



UNIVERSITA' DEGLI STUDI DI BERGAMO
DIPARTIMENTO DI INGEGNERIA GESTIONALE
QUADERNI DEL DIPARTIMENTO[†]

Department of Economics and Technology Management

Working Paper

n. 07 – 2008

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by

Damiano Bonardo, Stefano Paleari, Silvio Vismara

[†] Il Dipartimento ottempera agli obblighi previsti dall'art. 1 del D.L.L. 31.8.1945, n. 660 e successive modificazioni.

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The M&A Dynamics of European Science-Based Entrepreneurial Firms

Damiano Bonardo, Stefano Paleari, Silvio Vismara ^{◇*}

*Department of Economics and Technology Management
University of Bergamo*

Abstract

This paper investigates the dynamics of a sample of 131 Science-Based Entrepreneurial Firms (SBEFs), selected out of 500 innovative SMEs that went public in Europe in the period 1995-2003. We found that the market for the control of these firms was active, with most of our sample firms being acquired after the Initial Public Offering (IPO), especially by companies operating within the same industry. SBEFs showed a higher propensity to be acquired than independent firms, even controlling for intellectual capital and other possible determinants. While university affiliation enhanced attractiveness in the eyes of other companies, it negatively affected the propensity to acquire. The higher availability of internal technological resources was an important determinant of the decreased propensity of SBEFs to pursue acquisitions. We argue that university-based firms do contribute to the technology transfer process, as evidenced by the widespread interest of the business world in investing in these firms. The creation of a SBEF is a first step in the process of commercial exploitation of university-research, while the subsequent step of going public is a sign of the success of this entrepreneurial venture. The take-over of SBEFs may be a final outcome of the process of knowledge diffusion.

Keywords: SBEFs, university spin-offs, science-based entrepreneurship, Europe, IPOs, M&As.

[◇] We would like to thank Petra Ahrweiler, Massimo Colombo, Alan Hughes, Katrin Hussinger, Philippe Mustar, Donald Siegel, Mike Wright, two anonymous referees, participants at the PRIME seminar in Sestri, at the IRIS workshop in Turin, and at the Academy of Management Conference in Anaheim. Financial support of the Italian Ministry of University and Research is gratefully acknowledged (FIRB project RBNE03ZLFW). Table on complementary issues and appendixes are available from the authors, upon request.

* Corresponding author. Viale Marconi 5, 24044 Dalmine (BG) Tel.: +39 035 2052352; fax: +39 035 74231126. E-mail address: silvio.vismara@unibg.it, damiano.bonardo@unibg.it, stefano.paleari@unibg.it.

1. Introduction

Considerable academic and policy discussion has centred on creating a supportive environment for the development of innovative firms. The founding and growth of these companies is based on the availability of two critical resources: human capital, for the creation and management of innovations, and financial capital, for investments and growth.

In regards to human capital, a flourishing literature has investigated the contribution of universities to the creation of Science-Based Entrepreneurial Firms (SBEFs), which are considered a key driver of the rejuvenation of European innovative industries. Current literature suggests that, similar to the aim of policymakers, the creation of more direct links between universities and the business world is an effective solution for fostering the creation of innovative firms. Indeed, thanks to the creation of business incubators and formal programs for technology transfer, universities have been able to leverage the technology transfer process directly, while a variety of benefits are simultaneously offered to SBEFs (Ensley and Hmieleski, 2005). For instance, university affiliations provide firms with privileged access to cutting-edge scientific knowledge. Links with universities also have beneficial effects on reputation that, in turn, facilitate collaboration with other organizations and enhance the credibility of the firm in the eyes of other stakeholders (Mian, 1997).

A second critical factor in the development of innovative firms is the availability of financial capital. The research and policy debate is centred on understanding, evaluating and improving the external funding environment confronting innovative start-ups. Much of these discussions have revolved around the unsuitability of debt for early-stage financing and the merits of equity as sources of external finance for innovation, with equity invariably portrayed as patient and committed capital (Freel, 2007). Nonetheless, the existence of asymmetric information in capital markets means financial institutions may not adequately assess the investment projects they are asked to finance. This effect becomes marked in the case of small and innovative businesses, owing to the greater difficulties they encounter in transmitting reliable information about their real status and performance (Canovas and Solano, 2007). Financial constraints to firm growth are, in particular, a potential weakness in Europe, where the public equity markets are less developed than in the US. Thus, an explicit goal of current public policy is to promote the development risk capital markets in order to sustain innovative entrepreneurship and to facilitate the expansion of existing small firms. Indeed, in the absence of sufficient internally generated cash flows to fund investments, public capital markets offer

an opportunity for companies to obtain 'low cost' direct financing, without the costly interposition of a financial intermediary such as a bank or a venture capitalist (Holmström and Tirole, 1997). In this context, a primary role is assigned to the process of going public, traditionally considered as a natural step in the corporate life cycle. The IPO would therefore serve as a springboard for implementing strategies of internal and external growth. Moreover, the creation of public shares subsequent to the listing decision allows stocks to be used as currency to participate in Mergers and Acquisitions. Divesting after taking the company public may indeed constitute a better strategy, compared to directly selling the still private firm at a lower value due to illiquidity discount. Such advantages of the strategy of sequential divestiture though IPO would be higher, in particular, in knowledge-intensive industries.

In this perspective, it is interesting to analyse how the decision to go public affects the evolution of firms, particularly when taking into consideration the relationship with M&As. While this is of special interest in the study of the dynamics of SBEFs, it is rarely addressed in the literature. The current paper examines M&A deals of innovative firms that went public in Europe during the 1995-2003 period. The final sample is made of 500 companies, involved in a total of 3,000 M&As. Among these companies, 131 are SBEFs.

We found that university affiliation does influence the evolution of firms. Compared to their independent counterparts, SBEFs have a higher probability of being acquired and a lower propensity to make acquisitions. Given the scarce operational efficiency and profit-orientation of these university-based firms (Bonardo et al., 2007), the M&A market might establish new ownership and management structures, in SBEFs, that ameliorate their productivity and maximize the financial return of the embodied human and technological capital. From an external perspective, SBEFs might be attractive targets in acquisition due to their superior innovative capacity; or their university affiliation might carry out a certification role, enhancing their attractiveness in the eyes of other firms. However, even controlling for intellectual capital, profitability and other potential determinants, SBEFs showed a higher probability to be acquired. This suggested that the M&A market provides academic founders, less interested in maintaining a position in a mature firm (Meyer, 2003), with an exit opportunity that allows return to their original academic activities. On the other hand, SBEFs were less inclined to acquire other companies. This evidence was partially explained by the superior internal technological resources available to SBEFs, reducing their interest to seek external technology acquisitions. Moreover, the academic background of the management team might have led SBEFs to be less committed to engaging external growing strategies, and to focus on core technical aspects.

The market for the control of SBEFs is therefore quite active, with most of our sample SBEFs acquired after the IPO, typically by firms operating within the same industry. The high attractiveness of SBEFs is indicative of a positive role played by these companies in the process of technology transfer. The creation of a university-based firm is indeed a first step in the process of commercial exploitation of university-research. The subsequent step of going public is a signal of the success of this entrepreneurial venture. The take-over of the SBEF might be a final outcome of the process of knowledge diffusion. Moreover, the higher proportion of intra-industry M&As for university-based companies might also be viewed as a sign of interest for acquiring the intellectual capital embodied in science-based firms. Acquirers operating within the same industry are indeed assumed to be more attracted by such intellectual capital and also to be better able to value it.

Another characteristic of SBEFs was that they took part in cross-border M&As more frequently than did independent firms. This might be due to better resource endowments and the higher networking capacity of these companies. University affiliation might indeed have acted as a signal of organizational legitimacy, giving international visibility to the firm.

We also disaggregated the definition of SBEFs, making a distinction between companies where the TMT was (at least partially) composed of academics (University Spin-Offs, USOs) compared to firms created to capitalise on research carried out at universities, but with no formal involvement of academics in the TMT. This stricter definition strengthened our results as formal involvement of academics in TMTs led to even lower propensity to make acquisitions and to even higher probability of being acquired.

Finally, we added robustness to our results by focussing only on “SBEF-intensive” industries. This led us to identify the peculiar role played by patents in determining M&A activities in the pharmaceutical and biotech industry, that is the most science-based industry. For these companies, we found an inverse relationship between the level of internal technological resources and external sourcing.

The remainder of this paper is structured as follows. Section 2 summarizes the theoretical background and conceptual framework of this work. The research design, methodology and sample are described in Section 3. Section 4 presents the results of the empirical analysis on the propensity to either acquire or be acquired. Section 6 presents the conclusions.

2. Theoretical framework

2.1 Science-Based Entrepreneurial Firms

Firms competing in innovative industries base their competitive advantage on their capacity to raise and entrepreneurially exploit intellectual and financial capital. In this context, universities may represent an important source of knowledge on which technological innovations can be based. Accordingly, a series of policies have been adopted by national governments, with the aim of fostering the technology transfer process and of creating a supportive environment in which to create new science-based firms. As a result, the rate of formation of this type of firm has increased significantly in recent years (Wright et al., 2006).

