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AGENCY AND SIMILARITY EFFECTS AND THE VC'S ATTITUDE TOWARDS ACADEMIC SPIN-OUT INVESTING

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ABSTRACT

In this paper, we study which VC firm and investment manager related factors drive the VC's attitude towards academic spin-out investing by taking an agency and human capital perspective. In order to do so, we use a unique hand-collected dataset involving 68 investment managers working at early stage VCs in Europe who were interviewed and provided us with information on the fund characteristics and their human capital. First, the results show that academic spin-out investors work to a large extent at publicly funded VCs that often engage in a very hands-on type of post-investment behaviour. Second, the results show that human capital is associated with the willingness of the investment manager to invest in academic spin-outs. Investment managers that had worked in an academic environment and thus have similar human capital compared to the academic founders were more inclined to invest in academic spin-outs. Other specific human capital, such as technical education, and general human capital were not found to be associated with the investment manager's interest in academic spin-out investing, except for the amount of entrepreneurial experience that negatively affected the attitude towards academic spin-outs.

INTRODUCTION

The European Union has been confronted with a phenomenon commonly referred to as the knowledge paradox (EC, 1994; Pavitt, 2000). This paradox is illustrative of the high generation of knowledge within the EU, that has however not been translated into commercial applications. Therefore, the EU and national governments have taken a number of initiatives to increase the transfer of research to industry (Wright et al., 2007). One set of initiatives is directed towards the stimulation of technology transfer through the creation of academic spin-outs. Researchers have shown that, in several European countries, there has been a substantial increase in the number of academic spin-outs created (Wright et al. 2004; Moray and Clarysse, 2005). This increased activity has spurred the attention of academic research in the domain (Clarysse et al., 2007b).

Many of the initiatives to increase the transfer from research to industry are financing-related initiatives. Indeed, the lack of funding for high tech ventures (of which academic spin-outs are a subgroup) is often seen as the major reason why high tech companies in Europe find it difficult to get started and grow (Gill et al., 2002; Martin et al., 2002), in comparison to US firms. High tech start-ups require substantial amounts of financing to get started, which causes internal financial resources to be insufficient or inappropriate (Oakey, 1984; Westhead and Storey, 1995; Berger and Udell, 1998). Besides, they are often deprived from attracting external debt finance, given that they dispose of little collateral, and external equity finance, given that investors face potential high agency costs. Murray and Lott (1995) and Lockett et al. (2002) show that VCs are reluctant to invest in high tech start-ups, even though they are seen as the primary source for inventive high-tech start-up companies (Gompers and Lerner, 1999, 2000).

The specific nature of academic spin-outs may cause the lack of financing to be even more acute. Academic spin-outs are defined as new companies founded by employees of the university around a core technological innovation which had initially been developed at the university (Wright et al., 2006). Academic spin-outs are a particular set of high tech companies. First, universities focus on radically new and disruptive technologies that may create new industries and refine existing markets (Mason and Harrison, 2004; Gompers, 1995) and tend to exploit technologies that are radical, tacit, early stage and general-purpose (Shane and Stuart, 2002; Van de Velde, Clarysse and Wright, 2008).

Therefore, their financial needs will be high and VC funding will probably be the most appropriate source of funding. At the same time, the technological developments on which the spin-out company is based are often legally protected, causing the start-up process to be more complex, and requiring technology transfer from the research institute to the spin-out companies. As Wright et al. (2006) highlight, this may give rise to frictions between the spin-out and the research institute, and these frictions may cause VCs to refrain from investing in academic spin-outs. Technology Transfer Offices (TTOs hereafter) have been set up to support the management of intellectual property at universities and research institutes (Clarysse et al., 2005). As Wright et al. (2006) point out, the nature of individual universities' objectives, strategies and support for commercialisation may affect the ability of VCs to negotiate an appropriate deal that would enable them to achieve their target rates of return. Second, academic entrepreneurial teams dispose of little commercial human capital (Wright et al., 2006; Vanaelst et al., 2006). Even though the founders or the technology transfer office may encourage surrogate (external) entrepreneurs to assume a leadership role (Franklin et al., 2001), it is clear that team composition in academic spin-outs remains to a large extent homogeneous in terms of education, industry experience, functional expertise and skills (Ensley and Hmieleski, 2005). Or, as Lockett et al. (2005) indicate, spin-outs typically face a "knowledge gap". Given the importance that VCs attach to the lead entrepreneur and the management team during the selection process (Tyebjee and Bruno, 1984; MacMillan et al., 1985; 1987; Keeley and Roure, 1989), it seems natural that academic spin-outs may face even higher impediments to attracting VC funding than other early stage high tech firms.

On the other hand, the observation of the equity gap has recently given rise to public initiatives aimed at bridging this gap. Some of these initiatives were targeted at academic spin-outs and may have increased the supply of risk financing for this specific group of high tech start-ups (Wright et al., 2006; European Commission, 2003).

So far, little research has focused on the supply of venture capital for academic spin-outs and what drives this supply specifically. Wright et al. (2006) study the mismatch between the supply of and demand for spin-outs financing, but do not elaborate on the access of academic spin-outs to start-up financing or the drivers that affect the supply of VC financing to academic spin-outs. The specific nature of spin-out companies may have an impact on the supply of venture capital financing.

