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Science-based legitimacy: the value relevance of interacting signals for young firms

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Science-based legitimacy: the value relevance of interacting signals for young firms

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Abstract

This paper contributes to the literature on the legitimization of science-based firms, by investigating whether the affiliation by with prestigious universities affect their valuation at IPO, and how it interacts of the endorsements by prestigious underwriters and venture capitalists. Based on a sample of 254 European biotech firms, we find that scientific legitimization is valued by investors, and this is particularly true when the company is tied to a prestigious academic entity. We confirm previous results on the relevance of the certification provided by top-tier underwriters and venture capitalists. However, taking into considerations their interactions, we find that signal provided by venture capitalists shades, as it is moderated by its overlapping with the endorsements by reputable underwriters and universities. We argue that underwriters provide the strongest certification role due to positive selection, while universities bring the strongest certification of substantive business benefits. Venture capitalists mix these two roles.

1. Introduction

The information gap between the founders of a high-tech start-up and external investors is likely to be extraordinarily large. As a consequence, these firms face significant challenges gaining the attention of potential investors and, to some extent, the matter is conveying the right signals to potential financiers the quality of the firm. Such signaling challenge reaches its peak with the decision to go public, that assures financial means, but involves the convincement of the investment community that the firm has a long-term potential.

Scholars have identified a variety of internal and external signals of firm quality as a means to reduce uncertainties when valuing these new issues. In particular, researchers have documented the role of third-party endorsements as certification mechanisms. First, Beatty & Ritter (1986) and Carter & Manaster (1990) have documented the importance of highly reputable underwriters. The underline conjecture is that prestigious (repeated) players value their status highly and will guard carefully against tarnishing it. Hiring top investment banks as underwriters creates a perception in the market that the IPO firm must be of good quality, as top-tier financial intermediaries are expected to sign on to those deals they see as most likely to reinforce their reputation. The second certification mechanism which has been the subject of numerous studies is venture capital affiliation (Barry et al, 1990; Megginson & Weiss, 1991). The signal provided by VCs is partly similar to that of underwriters, in that more reputable VCs will be associated with firms of higher quality on the base of a positive selection. The certification provided by these two typologies of financial actors is therefore, to some extent, a subsititute and a complement. However, the function of VCs is not as 'event-based' (i.e. centred on the IPO) as it is that of underwriters. While the latter serve primarily a certification function, aiding a firm in capitalizing on the resources it has accumulated, venture capitalists contribute also with substantive resources, in the form of financial and relational capital and of managerial capacities (MacMillan et al. 1989; Sapienza 1992; Sapienza et al. 1996; Zahra et

al. 2007). Ongoing, they fulfil a monitoring role on which other investors may free ride. Due to their positive selection (cherry picking) and resources they bring to the invested firms (frog-kissing), venture-backing is expected to be recognized as a quality signal by 'subsequent' investors (Bertoni et al., 2010).

Prestigious venture capitalists are expected to have superior abilities to make judgments about the firms with which they affiliate. They presumably have achieved their prestige through a sustained series of decisions, and their affiliation with a particular IPO firm represents one more such decision. This certification is particularly crucial for science-based firms going public, given the tremendous uncertainty associated with their quality. In particular, the future prospects of newly public science-based firms is based not only on the availability of financial capital, but also on intellectual capital related to the creation and management of innovations. Accordingly, we posit that external investors look for signals of scientific and technological legitimacy when valuing science-based firms. Such signals can take various forms. Among biotech IPOs, Higgins & Gulati (2006) find that the presence of employment affiliations with prominent pharmaceutical companies is a signal that attracts new investors, while Higgins et al. (2011) show that the proceeds raised at the IPO are related to the reputations of university scientists affiliated with the firm. We focus on the scientific endorsement provided by the affiliation with a prestigious university. The entrepreneurship literature shows that university-based firms distinguish themselves in terms of their financial, physical, human and organizational resources, partly obtained through their affiliation (Quintas et al., 1992). They also enjoy some insulation from the competition at start-up, while deriving legitimacy from their association with a university-based technology (Markman et al., 2005). These factors, among others, can enhance the confidence of potential external stakeholders. Our view is that observers perceive university affiliation as a signal that the firm has access to scientific predispositions and resources. Thereby, we posit that the affiliation with a prestigious university eases investors' concerns over legitimacy and improves the attractiveness of the firm. This, in turn, enhances its valuation.

In this paper, we investigate the effect on the valuation of IPOs of the three kind of affiliations with have mentioned, namely prestigious underwriters, venture capitalists, and university. These different signals do no act independently, as they concur to endorse the quality of the firm to the same addresses, the market of investors. We therefore pay attention to their interaction. In this, our study is strictly related to the contribute by Pollock et al. (2010), who first investigate the interaction of signals in the IPO context. The hypothesis is that multiple endorsements by different affiliates are redundant in signalling the quality of a firm. First, there is also a finite amount of uncertainty that their certification can reduce (Pollock & Rindova, 2003). As certifications mechanisms accumulate, each subsequent signal will have less impact than prior signals. "The basic logic of (and even the term) certification, clearly suggests that multiple endorsements by prestigious actors will be somewhat redundant and thus will yield declining marginal benefits" (Pollock et al., 2010, p. 9). Second, signals to some extent overlap. Underwriters and venture capitalists share the certification role due to their reputational capital that is put in place as financial actors. Whereas, partly similar substantive business benefits are expected from the affiliation with high ranked venture capitalists and universities. Our results, based on a sample of 254 biotech IPOs in Europe, provide evidence that multiple prestigious affiliates operate in an additive and/or substitutive manner in affecting investors' valuations. Taken singularly, the signal provided by the affiliation with a top-tier underwriter, venture capitalist, or university enhance the valuation of the firm. Taking into considerations the interactions of signal, we find that signal provided by venture capitalists shades, as it is moderated by its overlapping with the endorsements by reputable underwriters and universities. We argue that underwriters provide the strongest certification role due to positive selection, while universities bring the strongest certification of substantive business benefits. Venture capitalists mix this two roles.

