

Valuing university-based firms

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Abstract

This paper studies the valuation of university-based firms. Out of 1 697 non-financial companies that went public in Europe during the period 1995-2002, 143 were university-based firms. University affiliation is perceived by the market of investors as a signal of firm quality, with university-based firms registering higher valuations and lower uncertainty levels compared to a matched sample of independent firms. However, despite the benefits yielded by links with universities in terms of a greater propensity to innovation, in the long term university-based firms do not out-perform their counterparts. By using a hierarchical regression analysis, we find that Top Management Team (TMT) composition and ownership play a different role between the two samples. In particular, the presence of independent members and venture capitalists in the TMT is more important in enhancing the performance of university-based firms, whose management often needs external help to improve its performance in carrying out its agency role. We argue that, when founding university-based firms, it should be considered if business competencies are or want to be achieved by the team members. Our conclusion is that university-based firms face a make-or-buy decision on management skills.

Keywords: University entrepreneurship, Corporate Governance, Technology transfer.

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1. Introduction

Universities and university researchers adopt three main mechanisms to transfer knowledge: conferences and scientific publications, training of skilled labour force, and commercialization of knowledge (Landry et al., 2006). Of these, the commercialization of university activities has become a key component in government agendas (Wright et al., 2006). There are fundamentally two main reasons why policymakers emphasize the concept of the entrepreneurial university. Firstly, the creation of more direct links between science and utilization may foster the process of technology transfer and contribute to global economic development. Secondly, in a context of restricted institutional funds, business activities may represent an important alternative source of financing for universities. Based on these assumptions, national governments have adopted a series of policy measures to increase recognition of intellectual property rights and create a supportive environment for the development of university-based firms. Universities have developed business incubators and formal programs for technology transfer. Consequently, universities are able to leverage the technology-transfer process directly while a variety of benefits are simultaneously provided to university-based firms (Ensley and Hmieleski, 2005). For instance, thanks to its affiliation with a university, a firm can access cutting-edge scientific knowledge more easily and more quickly (Smilor and Gill, 1986) and reduce the cost of acquiring resources it needs to build and maintain its competitive advantage (Mian, 1996). In addition, links with universities can have reputation effects that, in turn, can facilitate collaboration with other organizations and enhance the credibility of a firm in the eyes of powerful stakeholders (Mian, 1997). University-based firms are therefore expected to exploit these benefits in terms of superior performance. However, little is known about the ability of these firms to translate the potential benefits into performance gains. Indeed, involvement of academics in creating new ventures may not be driven by an entrepreneurial attitude, but rather by the prospect of enhancing their academic position (Fini et al., 2006). Consequently, concerns remain that the goal of achieving substantial returns from the commercialization of university research is yet to be achieved (Lambert, 2003; Shane, 2004).

Recent studies found university-based firms do not perform as well as independent firms (Ensley and Hmileski, 2005). So this has created an interest in understanding the potential drawbacks that hinder the translation of the benefits of being a university-

based firm into substantial performance gains. Moreover, it would be useful to gain an understanding of how these benefits are valued by potential investors. Does the market of investors perceive the benefits of university affiliation and are they reflected in higher valuations and better performances?

This paper addresses this issue by comparing a sample of European university-based firms with a control sample of independent firms. Numerous comparisons are made including valuation and performance, ownership structure, corporate governance, and innovative activity. We adopt a market-based perspective, using a sample of firms that recently went public on the stock markets of the four largest European economies (i.e. Germany, UK, France, and Italy). In the last decade, the launch of second-tier markets in every European country has, at least in part, fulfilled the aim of providing small and medium enterprises with the means to finance growth. Indeed, stock exchanges have successfully encouraged small firms to gain access to public listing by setting up dedicated markets with less stringent requirements. This gives us the opportunity to analyse successful university-based firms in a uniquely entrepreneurial activity, an Initial Public Offering (IPO)¹. In the short run, we question if the status of affiliation with university institutions is perceived as a credible quality signal by investors. In the long run, we compare the performance of university-based and independent firms and investigate the determinants of the differences between the two categories. In particular, this paper focuses on the role played by the composition of Top Management Teams (TMTs) and their eventual ownership of the firm. This is particularly interesting in light of the risk-relevance given by potential investor in university-based firms to the business development skills of management (Wright et al., 2006).

The remainder of the paper is structured as follows. Sections 2 and 3 contain a review of the literature on university-based firms and on the role of TMT composition and ownership in determining the performance of a firm. The research design is presented in Section 4, and then Section 5 examines the empirical analysis. The findings are discussed and conclusions presented in Section 6, along with policy implications.

¹ Thanks to the new and second-tier markets, the nature of the companies going public is rapidly changed in the last decade, with more small and medium companies going public. For instance, the average size is diminished, with an average sales of only 27 €mln in the year prior to the IPO on second markets in 2006. Source: Academic EurIPO Fact Book 2007 (the second markets are the AIM in the UK, Freiverkehr Markt in Germany, Alternext and Marché Libre in France, Expandi in Italy).

2. University-based firms

The dissemination of knowledge generated in universities beyond the confines of the academic community itself is considered to be a driver of national and regional economic growth (Mustar et al., 2006). Given the importance policy makers place on the concept of the entrepreneurial university, commercialization of university activities has become a key objective for governments and universities (Clarysse et al., 2005). Moreover, in the last decade, budget constraints changed the model of how public funds are allocated and encouraged an increasing number of university officials to view technology transfer as an alternative source of revenue for their institutions. This induced universities to initiate joint-ventures with private companies and to develop research programs with tighter commercial perspectives (Geuna and Nesta, 2006). While collaborative relationships between universities and firms have existed for nearly a century in the United States, it is only in more recent decades that the interest of universities in the commercialization of new technologies has considerably increased elsewhere in the world (Siegel et al., 2003)². A series of policies have been adopted by national governments, including European ones, with the aim of fostering the technology transfer process and of creating a supportive environment in which to create new technology based firms.

The growing importance of an entrepreneurial culture to the universities has seen a great many new studies appear in the literature that focus on the following aspects: the role of legislation and the national system in stimulating academic enterprise (Shane, 2004), factors in the university environment facilitating the creation of business activities (O'Shea et al., 2005), the institutional conditions under which spin-offs are incubated (Lockett et al., 2005), the characteristics of individual academics who become entrepreneurs (Landry et al., 2006), the benefits firms derive from affiliation with a university institution (Mian, 1996), and the value creation capacity of university commercial initiatives (Lambert, 2003). This study is related to the latter two streams of literature.

² In particular, the incentive for universities to extend their focus from basic research to commercialization is related to favourable legislation (e.g. Bayh-Dole Act of 1980 in the U.S.) that decreases the uncertainty associated with the commercialization of government funded research (Shane, 2004) and facilitates technological diffusion from universities to firms.

2.1 University-based firms: benefits of affiliation

Companies that compete in high-technology industries face major challenges in achieving competitive advantage and profitability (Oliver and Liebeskind, 1998). In science-based industries, success requires a firm to develop and accumulate diverse technological capabilities. However, firms suffer serious problems accessing the resources needed to build these competencies. The development of links with universities could represent a solution to accessing the resources needed to ensure value creation (Geisler et al., 1990).

The benefits firms obtain from affiliation with a university are well documented in the literature. Access to sources of knowledge and innovation, and to physical resources such as university laboratories and libraries, are some of the most important value-adding components that a university can offer a firm (Quintas et al., 1992). 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). The affiliation with a university can also foster collaboration with public research institutes (Oliver and Liebeskind, 1998) and information sharing, especially where knowledge is more likely to be tacit (Cohen and Levinthal, 1990). Moreover, links with universities can enhance the confidence of other stakeholders in a company (Mian, 1997), such as Venture Capitalists (VCs) and business angels. This can facilitate the raising of funds needed to finance the innovative activity and make the use of this capital more effective. Access to finance is indeed a key determinant of the growth and value generation associated with new technology based firms (Wright et al., 2006).

2.2 Performance of university-based firms

Although understanding the potential of university-based firms is important, few studies have analyzed the peculiarities and performance of this type of firms (Smith and Ho, 2006). Colombo and Delmastro (2002) compare a sample of 45 Italian New Technology Based Firms (NTBFs) located on technology incubators with a control sample of off-incubator firms and find no significant differences between the two groups in terms of innovative activity. However, NTBFs located in incubators are characterized by founders with better human capital compared to their off-incubator counterparts.

Furthermore, in-incubator firms find it easier to access public funds and perform better in terms of establishing collaborative arrangements, especially with universities.

Using data from U.S. publicly traded biotechnology companies, George et al. (2002) find that firms that establish links with universities outperform control firms in terms of the number of patents held and have lower R&D spending than firms without university links. The authors argue that links with universities might serve as a substitute for expensive in-house R&D spending. They also note that differences in accounting performance between firms with and without university links are not statistically significant³.