University affiliation may have a significant impact on the strategies firms pursue. From a resource-based view of the firm, the resource configuration of a company is related to its evolution and performance (Barney et al., 2001). Benefits and resource endowments companies obtain from their affiliations with universities are well documented in the literature. Access to sources of knowledge and innovation, as well as to physical resources, such as university laboratories and libraries, are some of the most important value adding factors (Quintas et al., 1992). Also, the window on emerging technologies provided by the affiliation to universities can improve the flexibility a firm has in conducting R&D activities (MacLachlan, 1995) and, at the same time, reduce the costs of developing technological capabilities (George et al., 2002). Links with universities can also foster collaboration with public research institutes (Oliver and Liebeskind, 1998) and consequently, information sharing, especially where knowledge is more likely to be tacit (Cohen and Levinthal, 1990). They can also enhance the confidence of other stakeholders, such as venture capitalists, and act as a signal, mitigating the legitimacy concerns of other key actors (Mian, 1997).

However, despite the benefits yielded, little is known about the evolution of university-based firms and their capacity to create wealth. In particular, the available evidence indicates that these firms are often not gazelles, and further that university affiliation may also have downsides. On a personal level, prestigious research achievements do not necessarily fit with an inclination to do business. The academic founders of SBEFs might not have enough business skills and commercial capabilities to exploit the innovative potential of their companies (Colombo and Piva, 2007). This may have a negative influence on the profitability of science-based firms and on their capacity to interact with other firms and to attract customers as well as managers with commercial expertise. Difficulties in identifying key decision makers can also represent a significant source of discouragement for potential

investors (Wright et al., 2006). Furthermore, involvement of academicians in creating new ventures may not be driven, solely or primarily, by an entrepreneurial vision. Such ventures may be motivated, at least in part, by the prospect of enhancing one's academic position (Meyer, 2003). As a consequence, university-based firms may not be as profit oriented as independent firms.

2.2 The dynamics of Science-Based Entrepreneurial Firms

University affiliation may influence the ability of a company to attract external investors and to develop partnerships with other firms. In this paper, we investigated the potential effects of university affiliation on the subsequent evolution of the firm, focusing, in particular, on the process of industrial restructuring through M&As. The study of M&A deals may be highly informative on the strategic dynamics of these companies and their ability to interact with other key actors in the global market. A number of theories have been developed to explain why a firm may choose to pursue or to be targeted in M&A transactions. Among these, we believe that the matching theory of ownership change (Lichtenberg and Siegel, 1987 and 1989) helps to explain the peculiarities of M&A activities by SBEFs. The rationale behind this theory suggests that M&As are important mechanisms in the market for corporate control as business transfers represent essential resource flows that facilitate the division of labour. In the neoclassical tradition, Meade (1968) argues that corporate takeovers promote economic natural selection, with inefficient companies being taken over and efficient ones remaining autonomous. The threat of takeover causes managers to try to maximize profits, because ownership change provides a way of getting rid of ineffective managers. On the other hand, the M&A market may be used by managers to pursue growth objectives rather than maximization of profit or stockholder wealth (Mueller, 1969). Takeovers could indeed be driven by agency problems between the management of a firm and its shareholders with managers aiming to expand the firm beyond its optimal size in order to increase their compensation and for the prestige associated with managing a large organization (Jensen, 1986). Consistently, the matching theory views ownership changes as a mechanism for correcting lapses of efficiency¹.

¹ This theory does not assume that there are good or bad owners, but rather good and bad matches between companies and managers. The quality of the match is indexed by the plant's efficiency, so that a low level of productivity indicates a poor match and will induce a change in ownership. Thus, deteriorating productivity provides a signal to a plant's owner that he is operating in a less efficient manner than an alternative parent could due to an inherent incompatibility (a comparative disadvantage) or due to an overall lack of managerial competence (an absolute disadvantage).

The role of human capital in M&A deals is also of great interest. In service-based companies, for instance, human capital certainly delivers the predicted value. However, even in a less obvious example, such as a patent-based acquisition, much of the value in the acquired company has still been created by people who contributed to the technology that leveraged the patent estate. In general, business transfers represent important human resource flows that facilitate division of labour, with individuals changing jobs to pursue other development opportunities (Holms and Schmitz, 1990). The M&A market therefore promotes the upgrading of the firm's human capital. However, upgrades may be not limited to human resources, but also involve physical and technological capital, so that companies may specialize in either internal development of R&D or acquisitions (Blonigen and Taylor, 2000). The existence of a negative relationship between external technology acquisition and the level of internally available resources has been empirically documented by Jones et al. (2001). Companies with internally available resources are expected to show less interest in seeking external technology acquisitions through M&As and, at the same time, they may be more frequent targets in the M&A market. To this extent, the Q-theory of Mergers (Jovanovic and Rouseau, 2002) predicts that a firm's investment rate should rise with its Q ratio (the ratio of market value and the replacement cost of capital). Thus, mergers may represent a channel through which capital flows to better projects and better management, with high-Q firms acquiring low-Q firms.

The implication of this theoretical framework for our study is the hypothesis that SBEFs have a higher probability of being acquired compared to independent firms. Previous studies suggested that the status of being a university-based firm was often associated with lower operational efficiency (Bonardo et al., 2007) and less profit-orientation (Meyer, 2003). Thus, the M&A market might establish new ownership and management structures in SBEFs that ameliorate their productivity and maximize the financial return of the human and technological capital embodied by them (matching theory of ownership change). Second, academicians that establish and manage SBEFs might be less interested in maintaining a position in a mature firm. Hence, the M&A market can provide them with an exit opportunity that allows return to their original academic activities (division of labour hypothesis). Also, SBEFs might be preferred targets in acquisition due to their internally available technological capabilities. In particular, we expected SBEFs to be more attractive than their independent counterparts because of their superior innovation capacity (Colombo and Piva, 2007).

On the other hand, SBEFs might be less keen in pursuing acquisitions. For instance, they might be less committed to engaging in growing strategies due to the academic

background of their ownership or management. Presumably, academics may be more focussed in core technical aspects and less interested in horizontal integration. The IPO is already a signal of the success of a business initiative that might be “enough” for academics, reducing their commitment to the achievement of further business growth. The firm’s growth might, therefore, not be the first and foremost aim in the management of these science-based firms (Meyer, 2003). However, in terms of division and specialization of labour, it is unlikely that academic personnel represent a solution for correcting inefficiencies of other firms in the market. Moreover, in a trade-off framework between internal resources and external technology acquisitions, the superior innovative capabilities of SBEFs might reduce their interest in pursuing acquisitions.

3. Research Design

3.1 Sample selection

In this paper, we analyse the M&A activity of innovative firms that went public in Europe in the period from 1995 to 2003. The list of IPO firms is from the EURIPO database that comprehends all the IPOs that took place in Europe over the last decade². We focus on the four largest economies in Europe, namely Germany (Deutsche Börse), United Kingdom (London Stock Exchange), France (Euronext) and Italy (Borsa Italiana). From this sample, we considered all the small and medium enterprises (SMEs) that operate in innovative industries: electronics (Electronics), information technology (IT), pharmaceutical and biotech (Pharma & Bio), industrial machinery (Machinery) and communications (Communications)³. The final sample is made of 499 firms (Table 1).

We identified as science-based entrepreneurial⁴ firms (SBEFs) those companies that had been developed by faculty members, based on their research, or companies created to capitalise on research carried out in universities. Our definition of SBEFs was in keeping with the literature⁵. However, in Section 5 we disaggregate the sample of SBEF firms with and

² EURIPO (www.euripo.eu) is a database on European IPOs built and managed by Universoft, a spin-off company of the University of Bergamo.

³ SMEs are defined according to the definition of the European Commission as firms with sales inferior to 50 €m at the IPO. Innovative industries are identified in line with other studies (e.g., Cloudt et al., 2006).

⁴ The entrepreneurial orientation concept as applied to a firm has its origins in the strategy literature (Becherer and Maurer, 1997). For instance, Miller (1983) defined an entrepreneurial firm as one that “engages in product marketing innovation, undertakes somewhat risky ventures, and is first to come up with proactive innovations, beating competitors to the punch”. This is certainly the case of new ventures created drawing on university-based technological and scientific knowledge.

⁵ For instance, Ensley and Hmieleski (2005, p. 1097) define university-based firms as those that were “developed by students or faculty based on their research, or utilized research from a university’s technology transfer area”;

without formal involvement of academics in the TMT (the former are labelled University Spin-Offs, USOs).

The categorization of the firms was based on information disclosed in the official IPO prospectuses, which is mandatory for companies when issuing public stocks and contains a wealth of information regarding the firm's history and management. In particular, companies going public are required to describe their history and to report the curriculum vitae of their founder(s) and members of the TMT⁶.