2. Theoretical Background

The existence of asymmetric information in capital markets means that financial institutions might not adequately assess their investment projects. This effect is most important in the case of small and innovative businesses, owing to a lack of reliable information about their real status and performance (Canovas & Solano, 2007). Providing convincing signals about the quality of the innovation project is indeed costly and sometimes leads to market failure, due to the lemon's problem (Akerlof, 1970; Spence, 1974; Stiglitz, 2000). Nevertheless, access to financing is a key determinant of growth in any new technology-based firm (Wright et al., 2006). The debate over financing is centered on understanding, evaluating and improving the external funding environment confronting innovative start-ups, in the absence of sufficient internally generated cash flows. Many discussions have revolved around the unsuitability of debt for early-stage financing (Stiglitz & Weiss, 1981): debt holders bear the downside risk, but do not share the upside of successful innovation (Berger & Udell, 1998). Prospects for contractual funding, such as securing collateral loans against appropriate assets, are severely limited for science-based firms since most of their resources are intangible and tend to have limited salvage value because of their highly specific nature (Hubbard, 1998). Thus, science-based firms should seek external equity investors willing to bet on future value creation opportunities (Carpenter & Petersen, 2002) . Both private (e.g. venture capital) and public (stock exchanges) equity are possible. These are indeed strictly interconnected, as venture capitalists are more likely to invest when there is an active equity market which permits them to exit by selling their shares (Black & Gilson, 1998). As such, many public policies (especially in the EU) have adopted the explicit goal of developing risk capital markets capable of sustaining entrepreneurship and facilitating the expansion of existing small firms. Accordingly, several stock exchanges have set up market segments dedicated to small firms, with lower listing barriers. In the last decade almost every European country has launched an alternative second-tier

market, thereby at least partially fulfilling the aforementioned EU goal (Paleari et al., 2010). This development has created a favorable setting for science-based firms to attract investment through IPOs.

2.1 Signaling quality in science-based IPOs

The theoretical foundation of our research is rooted in the signaling theory (e.g., Bhattacharya, 1979; Ross, 1977), due to it being premised on the need to specifically resolve information asymmetry (Spence, 1973). In the IPO market, investors are assumed incapable to discern the quality of the firms going public. If no signal is sent to them, asymmetric information will result in adverse selection and lead to market failure, due to the lemon's problem (Akerlof, 1970; Stiglitz, 2000). Clearly, to be reliable, a signal of quality must be too costly to be imitated by 'bad companies'. Prior research at the organization level has considered a wide variety of characteristics that can serve as informative signals in markets laden with uncertainty, in particular focusing on how specific signals can reduce uncertainty about a firm's quality and future prospects in the eyes of key stakeholders (Sanders & Boivie, 2004). These signals include corporate governance characteristics (Certo et al., 2003; Meoli et al., 2008), upper echelon prestige (Higgings & Gulati, 2006; Pollock & Gulati, 2007), founder presence, celebrity endorsements, certification contests and, of course, affiliation with prominent financial actors such as underwriters (Carter & Manaster, 1990) and/or venture capitalists (Megginson & Weiss, 1991; Gompers, 1996). More recently, this research stream has expanded to consider signals specific to science-based firms. For example, significant benefits accrue from endorsements that provide strong evidence for technological legitimacy. Higgins & Gulati (2003) identify technological partnerships as a signal of legitimacy and predictor of IPO success. In the biotech industry, Higgins & Gulati (2006) find that employment affiliations with prominent pharmaceutical companies also help firms attract new investors. Pollock & Gulati (2007) find that the recognition of technological alliance

partners helps IT companies gain access to post-IPO strategic opportunities. Chen et al. (2008) find evidence of a "dressing-up" behavior where firms hire prestigious executives in the final year prior to IPO. Following this line of research, our paper contributes by investigating whether academic affiliation affects investor valuations of firms going public.

2.2 Valuing biotech firms

The empirical setting of this paper is based on a specific industry, biotechnology, which is often considered the 'most intensively science-based' industry (Phlippen & van der Knaap 2007). This sector encompasses a collection of techniques that use living cells or their processes to solve problems and to perform specific industrial or manufacturing processes. As for that, biotechnology is not a separate science but rather a mix of disciplines transmuted into productive processes by coupling with such practical disciplines as chemical engineering, information technology, and robotics (Doyle & Persley, 1996). Such a multidisciplinary poses real challenges to the task of valuation by requiring to combine insights from finance to technology management. This is sector is therefore appealing also because it links up scientific discovery and economic valorization of science and several studies in the domain of technology transfer have already used this empirical setting (e.g. Shane & Stuart, 2002; Higgins & Gulati, 2006; Higgins et al., 2008; Zhang, 2009). There are several other motivations of interest. Biotechnology is one of the high tech industries whose development is largely based on the creation of research-intensive small and medium enterprises. SMEs are a leading force in a science push context, while the role of large firms is mainly to integrate new discoveries into their products after they have been developed by SMEs (Mangematin et al., 2003). The role of universities and public research organizations is also particularly relevant in this industry, given the great difficulties faced by entrepreneurs in starting business without this liaison. Bonardo et al. (2011) find that 40 percent of the university

