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# VENTURE CAPITALISTS' SELECTION PROCESS: THE CASE OF BIOTECHNOLOGY PROPOSALS

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**ABSTRACT**

The paper analyses venture capitalists' selection process in biotechnology ventures. Biotech ventures operate in an extremely risky environment making this an interesting research setting. The majority of venture capitalists exclude certain biotech sectors ex-ante because of regulatory uncertainty, the long development process to a market ready product and the difficulty to understand the technology. The more thorough due diligence process focusses on financial, market and technology criteria. Management team capabilities are more important for later stage investors, whereas early stage investors expect to have an impact on the future recruiting of professional managers. Despite the higher risk of biotech investments, we find no evidence that VCs require higher hurdle rates or more complete contracts for these investments, compared to investments in other technology-based companies. The most important reason for not reaching an investment agreement is disagreement over valuation, due to large differences in risk perception between entrepeneurs and venture capitalists and the lack of a standard valuation tool for biotech projects.

Keywords: venture capital; selection process; biotechnology

## 1 INTRODUCTION

All projects that create value find sufficient and adequate financing in perfect financial markets. Real world financial markets, however, are far from perfect. In the presence of market imperfections, investors may ration capital and value creating projects may be denied financing or only be able to obtain certain types of funding[1]. As a special type of new technology ventures, biotechnology companies may find it even harder to get financing[2]. First, biotech - especially biopharmaceutical companies - are characterised by a long development process and the high cash burn rates necessitate large investments[3]. Biotech is therefore perceived as one of the riskiest industries in our modern economy[4]. Second, regulatory uncertainty and a negative public opinion may hamper the search for financing[5]. Finally, the biotech technology and product development process are considered to be very complex[6].

The very nature of venture capital companies (VCs) as financial intermediaries is to reduce information asymmetries and act in uncertain environments[7]. Venture capital is therefore an important source of funding for biotech companies, especially when large investment amounts are needed[8]. In this paper we qualitatively study the biotechnology investment decision process of VCs. The biotech sector is chosen because it is an interesting setting to study the supply of financing under extreme circumstances. Our research question is: How do VCs handle the selection of investment proposals in biotechnology ventures? Does it differ from the selection process in other technology ventures?[9]

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[1] Guiso L. (1998) "High-tech firms and credit rationing" Journal of Economic Behavior and Organization, 35 (1): 39-59.

[2] Following segments are considered as biotech within the current paper: bio-pharmaceutical and biomedical (e.g. drug discovery, drug development and medical devices), services and technology platforms (e.g. bio-informatics, high throughput screening and contract research organisations), bio-agro-alimentary and bio-environmental.

[3] Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

[4] Senker J. (1998) Biotechnology and competitive advantage, Edward Elgar Publisher.

[5] Bower J.D. (2004) “Changes in biotechnology companies' strategic positioning.” Conference proceedings, 12th Annual International High-Technology Small Firms Conference at the University of Twente, Enschede, The Netherlands.

[6] Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

[7] Amit R., Brander J., and Zott C (1998) "Why do venture capital firms exist? Theory and Canadian evidence " Journal of Business Venturing, 13 (6): 441-466.

[8] Manigart S. and Struyf C. (1997) "Financing high technology start ups in Belgium: an explorative study" Small Business Economics, 9 (2): 125-135.

[9] “Risk is a situation in which probabilities are taken as given by everyone, whereas in a situation of uncertainty there is no general agreement about what the probabilities are or even whether they exist” (Hey, 2002, pp. 20). Hey J.D. (2002) “Experimental economics and the theory of decision making under risk and uncertainty.” The Geneva Papers on Risk and Insurance Theory, 27 (1): 5-21.

Previous research indicates that VCs have different mechanisms to deal with risk or uncertainty in their selection process (Figure 1). First, VCs define their overall investment strategy. During the screening phase VCs check whether the investment proposal fits the VCs' portfolio strategy.

Insert Figure 1 About Here

Second, VCs use thorough due diligence to reduce adverse selection and information asymmetry problems. Well performed screening and due diligence should lead to VCs financing the most valuable companies[10]. There is no consensus in the literature with respect to which criteria are most important in the investment decision of VCs. On the one hand, studies highlight the importance of the entrepreneurial management team as the most important factor. MacMillan et al. (1985, pp. 119), for example, argue that "There is no question that irrespective of the horse (product), horse race (market), or odds (financial criteria), it is the jockey (entrepreneur) who fundamentally determines whether the venture capitalist will place a bet at all"[11]. Other studies stress on the other hand that the investment decision of VCs does not depend on one criterion, but that a combination of criteria is important. Fried & Hisrich (1994), for example, argue that not only the entrepreneur, but also the concept and potential return play a crucial role in the screening of investment proposals[12].

Third, VCs may require higher hurdle rates for valuation purposes to take into account higher risk or uncertainty. Previous research points out that higher (perceived) technological risk increases the hurdle rate, i.e. the return potential that must be present in a proposal before it is considered as attractive[13,14]. Finally, VCs may shift risk or uncertainty from the VC to the entrepreneur through contracting. To reduce agency risk VCs may write more comprehensive contracts, i.e. contracts with more and more complete contract specifications, more use of preferred and/or convertible stock and a better

[10] Zacharakis A.L. and Meyer G.D. (2000) "The potential of actuarial decision models: Can they improve the venture capital investment decision?" Journal of Business Venturing, 15 (4): 323-346.

[11] MacMillan I.C., Siegel R., and Subbanarasimha P.N.S. (1985) "Criteria used by venture capitalists to evaluate new venture proposals" Journal of Business Venturing, 1 (1): 119-128.

[12] Fried V.H. and Hisrich R.D. (1994) "Towards a model of venture capital investment decision making" Financial Management, 23 (3): 28-37.