By studying a set of early stage VCs in Europe, this research aims at understanding which factors explain investment managers' attitudes towards academic spin-out investing. Understanding these factors is expected to have important implications for policy design as well as for the development of the literature concerning the behaviour of VCs and the success of academic spin-outs. First, we provide a conceptual framework for understanding the drivers of VC interest in academic spin-outs. By building on agency theory and human capital theory, specifically by extending the "similar-to-me" hypothesis (Byrne, 1971) regarding specific human capital, we hypothesize that both the characteristics of the VC fund and the human capital of the investment manager may affect the willingness to consider academic spin-out investing. Second, we provide an insight into the methodology used. Next, we discuss the results, conclude on the results and offer insights for practice and directions for further research.

THEORY AND HYPOTHESES

Selection behaviour by VCs has for a long time been of interest in the entrepreneurship and VC literature. A first group of researchers has focused on how VCs select their portfolio companies and what criteria they base their decision on (Hall and Hofer, 1993; McMillan et al., 1985; 1987; Muzyka et al., 1996). In a further stage, the VC literature has provided in-depth analyses of selection behaviour. In this stage, one group of researchers has focused on the impact of the investment manager's background and human capital on investment decisions (Dimov et al., 2007; Franke et al., 2006; 2008). Another group of researchers has analyzed the determinants of portfolio strategy of the VC firm, which is to a large extent a strategic decision taken by the top management team in VC firms (Dimov et al., 2007). Strategic decisions include the decision to focus portfolios on a specific investment stage (Elango et al., 1995; Manigart et al., 2002), to build portfolios that are diversified across industries or that focus on specific industries (Knockaert et al., 2006; Gupta and Sapienza, 1992), or to build portfolios that are geographically spread (Gupta and Sapienza, 1992). These decisions were found to be highly dependent on fund characteristics, such as public vs. private funds, fund size etc. So far, little research has integrated both VC fund characteristics and human capital characteristics when studying investment decisions.

We argue that, in order to understand fully the drivers of the investment manager's interest in academic spin-outs and subsequently investment behaviour with respect to spin-out investing, it is necessary to include both factors in the analysis. In what follows, we build a conceptual model to analyze the impact of VC firm characteristics and human capital characteristics on the investment manager's interest to invest in academic spin-outs. In order to do so, in what follows we build on agency theory and human capital theory.

Agency theory and attitudes towards academic spin-out investing

Given the lack of collateral and the risk connected to early stage high tech investments (Di Giacomo, 2004; Lerner, 1999), debt finance is not believed to be an appropriate source of financing for academic spin-outs. Neither is angel financing, given the limited amounts of funding that these financial parties provide, and given that angels are generally unfamiliar with high level science and engineering research. Mason and Harrison (2004) show that business angel investments may not be appropriate in the case of university based IP. Therefore, VCs are often viewed as the primary source for inventive high-tech start-up companies (Gompers and Lerner, 1999, 2001). Many researchers have pointed out that venture capital is a form of financial intermediation that is particularly well suited to support the creation and growth of early stage high tech companies (Hellmann and Puri, 2000, 2002; Kortum and Lerner, 2000). Research (Murray and Lott, 1995; Lockett et al., 2002) has however shown that VCs may be reluctant to invest in early stage high tech business proposals. This reluctance can be explained from an agency theory perspective. Entrepreneurs, by virtue of being intimately involved in their venture, are likely to possess greater information about it than are VCs who may find it difficult to access this information even with extensive due diligence. This information asymmetry leads to agency conflicts (Gompers, 1995). Agency theory suggests that although the entrepreneur can autonomously take certain decisions, part of the costs resulting from these decisions will be borne by the remaining shareholders, giving rise to problems of moral hazard. Agency costs may be especially important in high tech companies, where investors usually cannot evaluate the technology and have difficulties in assessing the commercial implications of strategic choices (Knockaert et al., 2006). The VC literature suggests that there are two ways to offset these agency risks. First, VCs may develop abilities in selecting entrepreneurial projects, which decrease the chance of encountering adverse selection and moral hazard problems caused by information asymmetries (Amit et al., 1998). Before making an investment, VCs carefully scrutinize the

founders and their business concepts (Fried and Hisrich, 1994). Second, VCs may engage in extensive monitoring and follow-up on investments made, in order to minimize potential agency costs. With significant equity blockholding, VCs have the incentive to become active in decision control (Wright and Robbie, 1998), which includes exerting costly effort to improve outcomes (Kaplan and Strömberg, 2001).

Even though VCs may develop specific abilities in selecting entrepreneurial projects, evidence shows that VCs will be in favour of projects that have minimal information asymmetries (Lockett et al., 2002), which often causes high tech start-ups to be deprived of funding. This problem is even more pertinent for academic spin-outs, for which specific technological and human capital resource configurations cause potential agency costs to be higher. The lack of funding for early stage high tech companies and academic spin-outs has typically been referred to as "the equity gap" (Murray, 1999). Governments have considered this lack of funding for high tech start-ups as a market imperfection, which justifies public intervention (Di Giacomo, 2004; Lerner, 1999). Governments can rectify market imperfections that exist with respect to the provision of early stage high tech financing by using a large number of instruments, ranging from the establishment of public funds to providing financing to private funds, over refinancing and guarantee schemes to the provision of fiscal incentives and incubation schemes (Wright et al., 2006). Wright et al. (2006) provide an overview of measures that have been taken in order to help academic spin-outs attract funding. They identify the establishment of public VC funds, such as Twinning Growth Fund and Biopartner and public/private equity funds, such as the University Challenge Funds and Technologiebeteiligungesellschaft as examples of public risk financing provided to academic spin-outs.