spin-offs that reached the IPO were biotech. To this extent, our study aims to relate two critical resources for these firms: access to scientific competencies and access to capital markets. Many studies on new entrepreneurial biotech firms are addressed mainly to the situation in the United States and neglected developments in other countries. Biotechnologies were actually started in the US, that are still by far the largest nation. However, Europe is catching up. Despite being a latecomer to bio-entrepreneurship and continuing to lag behind in absolute terms, today Europe has more biotech firms than the US. It is therefore of primary interest to investigate the valuation of biotech firms in a context with a more difficult access to seed or venture capital (Senker, 1998). Moreover, the prototypical biotech firm is created relying on optimistic forecasts of a promising scientific breakthrough to convince capital investors to fund their technological developments. In the early stages of life, the firm's capital needs may be met by venture capitalists or parent pharmaceutical companies. However, capital needs are deemed to become large to face high R&D expenses so they can only be satisfied via an IPO or a buyout by a large pharmaceutical company. As a result, successful biotech firms tend to go public fairly quickly, and by the time when they reach the market, they do not have significant records to show (Meoli et al., 2012). They are usually sustaining significant accounting losses, have very few tangible assets, and may be years away from any significant revenue stream. In the end, positioning a small biotech firm to go public is a major task.

3. Hypotheses

3.1 Affiliation with universities

The first signal we focus on is the affiliation with a university. Given the benefit a firms can obtain from affiliation with a university, we posit that such affiliation thereby eases investors' concerns over scientific legitimacy and improves the attractiveness of the firm. Further, we expect investors to rely more

on this signal either when it involves the university maintaining an equity position in the firm, or when the linked university is prestigious. These hypotheses are formalized below.

Hypothesis 1a: The affiliation with a university enhances the valuation of a company going public.

Hypothesis 1b: The investment of a university in the ownership of a firm going public is a signal that increases the valuation of the firm.

Hypothesis 1c: The higher is the prestige of the university tied with the firm, the higher is the valuation of the firm.

3.2 Venture capital backing

The backing of a prestigious VC has been well studied as a signal of the quality of the invested firm (Gompers, 1996; Higgins & Gulati, 2003; Lee & Wahal, 2004). The willingness of a prestigious VC to back a young firm with its reputation and capital clearly serves an endorsement function, suggesting that the young firm has good potential. But VC involvement with a young firm can also provide a host of substantive business benefits beyond infusions of capital, including access to the VC's social networks, advice and expertise in strategic planning, and assistance in recruiting experienced managers and prestigious underwriters (Bygrave & Timmons, 1992; Gompers & Lerner, 2004; Jain & Kini, 2000; Sahlman, 1990). In particular, the expectation that prestigious VCs will provide substantive enhancements to a young firm has been used to justify the value of VC backing generally (e.g., Megginson & Weiss, 1991). Most of the substantive resources that VCs provide help get a firm to the stage where it is ready to go public. Once the IPO occurs, VCs scale back their involvement and harvest their investments (Gompers & Lerner, 2004). Finally, venture capitalists frequently cooperate by syndicating investments and thereby jointly provide resources, including financial resources, to their portfolio companies. It is estimated that approximately 40% to 50% of all European venture capital

investments are syndicated (Wright & Lockett 2003). One of the main reasons to syndicate an investment, next to the ability to provide larger amounts of funding, is the potential to access the resource base of all partners in the syndicate (Manigart et al. 2006; De Clercq & Dimov 2008; Verwaal et al. 2010). We hence expect larger syndicates to lead to a stronger development of the portfolio company.

Hypothesis 2a: Venture capital backing is positively related to IPO valuations.

Hypothesis 2b: The size of the syndacate of venture capitals will be positively related to the valuation of the venture-backed IPO.

Hypothesis 2c: The presence of prestigious venture capital firm affiliated with an IPO will have a positive marginal effect on the IPO valuation.

3.3 Prestigious underwriters

Research has amply shown that the involvement of a prestigious lead underwriter reduces investor perceptions of uncertainty, thereby increasing the amount investors are willing to pay for an IPO's stock (e.g., Carter et al., 1998; Higgins & Gulati, 2003; Pollock, 2004; Stuart et al., 1999; see also Ritter & Welch, 2002, for an extensive review). Beyond this certification function, however, prestigious underwriters also offer some post-IPO substantive benefits. They may have prominent analysts who will cover the firm (Krigman et al., 2001); through their own holdings they can stabilize post-IPO stock prices (Ellis et al., 2000); they can place shares with investors who are less likely to quickly trade the stock, thereby creating a more stable investor network for the newly public firm (Carter & Dark, 1993; Fischer & Pollock, 2004); and they make their services available to help secure post-IPO financing (Jegadeesh et al., 1993). In sum, prestigious underwriters play primarily a certification role, but they also provide some substantive benefits to IPO firms. It is important to note that all prior research has focused primarily on the lead underwriter managing an

offering; thus, any implications of involving additional prestigious underwriters as co-managers have been largely overlooked. While the lead underwriter plays a central role in the IPO process (Pollock et al., 2004), co-managers also play an important role through their distribution of significant proportions of the shares; and they are prominently indicated on an IPO's prospectus. Investment banks may be given a co-manager role because of their prestige, because they employ a prominent analyst who will cover the IPO firm (Gutterman, 1991; Krigman et al., 2001), and/or because they have the resources to help support the stock following the IPO (Ellis et al., 2000). Thus the prestige of both the lead underwriter and any co-managing underwriters can provide informative signals to investors.

Hypothesis 3 naturally follows:

Hypothesis 3: The prestige of the underwriter of an IPO is positively associated with its valuation.

