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Portfolio Strategies of Life Science Venture Capital Firms in the USA and Europe

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Portfolio strategies of life science venture capital firms in the USA and Europe

Abstract

Motivated by the different development stages of both, the venture capital (VC) as well as the life science industry in the USA and Europe, we investigate portfolio strategies of US-American and European VC firms active in this sector. We analyse portfolios of 88 VCs financing a total of 1050 life science ventures. Our results show that US life science VCs are equally likely to have a focus on early stage ventures and to diversify across investment stages as their European counterparts. However, the latter invest more in the US industry than vice versa, more in traditional life science technologies developing therapeutics and diagnostics, and less in new medical technology and healthcare/IT firms. Regarding the VCs' internationalisation strategies, our results reveal that VCs investing globally and US VCs focusing on their home market invest more in medical technology and healthcare/IT and less in diagnostics firms than European VCs with European investees only. We conclude that European life science ventures developing medical and healthcare/IT technologies should internationalise early enough into the USA in order to access the US VC market. Therapeutics and diagnostics companies in the USA, on the other hand, may find good opportunities to raise VC in Europe.

Introduction

Young life science ventures are risky and capital-intensive businesses. The development of life science products such as biopharmaceuticals, e.g., demands on average more than 100 million $US R&D expenditure and a 12-year development process (DiMasi et al. 2003) with only one out of 5000 initial drug candidates reaching market launch (Evans and Varaiya 2003). Financing these expensive development processes is only possible if investors such as venture capitalists (VCs) are willing to take the risk and invest large amounts of money in the young ventures. Thus, the development of the life science industry essentially depends on the presence of a VC sector (Prevezer 2001; Powell et al. 2002).

On the other hand, life science ventures have an enormous revenue potential. If a new blockbuster drug, e.g., is successfully introduced to the market, the young firms may earn hundreds of millions $US in revenues per year. Thus, they are particularly attractive for VC investors and the life science industry has become one of the most important areas of investment for VCs over the last decades. In 2004, VCs invested in more than 1.4 billion $US in European and more than 3.5 billion $US in US-American life science firms, corresponding to 26 and 28 % of total VC investments, respectively (Ernst & Young 2005a; Stolis and Goodman 2004).

In this study we analyse differences in the investment and portfolio strategies of US-American and European VC firms active in the life science sector. We expect these differences to be substantial because both, the VC as well as the life science industry, look back on a fundamentally different history in the USA and Europe. The emergence of the VC market in the USA dates back to 1946, when the American Research and Development Corporation was founded in Boston, Massachusetts, with the aim of financing technological innovations of the Massachusetts Institute of Technology and

supporting young technology ventures in management (Gompers and Lerner 2004). The sector experienced further periods of significant growth in the late 1970s, the 1980s, and the late 1990s (Pfirrmann et al. 1997). In 2004, US-American VCs raised 17.9 billion $US from their fund investors and invested 21.1 billion $US in new ventures (NVCA 2005). The European VC industry, in contrast, did not emerge substantially until the beginning of the 1980s and experienced its major growth during the years 1998 – 2000. In 2004, private equity investments in Europe amounted to a record of 36.9 billion €, of which 10.3 billion € comprised early and expansion stage financing. This number corresponds to 63 % of VC investments in the USA. Total private equity funds raised in Europe equalled 27.5 billion € in 2004 (BVK 2005).

Because of the different development stages of the VC industries, today European VCs are less experienced than their US counterparts and often have major problems finding qualified professionals (Becker and Hellmann 2000), which in turn constitutes a major problem for maturation of the industry (Freeman 1998). Due to these and other differences such as cultural backgrounds, results of the 'rather limited research on international comparisons of venture capital firms' (Wright et al. 2002: 14) suggest that US VCs have different perceptions of different kinds of investment risk (Sapienza et al. 1995), use different valuation methods and information sources (Wright et al. 2004b), and require higher returns from their investments (Manigart et al. 2002) than their European counterparts. Moreover, on average US VC firms appear to impose tighter control on the management of their investees, have a better ability to screen projects, are less hesitant to liquidate underperforming portfolio firms, syndicate more because they have larger networks, are more specialised due to their accumulated industry-specific

knowledge and reputation, and perform better than VC firms in the USA (Hege et al. 2003).

