

5 HYPOTHESES

5.1 CONCEPTUAL FRAMEWORK

In this section, the most relevant contributions for the study are exposed and the hypothesis statements are formalized. Starting from the geographic diversification, and focusing on the relationship between international diversification and firm performance, the main contributions on this topic will be presented and the relevance for this study discussed. Then, considered the substantial evidence for seeing product diversification a critical factor in mediating the relationship between firm performance and geographical diversification, a specific paragraph will be devoted to present the main contributions on this matter.

As far as the second strand of hypotheses is concerned, technology relatedness, product substitution and product complementarity will be introduced. With the aim of emphasizing the relationship between these variables and the level of acquirer's post-deal R&D expenses, the main findings will be presented and the hypothesis specified.

5.2 GEOGRAPHIC DIVERSIFICATION

International diversification is capable to deliver several advantages to the firms embracing this strategy.

At first, firms that expand their geographical scope, benefit from the opportunity to offer their products and services to new customers. The idea of securing a new customer base triggers international expansion attempts either through a greenfield approach, either through the acquisition of already established firms. In addition, firms operating in

different countries, and performing consistent activity internally, have the possibility to recombine their operations and benefit from economies of scales, economies of scope and economies of learning.

Firms growing in different geographical areas can take advantage from rationalizing and coordinating operation more efficiently. The opportunity to spread costs of investments on a larger revenue and customer bases provides a compelling reason to foster firms' ambition to expand internationally.

Furthermore, firms operating internationally may exploit arbitrage opportunities arising from differences among countries. Brand image has also proved to improve following a firm geographical expansion. Augmented international presence deliver firms more negotiating and bargaining power thanks to a more global network. In addition, international diversification provides firms access to new sources of knowledge.

Competitive advantages that proved to be successful in the domestic market, can be exported in the international context with the aim of increasing company profitability and facilitate the exploitation of synergies. Some scholars have also provided evidence that debarking in foreign markets enhance future firms' growth opportunities (Buhner 1987)

Although most of the studies agree on the positive effect of international diversification on performance, there are also risks and costs connected to it.

The most compelling argument among scholars relies on the costs associated to internationalization expansions. Successful international diversification requires management to be involved. If the attention management devote to international expansion is subtracted from the time that was previously allocate to other operations,

the performance of other firms' areas might suffer a lack of resources. This shortage is likely to affect negatively the performance of the domestic business and might offset the benefits arising from the internationalization. (Roth 1992)

For example, to exploit economies of scale, firms have to develop a complex coordination among the several units spread across the different geographical areas. The cost faced to develop such coordination, and the abilities required to manage the distribution of goods in a global perspective, have to be carefully considered and assessed during the decision-making process. (Hitt and Hoskisson 1994)

Regulation may also be considered a threat for international expansion projects. Multinational firms, given the increased complexity arising from operating in different jurisdictions and from the duty to ensure the compliance with trade laws, may create a potential barrier, especially for small and mid-size firms. (Sundaram and Black 1992)

However, since the sample of M&A deals considered for this study is limited to public companies involved in a transaction for more than 100 million US dollars, the regulation issue is very unlikely to represent a compelling threat for those firms..

Several scholars have examined the relationship between international diversification and cultural factors. When companies decide to extend their geographical scope, the tendency towards acquiring an existing local player rather than starting a new venture in the target country is proved to be influenced by cultural diversity. (Vermulen and Barkema 1998) Empirical studies reveal that the larger the perceived cultural difference, the higher the propensity for acquiring a local player although the magnitude of such relation seems to mediated by the degree of product diversification. (Hitt and Hoskisson 1994) Overall, research studies support the existence of substantive benefits for companies expanding in culturally unrelated markets. (Ruigrok 2002)

5.3   PRODUCT DIVERSIFICATION

The concept of product diversification has attracted substantial attention among scholars and professionals in the last decades.

Although positive and negative effects of product diversification on firm performance have been extensively scrutinized, the benefit arising when firms leverage their skills into different businesses on one hand, and the resulting difficulties in facing a new set of demanding variables on the other, remains a trade-off. (Argyres 1996)

As for international diversification, firms applying their knowledge into multiple businesses may spread part of the costs and risks and benefit from economies of scope to improve profitability and overall performance. In addition, leveraging human capital to achieve product diversification may enhance firms' innovative potential. (Peteraf 1993)

However, research studies reveal that product diversification may harm firms' performance when the number of products and business increases beyond a certain threshold and the costs associated to the expansion offset the benefits .