In agreement with previous studies (e.g. Smith and Ho, 2006), we found that biotech and information technology (IT) industries were strongly associated with university spin-off activity⁷. In particular, we found that most biotech companies going public were SBEFs (52 out of 88 IPOs in this sector), consistent with the particular research-based nature of this industry. While the relevance of university-based firms was also significant for the IT and the electronic sectors, it was lower in Communications and Machinery⁸. As for country specificities, predictably, the UK and Germany were the most representative countries in the sample of innovative SMEs (39% and 38%, respectively), while Italy only contributed to 5.2% of the sample. This composition was due to the different size of the economies and to the different level of the development of stock markets. The proportion of firms based in the

Druilhe and Garnsey (2004, p. 274) identify companies “drawing on university-based technological and scientific knowledge and involving academics or students who were still members or who had just quit the university”; Smith and Ho (2006, p. 1560) refer to “technology-based company founded by a member/former member of a university or one of the seven laboratories using IP developed in the institution by the founding individual(s)”; Colombo et al. (2006, p. 3) define academic start-ups as “new ventures with an entrepreneurial team at least partially composed of academics and/or researchers from public research organizations”; O’ Shea et al. (2008) refer to spin-offs as companies that involve “1) the transfer of a core technology from an academic institution into a new company; 2) the founding member(s) may include the inventor academic(s) who may or may not be currently affiliated with the academic institution”.

⁶ Typical sections of the IPO prospectuses that report the information needed to identify SBEFs are in France, the paragraphs “Historique du Groupe”, “Recherche et développement” and “Ressources humaines”; in Germany, “Gründung”, “Organe der Gesellschaft” and “Forschung und Entwicklung”; in Italy “Storia ed evoluzione dell’attività”, “Politica di ricerca e sviluppo”, “Attività svolte dai componenti del Consiglio di Amministrazione” and “Struttura organizzativa”; in the UK, “History and background”, “Management”, “Directors” and “Research and Development Programmes”. The purpose of the prospectus is to sell stock. Therefore, it is assumed that all relevant information will be included. Since owners and managers can be held legally accountable for the accuracy of the information disclosed in this document, it represents the best source of information on the quality for the firm. As a result, prospectus data are considered reliable and there is a long tradition of using such information in strategy research and, more recently, in entrepreneurship research (Shrader and Siegel, 2007).

⁷ We relied on a sample of IPO firms, which, as such, can be viewed as a positive selection of successful SBEFs. However, we believe that it can be considered representative of the phenomenon of university-based firm creation. We find indeed a distribution of SBEFs among industries similar to previous studies (for instance, the Smith and Ho [2006] sample that focuses on spin-offs from the public sector research base in Oxfordshire [UK]). Moreover, the evidence that university affiliation still affects the behaviour of firms after the IPO may be viewed as a signal of a long-term effect of such affiliation on the resource endowment of firms.

⁸ Section 5 is devoted to complementary and robustness issues and contains an ad-hoc analysis of “SBEF-intensive” industries.

UK was even higher when SBEFs were taken into considered (62 UK SBEFs out of 131). This evidence suggested that the university system in Britain has probably been more entrepreneurial over the last decade (Slaughter and Leslie, 1999)⁹. German IPOs were particularly frequent in the IT industry (51% of the total number of IT IPOs), thanks to the success of the Neuer Market during those years. On the other hand, France and Italy were influential in the composition of the machinery industry. In particular, 49% of machinery firms were French, with 18% Italian. Finally, most firms (62%) went public between 1998-2000, coinciding with the favourable momentum of the stock markets, that ended during the first months of 2000, and with the burst of the new economy bubble.

3.2 Variables and measures

We utilized several variables of four typologies: (1) general characteristics of the firms, (2) intellectual capital, (3) ownership and corporate governance, (4) M&A characteristics. Firm-specific variables were measured at the IPO and were considered as possible determinants of M&A activity. M&A-specific variables encompassed several aspects in order to identify the aim and the relevance of M&A activity in the evolution of our sample firms. When sample firms were targets of M&A deals, we distinguished between the acquisition of minority interests (just being a target) and the acquisition of firm's control (identified as control transfer M&As). A more precise definition of variables is provided in Table 2.

3.3 Sample description

At the time of their IPO, SMEs going public in Europe were in median 8 years old and had an average market value at IPO of 79 €m (Table 3). Size varied among industries, from an average of 44.5 €m of market capitalization of machinery firms, to 99 €m for IT firms¹⁰. The leverage, measured as ratio between debt and total assets, spanned from an average of 21% (biotech companies) to 67% (machinery firms). Machinery was also the sector with the highest median profitability (measured as return on assets), and the lowest market-to-book

⁹ We found 47 SBEFs in Germany (35.9% of the sample of SBEFs), 19 in France (14.5%) and 3 in Italy (2.3%). Also, if we consider the number of SBEFs over the total number of companies selected in each country, UK had the highest proportion (31.6%). The percentage of SBEFs was 25% in Germany, 22% in France, and 11.5% in Italy.

¹⁰ The sample is made up of SMEs operating in innovative industries that went public in Europe in the period 1995-2003. According to the EU definition of SME, only companies with (pre-IPO) sales lower to 50 €m are selected. As a consequence, the average market size in our sample is higher for industries with high relevance of intangible assets, such as IT and biotech, and lower for machinery and electronics. This is due to the different levels of the price-to-sales ratio, that is higher in more intangible industries. Similar considerations can be drawn for the market-to-book ratio.

ratio. On the other hand, biotech companies were the least profitable (most had no earnings prior to the IPO) and had highest market-to-book ratio. There were, therefore, two extremes in the industry composition of the sample. Machinery companies were the smallest, oldest, and most indebted and more profitable companies, while biotech and pharmaceutical companies were the youngest, (second) biggest, less indebted and less profitable firms.

Comparing SBEFs and independent firms, we found that the former were less profitable (negative median return-on-assets), but more innovative (higher number of patents). University-based firms also had higher educational (Ph.D.s and MBAs in the TMT) and relational capital (TMT and CEO experience and relational capital¹¹) compared to independent firms. These findings, although partially due to industry biases, confirmed the conclusions of prior studies (e.g. Ensley and Hmieleski, 2005; Bonardo et al., 2007; Colombo and Piva, 2007). Moreover, we found that the market of investors recognized a higher value to university-based firms (the median market-to-book ratio was higher for SBEFs than for independent firms). Different explanations can be drawn. In a signalling framework, investors may view the status of affiliation with a university institution as a credible sign of the quality of a firm, as the linkage with a university can mitigate the concerns over legitimacy associated with the IPO process. Besides, since university-based firms are associated with higher innovative activity, the market may recognize greater growth opportunities in these firms.

As for ownership structure, we found that the median equity stake held by substantial shareholders (Ownership Concentration) was 54.5%, while the mean value of TMT and CEO ownership were 36.4% and 26.7%, respectively. These results suggested that innovative SMEs originally relied on capital from a limited number of backers, often coinciding with the TMT. This was particularly true for independent firms that showed higher values of ownership for all the categories of shareholders considered, reflecting less effort expended in acquiring external financial resources. On the contrary, TMT ownership may have also been lower in SBEFs because academics who become entrepreneurs have less personal funds to invest in their companies. This interpretation was suggested by the lower proportion of university-based firms in which the CEO was also the main shareholder associated, whereas

¹¹ Capello and Faggian (2005) define relational capital as any relationship – market relationships, power relationships and cooperation – established between firms, institutions and people. In our study, market relationships are measured by the TMT Experiences variable, calculated as the percentage of the firm's TMT members with TMT membership in at least another firm. The level of firms' relationship with institutions is measured as the percentage of directors with experiences in public institutions or in the TMT of financial entities (TMT Relational Capital). For the CEO, we consider the number of CEO memberships in other firms (CEO Experiences) and the number of CEO experiences in public institutions or in the TMT of financial entities (CEO Relational Capital).

the proportion of firms in which the CEO was also the founder was similar between science-based and independent firms.

University-based firms showed a higher propensity to view the IPO as a means of raising new funds, with a high level of fresh capital inflow at the IPO (45.9% vs. 32.2% for independent firms). Although SBEFs seemed to count more on limited personal funds than independent companies, access to venture capital had not yet become more important. Public grants were probably still perceived by universities as the primary way to raise funds for the creation and development of business activities (Wright et al., 2006). Finally, university-based firms seemed to be more compliant with the prescriptions on corporate governance practice, with SBEF TMTs having, on average, a larger number of components and a higher percentage of independent directors.

3.4 Methodology

The study of the dynamics of SBEFs was centred on their M&A activity. The data source on M&A deals was the Thomson One Banker Deals database, which in turn relies on other sources, such as stock exchange commissions, trade publications, law firms and surveys of investment banks. This database provides information on worldwide markets from publicly (private and public) announced M&As¹². We identified 2,997 M&A transactions involving our sample firms. Among these, 951 were deals in which the sample firms were targets and 2,046 were deals in which they were acquirers.