Ensley and Hmieleski (2005) investigate the role of TMT composition to explain the differences in performance between university-based and independent firms. Comparing a sample of 102 US high-technology university-based start-ups with a matched sample of independent new ventures, the authors find that the former are composed of more homogenous TMTs with less developed dynamics than the latter. Moreover, university-based start-ups are found to be significantly lower performing in terms of net cash flow and revenue growth than independent firms. They emphasize that the TMTs of university-based firms may not be representative of those in the 'outside world', and this may be one of the causes of poor performance. A TMT member may not be sufficiently committed to maximizing profit, or group cohesion and a shared strategic vision may be lacking.

Finally, Wright et al. (2006) study the problems faced by university-based firms seeking to access VCs. In taking investment decisions, venture capitalists perceive a greater risk with university-based firms because academics may not have the credibility to attract customers as well as managers with commercial expertise. Difficulties in identifying key decision makers are also identified as significant source of discouragement for potential investors.

2.3 Contribution to the literature

Although the literature on the entrepreneurial role of universities already contains important results with significant policy implications, there are still knowledge gaps that need research. In particular, as pointed out by Ensley and Hmieleski (2005), it is not

³ Although the study is very exhaustive in terms of innovative activity comparison, the only measure of financial performance considered is net sales over total asset.

clear whether the benefits derived from being a university-based firm translate into substantial performance gains⁴. Moreover, in spite of the importance attributed by institutions to collaboration between universities and commercial enterprises, little is known about this phenomenon in countries other than the U.S. In particular, there is a need to monitor the value creation capacity of university commercialization activities, and of university-based firms in particular (Wright et al., 2006). With this aim in mind, this study is the first to address the issue of market valuation and performance of university-based firms. This is of even greater interest in the light of the fact that accounting ratios provide less information than they used to due to the growing importance of intangible assets and to the related increase in discretion entering financial statements. Indeed, recent studies in the financial accounting literature agree on the greater informative value of market-based measures, able to capture a mix of information, including both financial statement and non financial statement information (Beaver et al., 2005).

3. TMTs and performance

The study of TMT characteristics as a key difference between university-based and independent firms discloses the stream of literature on entrepreneurial university to the ongoing debate on the relationship between the role of TMTs and firms' performance. The literature in corporate governance describes several ways through which the TMTs may affect the performance of the firms. In particular, the variables investigated typically refer to the composition of TMTs and to their ownership.

3.1 TMT composition and performance

TMT composition has been identified as a relevant internal governance mechanism designed to maximize value creation and to mitigate conflicts of interest between managers and shareholders. Previous literature has conventionally attributed two main functions to TMTs: the Agency and the Advisory. The Agency role stipulates that the

⁴ Ensley and Hmieleski (2005, p. 1092) state that 'most studies of affiliation between universities and high-technology start-ups have been primarily descriptive and lacking of theoretical and/or methodological grounding. Over the last 25 years we simply have not had enough empirical research

TMT monitors the behaviour of the management on behalf of the shareholders; the Advisory role considers that the TMT, through its expertise and wisdom, offers input to decisions on strategic direction and views the TMT members as a way of identifying and acquiring tangible and intangible resources on behalf of the firm. While the Advisory role is not expected to create a conflict of interest, managers are likely to resent the Agency role because its objective is to scrutinize their decisions and restrict any of their activities aimed at maximizing their own and not necessarily shareholders' interest (Lasfer, 2006). The distinction between these two main roles has some implication on the design of TMT structure. Previous studies and regulators argue that in order to accomplish their monitoring function under the agency framework, TMTs should be composed mainly of independent directors (Fama and Jensen, 1983; Cadbury, 1992). In contrast, studies that focus on the Advisory role advocate that companies perform better when the TMT members have a high level of education (Hayton, 2005), external links with institutions, or previous experience in other business companies (Lester et al., 2006).

With reference to university-based firms, TMT composition is of particular interest in terms of both the Agency and the Advisory role. As Ensley and Hmieleski (2005) show, TMTs of university-based firms may lack business experience. This suggests that adhering to criteria for the accomplishment of the Agency role, such as a large proportion of independent members may be even more essential to value creation in these firms. Moreover, the literature on corporate governance suggests that a way used by firms to reduce uncertainty and acquire legitimacy in the eyes of investors is to comply with institutional elements. There are several categorizations or ways in which firms might enjoy legitimacy in their environment, such as observance of corporate governance standards (DiMaggio and Powell, 1983) or locating in an environment conducive to fulfilling organization goals (Suchman, 1995). From this standpoint, the affiliation with universities and the presence of faculty in TMTs may represent an important signal to the stakeholders. Investors may indeed assess firm quality by examining the prestigious credentials of the TMT members of university-based

directly comparing equivalently matched groups of high-technology university-based and independent start-ups in order to draw definitive conclusions'.

companies⁵. In particular, prestigious TMT members may facilitate inter-organizational relationships with other stakeholders, such as bankers, investors, suppliers, and customers. In addition, prestigious executives also influence investor perceptions by having a largely symbolic role. This role, which is primarily rooted in social characteristics theory (Berger et al., 1992), is based on the belief that individuals ascribe different values, skills, and abilities to status characteristics such as education level, affiliations, and experience.

3.2 TMT ownership and performance

TMT ownership is an internal governance mechanism designed to mitigate conflicts of interest between managers and shareholders, and therefore maximize value creation. The basic idea is straightforward. Since the allocation of ownership directly influences the incentives, ownership would provide a strong incentive for TMT members to behave in the interest of other shareholders and thus increase the value of the firm (Jensen and Meckling, 1976). When TMT members own a stake in their firm, they are less likely to deviate from the value maximization behavior by consuming perquisites, shirking, or undertaking sub-optimal investment projects to maximize their own benefits. Moreover, the willingness TMT members to invest in their own projects may serve as a signal of projects quality (Leland and Pyle, 1977). Accordingly, TMT members may signal their confidence in the quality of the firm by holding large stakes. In this incentive-alignment (or signaling) framework, the performance of a company is predicted as an increasing function of TMT ownership.

Nevertheless, Fama and Jensen (1983) note the problem of managerial entrenchment, suggesting that both positive and negative effects arise out of TMT ownership. Greater equity ownership by the TMT members may indeed result in poorer financial performance because executives with large ownership stakes may be so powerful to not have to consider other stakeholders interest. On the base of the entrenchment hypothesis, the relationship between ownership and firm performance is thought to be non-linear, with a negative effect of TMT ownership on performance prevailing at

⁵ Even when TMT members have the correct incentives and the power to implement their decisions, they may take good or bad decisions because they differ in their capabilities. This is particularly true for high-tech start-ups companies, whose competitive advantage largely comes from non-physical assets including human capital, ideas and intellectual property rights (Audretsch and Lehmann, 2005).

intermediate levels and a positive effect for low and high levels of TMT ownership (Morck et al., 1988).

Taken as a whole, these studies suggest the relevance of TMT ownership in analyzing the role played by TMTs in the performance of a university-based firm. The differences between university-based and independent firms may indeed provide evidence of a different level of involvement by TMT members in the activities of a firm.

4. Research Design

4.1 Methodology and sample

We rely on one of the more notable entrepreneurial settings: an IPO is one of the more critical junctures in the development of a firm. The decision to take the firm public presents many opportunities for the continued growth and prosperity of the firm. The most important reason for listing is to generate capital that can be used to fund the continued growth of the firm (Rydqvist and Högholm, 1995). For many entrepreneurial ventures, an IPO enables the management of a firm to pursue growth opportunities that would otherwise be impossible to fund. Even when additional commercial credit is available to the entrepreneur, the covenants attached to the loan may be too restrictive for him or her to pursue opportunities with high-growth prospects, but also with high risk (Pagano et al., 1998). However, the downside is that at the IPO firms face the challenging task of winning acceptance from a variety of stakeholders. Undertaking an IPO moves the firm from the private to the public domain. The management of the firm must therefore convince relevant audiences that the firm has long-term potential.

Few organizational transitions receive the concentrated attention that an IPO generates. In agreement with listing requirements, vetted by the national exchange commissions, any firm undertaking an IPO must provide a series of documents that contain detail on the firm and the firm's managers. Potential investors carefully scrutinize these documents in an effort to assess the prospects of an equity position in the IPO-firm. In this study, we take advantage of such opportunity to access to firm-specific information to examine the university links of firms that recently went public in Europe.

The list of IPOs is selected from the EURIPO database that provides the IPO prospectus as well as very detailed information on all the companies that have recently gone public

in Europe⁶. The focus is on the four largest European economies, namely Germany (selecting the domestic companies listing on the Deutsche Börse), the United Kingdom (London Stock Exchange), France (Euronext), and Italy (Borsa Italiana). We consider the IPOs in the period between 1995 and 2002 excluding financial firms and property companies. After applying these filters, the original sample is composed of 1 697 firms. The curriculum vitae of TMT members and the history of these firms as reported in their IPO prospectus are carefully analyzed. We identify as university-based firms those companies that were developed by post-graduate students or faculty based on their research, or utilized research from a university's technology transfer area (Ensley and Hmieleski, 2005, p. 1097)⁷. The final sample is therefore composed of 143 University-based firms.