A similar pattern holds true with regard to the development of the life science industry in both continents. Already in 1986, the US industry counted more than 800 companies and employed more than 40.000 people, and in 2004 these numbers amounted to more than 1.400 firms and 137.000 employees (Ernst & Young 2003c; Ernst & Young 2005a). In European countries, the development of the sector is about 10 to 20 years behind the USA (Cooke 2001), and one of the major reasons for its late emergence was the late development of the European VC industry. Other reasons included unfavourable legal and regulatory frameworks, the lack of an entrepreneurial culture, and in some European countries a hostile attitude in the population with regard to the new technology (Giesecke 2000). In the 1990s governmental programs such as the BioRegio competition in Germany (Dohse 2000) were major drivers of the rapid growth of the European life science industry, and the number of firm grew from 450 in 1992 to more than 1800 in 2004 (Ernst & Young 2003a; Ernst & Young 2005a). However, few of these companies are established corporations yet, and total employment in the sector equalled only about 25.000 people, corresponding to less than 20 % of the US sector. Whereas in the USA 330 life science firms were quoted at the stock markets in 2004, this was the case for only 98 European firms. In that year, the US companies generated 42.7 billion $US in revenues, as compared to 7.7 billion $US of European firms (Ernst & Young 2005a). Due to these differences in industry development stage European life science ventures often have a harder time to get funding, experience slower growth, and are led by less experienced management than their US counterparts (Ernst & Young

2000; Ernst & Young 2001). Table 1 summarises the different development stages of the VC and the life science industries in the USA and Europe.

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So far no one has analysed whether and how the differences in industry development are reflected in the investment and portfolio strategies of life science VCs. Do European VCs follow different strategies than their US counterparts because they have less experience, smaller networks, and a less developed industry to invest in? And how do investment strategies of VCs which exclusively focus on their home markets (USA or Europe) differ from those which invest in both continents? These research questions are the focus of our study.

We structure the remainder of this article as follows. In the next section, we derive hypotheses about the effect of the VCs' location (USA or Europe) as well as their investees' location on portfolio strategy of life science VC firms. We then describe our data collection process, methodology, and sample. In the following part we present our results before we discuss them and draw conclusions.

Portfolio strategies of life science venture capital firms

The different development stages of the VC and life science sectors in the USA and Europe may impact the portfolio strategies of VC firms. We divide our theory analysing this impact in two parts. Firstly, we derive hypotheses about differences between portfolio strategies of US-American and European life science VCs (H1a – H1e).

Secondly, we hypothesise differences between the strategies of life science VCs which focus exclusively on their home markets (USA or Europe), and those investing globally (H2a – H2d).

In line with existing research, we describe the VCs' portfolio strategies along several dimensions. Firstly, we distinguish between life science VCs which prefer to invest in early stage ventures and those which do not. Secondly, VCs' investment strategies can differ regarding diversification across investment stages. Thirdly, we classify portfolio strategies according to the life science technologies their investees develop. Finally, when we compare US-American and European VCs, we examine their portfolio strategies with respect to the geographic scope of their investments.

US-American vs. European life science VCs

Early stage focus. Young ventures in early development stages are particular risky investments (Elango et al. 1995) since they face several liabilities of newness (Stinchcombe 1965). Specifically in the life science industry, technological uncertainty is high since technologies are complex and often have not yet been established at company foundation. Moreover, long product development cycles make market projections difficult, in particular in the hypercompetitive environment of the life science sector. Finally, early stage life science startups are often led by inexperienced academic founders and thus face a high risk of management failure. On the other hand, early stage ventures have the highest potential for high returns because VCs can cheaply buy a large portion of the company (Ruhnka and Young 1991; Sapienza and Gupta 1994).

