

**HOW DO EARLY STAGE HIGH TECHNOLOGY INVESTORS SELECT
THEIR INVESTMENTS ?**

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ABSTRACT

This study examines the investment selection behaviour of 68 European early stage venture capital funds specialized in high technology. In particular, we examine whether or not early stage high tech VCs exhibit heterogeneity in their selection behaviour, and if so, what drives this behaviour. To examine these issues we employ a conjoint analysis methodology, which requires venture capitalists make investment decisions in 27 well selected business proposals. Our results indicate that VCs exhibit substantial heterogeneity in investment selection behaviour, however, employing a cluster analysis three clear types of investors emerge: those who focus on technology, those who focus on finance and those who focus on people. We then examine differences between the three groups in terms of the sectoral focus, the sources of the funds and the background/ education of the investment manager. The results indicate that technology investors make most use of public money and invest in biotech. These investment managers sometimes have an academic background. Finance investors make the least use of public capital, invest in ICT and their investment managers are the least experienced. People investors are most often found in the other sectors and the investment managers combine experience within other VC funds and have a business education.

The results indicate that public money in the VC industry is used for investing in business proposals with strong technologies. In this way, public money aims at stimulation of technological renewal and thus economic growth, and helps to overcome the market failure that is existing for early stage high tech funding at an early stage.

INTRODUCTION

Getting an insight in to how venture capitalist funds make investment decisions has been a major topic of research during the past two decades. Previous research has identified a number of important criterions on which venture capital firms base their decision to invest. A first group of scholars found that the “human capital” of entrepreneurial teams was a very important decision factor. This human capital includes among others a) the ability of management, whether it is management skill, quality of management, characteristics of the management team or the management track record (Shepherd and Zacharakis, 1999); b) the management skills of the entrepreneur (Tyebjee & Bruno, 1984; MacMillan et al. 1985; 1987); c) the heterogeneity of the entrepreneurial team (Keeley and Roure, 1989). A second series of researchers have identified the market environment in which the venture starts up as one of the major decision factors. This environment includes the characteristics of the market/industry (Hisrich and Jankowitz 1990), environmental threats to the business (Tyebjee and Bruno 1984, Meyer et al, 1993), the level of competition (Hutt and Thomas 1985, Kahn 1987, Muzyka et al, 1996) and the degree of product differentiation (Tyebjee and Bruno 1984, Hutt and Thomas 1985, Kahn 1987, Hisrich and Jankowitz 1990). Other factors which are found to be important criteria used by venture capitalists to evaluate venture proposals are the financial criteria and exit opportunities (Macmillan et al., 1987) and the product/service characteristics (Macmillan et al., 1987; Muzyka, 1987).

Virtually all of the above mentioned studies have been undertaken with US based venture capitalists. Further on, Muzyka et al (1996) emphasize that the aforementioned studies were exploratory in terms of data collection technique and assume a single hierarchy of decision criteria. Along the lines of this criticism, Muzyka et al (1996) explored the trade offs in decision criteria among the European Venture Capitalists. They found three groups of VCs in Europe: those primarily concerned with investing nationally, those who focus solely upon the deal, and mainstream investors who consistently and instinctively rank management team criteria at the top of their list. The Muzyka et al. (1996) study was a first attempt to synthesize and hierarchically classify to selection criteria found by the first wave of VC studies. However the

results remained meagre, having one cluster with only four VCs and a very large one where – consistent with the previous studies – the “human factor” is the utmost important one.

Since the Muzyka study in the mid-nineties, the venture capital industry in Europe has grown significantly. In parallel, VC scholars have emphasized that the VC industry is fragmented into different segments. Many studies find that early stage VCs differ from late stage VCs (Elango, 1995; Sapienza et al 1994).

However, research on selection behaviour of VCs has so far has only focused on the venture capital industry as a whole. Several researchers have however indicated that high tech investing is different (Lockett et al, 2002; Murray and Lott 1996; Baum and Silverman 2003) and that some investors have a bias against investing in high tech. In this research, we are focusing on those venture capitalists for whom investing in high tech is core business. As economic growth is determined by, amongst others, technological renewal, it is important to study this group of high tech VCs from a policy perspective. High tech investors play a key role in funding high tech companies that can accomplish this technological renewal, and thus create economic growth.

This study builds upon the previous work of Muzyka, departing from the same hypothesis that not all venture capitalists use the same hierarchy of decision criteria. Consistent with Muzyka (1996), we test this hypothesis by investigating the trade offs made by venture capitalists in Europe at the moment they make a decision to further investigate an initial business plan or not. Taking into account the market fragmentation which is suggested by other scholars, we focus on a population of early stage high tech venture capital funds in Europe. This provides some degree of homogeneity in terms of the forms of the firms. Next to this, the methodology includes face-to-face interviews, having venture capitalists evaluate business proposals and comment on their decisions, thus capturing both quantitative and qualitative data.

The paper unfolds along the following lines. We start with the theoretical background and formulate a hypothesis framework. Second, we discuss the methodology used. In a third part of the paper, we analyse the cluster results. Then, we link the cluster results with the characteristics of the funds. The paper ends with a discussion of the conclusions and recommendations.

Theoretical background: ‘The heterogeneity of VC investment selection behaviour’

As described in the introduction, many studies have already looked at the selection criteria of venture capitalists. The early studies in the eighties and mid-nineties indicated that for the average venture capitalist the “human factor” is the most important criterion. This human factor can be found in the entrepreneurial experience, the management skills and the business experience, which are allocated to the founding team (Hall and Hofer, 1993 for a review of these early studies). Sandberg et al. (1988) suggest a contingent relationship among the criteria used by VCs. In line with most studies at that time, they argue that deals are selected based upon the human resource criteria in combination with the characteristics of the industry, the proposed strategy or business model and the structure of the deal.