[13] Murray G.C. and Lott J. (1995) "Have UK venture capitalists a bias against investment in new technology-based firms?" Research Policy, 24 (2): 283-299.

[14] Lockett A., Murray G.C., and Wright M. (2002) "Do UK venture capitalists still have a bias against investment in new technology firms?" Research Policy, 31 (6): 1009-1030.

alignment of management incentives through appropriate remuneration and bonding strategies[15,16,17].

Even though the very nature of VCs is to reduce information asymmetries and act in uncertain environments, it is documented that the selection criteria of a VC are different for non-technology-based proposals compared to technology-based proposals. UK VCs for example require higher hurdle rates and stress the need to address a larger market for technology-based companies[18]. Moreover, technology is seen as a more important risk factor than stage of development by UK VCs[19]. Therefore, we will stress the difference between biotech investments and other technology related investments in the current paper, rather than compare biotech investments with non-tech investments.

We find that the first way to cope with high uncertainty is embedded in the VCs' investment strategy. The majority of investors exclude investments in certain biotech segments because of regulatory uncertainty, the long time to develop technology into a market ready product and the difficulty to understand technology and product development. The due diligence process is more thorough for biotech companies compared to other technology-based companies. While previous literature stresses the entrepreneurial management team as most important investment criterion, we find that financial, technology and market criteria are more important in our setting, especially for early stage proposals. Management is important for later stage investments, however. This is explained by the development process of biotech companies: during the early stages technological progress is more important, whereas management and sales skills become more important as the company further develops. As a result, early stage investors are willing to invest in incomplete management teams as long as the scientists are willing to change positions as the company develops.

Our results further indicate that VCs do not consider the standard valuation tools to be appropriate for valuing biotech companies. They rely more heavily on qualitative data than on quantitative methods. Furthermore, contrary to expectations, VCs do not require higher hurdle rates for biotech investments compared to other technology-based

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[15] Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

[16] Kaplan S.N. and Strömberg P. (2003) "Financial contracting theory meets the real world: An empirical analysis of venture capital contracts" Review of Economic Studies, 70 (2): 281-315.

[17] Van Osnabrugge M. (2000) "A comparison of business angel and venture capitalist investment procedures: an agency theory-based analysis" Venture Capital, 2 (2): 91-109.

18 Murray G.C. and Lott J. (1995) "Have UK venture capitalists a bias against investment in new technology-based firms?" Research Policy, 24 (2): 283-299.

investments. This may be explained by the fact that increasing the hurdle rate may increase the risk of adverse selection, inducing the best projects to seek money from cheaper sources. Moreover, contrary to the predictions of agency theory, we find no evidence that VCs require more complete contracts. This might indicate that it is not agency risk that increases the risk of biotech investments, compared to other technology-based companies.

The remainder of the paper is organised as follows. The second section describes the method used in the study and the VC sector in Belgium. Section three gives an overview of the typical characteristics of a biotech investment proposal from the perspective of a VC. Section four describes how VCs deal with the distinctive biotech characteristics in their selection process. Finally, section five concludes and offers avenues for future research. We end with propositions that can be more formally tested in the future.

## 2 METHOD AND RESEARCH SETTING

Given the lack of in-depth insight in the selection process of biotech proposals, we opt for a qualitative research design. Data are collected through semi-structured interviews and questionnaires. Both interview guide and questionnaire are pre-tested with two sector specialists. We use interviews as a data collection method for several reasons. First, our pre-test indicated that VCs are not always willing to return comprehensive mail surveys but prefer face-to-face interviews. It is often necessary to establish a relationship with the venture capital manager before receiving a response[20]. Second, research based solely on mail questionnaires may fail to obtain the full essence of a VC's investment process[21]. It is, for example, difficult to get comprehensive answers on unprompted questions[22]. We supplement the interviews with a structured questionnaire, which includes both hard data on, for example, fund characteristics and investment criteria and Likert scales.

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19 Lockett A., Murray G.C., and Wright M. (2002) "Do UK venture capitalists still have a bias against investment in new technology firms?" Research Policy, 31 (6): 1009-1030.

20 Bruton G.D. and Ahlstrom D. (2003) "An institutional view of China's venture capital industry - Explaining the differences between China and the West" Journal of Business Venturing, 18 (2): 233-259.

21 Wright M. and Robbie K. (1998) "Venture capital and private equity: a review and synthesis" Journal of Business Finance & Accounting, 25 (5-6): 521-570.

22 Murray G.C. and Lott J. (1995) "Have UK venture capitalists a bias against investment in new technology-based firms?" Research Policy, 24 (2): 283-299.

The Likert scales, covering the pre-investment mechanisms which VCs may use to handle risk or uncertainty, are based on previous research[23,24]. The interviews provide qualitative insights into how VCs use these mechanisms.

All interviews are done with Belgian venture capital managers between October 2003 and February 2004. In contrast with the US and the UK where most studies on venture capital are done, Belgium has a Continental European financial system. The venture capital industry is nevertheless quite well developed in Belgium compared to other European countries[25]. Figure 2 gives an overview of venture capital biotech investments in Belgium and the UK -Europe's most developed venture capital market- as a percentage of GDP from 1999 to 2003. Biotech investments are high in Belgium compared to the UK, except in 2003. This shows that Belgian VCs are active in the biotech sector and that the research setting is appropriate to study the investment behaviour of Continental European VCs. The major players within the Belgian venture capital sector are independent VCs, public sector VCs and semi-captives, with respectively 62%, 17% and 12% of the total number of investments in 2003[26].