The different development stages of the US-American and European VC industry suggest that VCs in both countries have different capabilities to deal with the risk inherent in early stage investees. Experienced US VCs have built up larger networks with other VCs over time, which may enable them to find more syndication partners than their European counterparts as a means to reduce risk (Lockett and Wright 2001). Moreover, because US VCs have accumulated more industry-specific expertise and knowledge (Hege et al. 2003), they may be better in selecting and supporting risky early stage investees. Finally, since US VCs have a higher need for large returns on their investments than European VCs (Manigart et al. 2002), their preference for early stage ventures may be particularly high.

However, the different development stages of the US-American and European life science industries may counteract the preference of US VCs for early stage investments. Because the European life science sector is much younger than its US counterpart, European VCs will likely have a problem to generate a significant deal flow of late stage investment opportunities. Most life science ventures in Europe are early stage firms, and VCs active in the European industry will face the decision to invest in these young firms or not investing in life sciences at all. Therefore European VCs will invest more in early stage ventures than their lower experience and lower need for high returns would suggest. Taken together, we hypothesize that both effects outweigh each other.

H1a: The likelihood that VCs will invest with a focus on early stage ventures is not significantly different between US-American and European life science VCs.

Stage diversification. Research has shown that VCs which focus on a specific development stage of their investees (early or late stage firms) instead of diversifying across stages require a lower return on their investment (Manigart et al. 2002). The

theoretical argument underlying this finding is that specialised VCs are able to acquire deeper knowledge and understanding of a specific investment stage which may help them to better select investees at that stage and support them in developing their business. With regard to life science VCs in the USA and Europe, this argumentation suggests that the more experienced VCs in the USA have accumulated more stage-specific knowledge over time than the European VCs. This knowledge base may enable US VCs to focus more on a specific investment stage. In contrast, for European life science VCs diversification across stages may be a means to reduce their investment risk (Manigart et al. 1994; Manigart et al. 2002) as assumed by modern portfolio theory (Markowitz 1967).

However, a view on the deal flow limitations of US-American and European life science VCs counterbalances this argument. In the European life science sector, where most firms are early stage ventures, stage diversification opportunities are limited because VCs can not generate a significant deal flow of late stage investees. Thus, the European life science sector will attract more VC investors specialising in early investment stages than the generally missing experience and knowledge of European VCs suggests. Again, both effects may outweigh each other.

> *H1b: The likelihood that VCs will diversify across investment stages is not significantly different between US-American and European life science VCs.*

Life science technologies. The life science industry is comprised by firms operating in the fields of biotechnology, medical technology, and healthcare/information technology (healthcare/IT) (Arundale 2002). Of those, *biotechnology* can be further subdivided into technologies developing *therapeutics*, *diagnostics*, *service/supply*, and others (Ernst & Young 2003c). Therapeutics companies develop new therapeutics for

unmet clinical needs such as cancer or Alzheimer's disease. Diagnostics firms draw on new biotechnological methods to develop diagnostic tests for humans. Service/supply firms offer research services (e.g., DNA sequencing) to companies or research institutes, or supply laboratories with material for daily use (e.g., DNA and protein purification kits). The small group of other firms includes, e.g., firms which develop gene-manipulated, pest-resistant plants or animal therapeutics. *Medical technology* refers to the development of devices and machines which are used in diagnosis and therapy such as cardiographs, endoscopes, and positron emission tomographs. *Healthcare/IT* companies draw on information technology to increase the productivity of processes in the healthcare sector. These firms offer, e.g., efficient personnel management services, risk management for hospitals, and marketing and accounting services, but also software such as patent-specific information systems. It is important to note that the technologies of therapeutics and diagnostics serve markets traditionally occupied by established pharmaceutical firms (although with a different underlying basic technology), whereas modern medical technology and particularly healthcare/IT firms serve new markets which mainly have emerged over the last decade (Ernst & Young 2002b; Stolis and Goodman 2004).