We used two regression models to investigate the effects of university affiliation on the M&A dynamics of firms. The regressions also tested the influence of other factors, such as VC-backing, intellectual capital, and ownership structure or corporate governance¹³. The first model consisted of a Poisson regression, used to investigate the propensity of sample

¹² In line with other authors (e.g. Bertrand and Zuniga, 2006), we kept all deals of industrial restructuring. Thus, our sample firms could be targeted in several M&A transactions, since with M&As we do not refer exclusively to the combination of two companies to form a new company. The raw data were checked to eliminate double counting of transactions. Deals were identified by the cut-off ownership levels for mandatory disclosures required by national laws. In all the jurisdictions evaluated, there was a formal obligation which required major shareholders to disclose their holdings in a company. The percentage level at which such an obligation was triggered varied from country to country. France (Code de Commerce, article L. 233-7) and Germany (Securities Acquisition and Take-over Act, sections 21 and 22) adopted 5% as a base level, like in the US, while Italy (Law No. 58 of 1998) and the UK (Companies Act 1985 sections 198-212) were at 2% and 3%, respectively.

¹³ In all the models, we considered the post-IPO period because the large majority of deals were effectuated after the floatation. The post IPO period of analysis considered for each firm was different, depending on the date of the IPO. However, we tested that the distribution among IPO years (1995-2003) of SBEFs and independent firms was not statistically different. The proportion of SBEFs over the total sample reached its lowest value in 1996 (20.71%) and its highest value in 2000 (29.08%) with a mean value of 26.25%. Thus, we do not believe that considering different time spans can introduce a bias in the comparison between SBEFs and independent innovative SMEs. On the other hand, cutting the years considered after the IPO, to have similar time spans for all our sample firms, can appreciably reduce the informativeness of the available data.

firms to grow through M&As. Thus, the dependent variable in this model was the number of acquisitions pursued by sample firms after floatation. We also analysed the relevance of M&As in the process of divestment of original shareholders after the IPO. First, we used Cox proportional hazard regressions to investigate the characteristics of the firm at the IPO that improved the probability of it becoming a target (at least one time) after floatation. We then focused on companies that had transferred their control after the IPO. We studied the temporary distribution of the probability to be acquired after the IPO (targeted in a deal, or a sequence of deals, where the control stake of the company was transferred) and we used a Cox proportional hazard regression (where the output variable was equal to 1 if the control equity stake of the firm was acquired) to investigate the determinants of this probability.

In all our regression models, we used a common set of explaining variables grouped in four categories: baseline regression variables, institutional affiliation, intellectual capital, and ownership and corporate governance¹⁴. We included in the baseline regression a set of control variables that could have influenced post IPO M&A activity: (1) firm size, measured by the natural logarithm of market capitalization at the IPO; (2) firm leverage, measured by the ratio between debt and total assets at the IPO; (3) firm profitability, measured by return on assets at the IPO; (4) market to book, measured by the ratio between market and book value of equity at the IPO; and (5) a series of dummy variables for industry, countries and year specificities. Our most important theoretical variables referred to institutional affiliation. We used dummy variables to test the effect of university affiliation and pre-IPO VC financing. Moreover, we took into consideration the effect of intellectual capital by testing several variables such as patents (the logarithm of the number of patents held by each firm at the IPO, scaled by the logarithm of market capitalization), the proportion of directors with MBA and Ph.D. degrees, and the proportion of TMT members with experiences in other TMTs and TMT relational capital. Finally, we tested for the effects of ownership concentration, TMT ownership and TMT structure (number of directors and proportion of independent members).

4. Results

M&As are fundamental in the evolution of innovative SMEs, both in terms of opportunity to acquire and to be acquired. As reported in Table 4, three out of four of the

¹⁴ Our results were not significantly influenced by endogeneity problems, as our independent variables were measured at the IPO, while the dependent variables had post-IPO M&As characteristics. M&As could have, in general, influenced firm profitability (one of our independent variables), resulting in an endogenous relation. However, our models measured profitability prior to the IPO (ex ante), while we considered M&As that were pursued in the post-IPO period (ex post).

sample firms (78.6%) were involved as an acquirer in at least one M&A transaction during the 1984-2006 period; meanwhile, 64% were targets of M&As. The propensity to take part in M&A deals, both as a target and as an acquirer, was higher in the communication industry (84% of the firms in this sector performed acquisitions, 73% were targeted), while the propensity to acquire was particularly high in the IT sector (90%). Almost all deals (93%) occurred after the IPO, with one year passing on average from the IPO to the first acquisition of a deal. In contrast, M&As involving IPO firms as targets tended to occur later, being initiated, on average, three years after the IPO.

These findings indicate that the IPO and M&A markets are probably not as independent as often assumed. The IPO could, indeed, be viewed as a means to pursue external growth strategies. The fresh capital raised through IPO could simply make available the ready funds needed to fuel the firm's external growth. In addition to cash acquisitions, the IPO may also facilitate stock deals, as the creation of public shares allows stocks to be used as currency to participate in M&As. Similarly, we found that most transactions used stock as the payment method (51.5% when IPO-firms were acquired, 74.7% when targeted). This confirmed that forming a currency of stock for takeovers was one of the main reasons for conducting an IPO (Paleari et al., 2008)¹⁵. Also, the IPO and the contextual moving from the private to the public domain increased the level of a firm's disclosure and of investors' monitoring. The consequent decrease in information asymmetries at IPO may, in turn, increase the opportunities of equity deals (Reuer and Shen, 2003). Moreover, it might be that, to the extent that the process of going public credibly reveals information on the value of the firm, the IPO market can enhance the efficiency of the M&A market. The prospects of future deals grow as valuation challenges for would-be-investors are alleviated with the IPO placing a price on the firm.

The IPO may also mitigate inefficiencies in the M&A market in another way. IPOs can be part of a larger process of transferring control rights, where owner-managers of private firms use the IPO as part of a divestiture strategy. In order to identify potential acquirers and to increase a firm's visibility, shareholders of private firms could decide to use sequential divestitures through IPOs rather than outright sales. The process of going public would be therefore responsive to adverse selection problems by increasing the quantity of information

¹⁵ On reading the IPO prospectuses, one would find that the most cited reason for going public is the desire to raise equity capital to finance firm's growth and new valuable projects (Ellingsen and Rydqvist, 1997). Paleari et al. (2008) find that pursuing growth strategies through capital expenditures and acquisition has been the leading motivation for European companies to go public in the last decade. In a survey of 336 chief financial officers of companies going public in the US, Brau and Fawcett (2006) find that the primary motivation for going public is to facilitate acquisitions.

available on the firm (Reuer and Shen, 2003). Investment bankers involved in the IPO pricing can certify the quality of firms because the repeated nature of their business encourages them to preserve their reputational capital and to desist from opportunism (Paleari and Vismara, 2007). As a consequence, existing shareholders of private firms can find value-maximising the strategy of divesting after taking the company public, rather than directly selling the still-private firm at a lower value due to illiquidity discount, or lack-of-marketability discount (Silber, 1991). Such advantages of the strategy of sequential divestiture through the IPO are higher in knowledge-intensive industries, like those selected in this study, where M&A negotiations tend to be lengthier and buyers respond by offering lower bids (Coff, 1999). Our findings supported these arguments. The prevalence of post-IPO deals over pre-IPO deals was indeed consistent for transactions in which firms were targets. The recourse to stocks as currency (payment method), was also more extensive in deals targeting IPO-firms, rather than in deals which the latter was the acquirer (74% vs. 51%).

Comparing SBEFs and independent firms (Table 5), we found that the former were more often target of M&A deals (69% vs. 63%), while the latter were more active acquirers (80% of the independent firms performed M&As as the acquirer, vis-à-vis 73% of SBEFs). Also, the time lag from IPO to the first acquiring deal was shorter for independent SMEs than for SBEFs (8 vs. 18 months, on average), suggesting these companies were more prepared to use the IPO as a growth opportunity. This evidence confirmed our predictions on the effect of university affiliation on M&A activity of science-based firms. According to the matching theory, the lower profitability of SBEFs may improve their probability of being a target of takeover. Second, the division of labour hypothesis suggests that the M&A market can provide academics with an exit and a return to academic activities. Also, SBEFs may be the preferred target in acquisition due to their internally available technological capabilities (Jones et al., 2001; Blonigen and Taylor, 2000). This last hypothesis is corroborated by the lower incidence of financial acquirers for SBEFs¹⁶ and a higher proportion of intra industry deals where these firms are targets. Acquirers operating in the same industry are indeed assumed to be more attracted by the intellectual capital embodied in science-based firms, and also to be better able to value it. Symmetrically, the capital upgrading argument may also explain the lower propensity of SBEFs to pursue acquisitions. The superior innovative capabilities of university-based companies may indeed reduce the interest of these firms in

¹⁶ Acquirer firms are identified as Financial Acquirer when their first digit of the SIC code is 6. On average, 46.5% of the M&A deals targeting independent firms were made by financial companies, as reported in Table 5. This percentage lowered to 34.7% for SBEFs. The difference between the two sub-samples was statistically significant.

pursuing acquisitions. Finally, academicians may be more focussed in core technical aspects and less interested in growth or horizontal integration, hence limiting their interest in pursuing acquisitions.