Insert Figure 2 About Here

The population of Belgian biotech VCs is identified by using publications, trade directories and snowball sampling. We estimate that the total population of Belgian VCs with a potential interest in biotech proposals amounts to 25 of which 16 (64%) are included in the sample. There is a good balance between early stage and later stage VCs in our sample, ranging from seed financing specialists to pre-IPO investors (Table 1, Panel A), but most VCs have a broad investment strategy covering several stages of development. Eight out of sixteen VCs are independent and private. There are two independent quoted VCs, three university related VCs, two bank related VCs and one corporate VC (Table 1, panel B).

23 Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

24 Lockett A., Murray G.C., and Wright M. (2002) "Do UK venture capitalists still have a bias against investment in new technology firms?" Research Policy, 31 (6): 1009-1030.

25 Reynolds P.D., Bygrave W.D., Autio E., and Camp M. (2000) "Global Entrepreneurship Monitor Executive Report." Kauffman Center for Entrepreneurial Leadership, Kansas City.

26 European Venture Capital Association EVCA yearbook 2004. EVCA: Brussels.

Nine of the VCs are generalist investors with respect to sector preference, with no specialised biotech teams, while seven VCs are considered to be specialised investors in biotech (Table1, Panel C). The sample includes VCs that invested as little as €500,000 to as much as €194 million in biotech up to now.

Insert Table 1 About Here

We carefully select fund managers or senior investment managers for the interviews. They all have relevant experience in venture capital and more specifically in biotech investments. The interviewees were first contacted by phone; we additionally asked to prepare a questionnaire before the interview. If interviewees did not complete the questionnaire before the interview, we asked them to complete the questionnaire at the end of the interview.

During the interview, the two interviewers follow a guideline to minimise interviewer effects. The interviews last between one hour and a half and two hours. All interviews are transcribed verbatim. To ensure validity of the transcription process, the interviews are taped and one of the interviewers takes notes. Next to the interview, we collect data from the written questionnaires. For each of the pre-investment mechanisms VCs may use to deal with risk or uncertainty, we ask whether VCs use more of these mechanisms for biotech investments compared to other technology-based investments. We record responses on a 5-point Likert scale, where 1 equals strongly disagree, 3 equals neither agree nor disagree and 5 equals strongly agree. To test whether the median response is statistically different from 3 we use the non-parametric Signed Rank Test[27].

[27] Non parametric test have several advantages over parametric test: non-parametric test are appropriate for small samples, make fewer assumptions about the data and are available to analyse data which are inherently in ranks (Siegel & Castellan, 1988). As the measurement level of the data is ordinal, we use a one-sample Signed Rank Test. Siegel S. and Castellan J.N. (1988) Non parametric statistics for the behavioural sciences, Mc Graw-Hill.

## 3 VENTURE CAPITALISTS' PERCEPTIONS OF THE SPECIFIC BIOTECH CHARACTERISTICS

Biotech is perceived to be one of the riskiest industries in our modern economy[28]. This is explained by the main characteristics of biotech companies. First, biotech is characterised by a lengthy process to develop a technology into a market ready product, especially in the drug development segment. The whole process from the discovery phase to a market ready product takes on average 15 years[29]. The long path to a market ready product has several consequences. First, biotech companies are confronted with high failure probabilities. In the biopharmaceutical sector, for example, only one out of 5,000 compounds that emerge from pre-clinical testing is introduced on the market[30]. Consistent with Evans and Varaiya (2003), VCs in our sample perceive pre-market risks as an important risk factor for biotech companies. Eleven interviewees respond unprompted that technological failure or unsuccessful research projects are an important risk for biotech companies. A typical statement by interviewees is:

> *"There is a lot of risk associated with other technologies, but it normally has to do with market conditions and competitive business practises, once the product is on the market. The risks for biotech companies are nearly always pre-market and they cause a lot more damage to companies." (Later stage biotech specialist)*

Second, given the long time to market, the probability of a technology becoming obsolete increases. Ten interviewees state that maintaining a technological lead is a risk factor for biotech companies. Although intellectual property rights can protect a biotechnology company's technology, they do not protect biotech companies against superior technologies or products developed by competitors, nor against direct competition from large pharmaceutical companies. The following quotes illustrate:

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[28] Senker J. (1998) Biotechnology and competitive advantage, Edward Elgar Publisher.

[29] Evans A.G. and Varaiya N.P. (2003) "Anne Evans: Assessment of a biotech market opportunity" Entrepreneurship Theory and Practice, 28 (1): 87-105.

[30] Evans A.G. and Varaiya N.P. (2003) "Anne Evans: Assessment of a biotech market opportunity" Entrepreneurship Theory and Practice, 28 (1): 87-105.

*"The science may be good, you eventually may have a market ready product, which gets approval, but suddenly a new technology may rise only five years after your investment." (Early and later stage biotech specialist)*

*"A trend we clearly recognise the last two years is the way especially large pharmaceutical companies look at patents. … Companies do not hesitate today to challenge a patent, even if they know they will not win, but merely hope to silence a competitor." (Early stage generalist )*

Third, biotech requires large amounts of financing[31,32]. An early stage specialist estimates that biotech start-ups require four to five times more capital at start than ICT start-ups. Ten interviewees consider financial risk and more specifically the high cash burn rates of biotech companies and the companies' ability to attract future financing as an important risk factor.

Finally, due to the long path to a market ready product in biotech, there is huge uncertainty about the potential exit route. Three interviewees explicitly mention higher uncertainty on a potential exit as a risk factor for biotech. A generalist investor states exit routes are often discussed before investing in an ICT company, while this is not possible in biotech.