Differences between US-American and European life science VCs will likely impact the choice of their investees' technologies. The need for higher returns of US-American VCs (Manigart et al. 2002) as well as their better ability to screen projects and actively support and control investees (Hege et al. 2003) will motivate and enable them to invest a significant amount of their capital in new, disruptive technologies such as medical technologies and healthcare/IT, where little expertise is available so far. On the other hand, missing experience and a lower demand for high returns will prevent European

life science VCs from investing in these technologies. Those VCs will instead focus on the 'traditional' life science technologies (therapeutics and diagnostics), because expertise is available. Many European life science VC professionals have former careers in the pharmaceutical industry, and thus their knowledge and expertise are more applicable to technologies related to therapeutics and diagnostics development.

H1c: The likelihood that VCs will invest in 'traditional' life science technologies (therapeutics, diagnostics) is lower for US-American than for European life science VCs.

H1d: The likelihood that VCs will invest in 'new' life science technologies (medical technology, healthcare/IT) is higher for US-American than for European life science VCs.

Geographic scope. The differences in experience of US and European VCs suggest that the latter have a higher motivation to invest in the US life science sector than vice versa for two reasons. Firstly, European VCs can find more experienced syndication partners in the USA enabling them to access their knowledge and expertise, which is one of the main drivers of VC syndication (Bygrave 1987; Lockett and Wright 2001). Moreover, European VCs may spread their financial risk by syndicating with VCs (Lockett and Wright 2001) in the more developed equity markets in the USA, where exit of investees by IPO is easier. This motivation may be particularly strong once a market downturn occurs. For example, whereas the IPO window was mainly shut for European life science ventures in 2004, US VCs exited more than 30 life science investees by IPO in that year (BioCentury 2005).

The development stages of the life science industries in the USA and Europe further support the above argumentation. European VCs appear to have a higher necessity than US-American VCs to invest globally in order to enlarge their deal flow because their

home market is mostly comprised of young, early stage ventures, which are often led by inexperienced founders (Ernst & Young 2001). Moreover, the top life science research institutes such as the MIT or Harvard, Berkeley, and other top universities are located in the USA, and many of the most promising life science ventures are spun-off these organisations (Zucker et al. 1998). To participate in financing these high potential ventures, European VCs need to give up their European focus and pursue a global investment strategy.

H1e: The likelihood that US life science VCs will invest in European investees is lower than the likelihood that European life science VCs will invest in US investees.

Home market focus vs. global investment strategy

In analysing differences between life science VCs which exclusively focus on their home market (USA or Europe) and those pursuing a global investment strategy, we build on the following observations. Firstly, previous work found that a larger geographic investment scope is correlated to less investment in early stage ventures and more capital under management (Gupta and Sapienza 1992; Hall and Tu 2003). Secondly, globally investing life science VCs will face less deal flow limitations than their continentally focused counterparts.

Early stage focus. The effect of geographic scope on investment stage preference has been examined by Gupta and Sapienza (1992). These authors argued that for efficient monitoring and support of investees face-to-face interaction and local proximity is necessary. Because the monitoring and support effort decreases with the growing age and maturity of a company, VCs focusing on early stage ventures should prefer a narrow geographic investment scope. Gupta and Sapienza found empirical support for

this argumentation. Monitoring and support are particularly important in the life science industry, because of the high risks inherent in new ventures. Thus, globally investing life science VCs will have less preference for early stage ventures than US or European VCs which focus only on their home markets. Moreover, since globally investing VCs have a higher deal flow and can pick late stage investees in both continents, they are able to invest more in late-stage ventures than their continentally focused counterparts in the USA and Europe.

H2a: The likelihood that VCs will invest with a focus on early stage ventures is lower for life science VCs investing globally than for US-American and European life science VCs focusing on their home markets.