Table 1 describes the sample by country, industry, IPO date, and age at listing. Predictably, the United Kingdom is the most representative country, with 63 University-based firms (44% of the sample). In fact, the UK has the most developed stock exchange in Europe compared to the size of its economy (at the end of 2006, the ratio between stock market capitalization and gross domestic product was 1.5 in the UK and between 0.5 and 1.0 for most countries in Continental Europe⁸), and the university system in Britain is more entrepreneurial (Slaughter and Leslie (1999) defines the UK as the avant-garde of academic capitalism). In terms of industry, the greatest concentration is in both information technology, and in health, pharmaceuticals, and biotechnology (respectively 41.26% and 33.57% of the sample). Prior studies have coherently found these sectors to be strongly associated with spin-off activity (Smith and Ho, 2006). Other university-based firms are in the aerospace and electronic equipment sectors, in the media and support services⁹. Most of the firms (61.54%) went public in the period 1999-2000, commonly identified as a 'hot issue' period in IPO

⁶ The EURIPO database is developed by Universoft, a spin-off of the University of Bergamo (www.euripo.eu). It contains data on more than 4 000 companies that went public through IPO on a European stock exchange during the period 1985-2006. Specific data about the firms was collected from the IPO prospectuses and annual reports. The dataset combines information of different kinds, such as accounting data and information on the structure of the offer, ownership structure, post-IPO performance, corporate governance, human capital, and intellectual property rights.

⁷ Our definition of University-based firms is taken from Ensley and Hmieleski (2005). Similarly, Druilhe and Garnsey (2004, p. 274) define university spin-offs as 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'. Also Smith and Ho (2006, p. 1560) take the same approach to defining university spin-offs.

⁸ Source: Academic EurIPO Fact Book 2007; data from Eurostat and FESE (Federation of European Stock Exchanges).

markets, especially for IT companies¹⁰. As for age at IPO (measured from date of foundation), most of the firms have gone public within 15 years of their foundation.

The main objective of this study is to investigate whether or not the linkage with a university institution affects the valuation and performance of firms. To this aim, the sample of university-based firms is compared to a control sample of independent firms. The matching sample is also selected from the EURIPO sample of 1 697 non-financial companies in the UK, Germany, France, and Italy that went public during the period 1995-2002. The propensity score-matching method proposed by Rosenbaum and Rubin (1983) was used to carry out the matching process. The purpose of matching is to pair each university-based firm with an independent firm in similar industries, similar countries, and of similar age and size¹¹.

[TAKE IN TABLE 1]

4.2 Market valuation

The valuation of university-based firms is among the most stimulating and puzzling research issues. In general terms, valuing a company going public is already a question of considerable practical and theoretical importance, for policy makers, academics, as well as investors. In particular, it is important to understand how the linkage of a firm with a university is valued and whether it does affect its performance or not. IPO-firms therefore provide a favorable setting in which to study the valuation and performance of a company by using market-based measures. Consequently, this study examines the market valuation and performance of the university-based firms and compares them with their independent counterparts.

The uncertainty and information asymmetries surrounding IPO-firms make it difficult to discern firm quality. Much of this uncertainty is due to the lack of information available prior to the public offer, when the company is still in private hands. The primary means for communicating information about the firm is the offering prospectus, that is

⁹ Industries are defined according to the International Classification Benchmark (ICB) which covers over 50 000 companies around the world.

¹⁰ Firms may indeed time their IPO in order to take advantage of 'windows of opportunity' i.e. periods of market buoyancy during which companies have an incentive to issue new shares based on an over-valuation of other companies in their industry (Loughran and Ritter, 1995).

mandatory published by all the companies seeking floatation on a stock market. Since owners and managers can be held legally accountable with regard to the accuracy of the information disclosed in this document, it represents the best source of information on the quality for the firm. Previous research has relied on signalling theory to guide the exploration of those signals contained in the prospectus that might impact the potential investors' assessments of firm value and post-issue performance (Ritter and Welch, 2002).

The resource-based view of the firm (Wernerfelt, 1984) also applies to our prospectus-based approach. Consistent with this view, information contained in the prospectus might indicate firm-specific resources that could encourage investors to more highly value the IPO-firm, based on its potential for achieving sustained competitive advantage. Accordingly, being a university-based firm could be viewed as a valuable and non-substitutable resource sustaining future performance. The signaling theory and the resource-based view are therefore two complementary keys to investigating the extent to which IPO prospectus information on university-linkages is valued by the market and related to performance.

We compare the valuation of university-based and independent firms relying upon perceived value by investors. We use two measures: market-to-book ratio and the initial market valuation relative to offer price (underpricing). The market-to-book ratio is defined as the ratio between market capitalization and book value of equity at IPO. It provides a robust estimate of investor perceived future value of the firm. Indeed, the economic theory assumes that the market value of companies differ from their book value by the present value of their future abnormal earnings, where the latter are the result of either monopoly power or (more frequently) of innovation. The book-to-market ratio is therefore a widely used measure that reflects the future growth opportunities of the firm as assessed by the market (Fama and French, 1998).

Our second measure of valuation is underpricing. Underpricing exists when a firm's stock is initially offered at a lower listing price compared to its closing price on the first day of trading. The IPO underpricing anomaly is a worldwide phenomenon¹². Various theories have been developed to explain the first-day IPO underpricing, with most

¹¹ The success of the matching strategy is investigated by inspecting the distribution of the propensity score in the university-based and matched comparison groups and comparing summary statistics of matching variables between the two groups.

¹² Underpricing is a common occurrence for firms undertaking an IPO. A review of the international literature on IPO underpricing is provided by Ritter and Welch (2002).

postulating the existence of information asymmetry between certain parties to the IPO process. Common to these models is the prediction that the extent of information asymmetry is positively related to the first-day underpricing of IPOs characterized by greater valuation uncertainty as these tend to be more under-priced to compensate investors for the greater risk. Although the reasons for underpricing are still puzzling (Ritter and Welch, 2002), previous studies have identified a link between signaling theory and market valuation. Investors will utilize credible signals prior to the IPO to minimize their risk of investing in a low-quality firm. The voluminous research on IPO underpricing identifies several ways in which the firm may signal its quality and reduce information asymmetry. This literature suggests the importance of investigating the status of affiliation with a university institution as a credible signal to the market.

4.3 Firm performance

In addition to underpricing, long-run underperformance is the other well-documented anomaly associated with IPOs. Long term stock return performance tends to be lower than that of non-issuing firms as well as that of the overall market (Ritter, 1991). Obviously, the performance of the IPO firm is of concern to the owners and managers of the firm. Moreover, research that investigates the factors determining IPO performance may also help potential investors to evaluate IPO investment opportunities. Given the heightened likelihood that IPO firms tend to under-perform in the years following the IPO, it is likely that investors are on the lookout for clues which might lead to increasing the odds of picking a high quality firm, or at least minimize their risk as much as possible. The present study investigates the factors determining the performance of a firm and its relationship with the status of being affiliated with a university. Indeed, as highlighted in the review of the literature, although this affiliation yields several benefits for firms, there is no clear evidence for these benefits translating into performance gains.

IPO performance can be measured in a number of ways. The dominant methodology is the one first proposed by Ritter (1991) based on Cumulative Abnormal Returns (CARs). The long-term performance is examined in this paper using a robust hierarchical regression with post-IPO CARs as dependent variable. Post IPO returns are measured

for an aftermarket period of 36 months¹³. The monthly benchmark-adjusted return is defined as the monthly raw return on a stock minus the monthly benchmark return for the corresponding period. The use of abnormal return instead of raw return as a measure of performance is more informative because it neutralizes the particular market momentum. The benchmark used is the FTSE Euromid Index.

The abnormal return for stock i in month t is measured as follows.

$$AR_{i,t} = R_{i,t} - R_{m,t}$$

where $R_{i,t}$ is the raw return of firm i in month t and $R_{m,t}$ is the raw return of the benchmark in the same period.

The mean abnormal return of a portfolio of n stocks for month t is the equally-weighted mean of the abnormal returns, defined as follows:

$$AR_t = \frac{1}{n} \sum_{i=1}^n AR_{i,t}$$

The cumulative abnormal returns (CARs) from the beginning of the first month of trading to month s is calculated as follows.

$$CAR_{1,s} = \sum_{t=1}^s AR_t$$

The performance of the two samples of university-based and independent firms is compared by using CARs and referring to stock prices as a consistent data source. Moreover, by performing a separate hierarchical regression analysis, any existence of a different role of the explanatory variables for the two samples of firms can be recognized.