Most of the deals (63%) were between firms based in the same country, in particular for machinery firms (84%), while cross-border M&As were more common for electronics and pharmaceutical firms. SBEFs had a higher propensity to take part in cross-border M&As, both as acquirers (46% of the deals as compared to 34% for independent firms) and as targets (46% vs. 33%). University affiliation might therefore act as a signal of quality with a positive image impact that improves the credibility of the firm at the international level (Mian, 1997). Indeed, institutional affiliation may give legitimacy to firms, especially to innovative SMEs, attracting the attention of other prestigious affiliations, thus mitigating legitimacy concerns of other key actors. A similar role may be played by TMT relational capital and educational prestige, which may improve the networking capacity of the firm (Hsu, 2007). Prestigious directors are considered better able to form relationships with other individuals and to participate in important associations with bankers, investors, suppliers, and customers (Stuart et al., 1999). Moreover, from a network theory perspective, relational capital, in the form of social relations with public institutions or financial entities, is not just a form of resources, but can also be used as a conduit for information and resources. The latter should have its highest impact when it bridges a SBEF's intellectual capital and another company's complementary assets.

Overall, these preliminary results confirm our predictions of a more active M&A market targeting SBEFs and of a less active M&A market with SBEFs as acquirers. The next paragraphs untangle the various factors that may have influenced such results. We focus, in particular, on the role played by institutional affiliation (university affiliation vis-à-vis venture capital backing), intellectual capital, TMT characteristics and ownership structure.

4.1 External growth strategy

The establishment of a market price is the first step in the process of external growth. To this end, the creation of public shares is one of the most important motivations for going public (Brau and Fawcett, 2006). In addition to stock deals, the capital raised in the IPO may also encourage cash acquisitions. It is therefore of primary interest to investigate the acquisition activity of sample firms.

We used a Poisson model to analyse the influence of a series of variables on the number of M&A deals pursued as acquirer (Table 6)¹⁷. The baseline regression included control variables. Among these, firm size was positively related to number of deals, as acquirer. Large firms may be better able to realize efficiencies from the internalisation of talents or technologies from a target firm because they can apply these assets on a sufficiently large scale (Maksimovic and Philips, 2001). Other significant control variables were sector dummies, market-to-book ratio (negative coefficient), and the bubble period dummies (positive coefficient). The positive impact of the latter may, therefore, have been not only due to the incentive of managers of overvalued firms to engage in acquisitions. If this was indeed the case, the market-to-book ratio would have been positive as well. On the contrary, our evidence pointed to a bubble buoyancy also affecting the M&A market and the propensity to acquire, regardless of over-valuation motivation¹⁸.

We then investigated the role of institutional affiliation on the acquiring behaviour. Results were robust: university affiliation was negatively related to propensity to acquire. The same applied to VC affiliation. There was, therefore, a lower attitude of university-based or VC-backed firms to use acquisitions. Instead, variables of intellectual capital did not have any significant impact. The negative effect of university affiliation did not seem to be due to technological needs. However, the interaction between the dummy SBEF and the other covariates was specifically addressed in paragraph 4.3. The lower propensity to acquire VC-backed companies may have been due to the financial aims of venture capitalists, which typically consider the IPO as an exit strategy (Black and Gilson, 1998) rather than a means to financial growth.

As for ownership, we found a negative relation between ownership concentration and acquisitions and a positive correlation between TMT ownership and the dependent variable. The negative coefficient of ownership concentration could indicate that shareholders of

¹⁷ We also ran an ordered logistic regression as an alternative model to test the robustness of our results. Moreover, we tested if our results changed focussing only on majority acquisitions, defined as acquisition of an equity stake superior to 50% (this was the case of 80% of the deals in our sample). Results are presented in appendix (Tables A.2 and A.3). However, neither the different model specification, nor the focus on majority acquisitions, lead to significantly different results.

¹⁸ However, M&As may be driven mainly by acquiring managers' endeavour to take advantage of stock market overvaluation only when an acquirer uses stock payment to undertake M&As. We ruled out this possibility of stock-market-driven-acquisition by running the same Poisson regression with the number of stock-paid M&As as dependent variable (Table A.1 in Appendix). Nevertheless, we found that a higher market-to-book still decreases the propensity to pursue acquisitions. Furthermore, we investigated the influence of the market-to-book ratio on the propensity to use stock as payment method. To distinguish between payment methods, we considered only those firms that pursued at least one M&A deal. The sample was therefore reduced to 392 firms. We ran the Poisson regression on the total number of M&As, including as independent variable the proportion of stock-paid acquisitions. This proportion was also used as dependent variable in a linear regression, where we found that higher market valuations increase the propensity of firms to use stock as payment in acquiring deals.

closely held firms care more about preserving control and are more reluctant to dilute their ownership (Luypaert and Huyghebaert, 2007). On the other hand, the positive coefficient of TMT ownership may signal the willingness of TMT members to use their control rights to foster acquisitions and to increase firm size¹⁹. Such management-based explanations of acquiring deals can be less important for SBEFs, whose management may be less preoccupied with firm growth (see moderating effects in Table 10). Indeed, involvement of academics in creating new ventures can be considered to be driven not only by an entrepreneurial attitude, but also (or rather) by the prospect of enhancing academic position.

4.2 Sequential divestiture

The typical SBEF reveals significant technological competencies and is thus attractive for potential acquirers: they may be acquired either to commercially exploit such competencies, by combining them with the complementary assets possessed by acquiring firms, or to develop synergies in innovation activities, by combining different knowledge inputs so as to obtain super-additive effects between merging firms. Comparing the M&A activity of SBEFs and independent firms, we found that 69% of the former were involved as targets in M&A deals, while this variable was slightly lower for independent firms (63%)²⁰. In comparison, only 73% of the university-based firms were acquirers, compared to 80% of the independent firms.

In this section, we focus on two aspects of the M&A activity of our sample firms. First, we investigated innovative SME characteristics that increased their probability to become targets. To this end, we implemented a Cox proportional hazard model, where the dependent (failure) variable was equal to one if a company was a target in at least one deal after the IPO and the time variable was equal to the time elapsing from the IPO to the first

¹⁹ From a different perspective, the relation between TMT ownership and the propensity to pursue acquisitions might be interpreted in an Agency framework. Accordingly, an increase in managerial ownership may reduce the agency problems between TMT members (Agent) and shareholders (Principal), since their objectives tend to converge. Thus, TMT ownership could be negatively related to the propensity to acquire. However, this motivation may emerge only for low values of managerial ownership, where there is an actual separation between ownership and control. For high levels of TMT ownership, however, it is predictable that the agency framework does not hold, and TMT members (whose incentives are largely aligned with those of the ownership) may simply use their control rights to foster acquisitions. Our (unreported) results confirmed this prediction. We used moderating effects, introducing an independent variable defined as the product between TMT ownership and a dummy equal to one when TMT ownership is lower than a threshold. The positive relation between the variable measuring the TMT ownership and acquisitions was always confirmed. Instead, the interaction became significantly negative for levels of TMT ownership lower than 10%.

²⁰ Since the proportion of university-based companies was not homogeneous among the industries considered, results obtained comparing the two sub-samples may have been biased by industry specificities. For this reason, we compared the two sub-samples as a whole, and separately. In Table 5, we report the statistics only for the three industries with higher relevance of SBEFs, namely Pharma and Bio, IT and Electronics.

target deal. Second, we focused on companies that had transferred control after the IPO. We studied the time distribution of control transfers using a Cox proportional hazard model (the time variable was the time elapsing from the IPO to the control transfer). Results are shown in Table 7.

We found that firm size was positively related to the probability of being a target. In comparison, the negative coefficient of profitability may be interpreted as evidence of the matching theory of ownership change, with less efficient firms more subjected to being the target of other companies. Also, the negative coefficients of the market-to-book and bubble dummies may point to a lower appeal of firms with higher (over) valuations.