Stage diversification. Gupta and Sapienza (1992) found that VCs which invest with a broad geographic scope are usually larger (in terms of capital under management) than regionally focused VCs. Hall and Tu (2003) showed that large VCs tend more to invest overseas. Because fund investors will prefer investing money in experienced VCs, the conclusion is that VCs investing with a broader geographic scope have, on average, more experience than regionally focused VCs. Given the argumentation that sufficient experience is a prerequisite to accumulate stage-specific expertise over time (Manigart et al. 2002), it appears that life science VCs investing globally will be more able to focus on specific investment stages (early or late) than those focusing on their home continent, which will more likely diversify across stages.

However, as argued above, the early development stage of the European life science industry will limit the possibility of European life science VCs to diversify their portfolio across investment stages. The portion of stage-specialised European life science VCs will be particularly high among firms focusing on their home market,

because their deal flow consists almost exclusively of early stage ventures. In contrast, because the US-American life science sector is mature and comprises firms of all development stages, US VCs focusing on their home market are not forced to specialise on any development stage because of deal flow limitations but have the opportunity to diversify more across stages.

H2b: The likelihood that VCs will diversify across investment stages is lower for life science VCs investing globally and European life science VCs which focus on their home market than for US-American life science VCs focusing on their home market.

Life science technologies. Globally investing life science VCs may differ from continentally focused VCs with regard to the life science technologies they invest in. Our argumentation above suggests that globally investing VCs are more experienced than continentally focused VCs. This difference may become particularly manifest when we compare globally investing life science VCs with European life science VCs which exclusively focus on their home market. The latter can hardly have accumulated a significant amount of life science-specific knowledge and expertise since they gained their experience in a very young sector. In contrast, globally investing VCs as well as US VCs which focus on their home market have had the opportunity to gain experience already in the early days of the US life science industry. Therefore, these VCs may have more capabilities to select investees in new medical technologies and healthcare/IT than European VCs focusing on their home market, which will likely prefer the traditional life science fields where the knowledge which their professionals gained in pharmaceutical industry is applicable.

H2c: The likelihood that VCs will invest in 'traditional' life science technologies (therapeutics, diagnostics) is lower for life science VCs investing globally and

US-American life science VCs which focus on their home market than for European life science VCs focusing on their home market.

H2d: The likelihood that VCs will invest in 'new' life science technologies (medical technology, healthcare/IT) is higher for life science VCs investing globally and US-American life science VCs which focus on their home market than for European life science VCs focusing on their home market.

Data collection, methodology, and sample

The purpose of this study is to analyse portfolio strategies of life science VCs in the USA and Europe. We define a 'life science VC' as a VC firm with at least 10 investments in the fields of biotechnology, medical technology, or healthcare/IT. We only took into account investees which are still privately held. Exited ventures were omitted from the analysis.

As a starting point for identification of our target population of life science VCs we drew on industry reports of the consulting company Ernst & Young (Ernst & Young 2001; Ernst & Young 2002a; Ernst & Young 2003b; Ernst & Young 2003a), who are one of the leading industry observers. Ernst & Young's reports are published since 1986 and meanwhile cover the North-American, European, and global life science sector. We then used snowball-sampling to access further life science VCs and their portfolio companies. This method is often used to identify new target populations (Atkinson and Flint 2004). It is important to note that while there are some commercially available data bases on the life science industry in North America (e.g., BioScan), there are no data sources of comparable quality and completeness for the European sector. Thus, snowball sampling was the only appropriate method for identifying a major number of

European life science VCs. It appears to be particularly valuable for our purpose since life science ventures, because of their capital intensity and high failure risk, usually have a broad base of VC investors. Those, on the other hand, invest in a portfolio of start-ups. Thus, the VCs and their investees are highly connected in a network-like manner. Snowball sampling therefore allowed us to cover a major part of the industry in both continents, which is a prerequisite to ensure sample representativeness and validity (Van Meter 1990). Because of this close connectedness of actors in the VC market, snowball sampling has been applied successfully in VC research before (e.g., Wright et al. 2002). As a main data source for gathering information on the VCs and their investees we drew on the web pages and press releases of both. We supplemented these data with information from industry reports and biotech press. All data were collected from April to June 2005.