5. Results and discussion

5.1 University-based versus independent firms

The characteristics of university-based firms are studied from four perspectives: efficiency and profitability, innovative activity, ownership structure, and corporate

¹³ In agreement with the literature (Ritter, 1991 and subsequent papers), we refer to a 3-year post-IPO horizon. A month is defined as a 21 trading day interval and the first 21 trading days after the IPO date are excluded to avoid a potential bias from the price stabilization of underwriter banks during the period.

governance¹⁴. The return-on-assets ratio, defined as sales minus operating cost over total assets, measures the operating efficiency of the firm in its use of resources, while return-on-equity, defined as net profit over equity, expresses the profitability for the shareholders. We find that university-based firms show a lower level of operating efficiency and shareholders profitability at the IPO (Panel A, Table 2). On the other hand, university-based firms show greater innovative activity (Panel B). Indeed, on average, university-based firms own a larger number of patents (35 compared to 9 for the independent firms) and have a level of R&D investments twice that of the control sample (median value of R&D investment scaled by sales is 20% for university-based versus 10% for independent firms)¹⁵.

In terms of ownership structure (Panel C), university-based firms are characterized by a lower divestment level at IPO (on average 19% of the shares offered at listing are secondary shares, compared to 25% for independent firms) and by a higher ratio of new shares issued (25% of the market capitalization of university-based firms is composed of newly issued shares compared to 22% for independent firms)¹⁶. The high level of equity retention suggests that the IPO is typically used to finance business growth and so is not used as a divestment/diversification opportunity for the original shareholders. In particular, university-based firms show a higher propensity to view the IPO as a means of raising new funds to finance growth projects. In contrast, the ownership structure is more concentrated for independent firms. All the categories of shareholders (substantial, TMT members, and the Chief Executive Officer)¹⁷ hold a larger ownership stake in independent firms. In particular, the ownership fraction of substantial shareholders in independent companies is 77% compared to 69% for university-based firms. Similarly, the equity stakes for Chief Executive Officer (CEO) and TMT

¹⁴ The existence of differences is verified through the use of T, Mann-Whitney and Z tests.

¹⁵ Accounting data are hand-collected from IPO prospectuses, while the number of registered patents was obtained from the European Patent Office.

¹⁶ When a company goes public it can choose to place existing shares and/or issue new shares. By offering existing shares, the company launching the IPO raises no fresh capital as this simply records a change in its ownership structure. On the other hand, the offering of newly issued shares raises funds for the company. In Table 2, the variable Divestment at the IPO measures the percentage of the IPO offering composed of existing shares placed, while the Fresh Capital Inflow is the ratio between the number of newly issued shares and the total number of shares outstanding after the IPO. Using these measures of the structure of the IPO, it can be assessed whether the floatation is used to finance companies or if on the other hand it represents a divestment opportunity for existing shareholders.

¹⁷ The information on ownership interests contained in the IPO prospectuses, as well as in annual reports, is determined by the national securities commissions for each country. In particular, details of directors' interests and external interests which amounted to at least 2 or 3% (depending on the country) of issued share capital are required to be disclosed. Substantial shareholders are identified by these cut-off ownership levels for mandatory disclosures required by the national laws.

members are 22% versus 34%, and 34% versus 42%, respectively. Given that these companies seem to be largely financed by a small number of shareholders, arguably the so-called ‘family and friends’, this evidence may reflect the greater difficulty independent firms have in acquiring external financial resources.

The variables of corporate governance show that on average TMTs of university-based firms have a larger number of components and a higher percentage of graduate members (Panel D). Moreover, CEOs in university-based firms have a higher number of external links. This suggests that affiliation with a university may have a positive effect on the advisory function of the TMT. Indeed, the greater educational prestige of TMT members and access to a larger social and business network may improve the strategic decision process and foster interaction with other organizations. Another key difference between university-based and independent firms is the proportion of independent TMT members. The evidence of a higher proportion of independent directors in university-based firms (34% versus 25%) indicates that these firms have difficulty finding the business competencies necessary to accomplish the Agency role. On the other hand, this may be interpreted as a positive signal because university-based firms seem to be more compliant to the prescriptions on corporate governance practice.

The proportion of companies where the CEO is also the main shareholder is higher for the control sample. Together with ownership structure concentration, this evidence may be viewed as a signal of the financial constraints faced by independent firms as they often rely exclusively on capital from a very restricted number of sources¹⁸.

Finally, the slightly smaller presence of venture capitalists in university-based firms could be due to the greater reliance of these firms on external equity compared to independent companies. In fact, Wright et al. (2006) find that even for the universities most active in spinning-out ventures, VCs are only the second source of financing after ad-hoc public funds such as the University Challenge Fund in the UK. Public grants are perceived from universities as the primary way to raise funds for the creation and development of business activities. Wright et al. (2006) also suggest that venture capitalists are more likely to fund university-based firms once they have become established. However, our findings show that university-based firms at the IPO-stage still face problems accessing VC funds. Although these companies can count on limited personal funds compared to independent companies, access to venture capital has not

¹⁸ No substantial differences are found between the two samples in terms of age of the CEO, in terms of proportion of companies where the CEO is also the founder, and in terms of years of service as CEO.

become more importance yet. On the contrary, the fresh capital raised at IPO is significantly higher for university-based firms: 25.37 percent of the post-IPO capital comes from newly issued shares compared to 21.79 for independent companies. It therefore seems that access to the public equity market is viewed by university-based firms as a good way to equity-fund their projects, notwithstanding VCs.

[TAKE IN TABLE 2]

5.2 Market valuation and performance

In a signaling framework, the status of affiliation with a university institution may be viewed by investors as a credible signal of the quality of a firm. The linkage with university can indeed mitigate the uncertainty and concerns over legitimacy associated with the IPO process. Moreover, since university-based firms are associated with higher innovative activity, the market may recognize greater growth opportunities in these firms. Consequently, university-based firms should be associated with a higher initial market valuation (i.e. higher market-to-book ratio) and lower valuation uncertainty (i.e. lower underpricing). Our empirical results confirm the theoretical predictions (Table 3). Affiliation with universities increases the level of the market-to-book ratio and reduces underpricing.

[TAKE IN TABLE 3]

Although the market recognizes a higher valuation to university-based firms, these companies do not out-perform their independent counterparts (Figure 1). On the contrary, in the first two years after the IPO, university-based firms under-perform. However, the difference in performance fades with time. This evidence may be related to the window dressing theory. To induce optimistic valuations, managers may indeed window-dress their accounting figures to make the firms look better before public offering. Given the relatively limited amount of information about the issuing firms prior to go public, this unusually high dependence on (accounting) disclosures as reported in the IPO prospectuses, together with the firm's desire to go public at the

highest possible price, creates an incentive to follow aggressive reporting policies. It is predictable that prior to the IPO managers have extraordinary incentives to make their firms ‘shine’ before going public. At least, firms going public try to provide a fair picture of their assets, while private companies may be more concerned about hiding their value from the tax authorities (Pagano et al., 1998). Therefore, given the incentives for opportunism, managers can manipulate accounting earnings in their own best interest¹⁹. Consequently, the post-IPO performance will deteriorate due to mean reversion (Teoh et al., 1998). In other words, the market progressively corrects its valuation to the extent that new disclosures reveal a discrepancy between the initial valuation and the real firm value. The window dressing is probably a more widespread practice with independent firms than with the university-based ones. Indeed, the latter are subject to more constraints in earnings management because of their institutional affiliation. It is therefore possible that the underperformance of independent firms occurs later in time compared to that of university-based firms due to a negative market reaction to post-IPO disclosure of accounting figures lower than expectations. This hypothesis may explain the reason why the decline in performance is more severe for independent firms some months after their floatation. However, in spite of their greater innovative activity and the potential benefits arising out of their institutional affiliation, university-based firms do not perform better than independent firms.

[TAKE IN FIGURE 1]

5.3 Determinants of firms’ performance

To identify the determinants of firm’s performance, we carry out a hierarchical regression analysis using the CARs as dependent variable. When identifying the explanatory variables, we focused on a series of potential determinants that belong to five groups of variables: (1) firm characteristics, (2) market valuation, (3) innovative level, (4) TMT composition and (5) TMT ownership²⁰.

¹⁹ There are several ways in which managers can ‘window dress’ the pre-IPO performance of a firm. They can ‘borrow’ earnings from other periods (e.g. deferring R&D expenditures), capitalize rather than expense current costs, allocate costs over longer periods (e.g. straight-line rather than accelerated depreciation) or slow down earnings growth in the years before the IPO.

²⁰ When identifying the explanatory variables, we checked for absence of correlation. The correlation matrix is presented in Table 5.