Therefore, we hypothesize that VC funds that receive public funding will have at least partially a mission to offset market imperfections and will have as a portfolio strategy to invest in companies that are faced with the equity gap, amongst other academic spin-outs. Therefore, we offer the following hypothesis:

H1: The higher the share of public funding in the VC firm's capital, the higher the investment manager's willingness to invest in academic spin-outs

An alternative way to decrease information asymmetries and hence the likelihood that agency costs are incurred, is through extensive follow-up of portfolio companies post-investment. Agency theory suggests that equity finance provides entrepreneurs with incentives

to engage in activities from which they benefit disproportionately. Although the entrepreneur can autonomously take certain decisions, part of the costs resulting from these decisions will be borne by the remaining shareholders (Jensen and Meckling, 1976). This phenomenon is known as moral hazard and is viewed as one of the major agency costs, resulting from information asymmetry. Agency costs may be especially important in high tech companies, where investors usually cannot evaluate the technology strategy and have difficulties in assessing the commercial implications of strategic choices. The VC literature has shown great differences between VC funds in their post-investment behaviour (Elango et al., 1995; Schefczyk and Gerpott, 2001) and in terms of their attitudes towards investing in spin-outs (Wright et al., 2006). This post-investment behaviour includes both monitoring and value-adding behaviour (Knockaert et al., 2006). Funds that follow up on their investments intensively are called hands-on funds, whereas funds that mainly carry out monitoring activities in a non-intensive way are called hands-off funds (Sweeting and Wong, 1997). It may be expected that funds that choose to play an active post-investment role are in a better position to invest in academic spin-outs. First, by closely monitoring these companies the agency risks can be reduced. Second, hands-on funds may be better placed to invest in academic spin-outs since these spin-outs are typically resource-poor (Clarysse et al., 2007a) and hands-on investors can bring much needed human and social capital resources. Entrepreneurs specialise in the development of knowledge about combining resources to exploit new opportunities (Kirzner, 1973) and in the day-to-day development of new business activities (MacMillan et al., 1989), while VCs focus mainly on creating networks to reduce the cost of acquiring capital, to find customers and suppliers and to establish the venture's credibility (MacMillan et al., 1989; Lam, 1991). This involvement helps to protect the interest of the VC, to ameliorate the problems of information asymmetry and to add value to the venture (Sahlman, 1990). Therefore, hands-on funds may have a more positive attitude towards academic spin-outs investing, since they spend more effort in monitoring and value adding post-investment behaviour. Therefore, we offer the following hypothesis:

H2: The higher the post-investment involvement by the investment manager, the higher the willingness to invest in academic spin-outs

Human capital theory and attitudes towards investing in academic spin-outs

We build on the "similar-to-me" hypothesis (Byrne, 1971) to explain how the human capital of investment managers may influence their selection behaviour. The effect has earlier been applied to venture capital by Franke et al. (2006), who studied a sample of 51 VCs, and who found that VCs tend to favour teams that are similar to themselves in type of training and professional experience. The similarity effect has been confined to psychology and hardly been incorporated into behavioural economics or management studies. According to the "similar-to-me" hypothesis (Byrne, 1971), individuals rate other people more positively the more similar they are to themselves. A rationale for this hypothesis can be found in three different theoretical backgrounds, namely learning theory, self-categorization theory and social identity. According to learning theory, similarity is perceived as rewarding and dissimilarity works as a negative reinforcement (Lefkowitz, 2000). Self-categorization theory implies that a person's self-concept is based on the social categories s/he puts themselves in and that each person strives for a positive self-identity (Jackson et al., 1991). According to social identity theory (Tajfel, 1982), people strive to belong to a group as this leads to the positive feeling of social identity. Assignment to a specific group allows for in-group/out-group comparisons which are biased towards the own group. The impact of the "similar to me" hypothesis has been demonstrated in many management fields, such as buyer-seller relationships (Lichtenthal and Tellefsen, 2001) and employment selection interviews (Anderson and Shackleton, 1990). Vanaelst et al. (2006) also find similarities in new team members that added to founder teams in spin-outs.

Based on the similarity effect, we could hypothesize that investment managers who have similar human capital to the academic founding team are more likely to be positive towards academic spin-out investing. Two key demographic characteristics, education and experience, underlie the concept of human capital (Becker, 1975). Applying the human capital concept in a VC context, Dimov and Shepherd (2005) distinguished between general and specific human capital. General human capital refers to overall education and practical experience, while specific human capital refers to education and experience with a scope of an application limited to a particular activity or context (Becker, 1975; Gimeno et al., 1997). In a VC context, Dimov and Shepherd define specific human capital as education and experience that is directly related to the tasks of the VC. Bottazzi et al. (2008) explore the role of VC monitoring and its impact on portfolio firm performance among European VC firms in general.

They find that VCs whose partners have prior business experience are significantly more active in investee firms, that VC experience of the firm's partners is not significant, while the influence of a science background for executives is weak. They also find a positive relationship between active VC monitoring and exit performance that is both statistically and economically significant.