There is vast consensus on considering the marginal benefit arising from product diversification a decreasing function of the number of product lines. The reasons for this negative relation between diversification's additional benefit and number of firm's business lines seems related to information and financial reasons. (Arikan and Stulz 2014)

As firms cover more business, also the organizational structure grows in complexity. Consequently, information sharing among different divisions and among different level of the organization diminishes threatening firms' learning ability and weakening innovation potential.

Indeed, the financial argument for supporting a negative relationship between product diversification and firm performance is triggered by the cognitive limits of those actors entrusted with the management of the company. As the complexity of the organization increases, empirical evidence show that managers become less responsive to external stimuli and show more risk-adverse behaviors. As a result, suffering of this lack of comprehensive view, the financial division is more prone to focus on short-term goals, which in turn lessen investment in research and development even more.

Furthermore, focusing on the relationship between research and development expenses, a consistent number of research studies have proved that highly diversified firms invest less. (Baysinger and Hoskisson 1989)

Indeed, such evidence is crucial for this study. Considering the importance of research and development for high-tech firms and integrating the theoretical background so far illustrated, we state the following hypothesis:

> *Hypothesis 1. In high-tech deals, stock performance is negatively related to product diversification and positively related to geographic diversification*

5.4 INTERACTION BETWEEN GEOGRAPHIC AND PRODUCT DIVERSIFICATION

The theoretical framework presented in the previous section focused on product and geographic diversification as distinct, stand-alone expansion strategies. However, the complexity of reality requires to go beyond this aseptic distinction and analyze when product and geographic diversification coexist.

To formalize a hypothesis about the effect in terms of performance when product diversified firms grow internationally, or multinational companies expand their business lines, we rely on the main findings on this topic.

From a conceptual perspective, research studies on this topic compare the positive and negative effects of both approaches with the aim of inferring, under different set of conditions, which of the two will prevail.

The large majority of scholars agree that companies with a moderate degree of product diversification are positively affected by international diversification. However, for non-diversified firms, competing in a single business, a potential threat is represented by the implementation of international expansion. Early international diversification projects are usually carried out by means of a special unit, created on purpose by the management of the company that recognize a lack of experience and knowledge on this matter. The analyses of early international diversification of single-business firms also reveal that management tend to use an already existent internal department as a profit center to manage international transaction. This, in turn, leads to potential conflicts on transaction prices between the internal department transferring a good and the internal department receiving the good. While the former is interested in maximizing the price to secure a higher margin, the latter aim at lessening it to bolster its profits. (Hill and Snell 1988)

Although this suboptimal structure may harm the international expansion causing benefits to vanish, empirical evidence reveal that the adoption of a divisional structure allows firms to overcome this issue. (Chandler 1962) (Hoskisson and Hitt 1988)

However, compared to other industries and considered the characteristics of high tech companies, the cognitive limitation of management and the inadequate organizational structure arguments are less likely to apply. Consequently, we don't expect high tech

firms in their early stage of product diversification to be excessively affected in terms of performance.

Nevertheless, as firms expand geographically, research studies reveal that firms competing in multiple businesses are less prone to capture the benefits of potential synergies with respect to firms focused on a single business. (Geringer and Beamish 1989) (Rumelt 1974)

Moving from the cultural perspective, other studies find that domestic firms present in different businesses struggle in terms of performance when try to debark in new geographical areas, especially when they intend to penetrate new market with the whole range of products and services they offer in the domestic market. The costs of adapting goods and services to the needs of local customers and the additional burden for the internal R&D department might negatively affect the firm overall performance.

Hence, in high-tech companies, where the R&D function and firm's human capital are the quintessential elements, the experience and size of geographically diversified firms plays a key role in shaping the performance of firm. Thereby, we expect

H2. [In high-tech firms], performance is negatively related to product diversification for non-geographic diversified firm and positively related to product diversification for geographic diversified firms.

5.5 PRODUCT SUBSTITUTION AND COMPLEMENTARITY

As stated above, the research and development unit plays a key role in shaping the success of high-tech firms. Though, it seems interesting to investigate whether

investments in research and development have any relation with the motives and characteristics of business combinations.

A research study aimed at clarifying the effect of mergers or acquisitions on the performance of the research and development function concludes that the degree of similarity in terms of technology, is pivotal to explain the relation. (Cassiman, et al. 2005)

Several authors, in the same vein, delve into this topic distinguishing between product complementarity and product substitution as meaningful means to obtain a better understanding of the phenomenon. They conclude that key employees of the R&D unit are more productive when product and technologies of the two combining entities correspond. Conversely, when product and technology key employees are less productive and are likely to leave the organization in the aftermath. (Ernst and Vitt 2000) (Kaapor and Li 2007).