(1) Firm characteristics are Size (natural logarithm of market capitalization at the IPO), Age (natural logarithm of one plus firm age, where firm age is the time elapsed between the date of the foundation of the firm and the IPO) and Profitability (shareholders profitability defined as return-on-equity ratio). (2) Variables of market valuation are the market-to-book ratio and underpricing. (3) Innovative level is measured by the natural logarithm of one plus the number of patents owned by the firm (Patents). (4) TMT composition is studied using two variables: Agency and Advisory. The first step in constructing these variables is to analyze the correlation matrix between the variables that may be relevant in fulfilling the TMT monitoring and advisory role. Then factor analysis is used to collapse the variables representative of the two roles of TMT into two single variables, called Agency and Advisory. The Agency variable considers the following variables with loading factor greater than 0.5: the number of TMT members, the percentage of independent TMT members, and the presence of Venture Capitalists²¹. The Advisory variable considers the percentage of graduate TMT members, and the number of external experience of the CEO in public institutions or as TMT member in other firms. (5) TMT ownership (Own) is measured as the percentage of equity shares owned by TMT members²². In agreement with the predictions of the entrenchment theory (Morck et al., 1988), the variable TMT ownership squared (Own2) and cubed (Own3) is included so as to test for a non-linear relationship with the performance of a firm. In this way, we are able to test the presence of a negative effect of TMT ownership on performance for intermediate levels of managerial ownership and a positive effect for low and high levels.

Table 4 reports the results of the hierarchical regression. Model 1 considers only independent variables specifying characteristics of the firm and market valuation. The following models include variables of innovation (patents) and TMT composition and ownership. We find that for both university-based and independent firms, general characteristics of the firm (size, age, profitability) are not significantly related to post-IPO performance. On the contrary, valuation variables do affect the performance of a firm. Indeed, the relationship between underpricing and market returns is negative.

²¹ The presence of venture capitalists is included in the TMT composition analysis because this variable is positively related to the percentage of independent members. Indeed, VCs can introduce the managerial skills needed to accomplish the monitoring function in the TMT.

²² This measure includes ownership by TMT members via corporate vehicles (e.g. where TMT members are majority shareholders in other firms which have direct ownership stakes in the particular firm under consideration). This definition is consistent with previous studies on corporate governance (see, for example, Morck et al., 1988).

Underpricing is therefore due to the optimistic expectations of investors that are corrected in the long term. Furthermore, the market-to-book ratio is negatively related to performance, in particular for university-based firms. It therefore seems that a high level of intangibles is not related to subsequent high performance and particularly so for university-based firms, whose high initial valuations are not sustained in the long run.

In agreement with the findings of previous studies such as Chin et al. (2006) and Guo et al. (2006), the greater innovation capital of independent firms is associated with better performance. On the other hand, the number of patents held by university-based firms is not related to their performance. This evidence is controversial. It may be related to decline in patent quality and value associated with the expansion of university patenting (Henderson et al., 1998). The great focus of university-based firms on innovation may indeed also lead to investment in less profitable R&D projects that, in turn, leads to patents that do not generate substantial wealth. However, Sapsalis et al. (2006) argue the increased propensity to patent academic inventions is not the consequence of a greater propensity to obtain patents of a lower quality or potential value. The question of whether or not the university-based patenting level is 'over-optimal' is therefore still an open one and further analyses is required on this subject.

TMT variables have a different relevance for university-based compared to independent firms. For the former, it is the TMT composition that matters, while for independent firms it is the TMT ownership that is more important. Indeed, TMT members of university-based firms do not seem to exert a substantial influence on performance through their ownership²³. In these companies, the Agency and Advisory role of TMT members are among the determinants of their performance. In particular, the high level of statistical significance of the Agency variable (that takes into account the number of TMTs members, the percentage of independent members, and the presence of VCs) points to a critical need for external support to TMTs of university-based firms in order to increase their business skills and so to better accomplish the monitoring function. The positive relationship between Agency and the performance of the firm indicates that a larger number of TMT members associated with a higher percentage of independent members leads to better performances due to improved internal control mechanisms. TMT members, particularly the independent ones, are indeed hired on behalf of shareholders to reduce the agency problem between managers and investors that arises

²³ In agreement, the level of TMT ownership is lower in university-based firms than in their independent counterparts (see Table 3).

out of the separation of ownership from control²⁴. Similarly, the presence of VCs also represents an alternate governance control mechanism used to reduce agency costs and to enhance the monitoring role of TMTs. In a survey of VCs attitudes and perception of risks associated with investments, Wright et al. (2006) found that compared to high-tech companies university spin-offs are more likely to be required to build TMTs. The authors argue that academics may not have the credibility to attract customers or to attract management with commercial expertise.

Furthermore, the Advisory role of TMTs is essential to university-based firms. The performance of a firm is indeed not only influenced by the incentives given to TMT members, but also by their capabilities and vision. This problem is exacerbated in young and high-tech firms, where information about the kind of competition or the production process is seldom available and the performance of managers is difficult to measure (Audretsch and Lehmann, 2005). Therefore, it is required not only the incentive to control the managers, but also the ability to evaluate their actions. Our results support these theoretical predictions as the Advisory variable (which includes the percentage of graduate TMT members and the number of external experience of the CEO) correlates positively with performance.

In contrast, TMT ownership is more important than variables of TMT compositions (i.e. Agency and Advisory) for independent firms. In particular, for these companies we find evidence of the entrenchment theory, with a positive effect on performance for low and high levels of TMT ownership, and a negative effect at intermediate levels.

[TAKE IN TABLE 4]

²⁴ Many surveys have documented that independent TMT members are able to reduce financial fraud and improve quality of accounting information. For example, they are found to play an important role in CEO dismissal (Weisbach, 1988), and firms with high TMT composition are less likely to suffer from financial statement fraud (Beasley, 1996). Moreover, the survey of institutional investor opinions by Coombes and Watson (2000) shows that governance is a significant factor in the investment decision. Institutional investors are reported to believe a well-governed firm should have a majority of independent TMT members and formal evaluation for directors. In a separate survey, Useem et al. (1993) find that TMT composition is critical to pension funds and investment managers, who appear to prefer TMTs with independent members and with members who have diversified skills and experience.

6. Conclusions and policy implications

This research studies the firms with university affiliation that have gained access to the public equity markets in Europe in recent years. The main contribution is to investigate the previously unaddressed issue of the valuation of university-based firms. To this extent, we adopt a market-based perspective by selecting a sample of European university-based firms that recently went public. Matching the sample with independent firms, it is found that on average university-based firms are less profitable at the listing. On the other hand, these firms are more innovative and the affiliation with a university, associated with more prestigious TMTs, is perceived by the market of investors as a signal of firm quality. The listing of university-based firms is indeed associated with higher valuations and lower uncertainty levels (proxied by underpricing).

However, despite the benefits yielded by university affiliation, we find that university-based firms do not out-perform independent companies in the long run. Three years after the IPO, stock market abnormal returns show that university-based firms do not register better performance than independent firms. Using a hierarchical regression analysis, we look for differences in the determinants of performance and find that the number of patents owned is positively related to performance for independent firms but not for university-based ones. It could be that managers of university-based firms are less focussed than their independent counterpart on assessing R&D project in order to select and finance only profitable ones. Therefore, more realistic valuation of intellectual property and of its marketability might improve the performance of university-based firms.

Variables of TMT composition and ownership in the two samples of firms also play different roles. The presence of independent members and VCs in the TMT is more important in enhancing the performance of university-based than independent firms. This may be viewed as a signal that TMTs of university-based firms need external help so as to be able to better carry out their Agency role. This evidence is of particular importance because the sample includes university-based firms that successfully survived the seed stage and went on to the IPO phase. Even at this advanced stage, beyond technical and intellectual capital, inter-personal and managerial skills still matter.

We argue that more attention should be devoted to the development of the business acumen and abilities of university-based firms, as skill in these areas is essential for

long-term success. It is recommended that universities and public research institutions, in developing firms to foster the technology transfer process, seek to form proper TMTs, able to translate innovation into performance gains. For this purpose, it is important to introduce business competencies into university-based firms, for example, by seeking links with others business actors.