Although these early studies revealed interesting and useful insights, they were criticized for using simple methodologies in assessing the evaluation criteria. In short, the most often used method was a post hoc methodology which consisted effectively of asking why investment managers had invested in certain business proposals. This method, however, is problematic as it might generate biased results because people are poor at introspection (Shepherd and Zacharakis, 1998), are often motivated to bias results in a post hoc rationalisation (March and Feldman, 1981), and have limited capacity to recall what has happened (Fischhoff, 1982). As a reaction on these post hoc methods, researchers started to experiment with real time methods such as verbal protocol analysis. Hall and Hofer (1993) presented four venture capitalists six protocols for assessment. They found that VCs screen and assess business proposals very rapidly which makes it unlikely that they can persistently evaluate their decisions post hoc. They found that the key criteria used by the VCs have to do with the financial and economic conditions of the business plan such as long term growth and profitability. Surprisingly they found a lack of importance placed on the entrepreneur or his team. So far, they are the only study which has found financial criteria to be of utmost importance.

Riquelme and Rickards (1992) question the subjectivity of the analysis and interpretation involved in verbal protocol techniques without being supplemented with other techniques such as computer algorithms. They suggest that verbal protocol analysis is more an art than a science. Instead, they suggest using conjoint analysis as a technique for the analysis of VCs’ decision making. Conjoint analysis is not new, it is a general term referring to a technique that requires

respondents to make a series of judgements, based on profiles, from which their 'captured' decision processes can be decomposed into its underlying structure. A profile is simply a combination of all the attributes where each attribute is described by one of its levels. It has been used in other fields of research, especially in marketing, where it has a strong tradition.

Muzyka et al. (1996) followed Riquelme and Rickards' pioneering work to use conjoint analysis in assessing the decision criteria used by VCs. In a more sophisticated analysis, he analyses the key criteria used by European VCs in evaluation potential investments characterized by 53 profiles (each profile required the respondent to make a trade-off between a pair of independent criteria). To determine which attributes were to be included in the conjoint analysis, he carried out open-ended interviews with VCs. The venture capitalists made 53 pair wise trade-offs with multiple levels. They found that among the first seven, five management team criteria were ranked and product-market criteria appeared to be moderately important; fund and deal criteria were at the bottom of the rankings. Over 75% of the venture capitalists in their study had this kind of profile.

Zacharakis and Meyer further refined this use of conjoint analysis and let venture capitalists invest in 50 ventures in an experimental setting. They found that team factors were much less high in the hierarchy and a significant group of VCs ranked market and competition variables as being the most important.

Next to the methodological drawbacks of most previous studies, it is surprising how they all focus on the venture capital industry as a whole, while previous research shows that this venture capital industry is not homogeneous in its investment focus. Lockett et al (2002) found that, in comparison to the Murray and Lott study (1995) a bias remained against VC firms' involvement in the earliest stages of the technology investment cycle. Therefore, we have reasons to believe that the high tech VC industry is a distinct market in itself and that firms may behave differently from their non-tech counterparts. That is why this research only focuses on those venture capitalists investing in early stage high tech proposals.

To summarize, the aforementioned studies seem to suggest that there might be three groups of venture capitalists. One group, which is called by Muzyka et al. (1996), the mainstream venture capitalist, emphasizes most the human resource criteria, followed by product market and venture capital specific criteria such as exit possibilities. A second group of venture capital funds distinguished by researchers using real life protocols are investors which place

most importance on the financial aspects of the business plan such as growth, time to break-even and profitability. Finally, a new stream of research using conjoint analysis seems to recognize a group which is much more concerned about the product market characteristics of the business plan than of the management and entrepreneurial team criteria. This leads us to the following proposition:

Proposition 1: Early stage high tech investors will exhibit heterogeneity in terms of their focus of investment selection behaviour.

What drives differences in investment selection behaviour?

Detecting changes among investment criteria is only a first step in our understanding of the venture capital rationale. A subsequent question which arises is why venture capitalists differ in their selection criteria. A number of explanations have been suggested in the literature. For instance, Elango et al. (1995) showed that there are significant differences in investment criteria between venture capitalists focusing on early stage and late stage deals. Late stage investors seem to emphasize much more the market acceptance than the early stage investors. Mayer and Schoors (2002) confirmed these differences when they compared sources of funds and investment activities of venture capital funds in Germany, Israel, Japan and the UK. The country differences they found were related to the sources of VC funds that differed significantly across countries.

There is also some emerging evidence that venture capitalists, which invest in high tech use different criteria than the non tech VCs (Lockett et al, 2002). However, these studies suggest that there is a very strong correlation between investing in early stage business proposals and high tech ones.

Mayer and Schoors (2002) find that venture capitalists invest in different types of business proposals according to their own sources of funds. For instance, bank and pension fund backed VC firms are inclined towards late stage investments in low tech domestic sectors whereas government backed VC funds invest in early stage domestic high tech sectors. Although this study does not specifically look at the investment criteria used, it indicates that the

institutional structure has an important effect on the decisions which are made by the investment manager. In other words, it suggests that the investment criteria are indeed different.

It seems indeed reasonable investment managers investing funds from public initiatives have other than financial objectives , and may be focusing more on the capacity of technological breakthrough and renewal of a project, as this may influence economic growth. Bank and pension fund backed VC firms may be biased in their investment behaviour by guidelines set out by their investors, and may be influenced by the financial culture of these investors.

This leads us to the following proposition:

Proposition 2: The source of funds of European high tech early stage venture capitalists will have a significant effect on the selection criteria used by these VCs

Shepherd et al (2002) suggest that also the investment manager's experience plays an important role. They were the first to link selection behaviour to investment manager's experience. They examined whether more experience at the venture capital task resulted in better decisions. The results show that experience is beneficial to VC decision-making, but only up to a point (14 years of experience). In their model, age, stage of investment and technology were each individually added as a control variable and the results did not significantly change and none of these control variables were significant.

Also in our sample of early stage high tech investors it seems plausible that the emphasis investment managers put on certain criteria may evolve. An investment manager, who has experienced the difficulties the replacement of the portfolio company's CEO brings, may stress human factors when selecting new projects. Or this experienced investment manager may stress protect ability of the product that the portfolio company commercialises, as he learnt that this protection gives the possibility to reform the management team or change the company's strategy, without loosing value to competitors. It may even be that the most experienced investment managers attach little importance to financial forecasts in the business plan, as they often prove to be unreliable, and far away from reality.