Other scholars, focus instead on the investment in research and developments, and on the innovative performance of the corresponding unit. They find that the overall research and development process benefit from the complementarity of acquirer's and target's products. In contrast, when combining firms offer substitute products and services, they substantially reduce the investment in research in research and development in the aftermath. (Cassiman, et al. 2005)

In addition to these findings that derive from a resource-, knowledge-based viewpoint, embracing a more strategic perspective might contribute to the understanding of the relationship between product substitution, product complementarity and ex-post research and development investment.

Firms may opt for investing in a complementary product to compensate for a shortage of feasible idea to develop their own products. This lack of mo`mentum for the research and development expenses might than explain the reduction in performance and the departure of the corresponding key employees. If this firm acquires another one to take advantage of a previous competitor know how and market share this theory would also accommodate for a decrease in the stake of investment in research and development show when acquirer and target share the same product and technology base. However, it likewise accommodates for a more consistent investment in research and development when the acquirer sees a close target as a precious resource to further develop its product. As a result, we expect that

H3 Combination of technology substitute firms, results in an increase in the level of research and development expenses in the further years, while a combination of firms displaying technology complementarity results in a decreased level of research and development expenses after the completion of the deal

6 ANALYSIS AND RESULTS

The study entertains three hypotheses. In this section, we test the hypotheses, accompanying the reader thorough the formalization of the question, the definition of the variables, the choice over their combination and the presentation of the results.

Since this study belongs to the event study genre, we need to define the event the initiates our attention. We are interested in measuring the reaction of acquirer firm investors to the announcement of a merger or acquisition when the target is represented by a high-tech company.

The event day consists in the day of the announcement and the corresponding event window, the period over which we are interested in measuring the investor reaction, consists in the time interval in between the day before the announcement and the day after this event.

The first hypothesis states that firm performance is positively related to international diversification and negatively related to product diversification.

To test this hypothesis, the first element we need is a measure considered a proxy of firm performance. As many other scholars on event study, we rely on the stock cumulative abnormal return around the day of the event as the measure of investor reaction to the announcement of the deal.

As defined above, cumulative abnormal return is the sum of daily abnormal returns over the event window, where the daily abnormal return consists in the difference between the actual return of the stock and its expected return. (MacKinley 1997)

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Although the actual return is recorded in several databases and easily accessible, the expected return has to be calculated.

To derive it we rely in the Capital Asset Pricing Model (CAPM) as the model for calculating the daily expected return in each day of the (-1; +1) period around the deal announcement.

According to the model, to compute the value of the expected return we need three components: the "risk-free" rate, the beta of the stock and the return of the market.

We choose as risk-free rate the rate of return of the 3-months debt instrument issued by the country in which the firm is based on each day of the event window. The data was ready available in Datastream.

As proxy for the market return, we choose the relevant market index for the country in which the company is based considered the industry in which it operates. For each day of the event window the return of the market has been downloaded from Datastream.

The third component on which relies the model is the beta. Indeed, Datastream contains only the actual beta, and for our estimation we need the historical ones.

Therefore, to estimate the value of historical beta we run a OLS having as dependent variable the excess return of the stock and as independent variable the excess of return of the market.

The excess return of the stock consists in the difference between the actual return of the market and the "risk-free" rate at the day for which the calculation is performed. Similarly, the excess return of the market is the difference between the return of the market and the relevant "risk-free" rate at the date of interest.

A crucial decision on the estimation of the regression beta concerns the choice of the time window and its extent. From a conceptual viewpoint, the calculation of the abnormal return requires that the expected return of the stock is not polluted by information about the event.

Thereby, to avoid this bias, we rely on the estimation window between one hundred-fifty days before the announcement date and fifty days after the announcement date. For each stock, the corresponding beta results as the estimated coefficient of the market excess of return once this is regressed against the historical excess of return of the stock.

Once the historical beta corresponding to each transaction is obtained, the expected return for each stock is calculated. Thereafter, the daily abnormal return is determined. as the difference between the daily, actual and the expected return.

The last step consists in adding up the daily abnormal returns to get the cumulative abnormal return for each stock around the day of the announcement.

Since we choose as proxy for the firm performance the cumulative abnormal return of the stock, which in turn, it is none other than the evidence of investor reaction, henceforward we use cumulative abnormal return and performance with the same connotation.