In this study, we apply the concepts of specific and general human capital specifically to academic spin-out investing. First, academic spin-outs tend to exploit technologies that are radically new and disruptive, and often early stage and general-purpose (Christensen, 2003; Danneels, 2004; Nelson, 2001). Second, the human capital of academic founding teams has often been found to be very homogeneous in terms of education, industry experience, functional experience and skills (Ensley and Hmieleski, 2005; Vanaelst et al., 2006), or, as Franklin et al. (2001) point out, often bring a strong commitment to the technology, but frequently lack business experience and knowledge. It is therefore clear that academic founding teams will to a large extent have both education and experience in high tech domains. Therefore, we define specific human capital as experience or education in high-tech domains. Specific human capital in this context is defined as technical education and experience in a high tech research environment. General human capital in this high-tech VC context is defined as education in humanities, and experience in finance, consulting or investment management. Building on the "similarity" effect, we hypothesize that investment managers who possess specific human capital relating to academic spin-out investing will regard investment proposals from academic entrepreneurs in a more positive way given that they have the same background, whereas the general human capital of investment managers will not affect investment preferences. Therefore, we offer the following hypotheses:

H3a: The higher the degree of specific human capital relating to spin-out activity, the higher the investment manager's willingness to invest in academic spin-outs

H3b: The degree of general human capital will not affect the investment manager's willingness to invest in academic spin-outs

RESEARCH METHODOLOGY

The sample and data collection

Given that none of the publicly available databases and information sources on VC activity in Europe, such as VentureEconomics or VentureOne could provide sufficiently detailed information on the level we required, namely fund characteristics and investment management characteristics, and the VC's willingness to invest, we constructed our own dataset of European early stage VCs.

A stratified sample of 68 VC investors was drawn from different regions across Europe. As our research focus is on early stage VC investors, we needed to obtain an international dataset because the number of potential respondents within any one country, outside of the US, would have been too small. We selected the seven regions across Europe that had the highest R&D intensity and venture capital presence. The seven regions were: Cambridge/London region (UK), Ile de France (France), Flanders (Belgium), North Holland (the Netherlands), Bavaria (Germany), Stockholm region (Sweden), Helsinki region (Finland). In each region, we sought a representation of small and large funds with various degrees of public funding. A random sample based upon the most widespread available sample frame, i.e. the EVCA-filings, would have resulted in a sample biased towards the larger private venture capital firms. Therefore, we created our own sample frame, collating the directory information from EVCA with those of the various regional venture capital associations and information obtained through contacts we had with academics specific regional expertise and contacts. This resulted in a population of 220 funds across the 7 regions. These were all funds that are investing in early stage. The sample frame was stratified into different groups or subpopulations according to the scale of the funds (small funds versus mega funds) and their institutional investors. In terms of scale, 33 funds were small, 21 were large and 14 were mega funds[1]. With respect to institutional investors, 6 funds were private equity arms of banks, 9 funds were public funds, 12 were public/private partnerships and the others are private funds.

The interviews were conducted between January and December 2003. Each interview provided information on fund characteristics, investment manager's human capital and the willingness of the VC to invest in academic spin-outs.

[1] Venture funds having a fund size between 100 million Euro and 250 million Euro are considered to be large funds for venture investments. Mega funds are those funds having a size of more than 250 million Euro, small funds have less than 100 million Euro under management (EVCA definition)

Measures

Dependent variable

The dependent variable took the form of a dummy (0/1), indicating whether or not the VC showed an interest in investing in academic spin-outs. 25 VCs indicated that they would not consider investing in academic spin-outs, 43 indicated that they would consider academic spin-out investment.

Independent variables

Percentage public capital. This variable ranges between 0% and 100%, with 100% indicating that the fund is entirely funded by public means. 46 out of 68 funds were not funded by public means, 10 were 100% publicly funded, and the other funds were partially publicly funded.

Post-investment involvement. Post-investment involvement was measured as the number of days per month the investment manager on average spends per portfolio company. Our group of early stage investors spends on average 2.8 days per month (standard deviation of 2.6) per portfolio company on follow-up activities. The VC with the lowest involvement spends 2 hours per month, whereas the VC with the highest involvement spends up to 16 days per month per portfolio company (mainly carrying out part of the daily management, such as marketing and sales, financial function etc).

Specific human capital. To capture the extent to which the investment manager possesses human capital that relates to academic spin-out investing, we constructed two variables. The first measures how many years of academic experience the investment manager has through means of a PhD or a research position at a university or research institute (labelled “academic experience”). On average, the investment managers in our sample had 1 year of academic experience. The majority of investment managers (58) had not had any academic experience. Following Dimov and Shepherd (2005), we defined a second variable which measures whether or not the investment manager has a science education (all bachelor and master degrees in mathematics, natural sciences and engineering), and takes the form of a dummy. 34 investment managers had a science education.

General human capital. In order to capture general human capital, i.e. human capital not related to academic spin-out investing specifically, 5 variables were created, also following the definitions by Dimov and Shepherd (2005). Financial experience is measured as the number of years of experience in commercial, investment, and merchant banking, as well as investment fund management, in both public and private markets. The investment managers interviewed had on average 6.89 years of financial experience. Consulting experience is measured as the number of years working for a company designated at providing consulting services, which is on average 1.03 years for the investment managers in the sample. Entrepreneurial experience reflected the number of years the investment managers had previously been involved in a new venture as entrepreneur or founder. In our sample, the average number of years of entrepreneurial experience is 1.15 years, with 15 investment managers having had this experience. In addition, we constructed a variable which we labelled "management experience". The variable is measured as the number of years in general management, on average 4.04 years in our sample. This differs from Dimov and Shepherd (2005)'s definition of human capital. Whereas Dimov and Shepherd defined an extra variable that measured experience in the law industry, only one investment manager in our sample had such experience. On the other hand, 30 investment managers had experience as a manager in the industry, which made it more relevant to define "management experience" as an extra variable. Finally, education in humanities and MBA reflects all MBA degrees and degrees in art and social sciences and is measured as a dummy variable. 46 of the 68 interviewed investment managers had this education.

Control variables

We control for the fund size of the VC. The smallest fund manages 0.9 million Euro, whereas the largest fund has a size of 4400 million Euro. The average fund size is 269 million Euro. Additionally, we control for whether or not the VC fund invests in biotech or ICT.