This leads us to the following proposition:

Proposition 3: The background and experience of the investment manager will have a significant effect on the selection criteria

Baum and Silverman (2003) indicate that there are three broad types of signals that may affect VCs' assessments of start-ups: alliance capital, intellectual capital and human capital. Interestingly, their research only focuses on VCs investing in biotech companies. According to them, a start-up's alliances provide signals for both access to valuable resources and knowledge critical to early performance. Next to this, by signalling innovative capabilities, patents and patents pending (intellectual capital) helps start-ups possessing them to acquire additional resources, increasing the likelihood that they will obtain VC financing. Finally, they indicate that the identity and background of top management are widely regarded as important signals of a start-up's future potential, increasing its chances of obtaining VC financing. They found that start-ups with more downstream and horizontal alliances obtained significantly more VC financing than start-ups with fewer alliances. Start-ups with more patents granted or patent applications also obtained significantly more VC financing. Finally, start-ups with larger top management teams, presidents that take on a broader role and presidents who currently act as president of other biotechnology start-ups obtained significantly more VC financing.

It looks reasonable that VCs investing in biotechnology projects will stress the protect ability of the technology, while this is much less the case in ICT, where software is hard to protect. Having a team with strong commercial skills and a good network may matter more in ICT businesses where knowledge is hard to protect and time to market is crucial. Next to this, it would not be surprising that biotech investors prefer non-platform technologies over platform technologies. A lot of investments in companies using a platform technology in biotech turned out into service companies, and generated poor returns for investors in the past. Biotech investors may thus be less inclined to investing in platform technologies. Next to this, biotech companies looking for finance in an early stage hardly ever have a product that is already accepted by the market. We may then assume that market acceptance will be a little important criterion for biotech investors.

Proposition 4: the sector in which the business proposal is situated will have a significant effect on the importance of selection criteria

METHODOLOGY

As outlined above, most of the studies into VCs' decision making have relied on post-hoc methods of data collection. These methods include the use of questionnaires, surveys and interviews to collect data on the VCs' decision policy. Sandberg et al (1988), Hall and Hofer (1993) and Zacharakis and Meyer (1995) attempt to overcome these problems by using verbal protocols. These verbal protocols have the advantage of being real time experiments where VCs 'think aloud' while a business plan is being screened. The problem with these real time studies is that it is difficult to analyse the data in a consistent way and sophisticated computer algorithms are needed to detect patterns. In this study, we build upon the positive aspects of both the post hoc and the real time studies. Post hoc studies have the advantage of measuring complex issues in an easy to analyse way. Real time studies have the advantage of observing the decisions at the moment they are made.

Instead, we presented the venture capitalists with a number of fictive business cases that differ on attributes.

These attributes were selected in two steps. First of all, we made an overview of criteria that had been used in previous research. Apart from this, we had 2 VCs, 1 business angel investing in early stage high tech and 3 VC experts draw a list of criteria that were important to them. This was necessary given the fact that no research had been conducted with high tech investors exclusively and in order to impede that selection criteria important to those VCs were excluded. We got back to them after making the comparison between literature and their own lists, and ended up with a set of attributes that they accepted as being the criteria they judged on when screening a business plan in reality, and still remained concise enough in order to have VCs make judgements based on abstract information.

We ended up with four main categories of selection criteria: team, market, product and finance. In total, twelve different attributes were included: team, entrepreneur, contact with the entrepreneur, uniqueness of the product, protection of the product, market acceptance, platform technology, location, size and growth of the targeted market, time to break-even and return on investment.

An example of the business plan presented is shown in figure 2. In line with the conjoint analysis philosophy and consistent with Muzyka et al. (1996), potential events were matched to the different attributes (see table 1). Thirty levels or events were conceptually developed based upon the twelve attributes. For instance, team complementarity and experience are two important characteristics of the attribute “team”. A business start-up team can then be complementary, but have no experience or be not complementary and have experience, or have none of both. This means that four different combinations are possible for the attribute “team”. For other attributes such as uniqueness, only two levels are allowed: either it is unique or not.

-- Insert table 1 about here --

The possible events associated with the twelve attributes summarized in table one can then be combined into ‘business proposals’ (or profiles). Theoretically any combination of 12 (number of attributes) out of 30 potential events is possible. This would result in more than 1000 theoretically feasible business proposals or profiles. The total number of profiles resulting from all possible combinations of the levels would become too great for respondents to score in a meaningful way. Therefore, a fractional factorial design using Addelman’s basic plans (Addelman, 1962) for designing an orthogonal main effects plan was chosen. This resulted in 27 business proposals that were presented to the respondents (investment managers). These 27 proposals were printed on ‘cards’ used during the interviews (see figure 2 for example of such a business proposal). Investment managers were asked to judge the proposals on a five-point Likert scale (1= bad investment opportunity, I would certainly not invest; 5= major investment opportunity, large chance of investing). From these scores, conjoint analysis derived utility scores for each attribute. Utility scores are measures of how important each characteristic is to the respondent’s overall preference of a product. Based on these utility scores importance scores were computed by taking the utility range for the particular factor and dividing it by the sum of all utility ranges.

-- Insert figure 2 about here --

The sample

A stratified sample of 68 VC firms was drawn from different regions across Europe, which were selected as being those with the highest R&D intensity and venture capital presence. Since we only considered early stage high tech, we needed to get an international dataset because

the number of VCs of any one country, outside of the US, would have been too small. 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 wanted to have a representation of small and large funds with various degrees of public funding. Because a random sampling based upon the most widespread available sample frame, i.e. the EVCA-filings, would result in a sample biased towards the larger private venture capital firms, 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 that cover the topic in each of the seven regions selected. This resulted in a population of 220 funds. We only included funds that are early stage and high tech investors. The sample frame was stratified in different groups or subpopulations according to the scale of the funds (small funds versus mega funds) and their institutional investors (captives, private funds, public funds, private/public partnerships). Figure 1 shows also the representativity of these funds in comparison with the total number of funds in high tech and early stage and their capital managed per region, selected in our database.