As for affiliation, we found a positive correlation with the probability of being acquired for both university and venture capital backing (although the statistical significance was lower for the latter). These results were consistent with our theoretical framework. The ownership change (matching) and the capital upgrading and labour division theories predicted indeed that SBEFs should show a higher attitude to be targeted by other firms. Similarly, the presence of VCs may improve the attractiveness of a firm (Ragozzino and Reuer, 2007). There was, in addition, a positive relation between intellectual capital and M&A deals, with the number of patents held increasing the probability of being targeted. This last result supports the theoretical hypothesis that M&A can also be used as a means for acquiring technological capabilities (Blonigen and Taylor, 2000)²¹. Moreover, TMT member linkages with public institutions and financial entities improve the attractiveness of firms. Last, the negative correlation between ownership concentration and probability to be a target may be a signal of the low interest of external investors in acquiring stock position in closely held companies, or of a higher capacity of owners of these companies to protect their dominant position. On the other hand, the absence of statistical significance for the variable TMT Ownership suggests that managers foster acquisitions to acquire prestige and power, but are less active in hindering the acquisition of their company.

To further test our theoretical predictions on the effect of university affiliation, we identified those firms that transferred their control after the IPO. Focussing on control acquisitions (acquisition where the control of the firm was transferred), we found that SBEFs had a higher probability to be acquired (Table 8)²². Graphically, Figure 1 shows the Kaplan

²¹ Blonigen and Taylor (2000) documented a significantly negative relation between R&D investments and the probability of engaging in M&A in high-technology industries, concluding that firms in these industries specialize in either internal development of R&D or acquisitions.

²² As shown in Table 8, most control acquisitions were pursued in “one-shot” deals, while the others were pursued in more than one step. It is also possible that a single sample firm was acquired sequentially by more

Meier failure function, distinguishing SBEFs, while Figure 2 reports the smoothed hazard estimate. A similar distribution was identified between the failure and the hazard rate. In particular, the probability of transferring control increased in the first month after the IPO, and then rapidly decreased thereafter²³.

The results of the Cox regression on the probability to transfer control showed the positive role played by university affiliation and VC financing on the post-IPO divestment activity of innovative SMEs (Table 9). Even controlling for intellectual capital, both SBEF and VC dummies were still positively associated with the probability to be acquired. The presence of VC in a company and the university affiliation may indeed be perceived as a quality (certification) signal by a potential acquirer, improving the probability of being a target for other companies²⁴. Moreover, SBEFs seem to be, on average, more innovative than independent firms and so potentially more attractive for their competitors. On the other hand, the original founders of SBEFs (academics) and VCs may be more willing to sell their participations in firms after the IPO, so that IPO can be viewed as part of a more general process of sequential divestiture through M&As (Reuer and Shen, 2003). Finally, the matching theory suggests that SBEFs may be more subjected to acquisitions because they are less efficient in the use of their assets. The Cox analysis showed a negative correlation between profitability (return on assets) and probability to be acquired, suggesting that less efficient companies are more subject to control acquisitions.

4.3 Determinants of SBEFs specificities

The analysis on growth and divestment activities of SBEFs through M&As showed a lower propensity for these companies to acquire, and a higher probability to be targeted by other firms. In this paragraph, we test whether these specificities of SBEFs were driven by their characteristics in terms of intellectual capital, ownership and corporate governance. To this end, we reran our models adding interactive terms to the set of explanatory variables. Results are presented in Table 10. The first column reports the results of the Poisson

than one acquirer. In particular, the proportion of SBEFs sold to one acquirer only was 60% for SBEFs and 56% for independent SMEs, but this difference was not statistically significant.

²³ Although the shape of the smoothed hazard function is influenced by the level of smoothing, this figure reflects the initial increase of the probability to transfer control after the IPO and its subsequent decrease.

²⁴ The involvement of a venture capitalist at the time of an IPO can signal the quality of an entrepreneurial firm in a number of ways. VCs typically fund fewer than 1% of the proposals they receive (Megginson and Weiss, 1991), and this highly-selective screening process can be a useful tool for acquirers to weed out the “lemons” in M&A markets. Moreover, venture capitalists not only provide capital for the entrepreneurial firms they choose to fund, they often add directly to the quality of a firm by serving on its TMT, assisting in the formulation and implementation of strategy, contributing their network of relations, and hiring key personnel (e.g. Hellman and Puri, 2000).

regression on the number of deals as acquirer (previous model in Table 6), the second column reports the results of the Cox regression on the probability to become a target (previous model in Table 7), the third column reports the results of the Cox regression on the probability to transfer control (previous model in Table 9).

We found that an important variable influencing the attitude of university-based companies to make acquisitions was the availability of internal technological resources. Thus, the capital upgrading hypothesis is particularly relevant in explaining the acquisition activity of university-based firms. However, the dummy SBEF remained negatively correlated to the number of acquisitions (although its significance lowered) suggesting there were other factors differentiating SBEFs from independent companies. Among these, profitability seemed to act in the opposite direction (the interactive term between Profitability and SBEF was significantly positive). Profitability increased university-based companies' tendency to acquire, while it seemed not to be a significant determinant for independent firms.

The tendency of less profitable firms to be acquired and to transfer control was confirmed by regressions with interactive terms. The dummy SBEF remained significant, meaning that their attractiveness for potential acquirers was not only due to their superior intellectual or relational capital. There were only two (slightly) significant interactive terms: Patents x SBEF for the probability to be target, and Independent Directors x SBEF for the probability to transfer control. Therefore, the appeal of the technological capital embodied in patents, already significant for the whole sample, was particularly desirable in science-based firms. The role of independent directors, never significant in previous results, actually enhanced the probability of control transfer for SBEFs.

5. Conclusions

This paper analyses the M&A activity of innovative firms that went public, during the 1995-2003 period, on the main European stock markets. The IPO and the contextual moving from the private to the public domain decreases information asymmetries, therefore increasing the opportunities of equity deals. Moreover, the focus on IPOs is crucial as they create public shares for a firm that may be used as currency in either acquiring other companies or in being acquired in a stock deal. M&As are thereafter fundamental in the evolution of innovative SMEs, both in terms of opportunity to acquire and to be acquired. In addition to cash acquisitions pursued thanks to the fresh capital raised at IPO, going public also facilitates stock deals, as the creation of public shares allows stocks to be used as currency to participate

in M&As. Coherently, we found that most of the transactions involved stock financing. IPOs can also be part of a larger process of transferring control rights where owner-managers of private firms use the IPO as part of a divestiture strategy. In order to identify potential acquirers and to increase the firm's visibility, shareholders of private firms may indeed decide to use sequential divestitures through IPOs rather than outright sales.

Moving in this framework that links M&A and IPO markets, this paper addresses the role of institutional affiliation on the M&A behaviour of IPO firms and finds that university affiliation does influence firm evolution. SBEFs have a higher probability to be acquired, as compared to their independent counterparts. In particular, the market for the control of these firms is quite active, as most of our sample SBEFs were acquired soon after the IPO, especially by firms operating within the same industry. Hence the attractiveness of university-based firms is strong, while their relatively low profitability may reflect a deficient matching between technological expertise and managerial competencies. To this extent, an active M&A market may be an effective instrument leading to a better fit between technological and financial capital. One possible reason for the higher probability of university-based firms to be acquired lies in the nature and aims of their academic TMTs, who may be more prone to divest, once the company has become public.

On the other hand, university-based and VC-backed firms showed a lower propensity to acquire, even controlling for proxies of intellectual, educational and relational capital. Such low acquisition rate, on behalf of university-based firms, may be due to the limited management-based incentives to pursue acquisitions for academic managers-owners. Their academic background may indeed limit their appetite for growth, as they may be less tempted by managerial imperialism, or may have been partially driven in their entrepreneurial venture by return expectations on their academic position. Moreover, in the most science-based industry – biotechnologies - there was a negative relation between the level of internal technological resources of SBEFs and their acquiring behaviour. The lower propensity of university-based firms to pursue acquisitions may therefore also be due to their lower need for external technological resources.

In conclusion, we argue that although the capacity of wealth creation of SBEFs remains still under debate, and probably more can be done to enhance their performance, they do constitute an important element in the process of commercialization and transfer of university research. Indeed, the high attractiveness of SBEFs as targets in M&A deals, especially intra-industry, is a clear sign of the widespread interest of the business world in

investing in these firms, and confirms the validity of academic entrepreneurial initiatives as an instrument for technology transfer.

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Table 1: Sample

	Sample	Electronics	IT	Pharma & Bio	Machinery	Communications
No. firms	499	77	206	88	45	83
(%)		(15.43)	(41.28)	(17.64)	(9.02)	(16.63)
No SBEFs	131	21	44	52	3	11
(%)		(16.03)	(33.59)	(39.69)	(2.29)	(8.40)
% SBEFs	26.25	27.27	21.36	59.09	6.67	13.25
France	87	24	13	18	22	10
(%)	(17.43)	(27.59)	(14.94)	(20.69)	(25.29)	(11.49)
Germany	190	28	106	21	2	33
(%)	(38.08)	(14.74)	(55.79)	(11.05)	(1.05)	(17.37)
Italy	26	7	6	4	8	1
(%)	(5.21)	(26.92)	(23.08)	(15.38)	(30.77)	(3.85)
UK	196	18	81	45	13	39
(%)	(39.28)	(9.18)	(41.33)	(22.96)	(6.63)	(19.90)
1995-1997	117	23	34	19	15	26
(%)	(23.45)	(19.66)	(29.06)	(16.24)	(12.82)	(22.22)
1998-2000 (<i>Bubble</i>)	309	37	157	48	19	48
(%)	(61.92)	(11.97)	(50.81)	(15.53)	(6.15)	(15.53)
2001-2003	73	17	15	21	11	9
(%)	(14.63)	(23.29)	(20.55)	(28.77)	(15.07)	(12.33)

^a Percentages in the first column are relative to the entire sample.