To test the first hypothesis, as illustrated above we rely on a set of univariate regressions. Thereby, in addition to the cumulative abnormal return we also need two variables capable to capture the two different strategic choices we consider in the hypothesis: product and international diversification.

To discriminate among geographical and product diversification, we rely on two dummy variables. A "dummy", is a numeric variable which can assume either value zero or one.

We define the variable Product Diversification as a dummy variable that is equal to 1 when target and acquirer macro industry differs. The variable is equal to zero otherwise.

Similarly, we define Geographic Diversification as a dummy variable that is equal to 1 when the acquirer and the target firm are based in two different countries and is equal to 0 otherwise.

To ensure the robustness of the model, we include other variables that, in principle, may capture part of the explanatory power of the two dummy variables.

To assess whether the amount of debt borne by the acquirer firm is capable to affect the stock abnormal return around the announcement date, we decide to consider leverage as a characteristic of interest that may affect sign, magnitude and significance of our dummy variables. As defined in literature, leverage is the ratio between firm total debt and the respective total asset and data is readily available in Datastream. The reason for which we choose leverage rather than total debt, lies in the fact that, being leverage computed as a ratio, it makes possible to compare level of indebtedness among companies. If we used debt as a measure of indebtedness our result would be biased by the size of the firm. In fact, given a certain amount of debt, this might represent a consistent proportion of total asset for a small firm, while at the same time being an almost negligible part of a big firm total asset.

Although size should not bias the result of another variable, it remains, by far, a fundamental characteristic of a firm that could potentially impact on investor reactions. As rather common on this kind of analysis, we consider the logarithm of total asset. The rationale behind this choice relies on smoothing the volatility of the variable albeit providing an alternative means for interpreting the effect of the instrument on the dependent variable.

A third variable is also considered. Price to Book ratio is the market price of the outstanding shares divided by the book value of those shares. Price to book ratio is generally considered as proxy for misevaluation although, especially in cross-countries studies like this, differences due to accounting standards and/or accountants' decision, may harm the comparability of this variable.

Finally, categorical variable as country and year are added to check whether results remain consistent.

In the following table a set of univariate (1), (2) and multivariate (3) to (7) regressions are presented. With the aim of improving the readability of the results, we make use of the term low-tech as a residual category to denote firms that are not classified as high-tech.

As far as the first hypothesis is concerned regression (1) shows that the coefficient associate with the dummy variable Product Diversification is negative (-0.0131) and significant at 5% level. Hence we have compelling evidence that investors of a low-tech acquirer negatively react when the acquisition of a high-tech firm is announced. This is in line with our expectations and the large majority of literature in high tech mergers and acquisition supporting the idea that product diversification requires additional managerial cognitive effort. As the complexity of the organization increases, managers become less responsive to external stimuli and show more risk-adverse behaviors.

As managers' awareness decreases, information sharing among different divisions and among different level of the organization diminishes threatening firms' learning ability and weakening innovation potential. Moreover, suffering of this lack of comprehensive view, managers responsible for the financial division tend to focus more on short-term goals, which in turn lessen investment in research and development, life blood of high-tech firms.

This negative and significant result accommodates also for the theory that highly diversified firms invest less. (Baysinger and Hoskisson 1989) Investors, anticipating the decrease in investment negatively react to the deal announcement punishing the firm for such decision.

Looking at regression (1) we also have an estimation of the impact of a product-diversification strategic choice, made through the acquisition of a high-tech firm, on cumulative abnormal return. When a low-tech company announce the acquisition of a high-tech firm the cumulative abnormal return is expected to reduce by 1.31 basis points.

The first strand of hypotheses state also that, as opposite to product diversification, geographical diversification triggers a positive reaction from investors and the impact on stock performance is positive.

In regression (2) we test this second part of the hypothesis finding a positive (0.0249) and highly significant (p-value < 1%) relation between the dummy variable associated to geographic diversification and cumulative abnormal return.

Therefore, empirical evidence supports our hypothesis that international or geographical diversification is perceived by investors as value addictive and they react positively to the deal announcement. This is also in line with empirical studies attesting the existence of substantive benefits for companies expanding in culturally unrelated markets (Ruigrok 2002) as is the opportunity to offer their products and services to new customers. Moreover, firms operating in different countries, have the possibility to recombine their operations, implement economies of scales, and benefit from stimuli deriving from the new environment. Brand imagine has also proved to improve after a geographical expansion.