Results

Table 1 presents the descriptive statistics for the VCs that expressed an interest in investing in academic spin-outs and those that did not. The groups differ on a number of characteristics. First, the percentage of public capital in the fund capital is significant larger for academic spin-outs compared to those VCs not engaging in spin-out investing. Whereas the academic spin-out investors have an average of 28% of public capital, the other VCs have only about 7.7% of public capital. Second, the academic spin-out investors are to a larger extent involved in post-investing activities, or are more hands-on than non-academic spin-out investors. Except for experience in consulting, which is higher in VCs that do not invest in academic spin-outs, the univariate analysis did not show any significant differences at the level of human capital.

Insert Table 1 About Here

In order to test our hypotheses, we used a binary logistic regression model. The correlation matrix for the variables included in the analysis is provided in Table 2. Correlations between variables were all below 0.6. In order to make sure that multicollinearity was not an issue, VIF factors were calculated, and were found to be below 3.0 (maximum value 1.7), suggesting that multicollinearity was not an issue (see Hair et al, 1998).

Insert Table 2 About Here

The binary logistic regression model is presented in Table 3.

Insert Table 3 About Here

Hypothesis 1 states that publicly funded VCs will show a higher willingness to invest in academic spin-outs than private VC funds. The regression analysis supports this hypothesis: VC funds that have public capital are more interested in investing in academic spin-outs ($p<0.05$). Hypothesis 2 states that a higher degree of post-investment involvement will lead to an increased interest in investing in academic spin-outs. The regression analysis supports this hypothesis ($p<0.05$). Hypothesis 3 states that a higher degree of specific capital relating to academic spin-out investing will lead to an increased interest in investing in academic spin-outs, whereas general human capital was not expected to have any impact on willingness to invest in academic spin-outs. The results for these hypotheses are mixed. First, we find that one of the measures of specific human capital, namely the amount of academic experience affects the willingness to invest in academic spin-outs in a positive way. On the other hand, we do not find people who have had a technical education are more inclined to invest in these spin-out ventures. Second, even though we find no significant impact of general human capital on the willingness to invest in academic spin-outs, we do find that investment managers who have gained a more extensive experience as entrepreneurs are less inclined to invest in academic spin-outs. In summary, the results relating to human capital suggest that human capital affects the attitudes towards academic spin-outs to some extent.

DISCUSSION AND CONCLUSIONS

Using a unique hand collected dataset of European VC firms, this paper has examined the VC firm and investment manager related factors that drive the VC's attitude towards academic spin-out investing. Our findings highlight a number of important aspects. First, our results show that the percentage of public capital that the VC fund has available to it has a positive effect on the willingness of the fund to invest in academic spin-outs. This shows that public funds tend to invest in those areas for which they were established, namely the areas where the equity gap is most acute. Second, the results show that hands-on funds, or funds that are to a large extent involved in post-investment activities, are to a larger extent involved in academic spin-out investing. Approaching academic spin-outs investments with a more active post-investment behaviour may offset potential agency risks. Post-investment behaviour can be disentangled into two types of activities, namely monitoring and value-adding activities. During the latter activities, VCs create networks for their portfolio companies, help to find customers and suppliers, advise the venture and identify appropriate management (MacMillan et al., 1989; Steier and Greenwood, 1995).

Since our research does not allow differentiation between these two types of activities, it is unclear whether academic spin-out investors are mainly involved in monitoring their portfolio, or are involved in activities that are meant to add value to the venture. However, previous research shows that publicly funded VCs tend to be less involved in value-adding activities (Knockaert et al., 2006). Another indication of potential value-adding behaviour is, as Knockaert et al. (2006), Dimov and Shepherd (2005) and Botazzi et al. (2008) show, the human capital of the investment manager. Our third set of results shows that the human capital of the investment manager partially differentiates the academic spin-out investors from the funds that do not consider academic spin-outs: spin-out investors tend to have a higher degree of academic experience and tend to have less entrepreneurial experience. This points to a similarity effect: investment managers who have been in academia tend to have a more positive attitude towards academic founders, who tend to have similar human capital as theirs. This finding indicates therefore that on the one hand, investment managers who invest in academic spin-outs may be in the right position to understand the difficulties spin-outs face. They tend to understand the specific university culture that is often different from a commercial environment (Wright et al., 2006), which may help for instance during negotiations with the research institute during technology transfer negotiations. On the other hand, this finding also indicates that spin-out investors are not likely to possess human capital that is complementary to the academic founders. However, given that academic spin-outs are typically resource-poor and are dependent on their environment for the attraction of resources (Blau, 1964; Pfeffer and Salancik, 1978), it seems unlikely that VCs will be able to bring in the necessary human capital, especially commercial experience. This is in line with research by Clarysse et al. (2007a) that indicates that, in case of VCs investing, boards tend to be complementary to the (mainly technical) founding team. In addition, given that investment managers investing in academic spin-outs tend to have similar experience to the academic founders, it seems less likely that they will be able to engage in certain value-adding activities, such as creating networks, helping to find customers and suppliers and identifying appropriate management for the venture.

IMPLICATIONS AND DIRECTIONS FOR FURTHER RESEARCH

This research has a number of implications for policy makers, entrepreneurs, VC firms and further research.