Next to the long path from technology to a market ready product, other risk factors are mentioned by the interviewees, for example regulatory issues. European biotech companies have to pass higher hurdles compared to their American counterparts because of regulatory fragmentation between countries. A biotech specialist highlights that the drug approval and reimbursements systems are still fragmented in the European Union. Further, a negative public opinion will usually not directly influence VCs' investment decisions, but may influence their decision indirectly through its impact on governments and consequently on regulation.

[31] Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

[32] Evans A.G. and Varaiya N.P. (2003) "Anne Evans: Assessment of a biotech market opportunity" Entrepreneurship Theory and Practice, 28 (1): 87-105.

Finally, biotech technology and product development are more complex[33]. Understanding the technology and product development may present an extra difficulty, especially for generalist investors, but also for specialists.

In summary, biotech investors identify three distinctive characteristics of biotech companies, namely a long path to a market ready product, regulatory difficulties and a technology which is difficult to understand. In the next section we discuss the impact of these distinctive characteristics on VCs' selection process.

## 4 VENTURE CAPITAL COMPANIES' SELECTION PROCESS

When discussing the VCs' selection process for biotech proposals, the results are organised along the logical flow of the selection process of VCs (Figure 1). VCs receive hundreds of proposals a year. During the first rough screening phase, VCs check whether the proposals correspond to their investment strategy, which includes among other issues, target industries, preferred stages of development, geographical location and minimum and maximum size of investment. This quick exercise reduces the number of proposals significantly. Second, investment proposals that pass the screening phase are examined in more detail during the due diligence phase. Finally, the parties have to agree on the valuation of the investment proposal and contracts have to be signed. We discuss each of the stages separately.

### 4.1. Investment strategy and initial screening

One of the most radical ways to deal with the high risk environment is to exclude specific biotech proposals. This can either be based on the specific biotech segment, on the stage of development of the venture or on the VCs portfolio strategy.

Ten VCs in our sample reject proposals from certain biotech segments without further scrutiny. First, because of the unclear regulatory environment and negative public opinion, biotechnology companies active in segments as genetically modified organisms and stam cell research may find it difficult to attract sufficient financing. Typical statements by interviewees are:

[33] Brierley P. (2001) "The financing of technology-based small firms: a review of the literature" Bank of England Quarterly Bulletin, 41 (1): 64-76.

*"I would be interested to invest in plant biotech but the climate in Europe is against it. I think there is some very valuable research done in this segment, but the regulatory environment is the problem, not the companies, nor the companies' business plans. Therefore we do not invest in that segment." (Later stage biotech specialist)*

Second, the large financing needs of biopharmaceutical companies , make certain VCs unwilling to consider these ventures. This was expressed by one smaller VC as:

*"What we automatically exclude are drug discovery proposals. We do not have the funds for this. One has to leave this segment to the big players." (Early and later stage generalist)*

Third, an exit is essential for VCs to realise a return on their investment. Difficulties surrounding the exit may cause VCs not to invest in particular biotech segments. For example, a later stage biotech specialist stated he has looked at neutraceutical companies in the past, but was unwilling to invest, because it is difficult to realise an exit in this sector.

Next, given the difficulty to understand the biotech technology and product development, VCs lacking specialised teams may decide not to invest in particular biotech segments. As mentioned by several generalist investors:

*"If we cannot understand the biotech business plan, then we do not invest. One should not invest in what one does not understand." (Early and later stage generalist)*

A second investment strategy followed by VCs is to exclude early stage proposals and focus on later stage deals. This is not specific for biotech investments, but consistent with the behaviour of VCs in other sectors. The advantage of focusing on later stage deals is that the later a VC invests in a company, the lower the technological and pre-market risk is, which is the most important risk for biotech companies according to our interviewees. Additionally, future financing needs and uncertainty surrounding the exit route may be lower. A typical statement is:

*"We do not invest in seed. Companies should have gone trough the phase of one or two customers. The product should have proven itself." (Later stage generalist)*

A third VC portfolio strategy is to diversify[34,35]. Financial theory states that when investors compose a portfolio of 10 to 15 lowly correlated investments, the portfolio risk is almost completely reduced to the systematic or market risk. Ten VCs diversify by investing in both technology and non-technology proposals, thereby assuming that the returns of technology and non-technology ventures are not highly correlated. On the other hand, two VCs invest exclusively in the biotech sector but diversify over the different biotech segments. Furthermore, VCs reduce the risk by investing in companies with multiple technology projects in the pipeline. According to the majority of investors, companies with only one technology project in the pipeline have to meet stricter criteria before they are deemed attractive. The following quotes illustrate the diversification strategy:

*"We try to offer our investors a balanced portfolio, therefore we diversify over sectors, but we also diversify within the biotech sector. If we have invested in one genomic company, we will not invest in another genomic company unless it is extremely attractive." (Early stage biotech specialist)*

*"We reduce the technological risk by investing in companies which have several products in their pipeline. We do not like one-product companies." (Early and later stage biotech specialist)*

Table 2 summarises the strategies investors use at the investment strategy and screening phase. Investors may exclude certain biotech sectors, invest in later stage deals and use a portfolio diversification strategy to deal with the specific biotech characteristics.

Insert Table 2 About Here

[34] Zacharakis A.L. and Meyer G.D. (2000) "The potential of actuarial decision models: Can they improve the venture capital investment decision?" Journal of Business Venturing, 15 (4): 323-346.

[35] Norton E. and Tenenbaum B.H. (1993) "Specialization versus diversification as a venture capital investment strategy" Journal of Business Venturing, 8 (5): 431-442.