Table 2: Descriptive statistics

Variables ^a	Sample	Electronics	IT	Pharma & Bio	Machinery	Communications	SBEFs ^b
PANEL A: GENERAL CHARACTERISTICS OF FIRMS							
Market Value (€m)	78.57	55.25	99.05	79.56	44.52	59.62	85.41
Age (years, median)	8	9	9	6	10	6	7
Leverage (% , median)	28.66	54.98	23.12	21.08	67.03	50.48	34.86
Profitability (% , median)	7.31	8.51	4.84	- 3.58	14.05	9.73	- 1.82***
Market to Book	3.61	3.52	3.72	3.61	3.35	3.66	3.77**
PANEL B: INTELLECTUAL CAPITAL							
Patents (No.)	17.07	34.41	6.32	37.76	14.86	6.76	35.55**
Patents (No., median)	2	6	2	9	5	1	6***
Ph.D. in the TMT (%)	10.28	6.95	9.52	23.64	3.01	2.82	25.41***
MBA in the TMT (%)	10.79	16.14	6.38	19.54	9.51	8.24	16.98***
TMT Experience (% of directors)	72.61	61.92	74.58	80.24	62.15	71.78	84.15***
TMT Relational Capital (% of directors)	8.33	8.94	4.59	17.04	8.51	7.58	14.41***
TMT Age (years)	47.23	47.56	46.25	48.41	50.14	46.42	46.85
CEO Experience (No. of TMT memberships)	2.22	1.98	2.21	2.14	3.33	1.95	2.58**
CEO Relational Capital (No.)	0.69	0.46	0.78	0.79	0.29	0.65	0.87***
CEO Age (years)	46.79	48.68	46.63	47.58	49.61	45.34	45.44*
PANEL C: OWNERSHIP AND CORPORATE GOVERNANCE							
Ownership Concentration (%)	54.51	59.63	53.04	48.45	59.97	57.58	50.02***
TMT Ownership (%)	36.35	31.96	33.34	28.45	44.87	50.44	31.85*
CEO Ownership (%)	26.68	19.94	32.92	18.24	22.65	25.36	16.94**
TMT size (No. directors)	5.11	5.21	4.52	5.92	5.94	5.15	5.88***
Independent Directors (%)	34.71	40.89	30.19	41.32	33.13	34.15	36.98*
VC-backed (% of firms)	55.22	59.15	58.84	58.62	32.43	47.94	60.15
Capital Inflow at the IPO (%)	32.23	29.21	30.65	47.38	16.66	31.53	45.87**
CEO = Founder (% of firms)	58.69	56.33	60.64	54.02	45.94	68.05	60.76
CEO = Main Shareholder (% of firms)	48.34	43.05	49.19	40.22	56.75	57.35	42.01**
Split CEO Chairman (% of firms)	36.54	35.29	29.73	48.27	37.50	40.54	53.54***
Non Executive Chairman (% of firms)	27.27	27.53	20.04	35.63	38.71	31.08	34.62**

^a Averages.

^b Tests are between SBEFS and independent firms. The significance levels are based on t-statistics (mean), Mann-Whitney U-test (median), Z-tests of equal proportions, as required. Significance level at 1% (***), 5% (**) and 10% (*).

Table 3: M&A deals (target and acquirers)

Variables	Sample ^b	Electronics	IT	Pharma & Bio	Machinery	Communications
PANEL A: SAMPLE FIRMS AS ACQUIRERS						
Firms involved in M&A deals (% of the sample)	78.56***	63.64	89.81	64.77	68.89	84.34
Deals (average no. per firm)	5.22***	4.87	5.60	3.73	5.13	5.71
Deals after IPO (%) ^a	93.23	90.83	94.64	89.79	92.25	94.41
Time to first deal after IPO (months)	11.65***	7.87	11.95	15.89	21.02	15.61
Stock as Payment method (%) ^a	51.52***	55.97	51.67	51.56	44.72	51.01
Intra-industry (%) ^a	39.31***	28.41	40.85	45.43	35.29	39.62
Cross-border (%) ^a	36.63	38.41	37.46	46.38	15.58	30.57
Private Targets (%) ^a	69.25***	64.38	74.43	62.22	58.82	69.42
Equity Stake Acquired in Targets (%) ^a	83.41***	81.70	83.20	86.57	83.07	82.77
PANEL B: SAMPLE FIRMS AS TARGETS						
Firms involved in M&A deals (% of the sample)	64.32	58.44	64.08	68.18	51.11	73.49
Deals (average no. per firm)	2.96	3.01	2.76	2.97	3.22	3.26
Deals After IPO (%) ^a	90.35	87.14	91.22	91.43	85.51	91.55
Time to first deal after IPO (months)	26.94	19.22	28.23	25.41	24.72	31.05
Stock as Payment method (%) ^a	74.72	78.92	76.54	74.24	61.92	72.11
Intra-industry (%) ^a	20.94	20.59	21.85	21.84	23.87	17.68
Cross-border (%) ^a	36.86	51.55	28.96	48.86	17.11	37.18
Private Acquirers (%) ^a	44.92	23.94	49.93	42.43	56.59	47.63
Financial Acquirers (%) ^a	43.22	31.42	45.77	41.54	48.62	46.01
Equity stake sold to acquirer (%) ^a	62.07	60.38	60.85	56.51	69.76	68.02
Firms transferring control (% of the sample)	37.47	38.96	31.07	46.59	31.11	45.78

^a Percentage of deals per firm, average.

^b Statistical tests (first column) are on the difference between firms as acquirers and firms as targets. The significance levels are based on t-statistics (mean), Z-tests of equal proportions, as required. Significance level at 1% (***), 5% (**) and 10% (*).

Table 4: M&A deals of SBEFs and independent firms

	SBEFs				Independent ^b			
	SBEF sub-sample	Electronics	IT	Pharma & Bio	Independent sub-sample	Electronics	IT	Pharma & Bio
PANEL A: SAMPLE FIRMS AS ACQUIRERS								
Firms involved in M&A deals (% of the sample)	73.28	57.14	90.56	63.46	79.62*	64.68	88.89	66.68*
Deals as Acquirer (%) ^a	58.33	54.84	70.14	45.84	72.98***	64.84*	79.26**	63.59***
Deals (average no. per firm)	3.89	4.51	3.46	3.33	5.65**	5.01*	6.21***	4.29**
Deals after IPO (%) ^a	92.91	84.97	96.81	88.39	93.33	92.73	94.03	90.33
Time to first deal after IPO (months)	18.04	19.22	15.01	22.61	8.47***	5.96*	9.33**	6.28***
Stock as Payment method (%) ^a	48.34	36.33	47.66	55.01	52.54	62.33***	52.81	46.84
Intra-industry (%) ^a	42.29	31.13	49.39	42.22	38.34	27.21	38.43*	49.84
Cross-border (%) ^a	45.56	49.09	45.47	52.52	34.07***	28.95**	35.75**	37.92**
Private Targets (%) ^a	65.59	62.22	73.65	56.27	70.44	65.09	76.65	70.41**
Equity stake acquired in targets (%) ^a	88.67	89.39	87.68	90.58	81.69***	79.36**	81.85**	81.28**
PANEL B: SAMPLE FIRMS AS TARGETS								
Firms involved in M&A deals (% of the sample)	68.71	66.66	61.36	75.01	62.77*	55.35	64.81	58.33*
Deals (average no. per firm)	2.67	1.85	2.74	2.66	3.08**	3.52**	2.77	3.54**
Deals after IPO (%) ^a	91.52	87.52	92.74	90.18	89.88	86.98	90.83	93.73
Time to first deal after IPO (months)	27.54	24.11	28.78	25.72	26.58	16.38	28.58	24.98
Stock as Payment method (%) ^a	80.52	88.09	75.98	76.89	72.45***	74.78**	76.67	69.31**
Intra-industry (%) ^a	25.39	21.72	31.63	23.62	19.53**	19.64	19.34**	18.45*
Cross-border (%) ^a	46.13	55.35	31.97	52.42	33.13***	49.83*	27.85*	42.25**
Private Acquirers (%) ^a	38.53	29.76	47.65	36.31	47.42**	21.31	50.52*	53.82**
Financial Acquirers (%) ^a	34.75	27.38	36.21	36.89	46.51***	33.24*	48.23*	50.16**
Equity stake sold to acquirer (%) ^a	58.22	61.81	63.91	53.67	63.57	59.83	59.95	61.54
Firms transferring control (% of the sample)	51.14	47.62	43.18	55.77	32.61***	35.71**	27.77**	33.33***

^a Percentage of deals per firm, average.