-- Insert table 2 about here --

-- Insert figure 1 about here --

Data collection

The interview consisted of two parts and took on average 1,5 hours. Data were collected during the period January 2003-November 2003. First, we collected information about the resource-based characteristics of the venture capital firm, and the investment manager interviewed. Information that we obtained before the interview, such as website information was verified and completed during the interview. This includes information on fund size, origin of the funds, number of years since establishment, number of investments made in early stage high tech, sectors of investment etc. Information on the investment manager included information on education, experience (as entrepreneur, in business, as investment manager) and his/her sector focus. Second, we studied how these investment managers select projects using the 27 business proposals as an interview guideline. Before having the respondents score the proposals, we

showed a fictive business card (see figure 2), so that they would understand the criteria combined in the cards, and went in the meanwhile through the definitions used (see table 3). This allowed us to make sure that each respondent had the same understanding of a criterion. The investment managers judged the business proposals on a 1-5 scale. They were asked to motivate their scores. This allowed us not only to get an insight into the selection process and the importance of certain criteria, but also to get an insight into the reasoning process of the respondent. In this way, we could both collect quantitative and qualitative data on the selection process, in contrast to previous research using conjoint analysis. Quantitative analysis permitted to shed light on the importance of selection criteria and the respective importance scores, where as qualitative data permitted to interpret the results obtained from the analysis.

-- Insert table 3 about here --

RESULTS

The heterogeneity of early stage high tech VC investment selection behaviour

From the scores investment managers gave to the 27 business proposals, conjoint analysis derived utility scores for each attribute. Utility scores are measures of how important each characteristic is to the respondent's overall preference of a product. Based on these utility scores importance scores were computed by taking the utility range for the particular factor and dividing it by the sum of all utility ranges. Using the importance scores, relative rankings of the investment decision criteria per respondent could be made. The model proved the internal validity of the data (high Pearson's R and Kendall's tau statistics).

Figure 3 provides an insight into the ranking given by early stage high tech investors to selection criteria. Descriptives for the importance scores of each criterion are given in table 4.

-- Insert figure 3 here --

--Insert table 4 about here --

Potential return on investment, and people characteristics, such as the ability of the entrepreneur and the characteristics of his team seem to be on top of the list of important selection criteria. Size and geography of the market (global or regional) and whether or not a technology is a platform technology have little impact on the VC's decision.

But do this group of early stage high tech investors form a homogeneous group of investors, or do differences exist among them?

Analysis of proposition 1: Early stage high tech investors will exhibit heterogeneity in terms of their focus of investment selection behaviour.

Proposition 1 stipulates that different groups of investors will differ in the way they rank their selection criteria in order of importance. To explore this proposition, we used a cluster analysis. Cluster analysis encompasses a number of different classification algorithms, which can be classified into two broad families: hierarchical and non-hierarchical clustering. Ketchen & Shook (1996) suggest using both procedures as complements to each other: first a hierarchical procedure can be used as an exploratory methodology to determine the desired number of

clusters and as input to the non-hierarchical step. We follow this two-step approach. To perform the hierarchical cluster analysis, we follow Ward's procedure with squared Euclidean distance as linkage measures (Hambrick, 1983). We used the output of the conjoint analysis presented in figure, being the importance scores derived from the interviewee's responses. Importance scores link to the following criteria: characteristics of the team, characteristics of the lead entrepreneur, contact with the lead entrepreneur, market size, market growth, geography of the market, platform technology, protect ability of the product, uniqueness of the product, market acceptance, time to break-even and return on investment. Following the criteria of Hair et al. (1992), we find a three clusters-solution as the most appropriate for our data. Figure 4 shows the tree diagram for the cluster analysis. Subsequently, we performed a k-means clustering with three clusters as the predefined number of clusters and the same variables as inputs.

--Insert figure 4 about here --

For ease of interpretation, each cluster was given a name, indicating the selection behaviour of its members. The F-statistic of the variance analysis and the descriptive statistics for each cluster are given in Table 5. We found that 6 decision criteria were significantly different at the 0.05 level for the three groups. First, the importance given to the human resource variables as a reason to invest was significantly different between the clusters (complementarity of the venture team, competence of the lead entrepreneur and contact with the VC). Second, the market location (local versus global) was significantly different. Third, the importance given to the protect ability of the technology characterized certain investors. Finally, the financial part of the deal such as ROI was significantly different. The specific cluster characteristics are discussed below.

-- Insert table 5 --

CLUSTER 1 (20 VCs) we term the cluster of the *financial investors*. This group of investors emphasizes the potential return set out in the business plan. As shown in table 2, the ROI criterion receives an importance score of 25 out of 100. Business plans that do not show sufficient potential return are not selected. Next to this financial criterion, these investors also find the team complementarity and the market forecast important. These investors mainly invest in complementary teams with strong leaders that are focussing on fast growing markets. If we add the importance scores attached to the entrepreneurial team, competence of the lead

entrepreneur, market growth and potential return on investment, we get an importance score of 55 out of hundred. This means that these investors base their investment decision on a very rational logic which is based on a limited set of quasi objective factors such as ROI, growth and team completeness. In line with this, it is the group that attaches the least importance to the contact with the entrepreneur. It looks as if these investors want to have complementary teams with good leadership potential, but do not bother much about getting along with the entrepreneur. It looks as if they feel confident that a well established team will generate the financial return they are aiming for, without too much interference or coaching from them.

CLUSTER 2 (22 VCs) we term the cluster of the *technology investors*. These investors make a much more balanced analysis of a business proposal than the previous group. This means that they take into account much more criteria than the other VCs. Many criteria receive an equal weight in the final decision and only the degree to which the technology can be protected and the contact the investment manager has with the entrepreneur receive an importance score of more than 10 out of 100. This group of investors also emphasizes the “uniqueness” of the product. Next to these factors, also potential market growth, return on investment and uniqueness of the product matter. Protection ability and contact with the entrepreneur are factors on which they differ from other investors; they attach much more importance to these criteria than the other groups of VCs.