## 4.2. Due diligence

### *4.2.1. The due diligence process*

Based on a five point Likert scale (see method section), we find that VCs in our sample agree that biotech proposals require significantly more extensive due diligence compared to other technology-based investment proposals (p-value: 0.0234). Generalist VCs outsource part of their due diligence to external parties, because they do not have sufficient knowledge to carry out the due diligence internally. Specialised VCs rely on specialised investment managers to reduce risk or uncertainty**.** As one interviewee stated:

> *"We are a specialist investor because we have specialised people for each of the sectors we invest in. We will never invest in a company, if we have no one in our team who understands the business." (Early stage biotech specialist)*

Specialised VCs, however, not solely rely on their internal investment managers. It is interesting to note that the importance of external validation is stressed even by VCs which are considered to be the leading Belgian specialists in biotech investments by their peers. Even the investment decision of highly specialised VCs is taking external information and validation into account. For example, some specialist investors mention that they are more keen to invest in a biotech company which has a strategic alliance, because it offers an external validation of the technology. This implies that internal and external information and validation are complements, rather than substitutes.

### *4.2.2. Criteria*

Based on unprompted answers from the VCs we find that -in order of importance- financial elements, market, technology and entrepreneurial management team are the most important criteria within the due diligence phase of biotech companies. Our research leads to categories of investment criteria, which are consistent with previous research. We report, however, some differences in the relative importance of the different categories with previous research[36,37,38,39,40].

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[36] Zacharakis A.L. and Meyer G.D. (2000) "The potential of actuarial decision models: Can they improve the venture capital investment decision?" Journal of Business Venturing, 15 (4): 323-346.

[37] MacMillan I.C., Siegel R., and Subbanarasimha P.N.S. (1985) "Criteria used by venture capitalists to evaluate new venture proposals" Journal of Business Venturing, 1 (1): 119-128.

[38] Fried V.H. and Hisrich R.D. (1994) "Towards a model of venture capital investment decision making" Financial Management, 23 (3): 28-37.

First, nine VCs mention financial elements as the most important requirement of a business plan. VCs require a business plan with a complete financial plan based on realistic assumptions. This is somewhat inconsistent with VCs assertion that it is extremely difficult to forecast the future of a biotech venture, given technological and market uncertainties. VCs nevertheless require biotech entrepreneurs to seriously consider these financial elements.

VCs look beyond the current financing round: they anticipate follow-on financing and even require that sufficient funding is guaranteed to develop a venture before they invest in it. This, again, puts a strong burden on the venture, as it may lead to a chicken-and-egg problem. Early stage VCs require that the full investment cycle is laid out, while later stage VCs only want to commit themselves when the technology and market have been proven. As one interviewee stated:

> *"There is a risk that investors underestimate the amount of funds needed to develop the business. In that case, they get stuck somewhere in the middle of the process of creating a valuable business. This is a very important risk for us and this risk is more important for biotech compared to other businesses." (Early and later stage generalist)*

VCs further clearly fear dilution in subsequent financing rounds. This can largely be explained by the large financing needs of biotech companies.

Second, market strategy is seen as a key requirement of a biotech business plan by eight VCs. Because of the high risks and uncertainties within the biotech sector, VCs require a well-developed market model. Entrepreneurs are forced to think thoroughly about the following questions before seeking support from VCs: Who will the company's customers be? What will the company offer? How will the company create value?

Third, six VCs mention IP strategy as an important prerequisite of a biotech investment. VCs reckon they focus more on IP strategy for biotech ventures compared to other technology-based ventures. Intellectual property rights are important, especially because they offer an external validation of the uniqueness of the technology and

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[39] Kaplan S.N. and Strömberg P. (2004) "Characteristics, contracts, and actions: Evidence from venture capitalist analyses" Journal of Finance, 59 (5): 2177-2210.

[40] Muzyka D., Birley S., and Leleux B. (1996) "Trade-offs in the investment decisions of European venture capitalists" Journal of Business Venturing, 11 (4): 273-287.

consequently reduce at least partially the uncertainty surrounding the technology. Intellectual property rights are further a requirement to be able to realise an appropriate return, although they offer no guarantee for success. As previously discussed, intellectual property rights do not protect biotech companies against superior, competing technologies or products and are not always effective in protecting the biotech companies against large competitors.

The venture capital literature often suggests that it is the entrepreneurial management team, irrespective of other criteria, who fundamentally determines the investment decision of a VC. Much has been made in the venture capital literature on the importance of a quality management team[41,42,43]. Our findings do not support the prime importance of the management team, however, as only six VCs mention the entrepreneurial management team as an important requirement of a biotech business plan. We find that management is a more important factor for later stage investors than for early stage investors. A VC explains:

> *"What one sees more often in biotech compared to other tech companies is that a biotech company evolves in two phases. In a first phase, a university professor has an idea and becomes an entrepreneur. In a second phase, the company has something that starts to look like a product. At that point in time, deals with customers have to be generated, …and scientists are generally not good at this. Management has to change as the company evolves…In the beginning they have to be very good in science and at the end they have to be able to sell, to close deals,…." (Early and later stage generalist)*

Our results support the finding of Clarysse et al. (2005) that early stage biotech investors focus more often on technology criteria than on management team criteria[44]. Although early stage VCs accept purely scientific teams, scientific entrepreneurs should be willing to step down as CEO when the company evolves to the market stage. In line

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[41] MacMillan I.C., Siegel R., and Subbanarasimha P.N.S. (1985) "Criteria used by venture capitalists to evaluate new venture proposals" Journal of Business Venturing, 1 (1): 119-128.

[42] Kaplan S.N. and Strömberg P. (2004) "Characteristics, contracts, and actions: Evidence from venture capitalist analyses" Journal of Finance, 59 (5): 2177-2210.

[43] Muzyka D., Birley S., and Leleux B. (1996) "Trade-offs in the investment decisions of European venture capitalists" Journal of Business Venturing, 11 (4): 273-287.