On the whole the results presented in this paper show that the model of the entrepreneurial university has great promise and has become a critical vehicle driving European economies in the knowledge-based era. Along with considerations of technology transfer, university-based firms also represent a significant contribution made by high-profile companies to European economies and their financial markets. We find that 143 out of 1697 non-financial companies that went public in the UK, Germany, France, and Italy during the period 1995-2002 were university-based firms. This per se is a significant result. Moreover, these companies are distinguished by their greater propensity to innovation in terms of both inputs (R&D expenses) and outputs (patents). Their attitude toward the public equity markets is also encouraging. Indeed, their IPOs are characterized by a higher level of fresh capital raised and by a lower level of divestments compared to independent firms. Investors typically view these behaviors as signals of a firm commitment by TMT and extant shareholders. Capital raised at IPO serves as a springboard for university-based firms to implement new investments rather than as a divestment/diversification opportunity for existing shareholders, as sometimes happens to independent firms. The access to public equity markets would provide university-based firms with a means to overcoming borrowing constraints and accessing low cost direct financing. As the primary source of funds in the creation and seed stage of these firms (i.e. public grants) declines as these companies mature, their growth could otherwise be constrained by the scarce availability of internal finance and by the problems accessing VC funds. Indeed, in spite of their considerable knowledge potential, especially in the early stages, their access to venture capital does not yet assume large proportions. This may be due to a lack of the business orientation needed to attract early-stage financing by venture capitalists. Moreover, university-based firms may not be as profit-oriented as independent ones as the aims of academics when founding an enterprise may include objectives not entirely in line with maximizing the value of the firm, but rather driven by personal expectations of outcomes likely to enhance their academic prestige or to buy new infrastructure for their research activities. On the other hand, shortcomings could also be attributed to the venture capital market,

that still has difficulty understanding the complexities of universities and their differences from the traditional business environment. The best way to overcome the mismatch between demand and supply of venture capital is probably to enlarge their role as a source of financing and to include sourcing of managerial skills.

Finally, a parallel is found in the challenges involved in managing the vast potential of university-based firms on the one hand, and the dichotomy between innovation and financial capital on the other. Although more appealing from the point of view of innovation capacity, university-based firms face problems in sustaining their financial performance. The uncertainty surrounding real capacities of wealth generation through the commercialization of academic research is an issue under investigation and further studies are required in order to assess the relationship between innovation and valuation. Consequently, policy-makers should acknowledge that not all research programs can be economically profitable and, more importantly, that not all of them can be exploited using an entrepreneurial attitude. Once regarded by academia with misgivings, nowadays the concept of the entrepreneurial university is widely appreciated for its ability to improve knowledge transfer and for making universities more responsible for directly fostering the economy. As a result, pressuring academics to transfer their research into the marketplace is not enough for the solution necessarily requires a new sensitivity to the commercial realm that enables to identify the fields of research and the single projects viable of market exploitation. On basis of these premises, university-based firms need to assess the marketability of their business idea and the management skills of their top members. Following this, it should consider whether or not the team members can and want to develop these management abilities, so they need to decide whether to remain pure academics or to invest their time and effort in developing managerial skills, probably through specific training. Remembering that on a personal level prestigious research achievements do not necessarily fit with an inclination to doing business, it is concluded that university-based firms face a make-or-buy decision on management skills.

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References

- Audretsch, D.B., Lehmann, E.E., 2005. Does the Knowledge Spillover Theory of Entrepreneurship hold for regions? *Research Policy* 34, 1191-1202.
- Beasley, M.S., 1996. An Empirical Analysis of the Relation Between the Board of Director Composition and Financial Statement Fraud. *Accounting Review* 71, 443-465.
- Beaver, W., McNichols, M., F., Rhie, J., W., 2005. Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy. *Review of Accounting Studies* 10, 93-122.
- Berger, J., Balkwell, W., Zorman, R., Smith, R.F., 1992. Status Inconsistency in Task Situations: A Test of Four Status Processing Principles. *American Sociological Review* 57, 843-855.
- Cadbury, A., 1992. Report of the Committee on the Financial Aspects of Corporate Governance (Gee Publishing, London).
- Chin, C.L., Lee, P., Kleinman, G., 2006. IPO anomalies and innovation capital. *Review of Quantitative Financial Accounting* 27, 67-91.
- Clarysse, B., Wright, M., Lockett, A., Van de Velde, E., Vohora, A., 2005. Spinning off new ventures: a typology of incubation strategies from European Research Institutions. *Journal of Business Venturing* 20, 183-216.
- Cohen, W., Levinthal, D., 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* 35, 128-152.
- Colombo, M.G., Delmastro, M., 2002. How effective are technology incubators? Evidence from Italy. *Research Policy* 31, 1103-1122.
- Coombes, P., Watson, M., 2000. Three surveys on corporate governance. *McKinsey Quarterly* 4, 74-77.
- DiMaggio, P.J., Powell, W.W., 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review* 48, 147-160.
- Druilhe, C., Garnsey, E., 2004. Do Academics Spin-Outs Differ and Does it Matter?. *Journal of Technology Transfer* 29, 269-285.
- Ensley, M.D., Hmieleski, K.M., 2005. A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups. *Research Policy* 34, 1091-1105.
- Fama, E.F., French, K.R., 1998. Value versus growth: The international evidence. *Journal of Finance* 53, 1975-2000.
- Fama, E.F., Jensen, M.C. 1983. Separation of ownership and control. *Journal of Law and Economics* 26, 301-325.

- Fini, R., Grimaldi, R., Sobrero, M., 2006. Factors fostering academics to start up new ventures: an assessment of Italian founders' incentives. Paper presented at the 2006 Academy of Management Annual Meeting, TIM division, August 11-16, in Atlanta, Georgia.
- Geisler, E., Furino, A., Kiresuk, T.J., 1990. Factors in the success or failure of industry–university cooperative research centers. *Interfaces* 20, 99–109.
- George, G., Zahra, S.A., Wood, D.R., 2002. The effects of business-university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies. *Journal of Business Venturing* 17, 577–609.
- Geuna, A., Nesta, L.J.J., 2006. University patenting and its effects on academic research: The emerging European evidence. *Research Policy* 35, 790-807.
- Guo, R.J., Lev, B., Shi, C., 2006. Explaining the Short and Long-Term IPO Anomalies in the US by R&D. *Journal of Business Finance & Accounting* 33, 550–579.
- Hayton, J., C., 2005. Competing in the new economy: the effect of intellectual capital on corporate entrepreneurship in high-technology new ventures. *R&D Management* 35, 137-154.
- Henderson, R., Jaffe, A., Trajtenberg, M., 1998. University as a source of commercial technology: a detailed analysis of university patenting, 1965–1988. *The Review of Economics and Statistics* 80, 119–127.
- HM Treasury, 2003. Lambert Review of Business-University Collaboration (the Lambert Report).
- Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 4, 305–360.
- Landry, R., Amara, N., Rherrad, I., 2006. Why are some university researchers more likely to create spin-offs than others? Evidence from Canadian universities. *Research Policy* 35, 1599-1615.
- Lasfer, A.M., 2006. The Interrelationship between Managerial Ownership and Board Structure. *Journal of Business Finance & Accounting* 33, 1006-1033.
- Leland, H., Pyle, D., 1977. Informational asymmetries, Financial structure and Financial intermediations. *Journal of Finance* 32, 317-387.
- Lester, R.H., Certo, S.T., Dalton, C.M., Dalton, D.R., Cannella, A.A., 2006. Initial Public Offering Investor Valuations: An Examination of Top Management Team Prestige and Environmental Uncertainty. *Journal of Small Business Management* 44, 1–26.
- Lockett, A., Siegal, D., Wright, M., Ensley, M.D., 2005. The creation of spin-off firms at public research institutions: managerial and policy implications. *Research Policy* 34, 981–993.
- Loughran, T., Ritter, J.R., 1995. The New Issues Puzzle. *Journal of Finance*, 50, 23-51.
- MacLachlan, A., 1995. Trusting outsiders to do your research: how does industry learn to do it? *Research and Technology Management* 38, 48–53.
- Mian, S.A., 1996. Assessing value-added contributions of university technology business incubators to tenant firms. *Research Policy* 25, 325–335.
- Mian, S.A., 1997. Assessing and managing the university technology business incubator: an integrative framework. *Journal of Business Venturing* 2, 251–285.
- Morck, R., Shleifer, A., Vishny, R., 1988. Management ownership and market valuation: an empirical analysis. *Journal of Financial Economics* 20, 293–315.
- Mustar, P., Renault, M., Colombo, M.G., Piva, E., Fontes, M., Lockett, A., Wright, M., Clarysse, B., Maray, N., 2006. Conceptualising the heterogeneity of research-based spin-offs: A multi dimensional taxonomy. *Research Policy* 35, 289-308.