This may in turn be connected to the evidence that augmented international presence delivers firms more negotiating and bargaining power thanks to a more global network eventually granting the possibility to exploit arbitrage opportunities. Our finding are also consistent with the idea that competitive advantages that proved to be successful in the domestic market, can be exported in the international context facilitating the exploitation of synergies. (Buhner 1987)

With regards to the magnitude of the effect of Product Diversification on Cumulative Abnormal Return, we see from regression (2) that the announcement to acquire a firm operating in a different macro industry cause the Cumulative Abnormal Return for acquirer to raise by 2.49 basis points.

The first scenario we want to test is how the two strategic choices affects Cumulative Abnormal Return when both are announced.

From regression (3), we can appreciate the magnitude, signs and significance of the coefficients associated to Product and International Diversification showing the unique effect of each variable on the Cumulative Abnormal Return.

However, to reduce the gap with reality we open to the possibility that the firm might decide either to grow internationally either to expand into new industries. On this purpose, we created an additional dummy variable, Combined Diversification, that represents the interaction between Product and International Diversification.

In regression (4) we find a negative (-0.0180) significant (p-value $< 5\%$) coefficient for Product Diversification, a positive (0.0165), significant (p-value$< 5\%$) coefficient for International Diversification and a positive (0.0285), significant (p-value $< 5\%$) for Combined diversification.

Thanks to the interaction variable, we can measure the effect of investor reaction when the firm announce the acquisition of a target operating in a different country and in a different industry. Since the coefficient for Combined Diversification is positive, we can claim that the effect of a combined strategy is deemed positive for investors. However, focusing on the magnitude of the coefficient we can go further.

Such result indeed seems very interesting and provide supporting evidence for Hypothesis 2.

[In high-tech firms], performance is negatively related to product diversification for non-geographic diversified firm and positively related to product diversification for geographic diversified firms.

While investors negatively react to the announcement of the acquisition of a product diversified firm that is not geographically diversified, the overall reaction change when the target firm is both product and geographically diversified

The positive coefficient of Combined Diversification more than offset the negative coefficient of Product Diversification. This difference, added to the coefficient of the Geographic Diversification term, leads to a larger positive effect on Cumulative Abnormal Return.

When the three dummy variables are all equal to 1 in fact, namely the acquirer announces the acquisition of a product and geographic (combined) diversified firm, investors reaction impacts positively on Cumulative Abnormal Return which increases by 2.34 basis points.

If we compare this results with the impact on Cumulative Abnormal Return of a standalone geographic diversification strategy, which according to regression (4) is 1.65

basis points, we conclude that investors prefer product pure geographic diversification to product diversification, but prefer combined diversification even more.

Thereby, product diversification is not necessarily bad for investors if it is carried out together with geographic diversification.

As we add control variables we note that the coefficients associated to the main characteristics of interest remain significant without fluctuating excessively, proving the robustness and reliability of the model.

As research and development is deemed by scholar a key element for high tech firms, we are interested in investigating whether investments in research and development have any relation with the motives and characteristics of business combinations.

Thereby, to test our third hypothesis, which claims that combination of firms with consistent technology relatedness results in an increased level of research and development expenses in the further years, while a combination of firms displaying technology complementarity results in a decreased level of research and development expenses after the completion of the deal, we run a set of multivariate regressions.

To measure the level of research and development for the year after the acquisition, we rely on the values as recorded in Datastream. Specifically, for each transaction we divide the amount of R&D expenses in the year after the acquisition by the revenues of the acquirer in the year after the acquisition.

The instruments to test the effect of product affinity on the level of Research and Development expenses are Substitute Products and Complementary Products.

Substitute Products is a dummy variable that is equal to 1 when both the acquirer and the target belong to the same macro and micro industry and is equal to 0 otherwise. Complementary products is a dummy variable which is equal to 1 when the acquirer and the target belong to the same macro industry but different micro industry and it is equal to 0 otherwise. Macro and micro industry are respectively represented by Thomson Financial proprietary macro industry and SIC code classifications.

Therefore, to test our hypotheses we run a set of OLS regressions as shown in the following table. Regression (1) shows that the impact on the level of research and development expenses in the year following the acquisition is larger when acquirer and target offer substitute products (0.0913) and is less consistent when acquirer and target focus on complementary products (0.0433). Both coefficients are significant at 1% level.

Therefore, when the acquirer completes the acquisition of a target firm, and their products and technology correspond, the level of investment in research and development the following year change by 0.091. When the products of the target and acquirer are complementary the impact in the level of research and development is just 0.043.

To test the robustness of our result we add other variables that might affect both the coefficients and significance levels.