[44] Clarysse B., Knockaert M, and Lockett A. (2005) "Selection behavior of early stage high technology investors. A pan-European study." Frontiers of Entrepreneurship Research. Forthcoming.

with Hellmann and Puri (2002), VCs may play an important role in bringing outsiders into the position of CEO[45]. The following quote illustrates:

> *"If we are confronted with a university professor who has absolutely no management talent but thinks he has it, then we will not invest…We are willing to invest in companies with an incomplete management team, if we have an influence [on the HR policy] and can do the recruiting." (Early stage specialist)*

In summary, contrary to previous research, early stage investors do not require a complete management team from the start, but require to have an impact on the future composition of the management team, as the biotech company develops. Later stage investors, however, require a high quality and well balanced management team.

### 4.3. Valuation

A critical element in the negotiation process between the VC and the entrepreneur is the valuation of the business. A valuation is necessary to determine the required ownership percentage of the VC. Ten interviewees mention that they use discounted cash flow (DCF) and ten mention the use of multiples to value biotech proposals. This result is consistent with earlier studies on the valuation techniques used by VCs in Continental Europe[46]. The biotech setting clearly affects the valuation process of VCs. First, VCs find it harder to value biotech companies compared to other technology-based companies (p-value: 0.0039), but we find no evidence that VCs require higher hurdle rates contrary to expectations (p-value: 0.1211). This may be explained by an increased probability of adverse selection, should VCs increase the required hurdle rate. Similar to banks, who are unable to raise interest rates indefinitely, VCs may not be able to raise cut-off rates of returns indefinitely, as high-quality companies will look for cheaper financing sources and the average or low-quality companies will be the only ones willing to accept the excessive conditions of the VC[47]. This results in VCs developing a strategy not to invest in high risk proposals, rather than increasing their required return.

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[45] Hellmann T. and Puri M. (2002) "Venture capital and the professionalization of start-up firms: Empirical evidence" Journal of Finance, 57 ( 1): 169-197.

[46] Manigart S., De Waele K., Wright M., Robbie K., Desbrières P., Sapienza H., and Beeckman A. (2000) "Venture capitalists, investment appraisal and accounting information: a comparative study of the USA, UK, France, Belgium and Holland" European Financial Management, 6 (3): 389-403.

47 Stiglitz J. and Weiss A. (1981) "Credit rationing in markets with imperfect information" American Economic Review, 71 (3): 393-410.

Second, multiples and DCF may be the most commonly used valuation techniques for other technology-based and non-technology-based investments[48], but they are less frequently used for valuing biotech investments. VCs believe multiples do not offer realistic and stable values in the case of biotech ventures. Using a P/E multiple on the current earnings of a biotech company, for example, often leads to a negative value. Although the DCF model theoretically holds in the biotech setting, half of our respondents indicate that the DCF method is more frequently used for valuing other technology-based companies. This contrasts with Barrow et al. (2001), who reported that VCs switch to the DCF method if the assumptions of the multiples method do not hold[49]. Instead of using the traditional quantitative models to value a company, VCs tend to rely more heavily on qualitative measures to value a biotech proposal. Two generalist VCs even call it mere guesswork.

Given the lack of a standard valuation tool, the difficulty to assess the future in a biotech setting and the VCs' reliance on qualitative measures, it is not surprising that the most important reason why negotiations break down is disagreement concerning the value of the proposal. Ten interviewees mention they failed to close a deal due to disagree on valuation on at least one occasion in the previous three years. Furthermore, differences in risk perception between VCs and entrepreneurs make it even more difficult to agree on valuation. All VCs agree there are important differences in risk perception: entrepreneurs underestimate the risks. This was expressed by one interviewee as follows:

> *"When the technology is validated, a lot of entrepreneurs assume they reached the finish. What they do not realise is that the story here only begins." (Early and later stage biotech specialist)*

VCs attribute this difference in risk perception to entrepreneurs who are emotionally bounded to the project and underestimate risks in their enthusiasm, while VCs are experienced and therefore more realistic. VCs have seen numerous entrepreneurs, who are certain their invention will be extremely successful, but who eventually fail to become star performers. According to six interviewees, differences in risk perception are even

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[48] Van Osnabrugge M. (2000) "A comparison of business angel and venture capitalist investment procedures: an agency theory-based analysis" Venture Capital, 2 (2): 91-109.

stronger for biotech entrepreneurs than for other technology-based entrepreneurs. VCs attribute this greater difference to the long development path to turn technology into a market ready product and more specifically the larger financing needs and higher risks because of this lengthy process.

### 4.4. Contracting

A well-documented way to reduce agency risk is to use extensive contracts[50,51]. Given the high risk environment, we expect that biotech investors write more extensive contracts, as this restricts the entrepreneur from taking actions to the detriment of the principal, in this case the VC. However, we find no evidence that VCs require more extensive contracts for biotech investments compared to other technology-based investments. First, the Likert scales indicate that VCs do not require more or more detailed contract specifications for biotech investments compared to other technology-based investments (p-value: 0.1875). Second, VCs may use remuneration and bonding strategies, i.e. arrangements that penalise entrepreneurs if they make decisions which are not in the interest of outside investors[52]. Appropriate remuneration and bonding strategies, which tie the payoff of the entrepreneur to that of the VC, can prevent moral hazard or ex post changes in behaviour to the detriment of the principal. However, we do not find that biotech investors require more alignment of management incentives through appropriate remuneration and bonding strategies for biotech investments compared to other technology-based investments (p-value: 0.6250). Next, preferred and/or convertible stock may be used in order to stimulate the entrepreneur to perform well and protect investors, as entrepreneurs generally hold common stock[53]. Again, VCs in our sample do not use more preferred and/or convertible stock for biotech investments compared to other technology-based investments (p-value: 0.7500).