4. Research design and Methodology

4.1 Sample

In the last two decades, the launch of second-tier markets in every European country has, at least in part, fulfilled the aim of providing small firms in high-tech sectors with the means to finance growth (Vismara et al., 2011). The availability of these markets provides the ideal setting for investigating the final stage of the technology transfer process, with research-based spin-offs prone to go public (Shane, 2004). The company's primary tool for communicating information at this stage is the offering prospectus. Potential investors carefully scrutinize these documents to assess the prospects of an equity position. As such, this study relies on information in the offering prospectus to determine a firm's affiliation. In particular, companies going public are required to describe their history and to report the curriculum vitae of their board and TMT members (upper echelon, Higgins & Gulati, 2006). We refer to these section to distinguish the affiliation of

the firms between universities, which are defined as companies that were either developed by faculty members based on their own research or created specifically to capitalize on academic research. This definition is in keeping with the literature (Shane & Stuart, 2002; Shane, 2004; Lockett et al., 2005; Rothaermel et al., 2007; O'Shea et al., 2008; Colombo et al., 2010). Similarly, the affiliation with PROs is identified referring to affiliations to hospitals or government-based institutions such as the National Science Foundation. The affiliation with large established firms is identified as corporate spin-off. In this paper, we analyze the biotech firms that went public in Europe in the period from 1995 to 2008. The list of IPO firms is from the EURIPO database that provides prospectuses and other detailed information on all companies that have recently gone public in Europe (see Cogliati et al. (2011) for a description of the database). Based on these data, our sample is made of 254 biotech companies that went public in Europe in the period 1990-2008. Though firms in our sample are all biotechnology firms, they compete in different niches within this industry. To account for sectoral differences, we included indicator variables representing participation in various segments of biotechnology. Following Stuart et al. (1999), we included four categorical variables to indicate whether the start-up firm operated in any of the four segments: Immunology, Diagnostic, Genetics and protein engineering, Investigation new drug. Moreover, we added two categories dedicated to Instruments and Services.

4.2 Dependent variable

Our empirical analysis aims to investigate the determinants of the market initial valuation of university-based companies, relying upon perceived value by investors measured as Tobin's Q. These measures are robust indicators of the perceived future value of the firm. Indeed, economic theory assumes that the difference between market value and book value is the present value of a company's future abnormal earnings, the latter resulting from either monopoly

power or innovation (Cassia and Vismara, 2009). We use OLS regression to model the effects of university affiliation on initial market valuation.

4.3 Independent variables

All our analyses rely on set of explanatory variables related to the quality signals, and a wide set of controls. The most important theoretical variables refer to the quality signals. There are variables measuring the presence of signals (University Affiliation, Venture Capital Backing, and Corporate Venture Capital Backing), the strength of the signal (Strong University Affiliation, Strong Venture Capital Backing) and their prestige (Prestigious University Affiliation, Prestigious Venture Capital Affiliation and Prestigious Underwriter). In particular we define the three following variables to measure for the prestige of the affiliations. PRESTIGE-UNI [0,1] measures the prestige of the university to whom a firm is affiliated: the ranking is based each year on the Times Higher Education Supplement (THES) worldwide university ranking (the publication started in 2004; we use the 2004 ranking for the university-affiliated IPOs in previous years). Each university has been scored as $(\text{ranking})^{-1}$, so that the score has a maximum value of 1 for the University of Cambridge. As far as the Venture Capitalist affiliation is concerned, we define a variable PRESTIGE-VC [0,1]: The ranking is based on the number of companies in our IPO sample backed by a certain Venture Capitalist, scaled by the maximum value (3i Plc). When an IPO is backed by several VCs, the average score applies. Third, with regards to the underwriter, we define PRESTIGE-UW [0,1]: The ranking is based on the money raised by a certain underwriter in taking public the company in our IPO sample, scaled by the maximum value (Morgan Stanley).

4.4 Selection bias and Prone to IPO instrument

Because not all firms go public, studying only IPO firms may introduce a "success" bias that could influence our results (e.g., Higgins & Gulati, 2003; Stuart et al.,1999). To address this possibility, we included a selectivity instrument as a control. Following prior research on IPOs (Higgins & Gulati, 2003; Stuart et al., 1999), we employed the Heckman procedure (Heckman, 1979) to create the instrument. First, we collected data on a random sample of 254 private biotech firms that did not go public between 1995 and 2007, but were similar to the companies in our sample according to nearest-neighbor propensity scores based on size and age (Dehejia & Wahba, 2002). Thus, all of these firms were "at risk" of going public during our period of study. We obtained information about each private firm's founding year, revenues, and number of employees from the Bureau van Dijk's Amadeus database. We combined these data with similar data on our IPO firms and then used a probit regression to predict whether a firm went public during 1995–2007. Each of the predictor variables was strongly associated with the likelihood of going public. This regression was then used to create the selectivity instrument that was included among the baseline regressors in our regression models (Higgins & Gulati, 2003).