- O' Shea, R.P., Allen, J.T., Chevalier, A., Roche, F., 2005. Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities. *Research Policy* 34, 994-1009.
- Oliver, A.L., Liebeskind, J.P., 1998. Three levels of networking for sourcing intellectual capital in biotechnology: implications for studying interorganizational networks. *International Studies of Management and Organization* 27, 76-103.
- Pagano, M., Panetta, A., Zingales, L., 1998. Why Do Companies Go Public? An Empirical Analysis. *Journal of Finance*, 53, 27-64.
- Quintas, P., Wield, D., Massey, D., 1992. Academic-industry links and innovation: questioning the science park model. *Technovation* 12, 161-175.
- Ritter, J.R., 1991. The long-run performance of initial public offerings. *Journal of Finance*, 46, 3-27.
- Ritter, J.R., Welch, I., 2002. A Review of IPO Activity, Pricing and Allocations. *Journal of Finance* 57, 1795-1828.
- Rosenbaum, P., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70, 41-55.
- Rydqvist, K., Högholm, K., 1995. Going public in the 1980s: Evidence from Sweden. *European Financial Management* 1, 287-315.
- Sapsalis, E., Potterie, B.P., Navon, R., 2006. Academic versus industry patenting: An in depth analysis of what determines patent value. *Research Policy* 35, 1631-1645.
- Shane, S., 2004. Encouraging university entrepreneurship. The effect of the Bayh-Dole Act on university patenting in the United States. *Journal of Business Venturing* 19, 127-151.
- Siegel, D.S., Waldman, D., Link, A., 2003. Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research Policy* 32, 27-48.
- Slaughter, S., Leslie, L., 1999. *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*. Johns Hopkins, Baltimore.
- Smilor, R., Gill, M., 1986. *The New Business Incubator: Linking Talent, Technology, and Know-How*. Lexington Books, Lexington, MA.
- Smith, H.L., Ho, K., 2006. Measuring the performance of Oxford University, Oxford Brookes University and the government laboratories' spin-off companies. *Research Policy* 35, 1554-1568.
- Suchman, M.C., 1995. Managing Legitimacy: Strategic and Institutional Approaches. *Academy of Management Review* 20, 571-610.
- Teoh, S.H., Welch, I., Wong, T.J., 1998. Earnings management and the long-run market performance of initial public offerings. *Journal of Finance* 53, 1935-1974.
- Useem, M.E., Bowman, J.M., Irvine, C., 1993. US Institutional Investors Look at Corporate Governance in the 1990's. *European Management Journal* 2, 175-189.
- Weisbach, M.S., 1988. Outside Directors and CEO Turnover. *Journal of Financial Economics* 20, 431-460.
- Wernerfelt, B., 1984. A Resource-Based View of the Firm. *Strategic Management Journal* 5, 171-180.
- Wright, M., Lockett, A., Clarysse, B., Binks, M., 2006. University spin-out companies and venture capital. *Research Policy* 35, 481-501.

Table 1

The sample of 143 University-based firms

Country	%	Industry	%	IPO date	%	Age at IPO (years)	%
UK	44.06	Information Technology	41.26	1995-1996	11.19	Age < 5	25.08
Germany	42.66	Health, Pharmaceuticals & Biotechnology	33.57	1997-1998	11.19	5 < Age < 10	28.17
France	9.09	Media & Support Services	13.29	1999-2000	61.54	10 < Age < 15	27.77
Italy	4.20	Aerospace & Electronic Equipment	11.89	2001-2002	15.38	Age > 15	18.98

Table 2

University-based firms compared to independent firms

	University-based	Independent
Panel A: Characteristics and Operating performance		
Firm size (mean) ^a (market cap, €mln)	27.9	28.3
Firm age (mean) ^a (years)	9.7	10.4
Efficiency in the use of assets (median) ^b (%)	8.98***	15.16
Shareholders Profitability (median) ^b (%)	8.35***	17.27
Panel B: Innovative level		
Patents (mean) ^a (number)	34.51***	9.33
R&D Expenses / Sales (median) ^b (%)	19.86***	10.00
Panel C: Ownership structure		
Divestment at the IPO (mean) ^a (%)	19.34**	24.96
Fresh Capital Inflow at the IPO (mean) ^a (%)	25.37***	21.79
Pre-IPO stakes owned by substantial shareholders (mean) ^a (%)	68.88***	77.47
Pre-IPO stakes owned by TMT members (mean) ^a (%)	33.83**	42.31
Pre-IPO stakes owned by the CEO (mean) ^a (%)	22.25***	34.07
Panel D: Corporate governance		
TMT members (mean) ^a (number)	5.28***	4.54
Graduates (mean) ^a (% of the TMT)	90.26***	56.79
Independent director (mean) ^a (% of the TMT)	33.6***	25.06
Age of the CEO (mean) ^a (years)	46.55	45.08
Service as CEO (mean) ^a (years)	6.38	7.09
CEO = main shareholder (mean) ^c (% of the sample)	42.3*	54.37
CEO = founder (mean) ^c (% of the sample)	58.01	64.44
CEO external links (mean) ^a (number)	1.74**	1.38
Presence of Venture Capital (mean) ^c (% of the sample)	71.33*	79.72

^a *t*-Test of equal means;^b Mann-Whitney Test of equal medians;^c Test of equal proportions;

*** 1% significance level;

** 5% significance level;

* 10% significance level.

Table 3

Market valuation

	University-based	Independent
	<i>Market-to-Book</i>	
Mean ^a	3.98**	3.24
Median ^b	3.05***	2.46
	<i>Underpricing (%)</i>	
Mean ^a	31.33**	48.39
Median ^b	7.11**	19.98

^a *t*-Test of equal means;^b Mann-Whitney Test of equal medians;

*** 1% significance level;

** 5% significance level;

* 10% significance level.

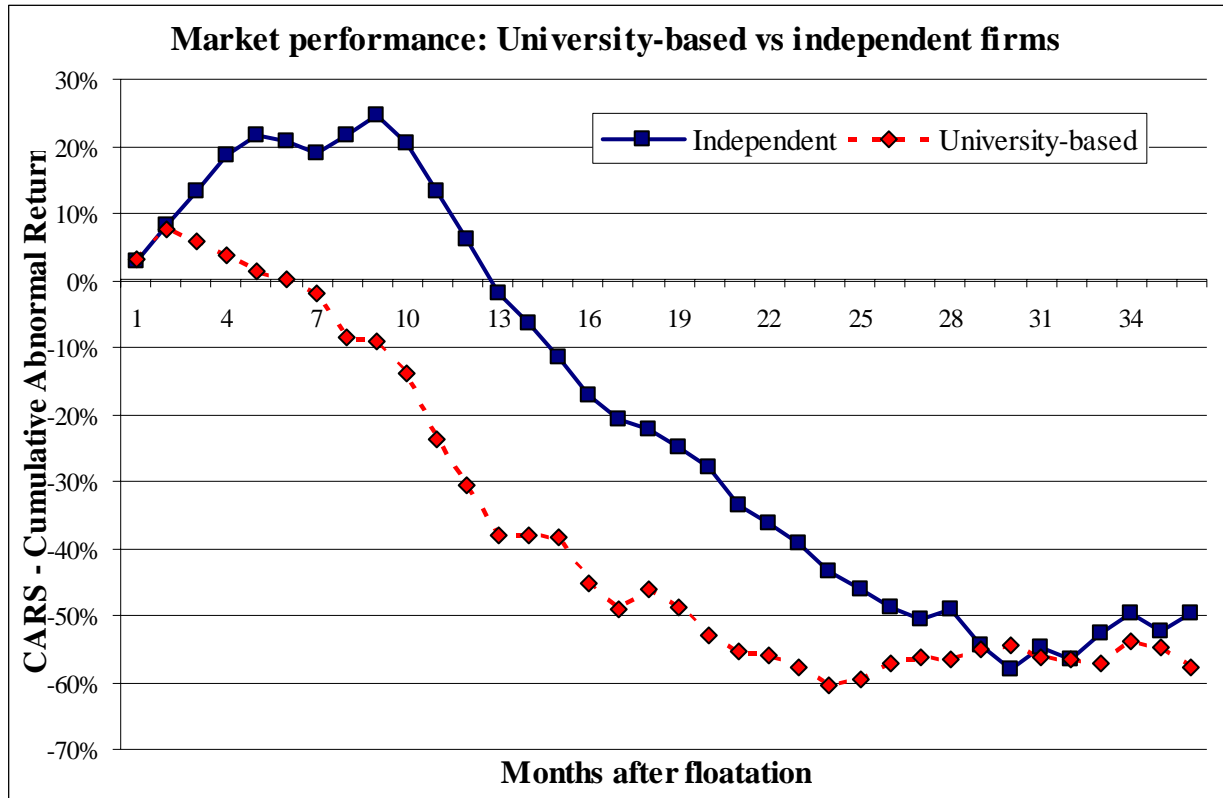


Fig. 1. Post-IPO performance of University-based and independent firms

Table 4

Hierarchical regression of the determinants of firms' performance, measured by post-IPO CARs (Cumulative Abnormal Returns)

University-based				
Variables ^b	Model 1	Model 2	Model 3	Model 4
<i>Firm Characteristics</i>				
Size	-0.08	-0.08	-0.10	-0.07
Age	-0.27*	-0.33	-0.19	-0.34
Profitability	0.23	0.09	0.15	0.16
<i>Market valuation</i>				
Underpricing	-1.63***	-1.53***	-1.17***	-1.19***
Price to Book	-0.26**	-0.28**	-0.25**	-0.24*
<i>Innovative Level</i>				
Patents		0.11	0.03	0.05
<i>TMT Composition</i>				
Agency			0.52***	0.41***
Advisory			1.01**	0.59**
<i>TMT Ownership</i>				
Own				-3.89
Own2				9.91
Own3				-6.95
<i>Intercept</i>	2.39*	2.55*	1.61	1.88
R ² % ^a	25.74***	27.38***	35.50***	38.19***
Independent				
Variables ^b	Model 1	Model 2	Model 3	Model 4
<i>Firm Characteristics</i>				
Size	-0.09	-0.12	-0.13	-0.09
Age	-0.33	-0.34*	-0.38	-0.43*
Profitability	0.15	0.21	0.23	0.07
<i>Market valuation</i>				
Underpricing	-1.49***	-1.57***	-1.43***	-1.55***
Price to Book	-0.21	-0.23	-0.35*	-0.42*
<i>Innovative Level</i>				
Patents		0.26***	0.25***	0.24**
<i>TMT Composition</i>				
Agency			0.32*	0.34
Advisory			-0.11	-0.02
<i>TMT Ownership</i>				
Own				5.43***
Own2				-15.16***
Own3				10.67***
<i>Intercept</i>	2.61	3.31*	3.58*	2.66
R ² % ^a	22.64***	31.81***	33.57***	45.25***

^a F-Test for significance of the regression;

^b *t*-Test for significance of the regressors;

*** 1% significance level;

** 5% significance level;

* 10% significance level.