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[49] Barrow C., Richardson A., Copin G., Paliard R., Lange J., Leleux B., and St-Cyr Hec L. (2001) "Valuing high growth potential companies: an international comparison of practices by leading venture capitalists and underwriters" Management International, 6 (1): 55-73.

[50] Kaplan S.N. and Strömberg P. (2004) "Characteristics, contracts, and actions: Evidence from venture capitalist analyses" Journal of Finance, 59 (5): 2177-2210.

[51] Van Osnabrugge M. (2000) "A comparison of business angel and venture capitalist investment procedures: an agency theory-based analysis" Venture Capital, 2 (2): 91-109.

[52] Smith J.K. and Smith R.L. (2000) Entrepreneurial Finance, John Wiley & Sons, Inc.,

[53] Prowse S. (1998) "Angel investors and the market for angels investments" Journal of Banking & Finance, 22 (6-8): 785-792.

The results from the Likert scales are consistent with the information collected from the interviews. Agency risk is neither mentioned directly nor indirectly by the majority of VCs interviewed. This indicates that agency risk is not necessarily (perceived to be) higher in biotech, but that uncertainty for both the VC and entrepreneur plays a more dominant role. In highly volatile, high R&D-intensive industries, where the actual outcome of a business is not necessarily determined by management commitment and competence, shifting risk beyond the control of the entrepreneurs from investors to entrepreneurs will be deemed as unfair and will therefore be expensive from the VCs' point of view. Our results are in line with incomplete contract theory, which states that incomplete contracts are negotiated because of uncertainty and more attention is paid to active involvement in the investment ex-post[54].

## 5. CONCLUSION

Previous research on UK VCs has shown that VCs use stricter selection criteria for technology-based companies compared to non-technology-based companies. We focus on how the typical characteristics of biotech companies influence the selection process of Belgian VCs. The biotech setting is chosen because it represents an interesting setting to study the supply of financing under extreme circumstances. There is a long development path to turn a technology into a market ready product, there are issues of regulatory uncertainty, negative public opinion and difficulty to understand the technology and product development. These are distinctive characteristics of biotech ventures.

Table 2 summarises the main findings of our study. The VCs' investment decision process usually starts with a rough screening to examine whether the proposal meets the VCs' investment strategy. The most radical way in which VCs deal with the particularities of biotech companies is to define an investment strategy that excludes certain biotech segments or investment stages, in order to reduce the risk or uncertainty inherent to biotech.

Proposals that fit the investment strategy and pass the screening phase are examined in more detail during the due diligence process. VCs combine information from the business plan with internal knowledge and information from external sources.

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[54] Hart O. (1995) "Corporate governance – some theory and implications" Economic Journal, 105 (430): 678-689.

Our results indicate that even highly specialised teams stress the importance of external validation. As a consequence, internal and external validation are complements, rather than substitutes.

Financial, market and technology criteria are important investment criteria. Management is especially important for later stage investors. This is explained by the lengthy process of turning technology into a market ready product. During the company's early stages of development, scientific progress is more important than market development. Later in the company's development, management and sales skills become more important. As a consequence, most early stage investors are willing to invest in biotech companies with an incomplete, purely scientific team as long as VCs have the freedom to recruit managers when necessary. One may assume that investment criteria differ between different types of investors. However, given our small sample size it is difficult to draw conclusions hereupon. This leads to the following proposition, to be tested in future research:

> *Proposition 1: The selection criteria used by VCs depend on the characteristics of the investment proposal (e.g. stage of development, sector) and of the investor (e.g. independent versus captive, generalist versus specialist).*

VCs further reckon that IP is more important for biotech companies compared to other technology-based companies. VCs see IP rights as a requirement to invest, but realise that it is no guarantee for success. IP rights are not able to protect biotech companies in all cases, for example, against superior substitutes or against legal attacks from large pharmaceutical companies. We suspect that VCs nevertheless focus so much on IP rights, because next to the limited protection they offer, they provide an external validation of the uniqueness of the technology. Finally, given the large financing need and long development path to a market ready product, VCs focus extensively on future financing rounds.

Next, valuation is essential to determine the required ownership percentage of a VC. VCs rely more on qualitative methods to value biotech investments compared to other technology-based companies. Contrary to expectations, we do not find that VCs require higher hurdle rates to compensate for higher risk or uncertainty. Valuation is nevertheless the most important stumbling block during negations between VCs and entrepreneurs. The discrepancy in perceived value between the entrepreneur and biotech investor is reinforced

by differences in risk perception. All VCs agree that entrepreneurs underestimate the risks. Our results offer a clear call for more research on valuation in highly uncertain environments.

Finally, contracting is a mechanism to reduce agency risk. Contrary to expectations based on agency theory, we do not find that VCs require more complete contracts for biotech ventures compared to other technology-based companies. This can be explained by incomplete contract theory: under high uncertainty, the parties in a contract are not able to include all contingencies. This might be an indication that agency risk is not (perceived as) higher in biotech, but that uncertainty for both the entrepreneur and VC plays a more dominant role. Incomplete contract theory predicts that higher uncertainty, which a VC cannot reduce through more thorough contracting, will be tackled by increased monitoring post-investment[55] 5]. This leads to following proposition:

> *Proposition 2: VCs require the same standard contractual terms in highly uncertain environments as in less uncertain environments, but manage the uncertainty by more post-investment monitoring and governance.*

A limitation of the present study is that it focuses only on the supply side in the investor-investee relationship. We have not discussed the VCs' investment decision process with biotech and other technology-based entrepreneurs. It might well be that entrepreneurs view the decision process of VCs differently than the VCs themselves. Second, given our small sample size it is difficult to distinguish between different types of VCs. With respect to valuation, for example, we find that the two bank related VCs use is the so-called venture capital method to value biotech companies. It is however difficult to conclude that bank related VCs use more financially-related and quantitative valuation methods compared to the other VCs who use more qualitative measures. These two bank related VCs are both later stage investors and more quantitative measures may be used simply because of reduced uncertainty in later stage investment proposals.