CLUSTER 3 (26 VCs) we term the cluster of the *people investors*. Most important factors in the selection process are human factors, such as leadership capacities of the entrepreneur and the quality (complementarity and experience) of his team. Financial criteria come in at a second place. Closely connected to these human factors, is the contact with the entrepreneur, however, it is less important than for the technology investors.. This cluster also attaches the least importance to the ability to protect the technology. The selection behaviour that this group demonstrates comes close to the findings of studies based on post-hoc data collection methods which found that the quality of the entrepreneur is the most important selection criterion (Wells, 1974; Poindexter 1976; Tyebjee and Bruno 1984 ; MacMillan et al 1985, 1987). It can be assumed that this group is a group of traditional VCs that have a long tradition and only recently turned to investing in high tech. Therefore, they are still focusing on the same criteria that were found by researchers studying selection behaviour of the overall VC industry, given their long tradition.

No significant country differences were found between clusters .

-- Insert table 6 about here --

We thus find partial support for our first proposition. Indeed, we find a considerable degree of heterogeneity in the way in which early stage high tech VCs select their investments. In particular, we find a group of investors, which emphasize the human resource or team characteristics; a group which puts most emphasis on the financial data (in line with real time studies); and a group which stresses the technology characteristics such as patent ability of the technology and the degree to which the technology can be protected. Furthermore not only do we identify key differences between the focus of different VC firms in terms of their selection behaviour we also identify differences between how balanced the firms selection criteria are. Financial and people investors tend to make their investments very focused on few criteria, where as the decision made by technology investors tends to be very balanced, taking into account several criteria, and making a balanced evaluation of the business proposal as a whole.

Origin of VC funds effects

In previous studies, we found arguments that the institutional origin of the venture capital fund had an impact on the kind of deals that the fund attracted. This argument was the basis for proposition two, which argues that the source of funds of the high tech, early stage venture European capitalists will have a significant effect on the selection criteria used by these VCs. For instance, public funded VCs may not only focus on realising a considerable return, but may also take into account other factors such as employment and technological renewal. Bank funded VCs may be inclined to following rules of thumb existing at the bank level, and may put much more weight on financial forecasts, given the financial culture at the bank.

To test this proposition, we analysed whether the three different types differed significantly from each other in terms of institutional origin. Institutional origin was operationalized in the following ways. First, we made a distinction between funds that are part of a larger holding and those that are not. A fund is considered to be part of a holding if it is part of a group of funds such as follow-up funds or funds with different investment focuses. . Finally, we analysed the degree of public capital in the fund structure.

The results of the univariate analysis are mixed. First, we do not find a significant difference with respect to holding structure although the funds that belong to a holding tend to be less prevalent among the technology investors. The latter group are more independent funds created by successful entrepreneurs, who looked for additional institutional investors to complement their own money. Even though the proportion of captive funds (funds being part of a larger group, more specifically a financial institution) is the highest within the cluster of the financial investors, this is not significant. So, Finally, we examined the difference in the degree of public money, which these funds have access to. It is clear that among the technology investors, the availability of public money is the largest. The venture capitalists that belong to these investors have over 30% of their money from public funds such as national government initiatives or the European Investment Fund. Financial investors however make the least use of these public sources. Only 8% of their fund structure is on average of public origin. This could signify that public money is being used to help overcome problems of market failure for high tech. Lockett et al (2002) conclude in their 1999 survey of UK VCs that a bias against VC firms' involvement in the earliest (seed and start-up) stage of the technology investment cycle remains. By investing in these early stage technology funds, governments want to stimulate technological renewal, and thus stimulate economic growth.

Experience of VCs Effects

Proposition 3 stipulates that the background and experience of the investment manager will significantly affect the way in which the selection is performed. To operationalize this hypothesis, we looked at three different kinds of experience or background. First, we made a distinction between those investment managers with a technical degree (engineering or scientists), those with a business degree (MBA) and those without any of the above. Second, we measured whether they had experience in previous jobs and if so, what kind of job they had done. If they worked in a bank or accountancy firm, we classified this as having financial experience. If they had worked at university after graduating, we labelled this academic experience. If they had worked as a consultant, this was coded as consulting experience. If they had been entrepreneurs themselves, we coded this as having entrepreneurial experience. Finally, if they had some overall experience in a company, we labelled this business experience.

Overall, we find that over half of the investment managers included in our sample had a technical degree. This is not surprising since we specifically focus in this study on high tech venture capital funds. Only in the category of people investors, we do find less of these technically educated investment managers. However, the difference is not significant. Even more of the investment managers have an MBA. In contrast to the technical degree variable, we find that the MBA variable is significantly different. In the category of people investors 83% of the investment managers had an MBA. There does seem to be a clear correlation between a business degree and the importance which is given to the people and team variables.

In terms of experience, we find that the few investment managers with academic experience seem to belong to the category of technology investors. This result is in line with the expectations since this category of venture capitalists tends to be specialized in pre-seed investments and are often linked to universities and/or public research labs. It seems then logic that the prevalence of academics among these investors is highest.

Quite counter-intuitive is the result that investment managers with banking experience belong to the group of people investors and *not* to the group of financial investors. Financial investors seem to have the least experienced investment managers with a technical degree. Few investment managers have entrepreneurial experience. This is surprising since the finds in our sample specifically focus on early stage investments.

Neither did we encounter a lot of investment managers with prior experience in other VC funds. Only one out of five of the investment managers had prior experience. This indicates that the emergence of early stage high tech venture capitalists is a pretty new phenomenon. We find that the technology investors often have investment managers which are brand new in the business. However, the result is not significant.

So it does seem again that the people investors are those that have been in the VC business for quite a long time, and shifted to making high tech investments recently.

-- Insert table 7 about here --

Sectoral Effects

In proposition 4, we argue that the sectoral focus of the fund will play a role. To operationalise this sectoral focus, we use the sectoral distinctions which are most often made by

the VCs themselves. We make a difference between biotech, ICT, industrial automation and other.