We first add a proxy for size, measured as the natural logarithm of the acquirer total assets in the year of the acquisition. We choose the measure in the year of the acquisition and not in the year following the acquisition because we are studying the impact in future expenses given the strategic motives that triggered the acquisition. Thereby, all the control variables considered here are measured in the year in which the decision about the acquisition has been taken.

Results remain significant even when control variables for leverage and price to book ration are added. Finally, we include Country and Year to verify the robustness of the model.

According to several studies, the performance of the research and development function depends on the degree of similarity in terms of technology. (Cassiman, et al. 2005)

We find supporting evidence to the theory claiming that key employees of the R&D unit are more productive when product and technologies of the two combining entities correspond. Conversely, when product and technology key employees are less comparable productivity decreases and employees are likely to leave the organization in the aftermath. (Ernst and Vitt 2000) (Kaapor and Li 2007).

However, we cannot grant support to scholars claiming that the overall research and development process benefit from the complementarity of acquirer's and target's product, neither that when combining firms offer substitute products and services, they substantially reduce the investment in research in research and development in the aftermath. (Cassiman, et al. 2005)

As we put forward above we hypothesize that firms may opt for investing in a complementary product to compensate for a shortage of feasible idea to develop their own products. This lack of momentum for the research and development expenses might than explain the reduction in performance and the departure of the corresponding key employees. If the acquisition is performed to take advantage of a competitor know how and market share this theory would also accommodate for a decrease in the stake of investment in research and development show when acquirer and target share the same product and technology base. Likewise, this idea also accommodates for a more

consistent investment in research and development when the acquirer sees a close target as a precious resource to further develop its product.

Combining evidence from the two main analyses performed on the sample, and considered the background theory, we argue that there is compelling evidence that generally, when acquiring company is more focused on its own set of resources, and try to expand internationally rather than seeking to expand towards alternative businesses, both the investment in research and development and the reaction of investor improve.

ferent

This table presents estimates of the OLS regressions of acquirer's cumulative abnormal return over the period (-1, +1) around the announcement. Instruments to test the effect of different motives for M&As on stock performance are product diversification, geographic diversification and combined diversification. Product diversification consists on a dummy variable equal to 1 when the acquirer and target belong to different macro industries; it is equal to 0 otherwise. Macro industry is represented by Thomson Financial proprietary macro industry classification. Geographical diversification is a dummy variable equal to 1 when acquirer and target are based in different country; it is equal to 0 otherwise. Regressions include control variables as size, measured by the logarithm of acquirer's total asset in the year before the acquisition, leverage, defined as the ratio between acquirer's total debt and total asset in the year before the acquisition, and Price to Book ratio, which is the ratio between the price and the book value of acquirer's shares in the year before the acquisition. Country and Year are also included for regression (8). Significance at 10%, 5% and 1% indicated by *, **, ***.

	Cumulative Abnormal return							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Product Diversification	-0.0131 **		-0.0118 *	-0.0168 **	-0.0180 **	-0.0180 **	-0.0189 **	-0.0165 **
	(-2.01)		(-1.81)	(-2.20)	(-2.28)	(-2.28)	(-2.33)	(-1.99)
Geographic Diversification		0.0249 ***	0.0240 ***	0.0165 **	0.0167 **	0.0167 **	0.0175 **	0.0243 **
		(3.79)	(3.64)	(2.04)	(2.06)	(2.06)	(2.07)	(2.57)
Combined Diversification				0.0237 *	0.0285 **	0.0285 **	0.0231	0.3872 **
				(1.70)	(2.02)	(2.02)*	(0.117)	(2.54)
Leverage					0.0000	0.0000	0.0000	0.0002
					(0.55)	(0.54)	(1.01)	(1.40)
Size						-0.0015	0.0004	-0.0019
						(-0.07)	(0.29)	(-1.05)
Price to Book ratio							-0.0003	-0.0004
							(-0.94)	(-1.27)
Country	No	No	No	No	No	No	No	Yes
Year	No	No	No	No	No	No	No	Yes

This table presents estimates of the OLS regressions of the level of Research and Development expenses for the acquirer in the year following the acquisition. The level of Research and Development expenses is defined as the ratio between the amount of acquirer's research and development expenses in the year after the acquisition on the acquirer's Revenues in the year after the acquisition. The instruments to test the effect of product affinity on the level of Research and Development expenses are Substitute Products and Complementary Products. Substitute Products is a dummy variable that is equal to 1 when both the acquirer and the target belong to the same macro and micro industry, the variable is equal to 0 otherwise. Complementary products is a dummy variable which is equal to 1 when the acquirer and the target belong to the same macro industry but different micro industry, it is equal to 0 otherwise. Macro and micro industry are respectively represented by Thomson Financial proprietary macro industry and SIC code classifications. Regressions include control variables as size, measured by the logarithm of acquirer's total asset in the year before the acquisition, leverage, defined as the ratio between acquirer's total debt and total asset in the year before the acquisition, and Price to Book ratio, which is the ratio between the price and the book value of acquirer's shares in the year before the acquisition. Country and Year are also included in regression (4). Significance at 10%, 5% and 1% indicated by *, **, ***.