Our results are especially important for entrepreneurs. Entrepreneurs should realise that an excellent technology is a necessary, but insufficient condition to attract the attention of investors.

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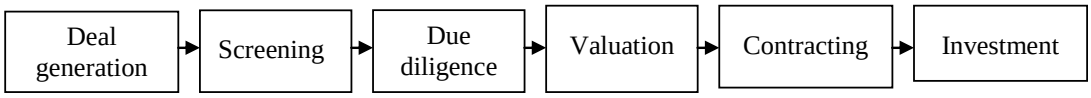
[55] Kaplan S.N. and Strömberg P. (2004) "Characteristics, contracts, and actions: Evidence from venture capitalist analyses" Journal of Finance, 59 (5): 2177-2210.

Entrepreneurs have to demonstrate their investor readiness by offering, on top of a solid IP strategy, a sound market analysis and a realistic financial plan to VCs. Furthermore, entrepreneurs of young biotech companies must be willing to change position over time as the company develops. It is not because the entrepreneur is a star scientist, that (s)he has sufficient talent to lead the company through the different stages of development, which require distinct qualifications. Finally, entrepreneurs should have realistic expectations with respect to the value of the venture when approaching external equity investors.

Finally our results are important for policymakers. High tech companies are considered to be important drivers for economic development. VC represents an important source of funding for the development of biotech companies. Our study offers important recommendations to policy makers in order to bring VCs and biotech entrepreneurs closer together. First, more coherence is needed at a European level. Existing regulatory market fragmentation due to differences in drug approval and reimbursement systems are barriers that are especially difficult to overcome for European entrepreneurial biotech companies. They are at a competitive disadvantage compared to their American competitors. These barriers should therefore be removed. Further, increasing the investor readiness of entrepreneurs, especially with respect to market development and financial issues, is badly needed. Educational and support services could be set up to assist in these areas.

**FIGURE 1**

**The selection process of a venture capital investment ***




* Our study focuses on the VCs activities after deal generation and before the actual investment.

**FIGURE 2**

**Investments in biotechnology as a percentage of GDP**

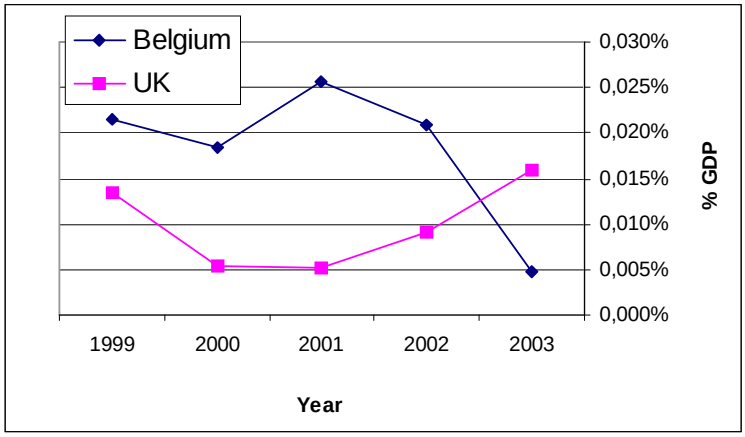


**TABLE 1**

**Overview of the sample by investment stage and type of investor**

| A. Investment cycle | Number of VC funds | B. Type of investor | Number of VC funds | C. Specialist versus generalist investor | Number of VC funds |
|---|---|---|---|---|---|
| Seed | 9 | Independent quoted VC | 2 | Specialist investor | 7 |
| Start-up | 12 | Independent private VC | 8 | Generalist investor | 9 |
| Expansion | 10 | University related VC | 3 | | |
| Replacement capital | 3 | Bank related VC | 2 | | |
| Buyout | 3 | Strategic investor | 1 | | |

Note: Venture capital funds may invest in different stages of the investment cycle.

## TABLE 2

## The impact of biotech characteristics on the selection process of venture capitalists

| *Venture capitalists' selection process* | *Strategy to manage biotech characteristics* | *Biotech characteristics* |
|---|---|---|
| ***Investment strategy and screening*** | *-Exclude specific biotech sectors* | *-Regulatory difficulties* |
| | | *-Long path to a market ready product and large financing needs* |
| | | *-Difficulty to understand* |
| | *-Exclude stages of investment* | *-Risk and uncertainty* |
| | *-Use portfolio strategy:*<br>• *diversify within technology and non-technology sectors*<br>• *diversify within the biotech sector*<br>• *preference for companies with multiple technology products in pipeline* | *-Risk and uncertainty* |
| ***Due diligence*** | *-Process: internal and external validation as complements* | *-Difficulty to understand technology* |
| | *-Criteria:* | |
| | • *financial criteria* | *-Large financing needs over long path to a market ready product* |
| | • *market criteria* | *-Long path to market ready product* |
| | • *IP criteria* | *-Difficulty to understand* |
| | • *willingness to change team (early stage deals)* | *-Long path to a market ready product* |
| | • *complete management team (later stage deals)* | |
| ***Valuation*** | *-Qualitative valuation measures rather than quantitative valuation methods* | *-Large financing needs over a long path to a market ready product*<br>*-Risky and uncertain* |
| | *-No higher hurdle rates* | |
| ***Contracting*** | *-Contracts not more complete* | *-Not more agency risk* |