We identified more than 170 VC firms with investments in the life science sector in both continents, of which 88 held at least 10 non-exited life science investees. These 88 VCs financed a total of 1050 life science ventures. This number corresponds to a substantial part of the total industry. In 2004, Ernst & Young listed about 1114 privately owned life science firms in the USA, and 1717 in Europe (Ernst & Young 2005a). However, by far not all of these firms are financed by VC. In Germany, e.g., where the largest number of life science ventures among all European countries is located, only about one third of them are VC-backed (Ernst & Young 2005b). Although this fraction may be substantially higher in the USA due to the more established VC market, it appears a conservative estimation that no more than two thirds of all privately held life science firms in both continents (about 1800) receive VC. We thus estimate that, in terms of investees, our sample covers considerably more than half of the life science

industries in the USA and Europe. With respect to VC investors, the coverage may even be higher due to the network-like connectedness of investees and VCs. The assignment of investees to one of the categories describing the VCs' portfolio strategies was done by two of the researchers together, with one of them holding a PhD in life sciences.

Our sample consisted of 65 US-American and 23 European life science VCs. 51 VCs exclusively invested in life sciences. We included the major players in the life science industry such as Advent International, Atlas Ventures, Polaris Venture Partners, and MPM Capital in the USA, and 3i, Apax, TVM, Abingworth, and Global Life Science Ventures in Europe, but also small firms such as POSCO Bioventures, Spray Partners, and Bioventure Investors. On average, the VCs in the sample held 21 life science portfolio firms and had 1.2 billion $US total capital under management (including non-life science investments). With regard to investees, 729 (69 %) of the 1050 life science ventures were located in the USA and Canada. Of the remaining 321 European firms, 73 (22.7%) had their headquarters in Germany, and 63 (19.6%) in the UK. Following Ernst & Young, we included Israeli firms in the European sample and Canadian firms in the US sample. Of the investee sample as a whole, 44% of firms developed therapeutics, 30% medical technology, 13% were service/supply, 8% healthcare/IT, 3% diagnostics, and 2% other companies.

In this study we perform two kinds of comparisons between different groups of our sample. Firstly, with regard to the home countries of the life science VCs, we analyse pairwise differences between US-American and European firms. Secondly, concerning the geographic investment scope of the VCs, we perform three-way comparisons of life science VCs which are (i) either from the USA or (ii) from Europe and exclusively invest in their home continent, or (iii) VCs which invest globally. Depending on

whether the variable of interest was categorical or continuous, we performed different kinds of tests for both kinds of analyses. For categorical variables, we performed Chi-square-tests in the case of both, two- and three-way comparisons. For continuous variables, we used Mann-Whitney-tests for pairwise comparisons. In contrast to t-tests, Mann-Whitney-tests do not demand a normal distribution of the variables of interest. Since we have no indication that the variables of our analysis are normally distributed, Mann-Whitney-tests are the appropriate method for our purpose. For three-way comparisons, we performed a Kruskal-Wallis-test, which is an extension of the Mann-Whitney-test for more than two groups (Silver 1992).

Table 2 shows differences between US-American and European life science VCs in our sample. European VCs have less capital under management, a larger portfolio, and a larger team of investment managers allocated to their life science investees. However, none of these differences is significant on a statistical basis. These results are in line with industry reports which observe only slightly smaller funds of life science VCs in Europe as compared to the USA (Ernst & Young 2002a). The lower number of portfolio firms of US VCs may be due to the higher tendency to liquidate underperforming investees, an observation described before in the life science industry (Howell et al. 2003).