More than half of the funds invest in biotech, which is not surprising since they are high tech venture capital funds. The percentage of technology investors investing in biotech is significantly higher than within the group of the financial and people investors. The last two categories are significantly more involved in ICT investments than the technology investors are. People investors invest more in industrial automation than their colleagues in other categories do.

Again, we find thus a significant difference between the different sectors.

CONCLUSION

In this paper, we analysed how high tech early stage venture capitalists in Europe select deals to invest in. To do so, we use a novel methodology which combines the advantages of the post hoc studies and the real time studies. The post hoc studies have the advantage that they generate well codified results that are easy to analyse, the real time studies offer insights in decision criteria, which might be more implicitly taken into account than explicitly remembered. The post hoc studies usually conclude that team variables are the most important ones, while real time studies indicate that other variables such as financial and product market expectations might be much more important than initially thought.

Whereas most real time and post hoc studies make only a listing of the criteria, which are found to be important, studies based upon conjoint analysis techniques go one step further and propose a hierarchy of decision criteria used. In line with these studies, we also propose a hierarchy of decision criteria in this paper. Further, we limited the analysis to early stage, high tech venture capitalists in Europe. There are several reasons for this: first, the venture capital industry in Europe has boomed since the mid-nineties and several specialized early stage venture capitalists have been created. Second, most studies find a difference in selection criteria between early and later stage venture capitalists. Our focus of interest is specifically on early stage deals and the differences among these investors. Finally, investment in high tech companies has emerged as a specific business in itself, attracting a number of investment managers and newly created funds which would else not have been in the venture capital industry.

Using a cluster analysis, we find that the 68 funds are equally spread over three clusters, which we labelled the “financial investors”, the “people investors” and the “technology investors”. The people investors correspond most to the investors found in the post hoc studies. They overemphasize the team and leadership criteria of the founders. However, we also find the financial variables to play an important role. Market size and growth are much less important. People investors tend to have the most experienced and educated investment managers. It might well be that they are the longest in industry and therefore it is not surprising that they correspond most to the profile found in the older studies; A second group, which can be clearly distinguished are the financial investors. 25% of their investment decision is based upon expectations about

ROI. These investors usually take minority positions in deals and are managed by the least experienced investment managers. It seems as if they compensate lack of experience with technical knowledge about financial engineering. Also for them the market prospect is quite unimportant. Finally, we detected the category of technology investors. For this category, the extent to which the technology can be protected and the contact they have with the prime founder of the start-up are key. However, they also look at other variables such as ROI, market prospects and founder characteristics. After all, they make the most balanced due diligence.

In comparison to the previous studies, we find that the product market characteristics are overall considered to be relatively unimportant. This might be explained by the fact that we look here specifically at *early stage* venture capitalists. Start-ups usually have a less clear idea about the downstream market and make more assumptions about this market in their business plan. This might explain why the venture capitalists investing in these business plans pay less attention to the proposed market expectations. We also find that there is a category investors, which is quite different from the ones found in previous studies: the technology investors. They might be unique for early stage high tech venture capitalists.

We further made some hypotheses in the paper about how to explain the differences in selection behaviour. Previous studies indicated that institutional background, the sector in which the venture capital fund is active and the background of the investment manager plays a role. Indeed, we find differences that can be related to these three groups of variables. First, we find that the extent to which these funds use public capital is different. Especially technology investors make use of different public forms of support. We also find clear sectoral differences. Technology investors have more frequently a focus on biotechnology, while financial investors are most often found among the ICT investors. Finally, the people investors focus on industrial automation. Finally, we looked at the background and education of the investment managers interviewed. People investors tend to be the most experienced and have obtained the highest degree. Technology investors have often an academic background.

If we look at the analysis from a policy point of view, we find the most public money in the funds of the technology investors. Given that these investors focus the most on the technological strength of a business plan, it looks as if this money is used for technological renewal and for stimulation of economic growth. This public money is managed by investment managers that have a profile that is not very usual in the VC industry. Quite a lot of these

investment managers have academic experience, working as research assistant or Ph. D. student in a technological domain before coming to the VC industry. Very little of them have prior experience as manager of other funds, and are thus new in business. They are more than other funds involved in biotech investing, and less in ICT investing. As these investors are active in a very early stage more frequent than the other groups (often provide seed financing), it is acceptable that they are helping to overcome the market failure high tech entrepreneurs are confronted with.

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Table 1: Trade-off table

Characteristics of...	Attribute	Levels (potential events)
A) Team	1) Team	1) Non complementary and no business experience 2) Complementary and business experience 3) Non complementary and business experience 4) Complementary and no business experience
B) Entrepreneur lead entrepreneur	2) Entrepreneur	5) Leader: yes 6) Leader: no 7) perseverance: yes 8) perseverance: no
C) Proposed product or service	3) Contact with the entrepreneur	9) contact with VC: good 10) contact with VC: bad
	4) Uniqueness	11) Product is unique: 12) Product is not unique
	5) Market acceptance	13) product is accepted by the market 14) product is not accepted by the market
D) Technology	6) Protection	15) Protection is possible
	7) Platform technology	16) Protection is not possible 17) It is a platform technology 18) it is no platform technology
E) Targeted market	8) Location	19) the market is regional
	9)-Size	20) the market is global
	10) Growth	21) it is a niche market 22) it is a mainstream market
		23) the market is seemingly high growth 24) the market is low growth
F) Financial forecast	11) Time to break-even	25) expected time to breakeven is Less than 1,5 years,
	12) Return	26) expected time to breakeven is more than 3 years 27) expected time to breakeven is between 1,5 and 3 years
		28) expected return is Less than 30%, 29) expected return is more than 50%
		30) expected return is between 30 and 50%

Table 2: Distribution of interviews by region

Region	Country	Number of interviews carried out
Ile-de-France	France	10
Helsinki region	Finland	7
Stockholm region	Sweden	11
Flanders	Belgium	8
Bavaria (Münich region)	Germany	10
South-East England	UK	11
North-Holland	The Netherlands	11
		68