4.5 Control variables

As far as controls are concerned, they are grouped into four categories : (1) general characteristics of the firm and of its offer, (2) innovation variables, (3) upper echelons, (4) inter-firm relationships. The first set includes control variables that could influence our dependent variables: firm characteristics at the IPO (Khurshed et al., 2005); dummy variables for the industry, country and year; characteristics of the initial offer (relative size and structure); the prone to IPO instrument presented above. The effects of innovation variables, the third category, are quantified using measures of input, such as the R&D investment;

and measures of output, such as the number of patents held; the number of products already sold; the presence of specific anti cancer products. The third and fourth groups refer to specific qualities and roles of the member of the upper echelon (UE), namely the combination of the top management team and non-executive directors. The third set of variables measures the advisory role of the upper echelon, proxied by the proportion of directors with MBA or Ph.D. degrees, by a dummy variable controlling for co-operations with Nobel prize winners; by an index of experience for the members of the upper echelon we created by averaging the proportions of UE members with previous employment at: 1) companies in the same industry or sector; 2) research and development institutions such as prestigious universities or government-based institutions; 3) companies that are one step closer in the business cycle to bringing a young firm's products to market; 4) banks or other financial entities. The last group of variables controls for the agency role of UE, proxied by the size of the UE, the proportion of independent directors in the UE, and by two control variables controlling for the cases when the CEO is also the chairman or the founder of the company (Bonardo et al., 2010).

4.6 Sample description

This sample of companies, classified according to the different forms of signals, and disaggregated by country, age and year of IPO, is described in Table 1. In Table 2 we report the descriptive statistics, calculated on the full sample, and on the sub-sample of companies affiliated to universities, with reference to all variables employed in the following empirical analysis. By looking at Tobin's Q, we notice how affiliated firms are more valued than the average at the time of their IPO.

5. Empirical results

In this section. we report the result of our empirical validation of the research hypotheses introduced above. In the Table 3 we report the results obtained by regressing the Tobin's Q, at the time of the IPO, for our sample set of biotech companies. In particular, we present here four models: in the first model (Model 1) we test for the role of the university affiliation signals, in model (2) we control for the role of VC backing, in model (3) we analyse the role of the underwriter prestige, and in model (4) we include all prestige signals, and study their interaction.

By analyzing in model (1) the university affiliation signals, we find evidence of a significant effect of university prestige. This result provides support for hypotheses 1c. In model (2) we present results on the VC backing. Again, when presence, strength and prestige of the signal are tested jointly, the evidence supports the idea that only experienced and prestigious VCs provide an effective value signal, as a support to hypothesis 2c. Model (3) provides evidence on the positive value effect of prestigious underwriters, supporting hypothesis 3. We conclude the analysis on the Tobin's Q by testing together the effects of university affiliation, VC backing and underwriter prestige. Our results, reported in Model (4), support the idea that all prestige signals are significant, although the moderating terms show that financial signals are overlapping, as their joint presence is characterized by a negative sign.

6. Conclusions

This paper examined a sample of biotech firms that went public in Europe between 1995 and 2008, and analyzed the value relevance and the interaction of the different signals, such as the legitimization provided by the affiliation with a research institution, the presence of Venture Capitalists, and role of Underwriters. The value effect of all signals is studied at three levels: their presence, their

relevance stake, and the importance of prestige. Moreover, we investigate the interaction of the signals. We find that the scientific legitimacy coming from an affiliation with a prestigious university is effective in enhancing the valuation of the firms going public. For firms who publicize the fact that they are university-based and have chosen to go public, the affiliation with a university is recognized as beneficial by investors. The role of prestigious VC backing is also positive, but it overlaps the role of prestigious underwriters. Although our study is exploratory, our results suggest potentially important theoretical implications for future research on signaling via the accumulation of value signals. First, some signals have a permanent effect on the long-run, while others are correlated with short-term price anomalies. Second, some signals are redundant, so that the value effects tend to be overlapped. Third, the relevance of the prestige analysis suggests that "who is the signal" is the key to understand the value effect. Future research should continue to explore the implications of different kinds of signals and the ways that multiple signals add value. For instance, we need to know more about the cost and benefit of enlisting value relevant signals. We know that affiliates, and in particular prestigious ones, are valuable. But does the positive effect tied to their presence overweight the expenses for their participation? We leave the question open for further research.

References

Akerlof, G. A. (1970). The Market for "Lemons: Quality, Uncertainty and the Market Mechanism. *Quarterly Journal of Economics 84*, 488-500.

Barry C. B., Muscarella, C. J., Peavy III, J. W. & Vetsuypens, M. R. (1990). The Role of Venture Capital in the Creation of Public Companies: Evidence from the Going-Public Process. *Journal of Financial Economics 27*(2), 447-471.

Beatty, R. P. & Ritter, J. R. (1986). Investment Banking, Reputation, and the Underpricing of Initial Public Offerings. *Journal of Financial Economics 15*, 213-232.

Berger, A.N. & Udell, G.F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking and Finance 22*, 613-74.

Bertoni, F., D Adda, D., & Grilli, L. (2010). Cherry pickers or frog kissers? The double sided matching between Venture Capital and high-tech companies. 2010 EARIE conference, 2-3 September 2010, Istanbul (Turkey).

Bhattacharya, S. (1979). Imperfect Information, Dividend Policy, and "The Bird in the Hand" Fallacy. *The Bell Journal of Economics 10*(1), 259-270.

Black, B. S. & Gilson, R. G. (1998). Venture capital and the structure of capital markets: Banks versus stock markets. *Journal of Financial Economics 47*, 243-277.

Bonardo, D., Paleari, S. & Vismara, S., (2010). "The M&A dynamics of European Science Based Entrepreneurial Firms", *Journal of Technology Transfer*, 35 (1), 141 - 180.

Bonardo, D., Paleari, S. & Vismara, S., (2011). Valuing University Spin-Offs: the effects of academic affiliation on IPO performance. *Entrepreneurship: Theory and Practice*, forthcoming.

Bygrave, W. & Timmons, I. (1992). *Venture capital at the crossroads.* Cambridge, MA: Harvard Business School Press.