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Differences between groups of VCs in our sample become more manifest if we compare the characteristics of VCs which either invest exclusively in their home markets or

globally (Table 3). We find statistically significant differences with regard to all three variables. Globally investing VCs have significantly more capital under management, a larger portfolio, and a larger team of life science investment managers than US-American and/or European VCs with a continental focus. Again these properties of our sample VCs have been observed before. Gupta and Sapienza (1992) found that larger VCs (in terms of capital under management) in the USA invest with a broader geographic scope, probably because they have to generate a higher deal flow in order to invest their capital in the best possible way. Hall and Tu (2003) found that larger VCs tend more to invest overseas. Bygrave (1987) argues that larger VCs have a more extended communication network which allows them to pick promising investees in more geographic regions. The larger team size of globally investing VCs may indicate a higher monitoring and support effort for a larger number of investees in the portfolio.

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In summary, the characteristics of our sample life science VCs are largely in line with published data on VCs in the USA and Europe, suggesting that our sample well represents the VC industries.

Results

US-American vs. European life science VCs

Table 4 shows differences between US-American and European life science VCs with regard to their focus on early stage investees, investment stage diversification, and the geographic scope of their investees.

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As table 4 demonstrates, US-American life science VCs are not significantly more likely to invest with an early stage focus than European VCs. Moreover, they are not significantly more diversified across investment stages than their European counterparts. It is interesting to note that all 13 European VCs with a stage focus (non-diversified VCs) have this focus on early stage investees. In other words: there is no European life science VC in our sample which focuses on late stage investments. This probably reflects the impossibility for European VCs to generate a significant deal flow of late stage investees in the young European life science industry. We conclude that hypotheses H1a and H1b receive support.

Moreover, table 4 shows that US-American VCs have a significantly higher tendency to invest exclusively in their home markets than their European counterparts. Almost two thirds of the European life science VCs in our sample also have investments in the US industry. Therefore, hypothesis H1e is supported.

Table 5 displays differences between US-American and European life science VCs with regard to the life science technologies they invest in.

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Table 5 demonstrates that the portfolios of US-American life science VCs comprise about twice as many firms developing medical technology and healthcare/IT, but a lower fraction of investees in the fields of therapeutics and diagnostics, respectively. These differences are significant on a statistical basis. We therefore conclude that hypotheses H1c and H1d are supported.

Home market focus vs. global investment strategy

We further spilt our sample into life science VCs which invest globally, and those which invest with a focus on their home continent (USA or Europe). In table 6 we show differences between these three groups with regard to their focus on early stage investees and investment stage diversification.

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The data in table 6 show that, although most of the observed effects are in the predicted directions, there are no statistically significant differences between globally investing life science VCs and US-American and European life science VCs which focus on their home market regarding both, focus on early stage investees and diversification across stages. We conclude that there is no support for hypotheses H2a and H2b.

Table 7 provides an overview of differences between globally investing life science VCs and those with a continental focus concerning their preference to invest in different life science technologies.

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Table 7 demonstrates significant differences between the life science technologies the three different groups invest in with respect to therapeutics, diagnostics, medical technology, and healthcare/IT. A more detailed examination shows pairwise differences between globally investing VCs and US-American and European firms which focus on their home markets.

Regarding investments in the traditional life science technologies, we find that US life science VCs which focus of their home market invest significantly less in therapeutics and diagnostics firms than their European counterparts. Moreover, VCs which invest globally have significantly less diagnostics firms in their portfolio than European life science VCs focusing on their home market. However, the latter relationship does not hold for therapeutics firms. Thus, hypothesis H2c is only partially supported.

With respect to new life science technologies, we find that US life science VCs with a continental focus invest significantly more in healthcare/IT firms than those VCs which invest only in Europe. However, do not find any other of the hypothesised differences between the groups to be significant on a statistical basis. Thus, we receive only limited support for hypothesis H2d.

Discussion and conclusions

The aim of this study was to analyse differences in investment and portfolio strategies of VCs which are active in the life science industry in the USA and Europe. Because of

the different histories of both, the VC as well as the life science sectors in both continents, we hypothesised and empirically found differences between strategies of US-American and European life science VCs, and between life science VCs which either invest globally or exclusively focus on their home market. Table 8 summarises our results.