First, our findings have a number of implications for policy makers. The European Commission observed the existence of a so-called knowledge paradox in Europe, indicating that too little knowledge is converted into commercial products and processes (OECD, 2002). The main focus of the EC is therefore on facilitating technology transfer and dissemination of knowledge. Academic spin-out establishment is one potential way to bridge the gap between research and industry (Wright et al., 2008). This research indicates that the market imperfection that arises for early stage high tech companies is even more acute for academic spin-outs. Besides, it indicates that publicly funded funds have carried out their investment policy in line with the expectations of government: the funds are to a large extent used for making the investments they were launched for, namely bridging the equity gap for those companies that face market failures. However, this research also holds a number of caveats for policy makers. The results show that the human capital of the VCs that invest in academic spin-outs is to a large extent similar to that of the founding team of these spin-outs. Therefore, this research also shows that, even though publicly funded VCs are positive towards spin-out investing, they may not be in the best position to help academic spin-outs overcome their resource dependency and add value to the venture. Governments could remedy this shortcoming by providing more funds to public fund management, that should allow them to attract people from industry or who worked previously in investment banking.

Second, for academic entrepreneurs, it provides an insight into which VCs may be interested in investing in their spin-out venture. This research indicates that mainly publicly funded VCs may be willing to invest in academic spin-outs, and that the VCs investing will employ an active post-investment approach. Therefore, this also requires that the academic entrepreneur is sufficiently open to accepting high involvement by the VC, which often may result in a loss of control and autonomy by the entrepreneur (Clarysse et al., 2007a). In addition, this research indicates that for academic entrepreneurs, it may be useful to identify the investment manager within the VC firm who may have the most positive attitude towards spin-out investing. This research shows that this person should be quite easily identifiable, since investment managers frequently publish their CV on websites, and will mention for instance a PhD title.

Third, for VCs and investment managers, this research confirms that investment managers suffer from a similarity bias in decision taking. It would therefore be advisable to make sure that people with different backgrounds analyze business proposals.

Fourth, for academia, this research shows that VC behaviour is both determined by human capital and fund characteristics and calls upon an integration of both types of characteristics in further research into VC behaviour. Given that this research does not allow us to analyse how and to what extent the academic spin-out investor adds value to the spin-out during the post-investment phase, we call for an increased interest in studying post-investment activities by VC firms, such as monitoring behaviour, value adding behaviour and board composition and roles. Further, this research aimed at understanding the circumstances that would generate an interest by VC firms to invest in academic spin-outs. More research is needed to examine whether the VCs that expressed an interest in investing in these companies eventually do so.

REFERENCES

Amit R., Brander J., Zott C. (1998). Why do venture capital firms exist? Theory and Canadian evidence. *Journal of Business Venturing*. 13: 441-466.

Anderson N., Shackleton V. (1990). Decision Making in the Graduate Selection Interview: A Field Study. *Journal of Occupational Psychology*. 67, pp. 63-77.

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: 613-673.

Blau P.M. (1964). Exchange and Power in Social Life. New York: John Wiley.

Bottazzi, L., Da Rin, M., Hellmann, T. (2008). Who are the active investors? Evidence from venture capital. *Journal of Financial Economics*, forthcoming,

Byrne D. (1971). The Attraction Paradigm. New York.

Christensen C. (2003). The innovator's solution: creating and sustaining successful growth. Boston: Harvard Business School Press.

Clarysse B., Wright M., Lockett A., Van de Velde E., Vohora A. (2005). Spinning out new ventures: a typology of incubation strategies from European research institutions. *Journal of Business Venturing*, 20(2), pp. 183-216.

Clarysse B., Knockaert M., Lockett A. (2007a). Outside Board Members in High Tech Start-ups. *Small Business Economics*. 29(3), pp. 243-259.

Clarysse B., Wright M., Lockett A., Mustar P., Knockaert M. (2007b). Academic spin-offs, formal technology transfer and capital raising. *Industrial and Corporate Change*. 16 (4), pp. 609-640.

Cumming D. (2007). Government policy towards entrepreneurial finance: Innovation investment funds. *Journal of Business Venturing*. 22, 193-235.

Danneels E. (2004). Disruptive technology reconsidered: a critique and research agenda. *Journal of Product Innovation Management*. 21(4), 246-258.

Di Giacomo M. (2004). Public Support to Entrepreneurial Firms: An Assessment of the Role of Venture Capital in the European Experience. *The Journal of Private Equity*, 22-38.

Dimov P.D., Shepherd D.A. (2005). Human capital theory and venture capital firms: exploring "home runs" and "strike outs". *Journal of Business Venturing.* 20: 1-22.

Dimov D., Shepherd D., Sutcliffe K. (2007). Requisite expertise, firm reputation, and status in venture capital investment allocation decisions. *Journal of Business Venturing*. 22(4): 481-502.

EC (1994). European Report on S&T indicators.

Elango B., Fried V., Hisrich R., Poloncek A. (1995). How venture capital firms differ. *Journal of Business Venturing.* 10(2): 157-179.

European Commission (2003). Raising EU R&D Intensity: Risk Capital Measures. Brussels and Luxembourg: European Commission.

Ensley M., Hmieleski K. (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.

Franke N., Gruber M., Harhoff D., Henkel J. (2006). What you are is what you like- similarity biases in venture capitalists' evaluations of start-up teams. *Journal of Business Venturing*. 21(6): 802-826.

Franke N., Gruber M., Harhoff D., Henkel J. (2008). Venture capitalists' evaluations of start-up teams: trade-offs, knock-out criteria, and the impact of VC experience. *Entrepreneurship Theory and Practice*. 459-483.

Franklin S., Wright M., Lockett A. (2001). Academic and surrogate entrepreneurs in university spin-out companies. *Journal of Technology Transfer*. 26(1-2), pp. 127-141.

Fried V., Hisrich R. (1994). Toward a model of venture capital investment decision making. *Financial Management*. 23(3): 28-37.