Canovas, G. H. & Solano, P. M. (2007). Effect of the number of banking relationships on credit availability: Evidence from panel data of Spanish small firms. *Small Business Economics 28*, 37-53.

Carpenter, R.E. & Petersen, B.C. (2002). Capital market imperfections, high-tech investment, and new equity financing. *Economic Journal 112*, F54–F72.

Carter, R. B. & Dark, F. H. (1993). Underwriter Reputation and Initial Public Offers: The Detrimental Effects of Flippers. *Financial Review 28*(2), 279-301.

Carter, R. B., Dark, F. H. & Singh, A. K. (1998). Underwriter reputation, initial returns, and the long-run performance of IPO stocks. *Journal of Finance 53*, 285-311.

Carter, R. B. & Manaster, S. (1990). Initial Public Offerings and Underwriter Reputation. *Journal of Finance 65*, 1045-67.

Cassia L., & Vismara S., (2009), "Valuation accuracy and infinity horizon forecast: Empirical evidence from Europe", *Journal of International Financial Management and Accounting*, 20 (2), 135-165.

Certo, S. T., (2003). Influencing Initial Public Offering Investors with Prestige: Signaling with Board Structures. *Academy of Management Review 28*, 432-46.

Chen, G., Hambrick, D. C. & Pollock, T. G. (2008). Puttin' on the ritz: pre-IPO enlistment of prestigious affiliates as deadline-induced remediation. *Academy of Management Journal 51*, 954-975.

Cogliati G. M., Paleari S., Vismara S., (2011), "IPO Pricing: Growth Rates Implied in Offer Prices", *Annals of Finance*, 7 (1), 53-82.

Colombo, M. Mustar P. & Wright M. (2009). Dynamics of Science-based entrepreneurship. *Journal of Technology Transfer 35*(1), 1-15.

De Clercq, D. & Dimov, D. (2008). Internal Knowledge Development and External Knowledge Access in Venture Capital Investment Performance. *Journal of Management Studies 45*(3), 585-612.

Dehejia, R.H. & Wahba, S. (2002). Propensity score matching methods for nonexperimental casual studies. *Review of Economics and Statistics 84*, 151–161.

Doyle, J. & Persley, G. (1996). *Enabling the Safe Use of Biotechnology, Principles and Practice.* Washington, DC: World Bank.

Ellis, K., Michaely, R. & O'Hara, M. (2000). When the Underwriter Is the Market Maker: An Examination of Trading in the IPO Aftermarket. *The Journal of Finance 55*(3), 1039-1074.

Fischer, H. M. & Pollock, T. G. (2004). Effects of Social Capital and Power on Surviving Transformational Change: The Case of Initial Public Offerings. *Academy of Management Journal 47*, 463-81.

Gompers, P. A. (1996). Grandstanding in the Venture Capital Industry. *Journal of Financial Economics 42*, 133-56.

Gompers, P. A. & Lerner, J. (2004). *The Venture Capital Cycle.* Cambridge, MA: MIT Press.

Gutterman, A. (1991). Marketing the initial public offering: Strategic planning analysis—Part II. *Securities Regulation Law Journal 18*, 422– 432.

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica 47*(1), 53-161.

Higgins, M. C. & Gulati, R. (2003). Getting Off to a Good Start: The Effects of Upper Echelon Affiliations on Underwriter Prestige. *Organization Science 14*, 244-63.

Higgins, M. J. & Gulati, R. (2006). Stacking the Deck: The Effect of Upper Echelon Affiliations for Entrepreneurial Firms. *Strategic Management Journal 27*, 1-26.

Higgins, M. J., Stephan, P. & Thursby, J. G (2008). Conveying quality and value in emerging industries: star scientists and the role of learning in biotechnology. NBER Working Papers 14602.

Higgins, Stephan, P. E. & Thursby, J. G. (2011). Conveying quality and value in emerging industries: Star scientists and the role of signals in biotechnology, *Research Policy 40*(4), 605-617.

Hubbard, R. G. (1998). Capital-Market Imperfections and Investment. *Journal of Economic Literature 35*,193-225.

Jain, A. B. & Kini, O. (2000). Does the Presence of Venture Capitalists Improve the Survival Profile of IPO Firms? *Journal of Business Finance & Accounting 27*, 1139–1183.

Jegadeesh, N., Weinstein, M. & Welch I. (1993). IPO Signaling and Subsequent Equity Offerings: An Empirical Investigation. *Journal of Financial Economics 34*(2), 153-176.

Khurshed, A., Paleari S. & Vismara, S., (2005). The Operating and SharePrice Performance of Initial Public Offerings: The UK Experience. *Working Paper*, SSRN.

Krigman, L., Shaw, W. H. & Womack, K. L. (2001). Why do firms switch underwriters? *Journal of Financial Economics 60*, 245-284.

Lee, P. M. & Wahal, S. (2004). Grandstanding, certification and the underpricing of venture capital backed IPOs. *Journal of Financial Economics 73*, 375-407.

Lockett, A., Siegel, 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.

Macmillan, I. C., Kulow, D. M. & Khoylian, R. (1989). Venture capitalists' involvement in their investments: Extent and performance. *Journal of Business Venturing 4*(1), 27-47.

Mangematin, V., Lemarie, S., Boissin, J. P., Catherine, D., Corolleur, F., Coronini, R. & Trommetter, M. (2003). Sectoral system of innovation, SMEs development and heterogeneity of trajectories. *Research Policy 32*(4), 621–638.

Manigart, S., Lockett, A., Meuleman, M., Wright, M., Landström, H., Bruining, H., Desbrières, P. & Hommel, U. (2006). Venture Capitalists' Decision to Syndicate. *Entrepreneurship Theory and Practice 30*(2). 131-153.