Figure 1: Sample of European early stage high tech investors

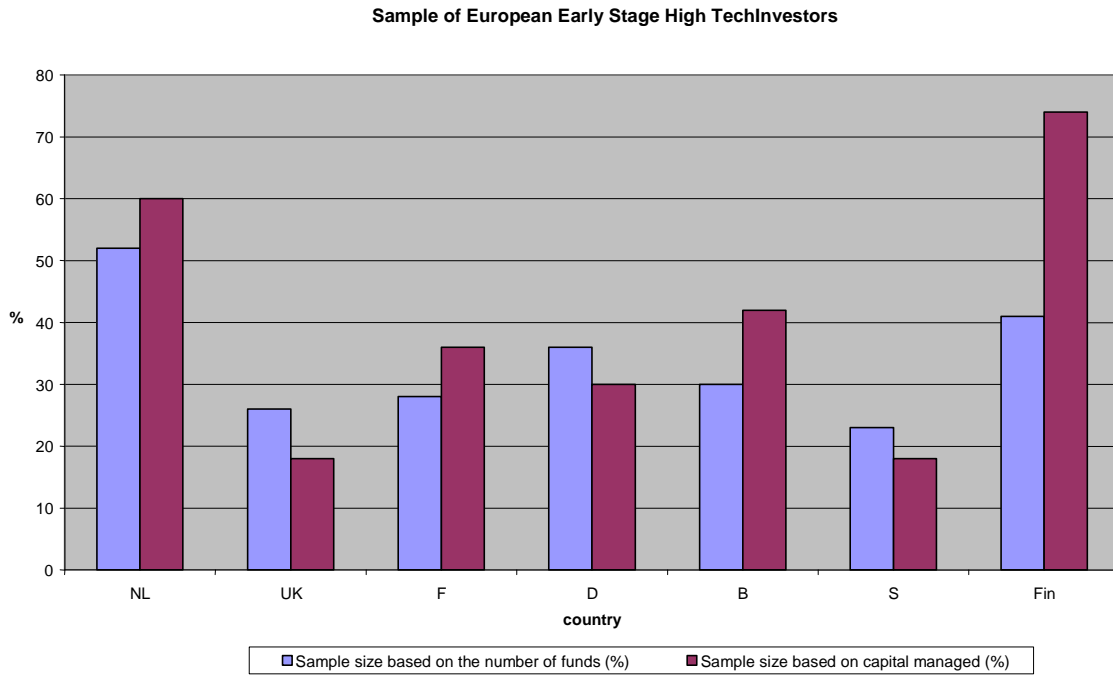


Figure 2 : Example business proposal scored by investment manager

You will be presented a project with following features

- The team is NOT COMPLEMENTARY and has NO BUSINESS EXPERIENCE
- The entrepreneur is a LEADER with PERSEVERANCE, with whom you have a GOOD contact
- The company will play on a WORLDWIDE NICHE market with HIGH growth potential
- The product is UNIQUE and can be PROTECTED, and is ALREADY ACCEPTED by the market
- We can speak of a PLATFORM technology
- We expect break -even AFTER MORE THAN 3 YEARS and a return which is LOWER THAN 30%

Your scores for this project as an investment opportunity?

Table 3: definitions given to selection criteria

Selection criterium	Definition
Complementary team	Both technical and commercial competencies are in the team
Business experience	At least one of the entrepreneurs has commercial experience in the sector
Entrepreneur is leader	Entrepreneur can motivate people, can be in charge
Entrepreneur is perseverant	Entrepreneur goes on, even if things get tougher
Good contact with the entrepreneur	You get along, you are on the same wavelength with respect to his business ideas
Regional market	Submarket of the world market (for instance: Europe)
Niche market	Small, specialised market with small number of players
Mainstream market	Large market with a lot of players
Unique product	The customer has the perception that there are no alternatives for the product
Protected product	Protection by patent or trade secrets
Market acceptance	First sales have been realised by the company or its competitor
Platform technology	Broad technology with lots of different applications
Break-even	Point at which cash is in balance (cash-out equals cash-in)
Return	Yearly return on investment