^b Tests are on the difference between SBEFs and independent firms. The significance levels are based on t-statistics (mean), Z-tests of equal proportions, as required. Significance level at 1% (***), 5% (**) and 10% (*).

Table 5: Poisson regression on the number of deals as acquirer

Model ^a	(1)	(2)	(3)
<i>Baseline regression</i>			
Market Value	0.22***	0.18**	0.19**
Leverage	- 0.01	- 0.06	- 0.05
Profitability	- 0.08	- 0.16	- 0.18
Market to Book	- 0.93***	- 0.92***	- 0.87***
Electronics	- 0.41**	- 0.31*	- 0.28*
Pharma & Bio	- 0.47**	- 0.47*	- 0.29
IT	0.08	0.08	0.07
Bubble period	0.25*	0.21*	0.23*
UK	- 0.06	- 0.09	- 0.11
Germany	0.51**	0.42**	0.19*
<i>Institutional affiliation</i>			
SBEF	- 0.47***	- 0.78***	- 0.85***
VC-backed	- 0.31***	- 0.38***	- 0.44***
<i>Intellectual Capital</i>			
Patents		- 0.07	- 0.19
Ph.D. in the TMT (%)		- 0.71*	- 0.61
MBA in the TMT (%)		- 0.16	- 0.11
TMT Experience (% of directors)		0.38*	0.25
TMT Relational Capital (% of directors)		0.83*	0.42
<i>Ownership and Corporate Governance</i>			
Ownership Concentration			- 0.76**
TMT Ownership			0.14***
Independent Directors			0.18
TMT size			0.03
<i>Constant</i>	2.69**	3.63***	3.72***
Pseudo R ² % ^b	11.88***	13.12***	15.12***
N = 499			

The dependent variable is the number of deals as acquirer.

^a z-Test for significance of the independent variables.

^b Wald χ^2 -Test for significance of the regression.

*** 1% significance level; ** 5% significance level; * 10% significance level.

Table 6: Cox proportional hazard regression on the probability to be target after the IPO

Model ^a	(1)	(2)	(3)
<i>Baseline regression</i>			
Market Value	0.31***	0.28***	0.29***
Leverage	0.22	0.23	0.25*
Profitability	- 0.31*	- 0.29*	- 0.41*
Market to Book	- 0.66**	- 0.71**	- 0.71**
Electronics	- 0.56**	- 0.69**	- 0.46*
Pharma & Bio	- 0.11	- 0.22	- 0.16
IT	- 0.33	- 0.31	- 0.37
Bubble period	- 0.36**	- 0.36**	- 0.33**
UK	0.49**	0.49**	0.39*
Germany	1.01***	1.05***	0.89***
<i>Institutional affiliation</i>			
SBEF	0.31*	0.31*	0.28*
VC-backed	0.22*	0.16	0.12
<i>Intellectual Capital</i>			
Patents		1.93**	1.78**
Ph.D. in the TMT (%)		0.25	0.22
MBA in the TMT (%)		0.76	0.79
TMT Experience (% of directors)		0.45	0.21
TMT Relational Capital (% of directors)		1.01*	0.98*
<i>Ownership and Corporate Governance</i>			
Ownership Concentration			- 0.85**
TMT Ownership			0.15
Independent Directors			0.17
TMT size			0.03
Log Pseudo Likelihood ^b	- 1468.14***	- 1464.60***	- 1461.32***
N = 499			

^a z-Test for significance of the independent variables.

^b Wald χ^2 -Test for significance of the regression.

*** 1% significance level; ** 5% significance level; * 10% significance level.

Table 7: Control acquisitions of sample firms.

	SBEFs				Independent ^b			
	SBEF sub-sample	Electronics	IT	Pharma & Bio	Independent sub-sample	Electronics	IT	Pharma & Bio
Firms Transferring Control (%)	51.14	47.62	43.18	55.77	32.61***	35.71**	27.77**	33.33***
One-Shot Acquisition (%)	56.53	55.56	49.99	66.66	53.66	54.99	52.69	54.55
Only One Acquirer (%)	60.87	55.55	61.91	70.01	56.63	55.01	54.01	54.54*
Time to First Control Acquisition (months, mean)	29.43	29.2	27.87	24.22	27.41	28.9	26.93	24.42
Time to Transfer Control (months, mean)	50.07	55.18	43.96	48.33	53.82	47.49	43.29	65.54*

^b Tests are between SBEFs and independent firms. The significance levels are based on t-statistics (mean) and Z-tests of equal proportions, as required. Significance level at 1% (***), 5% (**) and 10% (*).

Table 8: Cox proportional hazard regression on the probability to transfer control.

Model ^a	(1)	(2)	(3)
<i>Baseline regression</i>			
Market Value	0.26***	0.23***	0.21**
Leverage	0.52*	0.52*	0.47*
Profitability	- 0.55*	- 0.54*	- 0.49*
Market to Book	- 0.64*	- 0.52	- 0.74*
Electronics	- 0.31	- 0.33	- 0.12
Pharma & Bio	- 0.15	- 0.21	- 0.22
IT	- 0.42	- 0.35	- 0.63
Bubble period	- 0.45*	- 0.56*	- 0.33
UK	0.29	0.31	0.18
Germany	0.19	0.27	0.47
<i>Institutional affiliation</i>			
SBEF	0.87***	0.89***	0.92***
VC-backed	0.43*	0.41*	0.41*
<i>Intellectual Capital</i>			
Patents		0.64	0.38
PhD in the TMT (%)		0.38	0.15
MBA in the TMT (%)		0.27	0.18
TMT Experience (% of directors)		- 1.09	- 1.11
TMT Relational Capital (% of directors)		1.18*	1.31*
<i>Ownership and Corporate Governance</i>			
Ownership Concentration			- 0.52**
TMT Ownership			- 0.19
Independent Directors			0.04
TMT size			0.08
Log Pseudo Likelihood ^b	- 728.99***	- 727.95***	- 725.53***
N = 499			

^a z-Test for significance of the independent variables.

^b Wald χ^2 -Test for significance of the regression.

*** 1% significance level; ** 5% significance level; * 10% significance level.

Table 9: Determinants of SBEFs specificities.

Model ^a	Poisson on propensity to acquire	Cox on probability to become a target	Cox on probability to transfer control
<i>Baseline regression</i>			
Market Value	0.20**	0.28***	0.24**
Leverage	- 0.05	0.32*	0.48*
Profitability	- 0.26	- 0.78***	- 1.08**
Market to Book	- 0.97***	- 0.89**	- 0.72*
Electronics	- 0.29*	- 0.45*	- 0.24
Pharma & Bio	- 0.36*	- 0.21	- 0.18
IT	0.09	- 0.37	- 0.84
Bubble period	0.28*	- 0.29*	- 0.32
UK	- 0.14	0.02	0.17
Germany	0.26*	0.62**	0.64
<i>Institutional affiliation</i>			
SBEF	- 0.63*	0.77*	0.74**
VC-backed	- 0.38***	0.18	0.35*
<i>Intellectual Capital</i>			
Patents	0.05	1.81*	0.43
PhD in the TMT (%)	- 0.18	0.01	0.47
MBA in the TMT (%)	- 0.19	1.26	0.21
TMT Experience (% of directors)	0.20	0.66	- 0.18
TMT Relational Capital (% of directors)	0.80	1.81**	1.45*
<i>Ownership and Corporate Governance</i>			
Ownership Concentration	- 0.75**	- 0.94**	- 0.85**
TMT Ownership	0.86***	0.85	- 0.14
Independent Directors	0.07	- 1.12	0.02
TMT size	0.02	0.01	0.10
<i>Interaction effects</i>			
Profitability × SBEF	0.53*	0.65	0.84
Patents × SBEF	- 2.73 **	1.42*	0.30
PhD in the TMT (%) × SBEF	- 0.81	0.26	0.05
MBA in the TMT (%) × SBEF	- 1.09	0.42	0.04
TMT Experience (% of directors) × SBEF	0.47	- 0.54	- 0.97
TMT Relational Capital (% of directors) × SBEF	- 0.94	- 0.25	0.23
Ownership Concentration × SBEF	0.28	- 0.21	- 0.12
TMT Ownership × SBEF	- 0.88	- 0.73	- 0.43
Independent Directors × SBEF	0.23	1.59	0.78*
TMT size × SBEF	0.05	0.12	0.02
<i>Constant</i>			
	3.57***		
Pseudo R ² % ^b	16.88***		
Log Pseudo Likelihood ^b		- 1458.06***	- 722.03***
N = 499			

^a z-Test for significance of the independent variables.

^b Wald χ^2 -Test for significance of the regression.

*** 1% significance level; ** 5% significance level; * 10% significance level.