Table 5

Correlation matrix

University-based	1	2	3	4	5	6	7	8
1. Size								
2. Age	0.21**							
3. Profitability	0.07	0.22**						
4. Underpricing	0.01	0.13	0.14					
5. Price to Book	0.09	-0.21**	0.03	0.07				
6. Patents	0.31***	0.09	-0.15	0.01	0.03			
7. Agency	0.01	-0.06	-0.11	-0.14	-0.13	0.24***		
8. Advisory	0.19**	-0.14	-0.19	-0.04	0.02	0.01	-0.33***	
9. TMT Ownership	-0.12	-0.12	0.08	0.01	0.16	-0.23**	-0.27***	0.14
Independent	1	2	3	4	5	6	7	8
1. Size								
2. Age	0.03							
3. Profitability	-0.02	0.32***						
4. Underpricing	0.19**	-0.12	-0.08					
5. Price to Book	0.16	0.12	0.08	-0.11				
6. Patents	0.16*	0.06	-0.12	0.10	0.05			
7. Agency	-0.31***	0.04	0.07	-0.27***	0.06	0.01		
8. Advisory	0.16*	-0.23	0.02	-0.05	0.11	0.15	-0.06	
9. TMT Ownership	0.21**	0.05	0.07	0.02	-0.03	0.01	-0.24***	-0.05

*** 1% significance level;

** 5% significance level;

* 10% significance level.

¹ Thanks to the new and second-tier markets, the nature of the companies going public is rapidly changed in the last decade, with more small and medium companies going public. For instance, the average size is diminished, with an average sales of only 27 €mln in the year prior to the IPO on second markets in 2006. Source: Academic EurIPO Fact Book 2007 (the second markets are the AIM in the UK, Freiverkehr Markt in Germany, Alternext and Marché Libre in France, Expandi in Italy).

² In particular, the incentive for universities to extend their focus from basic research to commercialization is related to favourable legislation (e.g. Bayh-Dole Act of 1980 in the U.S.) that decreases the uncertainty associated with the commercialization of government funded research (Shane, 2004) and facilitates technological diffusion from universities to firms.

³ Although the study is very exhaustive in terms of innovative activity comparison, the only measure of financial performance considered is net sales over total asset.

⁴ Ensley and Hmieleski (2005, p. 1092) state that ‘most studies of affiliation between universities and high-technology start-ups have been primarily descriptive and lacking of theoretical and/or methodological grounding. Over the last 25 years we simply have not had enough empirical research directly comparing equivalently matched groups of high-technology university-based and independent start-ups in order to draw definitive conclusions’.

⁵ Even when TMT members have the correct incentives and the power to implement their decisions, they may take good or bad decisions because they differ in their capabilities. This is particularly true for high-tech start-ups companies, whose competitive advantage largely comes from non-physical assets including human capital, ideas and intellectual property rights (Audretsch and Lehmann, 2005).

⁶ The EURIPO database is developed by Universoft, a spin-off of the University of Bergamo (www.euripo.eu). It contains data on more than 4 000 companies that went public through IPO on a European stock exchange during the period 1985-2006. Specific data about the firms was collected from the IPO prospectuses and annual reports. The dataset combines information of different kinds, such as accounting data and information on the structure of the offer, ownership structure, post-IPO performance, corporate governance, human capital, and intellectual property rights.

⁷ Our definition of University-based firms is taken from Ensley and Hmieleski (2005). Similarly, Druilhe and Garnsey (2004, p. 274) define university spin-offs as 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’. Also Smith and Ho (2006, p. 1560) take the same approach to defining university spin-offs.

⁸ Source: Academic EurIPO Fact Book 2007; data from Eurostat and FESE (Federation of European Stock Exchanges).

⁹ Industries are defined according to the International Classification Benchmark (ICB) which covers over 50 000 companies around the world.

¹⁰ Firms may indeed time their IPO in order to take advantage of ‘windows of opportunity’ i.e. periods of market buoyancy during which companies have an incentive to issue new shares based on an over-valuation of other companies in their industry (Loughran and Ritter, 1995).

¹¹ The success of the matching strategy is investigated by inspecting the distribution of the propensity score in the university-based and matched comparison groups and comparing summary statistics of matching variables between the two groups.

¹² Underpricing is a common occurrence for firms undertaking an IPO. A review of the international literature on IPO underpricing is provided by Ritter and Welch (2002).

¹³ In agreement with the literature (Ritter, 1991 and subsequent papers), we refer to a 3-year post-IPO horizon. A month is defined as a 21 trading day interval and the first 21 trading days after the IPO date are excluded to avoid a potential bias from the price stabilization of underwriter banks during the period.

¹⁴ The existence of differences is verified through the use of T, Mann-Whitney and Z tests.

¹⁵ Accounting data are hand-collected from IPO prospectuses, while the number of registered patents was obtained from the European Patent Office.

¹⁶ When a company goes public it can choose to place existing shares and/or issue new shares. By offering existing shares, the company launching the IPO raises no fresh capital as this simply records a change in its ownership structure. On the other hand, the offering of newly issued shares raises funds for the company. In Table 2, the variable Divestment at the IPO measures the percentage of the IPO offering composed of existing shares placed, while the Fresh Capital Inflow is the ratio between the number of newly issued shares and the total number of shares outstanding after the IPO. Using these measures of the structure of the IPO, it can be assessed whether the floatation is used to finance companies or if on the other hand it represents a divestment opportunity for existing shareholders.

¹⁷ The information on ownership interests contained in the IPO prospectuses, as well as in annual reports, is determined by the national securities commissions for each country. In particular, details of directors’ interests and external interests which amounted to at least 2 or 3% (depending on the country) of issued share capital are required to be disclosed. Substantial shareholders are identified by these cut-off ownership levels for mandatory disclosures required by the national laws.

¹⁸ No substantial differences are found between the two samples in terms of age of the CEO, in terms of proportion of companies where the CEO is also the founder, and in terms of years of service as CEO.

¹⁹ There are several ways in which managers can ‘window dress’ the pre-IPO performance of a firm. They can ‘borrow’ earnings from other periods (e.g. deferring R&D expenditures), capitalize rather than expense current costs, allocate costs over longer periods (e.g. straight-line rather than accelerated depreciation) or slow down earnings growth in the years before the IPO.

²⁰ When identifying the explanatory variables, we checked for absence of correlation. The correlation matrix is presented in Table 5.

²¹ The presence of venture capitalists is included in the TMT composition analysis because this variable is positively related to the percentage of independent members. Indeed, VCs can introduce the managerial skills needed to accomplish the monitoring function in the TMT.

²² This measure includes ownership by TMT members via corporate vehicles (e.g. where TMT members are majority shareholders in other firms which have direct ownership stakes in the particular firm under consideration). This definition is consistent with previous studies on corporate governance (see, for example, Morck et al., 1988).

²³ In agreement, the level of TMT ownership is lower in university-based firms than in their independent counterparts (see Table 3).

²⁴ Many surveys have documented that independent TMT members are able to reduce financial fraud and improve quality of accounting information. For example, they are found to play an important role in CEO dismissal (Weisbach, 1988), and firms with high TMT composition are less likely to suffer from financial statement fraud (Beasley, 1996). Moreover, the survey of institutional investor opinions by Coombes and Watson (2000) shows that governance is a significant factor in the investment decision. Institutional investors are reported to believe a well-governed firm should have a majority of independent TMT members and formal evaluation for directors. In a separate survey, Useem et al. (1993) find that TMT composition is critical to pension funds and investment managers, who appear to prefer TMTs with independent members and with members who have diversified skills and experience.