	Level of Research & Development expenses				
	(1)	(2)	(3)	(4)	(4)
Substitute Products	0.0913 ***	0.0855 ***	0.0791 ***	0.0800 ***	0.0749 ***
	(14.68)	(14.28)	(13.04)	(14.30)	(12.85)
Complementary Products	0.0433 ***	0.0496 ***	0.0431 ***	0.0450 ***	0.0418 ***
	(7.61)	(8.93)	(7.80)	(8.59)	(7.78)
Size		-0.0097***	-0.0086 ***	-0.0081 ***	-0.0069 ***
		(-9.68)	(-8.66)	(-8.41)	(-4.16)
Leverage			-0.0006 ***	-0.0007 ***	-0.0007 ***
			(-5.51)	(-6.57)	(-6.90)
Price to Book ratio				0.000	0.0001
				(0.46)	(0.79)
Country	No	No	No	No	Yes
Year	No	No	No	No	Yes

7 CONCLUSION

Despite the escalation of high-tech deals, the relationship between firms' strategic decision and market reaction is still unclear. This research aims at closing this gap reconnecting strategic choices, firms' key-resources and investors response to support both managers and investors in their decision-making process.

Considered the specificity of high-tech firms, the study sheds a light on the relationship between two general strategic options available to managers – product diversification and geographic diversification- and try to reconcile such strategic decisions with the market reaction.

First, we found that acquirer investors react negatively to the announcement of a deal when the aim of the acquirer is buying a high-tech company to diversify the business. In contrast, we found that investor react positively when the objective is international expansion.

Second, we delve deeper into the relationship between strategic decision and market reaction unveiling a more sophisticated pattern in which investor react positively to the announcement of acquisitions performed to expand in a new business if, simultaneously, the acquisition allows to expand geographically.

Third, compelling evidence from our sample shows that the level of investment in research and development after the acquisition is profoundly influenced by the closeness of target and acquirer products and technology. When acquirer and target product market overlap, research and development function benefit of larger investment while when the product and technology are more complementary the investment is less consistent.

Indeed, regardless how rationally investors react, managers and all those entrusted with the management of the company should be able to anticipate those reactions accordingly If the ultimate objective remains to maximize shareholders value this study represents an effective support to managerial decisions.

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9 APPENDIXES

Thomson Financial macro/Mid Industry Hierarchy			
Macro code	Macro Description	Mid Industry Code	Mid Industry Description
CPS	Consumer Products and Services	EDSERV	Educational Services
CPS	Consumer Products and Services	EMP	Employment Services
CPS	Consumer Products and Services	HF	Home Furnishings
CPS	Consumer Products and Services	LEGAL	Legal Services
CPS	Consumer Products and Services	OCPS	Other Consumer Products
CPS	Consumer Products and Services	PS	Professional Services
CPS	Consumer Products and Services	TRAVEL	Travel Services
STAPLES	Consumer Staples	AL	Agricolture & Livestock
STAPLES	Consumer Staples	FOODBEV	Food and Beverage
STAPLES	Consumer Staples	HPP	Household & Personal Products
STAPLES	Consumer Staples	OTHERCS	Other Consumer Staples
STAPLES	Consumer Staples	TEXTILE	Textiles & Apparel
STAPLES	Consumer Staples	TOBACCO	Tobacco
ENERGY	Energy and Power	AES	Alternative Energy Sources
ENERGY	Energy and Power	OILGAS	Oil & Gas
ENERGY	Energy and Power	OTHEREP	Other Energy & Power
ENERGY	Energy and Power	PETRO	Petrochemicals
ENERGY	Energy and Power	PIPE	Pipelines
ENERGY	Energy and Power	POWER	Power
FINANCE	Financials	WATER	Water and Waste Management
FINANCE	Financials	ASSET	Asset Management
FINANCE	Financials	BANKS	Banks
FINANCE	Financials	BROKER	Brokerage
FINANCE	Financials	CREDIT	Credit Institutions
FINANCE	Financials	DFINANCE	Diversified Financials
FINANCE	Financials	GSE	Government Sponsored Enterprises
FINANCE	Financials	INS	Insurance
FINANCE	Financials	OTHERFIN	Other Financials
GOVAGY	Government and Agencies	CA	City Agency
GOVAGY	Government and Agencies	CG	City Government
GOVAGY	Government and Agencies	NA	National Agency
GOVAGY	Government and Agencies	NG	National Government
GOVAGY	Government and Agencies	OTHERGA	Other Government and Agencies
GOVAGY	Government and Agencies	PUBADMIN	Public Administration
GOVAGY	Government and Agencies	RA	Regional Agency
GOVAGY	Government and Agencies	RG	Regional Government
GOVAGY	Government and Agencies	OA	Supranational
HEALTH	Healthcare	BIOTECH	Biotechnology
HEALTH	Healthcare	HEALTHEQ	Healthcare Equipment & Supplies
HEALTH	Healthcare	HEALTHPS	Healthcare Providers & Services (HMOs)
HEALTH	Healthcare	HOSP	Hospitals
HEALTH	Healthcare	OTHERHC	Other Healthcare
HEALTH	Healthcare	PHARMA	Pharmaceuticals