Gill D., Martin C., Minshall T., Rigby M. (2000). Funding Technology: Lessons from America. London: Wardour Publications.

Gimeno J., Folta T.B., Cooper A.C., Woo C.Y. (1997). Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. *Administrative Science Quarterly*. 42(4): 750-784.

Gist, M.E., Mitchell, T.R (1992) 'Self-efficacy: a theoretical analysis of its determinants and malleability', *Academy of Management Review*, Vol. 12 (2), pp. 183-211.

Gompers P. (1995). Optimal Investment, Monitoring, and the Staging of Venture Capital. *Journal of Finance*, Vol. 50, issue 5, 1461-1489.

Gompers P., Lerner J., (1999). The Venture Capital Cycle. MIT Press. Cambridge.

Gompers P., Lerner J. (2001). The Venture Capital Revolution. *Journal of Economic Perspectives*. 15(2): 145-168.

Gupta A., Sapienza H. (1992). Determinants of venture capital firms' preference regarding the industry diversity and geographic scope of their investments. *Journal of Business Venturing*. 7(5): 347-362.

Hair J.F., Anderson R.E., Tathum R.L., Black W.C. (1998). Multivariate data analysis with readings. Macmillan, New York.

Hall J., Hofer C.W. (1993). Venture Capitalists' Decision Criteria in New Venture Evaluation. *Journal of Business Venturing*. 8: 25-42.

Hellmann T., Puri M. (2000). The interaction between product market and financing strategy: the role of venture capital. *The Review of Financial Studies*. 13(4): 959-984.

Hellmann T., Puri M. (2002). Venture capital and the professionalization of start-up firms: Empirical evidence. *The Journal of Finance*. 57(1); 169-198.

Jackson S.F., Brett J.F., Sessa V.I., Cooper D.M., Julin J.A., Peyronnin K. (1991). Some Differences make a Difference: Individual Dissimilarity and Group Heterogeneity as Correlates of Recruitment, Promotion and Turnover. *Journal of Applied Psychology*. 76, pp. 675-689.

Jensen, M., Meckling, W. (1976). Theory of the firm: Managerial behaviour, agency costs and ownership structure. *Journal of Financial Economic. 3(4), 305-360.*,

Kaplan S.N., Strömberg P. (2001). Venture Capitalists as Principals: Contracting, Screening and Monitoring. *American Economic Review Proceedings*. 91(2): 426-431.

Keeley R.H., Roure J.B. (1989). Determinants of new venture success before 1982 and after a preliminary look at two eras. *Frontiers of Entrepreneurship Research*. 274-287.

Kirzner I. (1973). Competition and entrepreneurship. University of Chicago Press.

Knockaert M., Lockett A., Clarysse B., Wright M., 2006, 'Do Human Capital and Fund Characteristics Drive Follow-Up Behaviour of Early Stage High Tech VCs?' *International Journal of Technology Management.* 34(1-2), 7-27.

Kortum S., Lerner J. (2000). Assessing the contribution of venture capital to innovation. *The Rand Journal of Economics*. 31(4): 674-693.

Lam S. (1991). Venture capital financing: a conceptual framework. *Journal of Business Finance and Accounting*. 18(2): 137-149.

Lefkowitz J. (2000). The Role of Interpersonal Affective Regard in Supervisory Performance Ratings: a Literature Review and Proposed Causal Model. *Journal of Occupational and Organizational Psychology*. 73, pp. 67-85.

Lerner J. (1999). The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program. *Journal of Business*, 72(3), 285-318.

Lichtenthal J.D., Tellefsen T. (2001). Toward a Theory of Business Buyer-Seller Similarity. Journal of Personal Selling and Sales Management. 1, pp. 1-14.

Lockett A., Murray G., Wright M. (2002). Do UK venture capitalists still have a bias against investment in new technology firms. *Research Policy*. 31, 1009-1030.

Lockett A., Siegel D., Wright M., Ensley M. (2005). The creation of spin-off firms at public research institutions: managerial and policy implications. *Research Policy*. 34: 981-993.

MacMillan I.C., Siegel R., Subbanarashima P.N. (1985). Criteria used by venture capitalists to evaluate new venture proposals. *Journal of Business Venturing*. 1: 119-128.

MacMillan I.C., Zemann L., Subbanarashima P.N. (1987). Criteria distinguishing successful from unsuccessful ventures in the venture screening process. *Journal of Business Venturing*. 2: 123-137.

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

Manigart S., Waele K., Wright M., Robbie K., Desbrieres P., Sapienza H., Beekman A. (2002). Determinants of required return in venture capital investments: a five-country study. *Journal of Business Venturing*. 17(4): 291-312.

Martin R., Sunley P., Turner D. (2002). Taking risks in regions: the geographical anatomy of Europe's emerging venture capital market. *Journal of Economic Geography*. 2(2): 121.

Mason C., Harrison R. (2004). Does investing in technology-based firms involve higher risk? An exploratory study of the performmance of technology and non-technology investments by business angels. *Venture Capital*. 6(4): pp. 313-332.

Moray N., Clarysse B. (2005). Institutional change and resource endownments to science-based entrepreneurial firms. *Research Policy*. 34(7), pp. 1010-1027.

Murray G. (1999). Early-stage venture capital funds, scale economies and public support. *Venture capital*. 1(4): 351-384.

Murray G., Lott J. (1995). Have venture capitalists a bias against investment in new technology firms? *Research Policy*. 24, 283-299.

Nelson R. (2001). Observations on the post Bayh-Dole rise in patenting at American universities. *Journal of Technology Transfer*. 26: 13-19.