Figure 3: Importance of selection criteria to early stage high tech investors

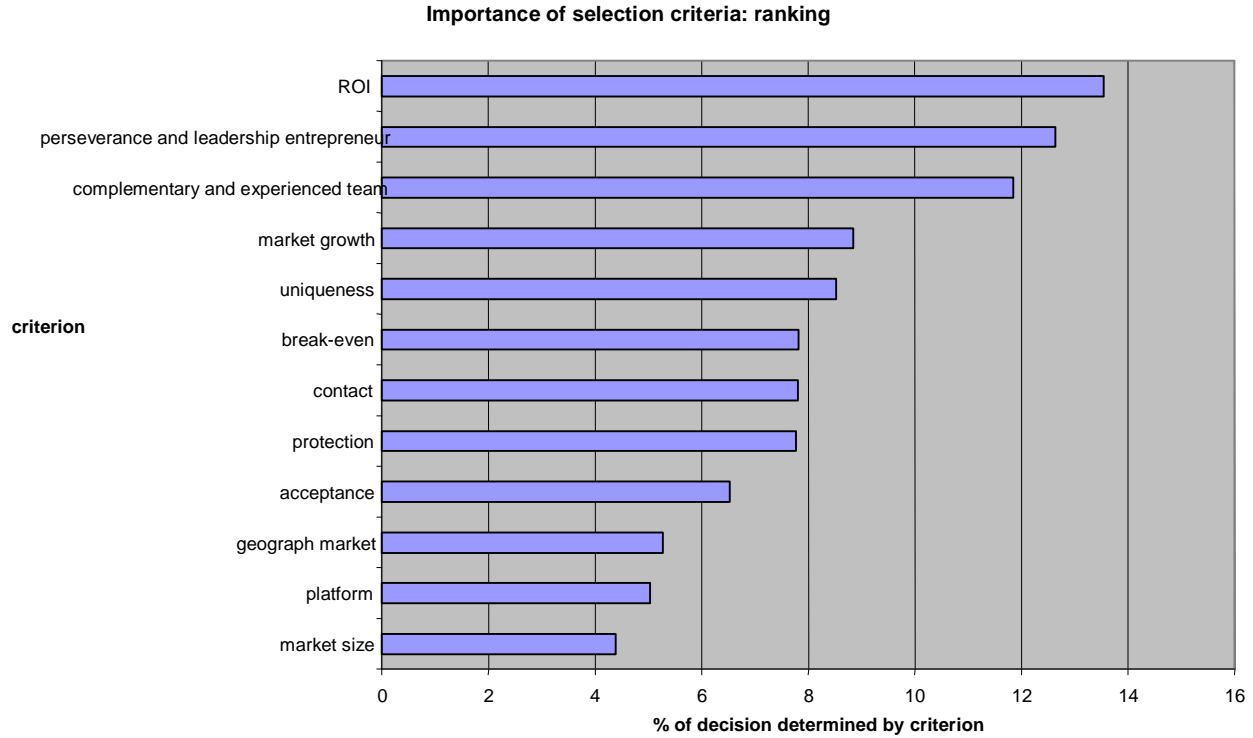


Table 4: Descriptive statistics on conjoint analysis**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Importance team	68	,97	29,14	11,8534	6,19212
Importance leader	68	1,85	33,33	12,6353	7,92478
Importance contact	68	,00	46,19	7,8056	7,85183
Importance market size	68	,00	20,43	4,3863	3,34188
Importance market growth	68	,00	26,25	8,8418	5,56971
Importance geograph market	68	,00	17,24	5,2678	3,88205
Importance platform	68	,00	14,49	5,0318	3,81331
Importance protection	68	,00	30,14	7,7643	6,45765
Importance uniqueness	68	,00	17,59	8,5259	4,29999
Importance acceptance	68	,00	25,81	6,5222	5,43668
Importance break-even	68	,00	19,93	7,8182	3,68857
Importance ROI	68	,00	44,71	13,5475	8,70958
Valid N (listwise)	68				

Table 5: Selection profile (means and standard deviations): results from cluster analysis

Selection criterion	Financial Investors	Technology Investors	People Investors	F (p)
Venture Team	11.91 (5.22)	8.42 (3.74)	14.71 (7.17)	7.309*** (0.0014)
Competence Lead entrepreneur	8.69 (5.91)	7.77 (3.32)	19.78 (6.79)	34.284***** (<0.001)
Contact with the VC	4.37 (3.60)	11.70 (10.90)	7.16 (5.69)	5.315*** (0.0073)
Market Size	4.04 (2.48)	5.13 (4.40)	4.02 (2.88)	0.81 (0.4490)
Market Growth	10.02 (6.49)	9.54 (5.92)	7.34 (4.21)	1.592 (0.2113)
Market Location	4.01 (3.16)	7.68 (4.31)	4.19 (3.10)	7.532*** (0.0011)
Platform Technology	4.94 (4.14)	6.12 (3.65)	4.18 (3.59)	1.573 (0.2152)
Protection Ability	6.12 (4.79)	12.45 (8.04)	5.06 (3.31)	11.457***** (<0.001)
Uniqueness	7.80 (3.92)	9.29 (4.23)	8.44 (4.68)	0.6280 (0.5369)
Market Acceptance	5.85 (6.29)	5.74 (3.46)	7.69 (6.06)	0.986 (0.3785)
Time to Break-even	7.99 (3.65)	6.82 (2.55)	8.53 (4.41)	1.3193 (0.2744)
Return on Investment	24.25 (6.82)	9.33 (4.60)	8.88 (4.49)	57.608***** (<0.001)
Cluster Size	20	22	26	

Levels of significance: *=.10; **=.05; ***=.01; ****=.001

Table 6: conjoint analysis results by investor type

	People investors	Technology investors	Financial investors
Venture Team	14,71	7,77	11,91
Competence Lead entrepreneur	19,78*	8,42	8,69
Contact with the VC	7,16	11,70	4,37
Market Size	4,02	5,13	4,04
Market Growth	7,34	9,54	10,02
Market Location	4,19	7,68	4,00
Platform Technology	4,18	6,12	4,94
Protection Ability	5,06	12,45	6,12
Uniqueness	8,44	9,29	7,80
Market Acceptance	7,70	5,74	5,85
Time to Break-even	8,53	6,82	7,99
Return on Investment	8,88	9,33	24,25

* percentage of the investment decision which can be attributed to this criterion. The criteria which make up for 50% of the decision are displayed in red!

Table 7: Univariate Statistics

	Financial Investors	Techn Investors	People Investors	Overall	Chi Squared
Origin of Funds					
Holding	45%	27.3%	46%	39.7%	2.1 (p= 0.353)
Captive	15%	0%	4.2%	5.9%	4.3 (p= 0.123)
% public capital	8.07%	32%	21.6%	20.82%	7.0 (p=0.031)**
Sectoral					
Biotech	45%	77%	50%	57.4%	5.4 (p=0.06)*
ICT	95%	68%	92.3%	85.3%	7.658 (p=0.02)**
Industrial Automation	10%	27.3%	50%	30.9%	8.7 (p=0.01)**
Other	15%	36.4%	29.4%	29.4%	2.9 (p=0.24)
Investment Manager					
Technical education	60%	66%	41%	55.38%	3.08 (p= 0.21)
Business Education	55%	57%	83%	66.15%	5.03 (p=0.08)*
Academic Experience	5%	22.7%	5.2%	10.6%	5.12 (p=0.08)*
Banking Experience	25%	13.4%	46%	28.78%	6.05 (p=0.05)**
Consulting Experience	35,29%	29.41%	35.29%	25.7%	0.301 (p=0.86)
Entrepreneurial Experience	15%	13.64%	16.67%	15.15%	0.82 (p=0.95)
Business Experience	50%	68.18%	47.83%	55.38%	2.22 (p= 0.33)
Prior Experience as manager of other funds	20%	9.5%	33.3%	21%	3.79 (p=0.15)

Levels of significance: *=.10; **=.05; ***=.01; ****=.001

Figure 4: Cluster analysis – graphical presentation