HT	High Tecnology	COMPUT	Computers & Peripherals
HT	High Tecnology	ECOMM	E-commerce / B2B
HT	High Tecnology	ELECT	Electronics
HT	High Tecnology	HARD	Hardware
HT	High Tecnology	INTINFR	Internet Infrastructure
HT	High Tecnology	ISS	Internet Software & Services
HT	High Tecnology	ITCS	IT Consulting & Services
HT	High Tecnology	OTHERHT	Other High Tecnology
HT	High Tecnology	SEMI	Semiconductors
HT	High Tecnology	SOFT	Software
IND	Industrials	AERO	Aerospace & Defence
IND	Industrials	AUTO	Automobiles & Components
IND	Industrials	BLDGCE	Building/Construction & Engineering
IND	Industrials	INDCOM	Industrial Conglomerates
IND	Industrials	MACHINE	Machinery
IND	Industrials	OTHERIND	Other Industrials
IND	Industrials	TRANS	Transportation & Infrastructure
MATERLS	Materials	CHEM	Chemicals
MATERLS	Materials	CONS	Construction Materials
MATERLS	Materials	PACKAGE	Containers & Packaging
MATERLS	Materials	METALS	Metals & Mining
MATERLS	Materials	OTHERMAT	Other Materials
MATERLS	Materials	PAPER	Paper & Forest Products
MEDIA	Media and Entertainment	ADVER	Advertising & Marketing
MEDIA	Media and Entertainment	BROAD	Broadcasting
MEDIA	Media and Entertainment	CABLE	Cable
MEDIA	Media and Entertainment	GAME	Casinos & Gaming
MEDIA	Media and Entertainment	HOTEL	Hotels and Lodging
MEDIA	Media and Entertainment	MOVIES	Motion Pictures / Audio Visual
MEDIA	Media and Entertainment	OTHERME	Other Media & Entertainment
MEDIA	Media and Entertainment	PUBLISH	Publishing
MEDIA	Media and Entertainment	LEISURE	Recreation & Leisure
REALEST	Real Estate	NONRES	Non Residential
REALEST	Real Estate	OTHERRE	Other Real Estate
REALEST	Real Estate	REMGT	Real Estate Management & Development
REALEST	Real Estate	REITS	REITs
REALEST	Real Estate	RESID	Residential
RETAIL	Retail	APPAREL	Apparel Retailing
RETAIL	Retail	AUTORET	Automotive Retailing
RETAIL	Retail	COMPRET	Computers & Electronics Retailing
RETAIL	Retail	DEPT	Discount and Department Store Retailing
RETAIL	Retail	FOOD	Food & Beverage Retailing
RETAIL	Retail	HOME	Home Improvement Retailing
RETAIL	Retail	INTER	Internet and Catalog Retailing
RETAIL	Retail	OTHERRET	Other Retailing
TELECOM	Telecommunications	OTHERTE	Other Telecom
TELECOM	Telecommunications	SPACSAT	Space And Satellites
TELECOM	Telecommunications	TELEQ	Telecommunications Equipment
TELECOM	Telecommunications	TELESERV	Telecommunications Services
TELECOM	Telecommunications	WIRE	Wireless

10 AFFIDAVIT

Affidavit

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