Markman, G.D., Phan, H.P., Balkin, D.B. & Gianiodis, P.T., (2005). Entrepreneurship and university-based technology transfer. *Journal of Business Venturing 20*(2), 241-263.

Megginson, W. L. & Weiss, K. (1991). Venture Capitalist Certification in Initial Public Offerings. *Journal of Finance 46*, 879-903.

Meoli M., Paleari S., & Vismara S., (2008), "Does Ownership Structure Affect IPO Valuation?", *Working Paper*, SSRN.

Meoli M., Paleari S., & Vismara S., (2012), "Completing the Technology Transfer process: M&As of Science-Based IPOs", *Small Business Economics*, forthcoming.

O'Shea, R. P, Chugh, H. & Allen, T. J. (2008). Determinants and consequences of university spin-off activity: A conceptual framework. *Journal of Technology Transfer 33*, 653-666.

Paleari, S., Ritter, J. R. & Vismara, S. (2011). Explaining the Simultaneous Consolidation and Fragmentation of Europe's Stock Markets. Working paper, University of Florida.

Phlippen, S. & van der Knaap, B. (2007). When clusters become networks. Working paper, Tinbergen Institute.

Pollock, T. G. (2004). The benefits and costs of underwriters' social capital in the US initial public offerings market. *Strategic Organization 2*(4), 357-388.

Pollock, T. G. & Gulati, R. (2007). Standing out from the crowd: the visibility-enhancing effects of IPO-related signals on alliance formation by entrepreneurial firms. *Strategic Organization 5*, 339-374.

Pollock, T. G., Porac, J. F. & Wade, J. B. (2004). Constructing Deal Networks: Brokers as Network "Architects" in the U.S. IPO Market and Other Examples. *The Academy of Management Review 29*(1), 50-72.

Pollock, T. G. & Rindova V. P. (2003). Media Legitimation Effects in the Market for Initial Public Offerings. *The Academy of Management Journal 46*(5), 631-642.

Pollock, T. G., Chen, G., Jackson, E. M., & Hambrick, D. C. (2010). How much prestige is enough? Assessing the value of multiple types of high-status affiliates for young firms, *Journal of Business Venturing 25*(1), 6-23.

Ritter, J.R. & Welch, I., 2002. A Review of IPO Activity, Pricing and Allocations. *Journal of Finance 57*, 1795-1828.

Ross, S. A. (1977). The Determination of Financial Structure: The Incentive-Signalling Approach. *The Bell Journal of Economics 8*(1), 23-40.

Rothaermel, F. T., Agung, S. D. & Jiang, L. (2007). University entrepreneurship: a taxonomy of the literature. *Industrial and Corporate Change 16*, 691–791.

Sahlman, W. A. (1990). The structure and governance of venture-capital organizations. *Journal of Financial Economics 27*(2), 473-521.

Sanders, G. W., & S. Boivie (2004). Sorting Things Out: Valuation of New Firms in Uncertain Markets. *Strategic Management Journal 25*, 167-186.

Sapienza H. J. (1992). When do venture capitalists add value?, *Journal of Business Venturing 7*(1), 9-27.

Sapienza H. J., Manigart, S. & Vermeir, W. (1996). Venture capitalist governance and value added in four countries. *Journal of Business Venturing 11*(6), 439-469.

Senker, J. (1998). Changing organisation of public-sector research in Europe - implications for benchmarking human resources in RTD. *Science and Public Policy 28*(4), 277-284.

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.

Shane, S. & Stuart, T. (2002). Organizational Endowments and the Performance of University Start-ups. *Management Science 48*, 154-170.

Spence, A. M. (1973). Job market signalling. *The Quarterly Journal of Economics 87*(3), 355-374.

Spence, A. M. (1974). Competitive and optimal responses to signals: An analysis of efficiency and distribution. *Journal of Economic Theory 7*(3), 296-332.

Stiglitz, J. E. & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *The American Economic Review 71*(3), 393-410.

Stiglitz, J. E. (2000). The Contribution of the Economics of Information to Twentieth Century Economics. *The Quarterly Journal of Economics 115*(4), 1441- 1478.

Stuart, T. E., Hoang, H. & Hybels, R. C. (1999). Inter organizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly 44*, 315-349.

Verwaal, E., Bruining, H., Wright, M., Manigart S. & Lockett, A. (2010). Resources access needs and capabilities as mediators of the relationship between VC firm size and syndication. *Small Business Economics 34*(3), 277-291.

Vismara S., Paleari S., Ritter J. R., (2012), "Europe's Second Markets for Small Companies", *European Financial Management*, forthcoming.

Wright, M. & Lockett, A. (2003). The Structure and Management of Alliances: Syndication in the Venture Capital Industry. *Journal of Management Studies 40*(8), 2073–2102.

Wright, M., Lockett, A., Clarysse, B. & Binks, M. (2006). University spin-out companies and venture capital. *Research Policy 35*, 481-501.

Zahra, S. A., Velde, E. V. & Larraneta, B. (2007). Knowledge conversion capability and the performance of corporate and university spin-offs. *Industrial and Corporate Change 16*, 569-608.

Zhang, J. (2009). The Performance of University Spin-Offs: An Exploratory Analysis Using Venture Capital Data. *Journal of Technology Transfer 34*, 255-285.