Muzyka D., Birley S., Leleux B. (1996). Trade-offs in the investment decisions of European Venture Capitalists. *Journal of Business Venturing*. 11: 273-287.

Oakey R. (1984). Finance and Innovation in British Small Independent Firms. *International Journal of Management Science*. 12: 113-124.

OECD (2002), Benchmarking Industry Science Relations. OECD, Paris.

Pavitt K. (2000). Why European Union funding of academic research should be increased: a radical proposal. *Science and Public Policy*. 27(6), pp. 455-460.

Pfeffer J., Salancik G. (1978). The External Control of Organizations: A Resource Dependence Perspective. New York: Harper & Row.

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

Schefczyk M., Gerpott T.J. (2001). Management support for portfolio companies of venture capital firms: an empirical study of German venture capital investments. *British Journal of Management*. 12: 201-216.

Shane S., Stuart T. (2002). Organizational endowments and the performance of University Start-ups. *Management Science*. 48(1): 154-161.

Steier L., Greenwood R. (1995). Venture capitalist relationships in the deal structuring and post-investment stages of new firm creation. *The Journal of Management Studies*. 32(3): 337-358.

Sweeting, R., Wong, C. (1997). A UK hands-off venture capital firm and the handling of post-investment investor-investee relationships. *Journal of Management Studies*, 34(1), 125-152.

Tajfel H. (1982). Social Identity and Intergroup Relations. New York.

Tyebjee T.T., Bruno A.V. (1984). A model of VC investment activity. *Management Science*. 30: 1051-1066.

Vanaelst I., Clarysse B., Wright M., Lockett A., Moray N., S'Jegers R. (2006). Entrepreneurial Team Development in Academic Spinouts: An Examination of Heterogeneity. *Entrepreneurship Theory and Practice*. 30(2): 249-271.

Van de Velde, E., Clarysse, B., Wright, M. (2008). Entrepreneurial origin, technology endowments and the growth of spin-off companies, Working Paper: Imperial College.

Westhead P., Storey D. (1995). Financial constraints on the growth of high technology small firms in the United Kingdom. *Applied Financial Economics*. 7: 197-201.

Wood, R., Bandura, A. (1989). 'Social Cognitive Theory of Organizational Management', *Academy of Management Review*, Vol. 14 (3), pp. 361-384.

Wright M., Robbie K. (1998). Venture Capital and Private Equity: A Review and Synthesis. *Journal of Business Finance and Accounting*.25 (5/6): 521-570.

Wright M., Vohora A., Lockett A. (2004). The formation of high tech university spinout companies: the role of joint ventures and venture capital investors. *Journal of Technology Transfer*. 29, pp. 287-310.

Wright M., Lockett A., Clarysse B., Binks M. (2006). University spin-out companies and venture capital. *Research Policy*, 35(4), 481-501.

Wright M., Clarysse B., Lockett A., Knockaert M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. Research Policy, 37(8): 1205-1223.

TABLE 1

Univariate statistics for interest in academic spin-out investing (Mann-Whitney U test)

	Academic spin-out investors	Non-Academic spin-out investors
Percentage public capital**	28.29 (40.96)	7.77 (18.36)
Post-investment involvement (average number of days per month)***	3.32 (2.94)	1.73 (1.07)
Specific human capital		
Academic experience (number of years)	1.57 (4.01)	0.28 (1.21)
General human capital		
Financial experience (number of years)	8.01 (7.81)	5.00 (2.97)
Consulting experience (number of years)*	0.95 (2.32)	1.16 (2.10)
Management experience (number of years)	4.38 (6.21)	3.48 (6.67)
Entrepreneurial experience (number of years)	1.30 (3.43)	0.88 (2.09)
Number	**43**	**25**

Levels of significance for differences between groups: * p< .10; ** p<.05; *** p<.01; **** p<.001; n=68

TABLE 2

Correlation matrix

	Mean (s.d.)	1	2	3	4	5	6	7	8
(1) Percentage of public capital	20.83 (35.73)	1	-.20	.12	.37*	-.07	.05	.19	-.16
(2) Post-investment involvement	2.81 (2.60)		1	.03	.09	.00	-.13	-.07	-.17
(3) Academic experience	1.09 (3.31)			1	-.19	.03	.30*	.50*	.10
(4) Financial experience	6.89 (6.77)				1	-.25*	-.28*	-.04	.10
(5) Consulting experience	1.03 (2.22)					1	.04	-.06	-.05
(6) Management experience	4.04 (6.35)						1	.05	-.07
(7) Entrepreneurial experience	1.15 (3.00)							1	-.11
(8) Fund size	269.04 (654.25)								1

Pearson correlations level of significance: * $p<.05$; n=68

TABLE 3

Binary logistic regression

	Academic spin-out investor (0/1)
Independent variables	
Percentage public capital	0.03**
	(0.02)
Post-investment involvement (average number of days per month)	1.27***
	(0.48)
Specific human capital	
Academic experience	0.41**
	(0.20)
Technical education	-1.51
	(1.85)
General human capital	
Financial experience	0.15
	(0.11)
Consulting experience	0.16
	(0.22)
Management experience	0.08
	(0.07)
Entrepreneurial experience	-0.40*
	(0.22)
Business administration education	-.00
	(1.81)
Control variables	
Fund size	0.00
	(0.00)
Biotech	-1.21
	(0.90)
ICT	2.09
	(1.50)
Constant Term	-4.47
Nagelkerke R^2	0.55

Levels of significance: * p< .10; ** p<.05; *** p<.01; **** p<.001; n=68