Table 1 - Sample by signal

	Total (n)	University Affiliation (n)	Strong University Strong (n)	Prestigious University Affiliation (n)	VC Backing (n)	Strong VC Backing (average)	Prestigious VC Backing (n)	Prestigious Underwriter (n)
Country								
UK	110	38	11	10	44	0.77	37	33
France	45	5	4	0	12	0.47	8	12
Germany	39	13	8	0	21	1.13	12	19
Italy	10	1	0	0	3	0.50	2	4
Other	50	8	4	2	27	1.22	15	18
Age at IPO (years)								
Age <= 1	18	5	1	1	2	0.33	1	5
1 < Age <= 5	74	22	11	5	34	0.81	21	26
5< Age <= 10	99	29	13	6	53	1.26	40	35
Age > 10	63	9	2	0	18	0.46	12	20
IPO year								
Nineties	57	12	4	3	25	1.02	19	16
2000-2002	62	18	9	4	23	0.64	17	22
2003-2005	58	15	3	3	27	0.96	21	21
2006-2008	77	20	11	2	32	0.86	17	27
Total	254	65	27	12	107	0.87	74	86

Table 2 - Descriptive statistics (Average Values, where not differently indicated)

	Full sample	University Affiliated
Ipo Valuation and Performance		
Tobin's Q (cut off at 15)	3.94	4.34
BHAR 1 year (%)	-3.65	-11.88
BHAR 3 years (%)	-3.15	-6.11
BHAR 5 years (%)	-3.57	-3.27
Firm And Offer Characteristics		
Firm Size, €m	94.55	46.20
Age (Median, years)	7	6
Profitability (Median, %)	-30.69	-9.38
Leverage (Median)	30.78	22.97
Bubble period (%)	21.76	14.29
Offer size (%)	47.83	67.57
Offer structure (%)	22.59	8.49
Innovation		
R&D Investments (%)	46.43	81.32
Patents (Median, No.)	11	22
Products (No.)	20	20
Anticancer Products (% of firms)	21.76	26.53
Upper Echelon Advisory Role		
Ph.D. (%)	23.25	31.18
MBA (%)	17.95	19.95
Upper Echelon experience index (%)	33.82	38.47
Co-operations with Nobel (% of firms)	3.54	1.54
Upper Echelon Agency Role		
Upper Echelon Size	9.43	10.02
Non-Ex Directors (%)	28.39	25.02
CEO is Founder (% of firms)	49.61	52.31
CEO is Chairman (% of firms)	46.45	46.15
Number	254	65

Table 3. Valuation at the IPO: OLS on the Tobin's Q

	(1)	(2)	(3)	(4)
Firm size	-0.255***	-0.280***	-0.297***	-0.275***
	(0.0619)	(0.0617)	(0.0608)	(0.0595)
Age	-0.307	-0.396	-0.465	-0.266
	(0.575)	(0.578)	(0.572)	(0.558)
Profitability	0.237	0.252	0.278*	0.252*
	(0.157)	(0.157)	(0.156)	(0.151)
Leverage	0.425***	0.420***	0.442***	0.438***
	(0.126)	(0.128)	(0.127)	(0.122)
Dilution ratio	0.272	0.108	0.150	0.160
	(0.337)	(0.344)	(0.339)	(0.350)
Participation ratio	1.632	1.966	1.569	1.569
	(1.231)	(1.243)	(1.235)	(1.194)
Prone to IPO	-1.537	-0.836	-1.222	-1.217
	(3.413)	(3.443)	(3.408)	(3.302)
R&D Investments	2.137*	1.698	2.126*	1.728
	(1.241)	(1.258)	(1.243)	(1.205)
Patents	0.00498	0.0631	0.0551	-0.00779
	(0.163)	(0.165)	(0.162)	(0.158)
UE with Ph.D.	0.0630	-0.0335	-0.115	0.0112
	(1.442)	(1.489)	(1.449)	(1.404)
UE with MBA	-2.365	-2.283	-2.423	-2.336
	(1.529)	(1.558)	(1.534)	(1.479)
UE business experience	-0.0806	0.687	0.461	-0.0676
	(2.761)	(2.767)	(2.735)	(2.642)
UE size	0.410	0.637	0.514	0.258
	(0.615)	(0.618)	(0.614)	(0.596)
Non Executive Directors	-2.083	-2.700*	-2.155	-2.672*
	(1.513)	(1.510)	(1.489)	(1.447)
CVC Backing	0.154	-0.509	-0.635	-0.155
	(0.672)	(0.599)	(0.595)	(0.590)
Alliances	-1.273	-1.795	-6.535*	-5.899*
	(3.222)	(3.292)	(3.864)	(3.344)
University Affiliation	1.192	-	-	-
	(0.918)			
University Ownership	0.107	-	-	-
	(1.133)			
PRESTIGE-UNI [a]	15.91**	-	-	31.72***
	(6.529)			(9.967)
VC Backing	-	0.0209	-	-
		(0.999)		
Size of VC syndicate	-	-0.0286	-	-
		(0.329)		
PRESTIGE-VC [a]	-	2.781**	-	3.516***
		(1.294)		(1.337)
PRESTIGE-UW [a]	-	-	2.579**	6.990***
			(1.009)	(1.973)
Constant	8.056**	7.835**	8.923***	8.249**
	(3.324)	(3.385)	(3.323)	(3.238)
Observations	254	254	254	254
Adjusted R-squared	0.199	0.183	0.190	0.249

[a] PRESTIGE-UNI is defined according to the THES ranking, PRESTIGE-VC according to the number of venture-backed IPOs in the sample, PRESTIGE-UW in money raised by a particular underwriter taking public the IPOs in the sample. OLS regression on the Tobin's Q at the IPO as dependent variable. Controls for years, countries and sub-industries are included. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1