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This paper adds to the so far sparse empirical work (Wright et al. 2002) on international comparisons of VC investment strategies. These comparisons are important to understand how different contingency variables influence the behaviour of VCs. Recent research has, e.g., examined the effect of culture and the regulatory environment on VC investment strategies in emerging markets in Asia and Eastern Europe (Bruton et al. 2002; Bruton and Ahlstrom 2003; Wright et al. 2004a). In this paper, we analyse a different contingency variable, i.e., the structure and development stage of the specific industry the VCs of our sample focus on. Industry-focused VCs have a more limited deal flow than their non-specialised counterparts, and our theory and data suggest that these limitations impact the VCs' investment strategies. For example, we find that specialised life science VCs in Europe are more likely to invest in early stage ventures than their background and experience would suggest when compared to life science VCs in the USA. This result can be explained by the early development stage of the European life science industry, which makes it difficult for VCs without an early stage focus to access investment opportunities in this sector. Our finding that no European life

science VC in the sample is a late stage specialist further supports this argumentation. Thus, our study highlights the effect of deal flow limitations on VCs' investment strategies, an issue seldom analysed in the VC literature so far (Wright and Robbie 1998).

This paper also contributes to the literature on internationalisation of VCs. We find that life science VCs in Europe are more likely to pick investments in the USA than US VCs to invest in the European life science sector. Whereas existing studies have mainly emphasised and analysed the internationalisation strategies of VCs into emerging markets (e.g., Wright et al. 2002), our result is interesting because it suggests that the opposite direction of internationalisation is also important for VCs. European VCs active in the young and emerging European life science industry appear to have a particular need to internationalise into the more established life science market in the USA. Motives for such internationalisation may include the access to experienced syndication partners, more developed capital markets, and, particularly in the context of industry-specialised VCs, the generation of a deal flow of promising investees. We suggest that future research may analyse the internationalisation strategies of VCs into more developed markets in more detail.

Our focus on industry-specialised VCs allowed us to gain a deeper insight than previous studies into VCs' investment strategies with regard to the technologies and markets they invest in. Whereas the very limited work on industry diversification of VC portfolios measures the aggregate number of industries VCs invest in (Gupta and Sapienza 1992; Norton and Tenenbaum 1993), we go one step further and distinguish different technologies within the life science industry. This view implies that VCs, which have been classified as undiversified in previous studies, do have the opportunity to diversify

with respect to technologies. Our results indicate that life science VCs do indeed differ regarding their preference for certain technologies such as therapeutics and diagnostics development, medical technology, and healthcare/IT. The kind of technologies VCs invest in may depend on their experience, which allows them to accumulate technology-specific knowledge and understanding, but may also be associated with different needs for high returns and risk perceptions of US-American and European VCs (Sapienza et al. 1995; Manigart et al. 2002). Moreover, deal flow limitations may have an effect on the technologies of VCs' investees in their portfolios, because we find different preferences for VCs investing globally and those with a continental focus on their home markets in the USA or Europe. Further research is necessary to analyse the determinants of the VCs' technological preferences when designing their industry-specialised portfolios.

Our paper has implications for going forward scholars, which arise from the limitations of the study. Firstly, our argumentation that European life science VCs are less experienced than their US counterparts is derived from the fact that both, the European VC as well as the life science industries, are younger and less developed than the sectors in the USA. We do, however, not have data on the experience of individual VC managers, who decide whether to invest in a company or not. It may be an interesting avenue for future research to study how, in the specific context of the life science industry, individual experience and expertise of managers influences investment behaviour of VCs. An experimental design as employed previously for evaluation of VC managers' decision policies (Shepherd et al. 2000) may be an appropriate methodology. Secondly, although we provide insights into differences of portfolio strategies between life science VCs in the USA and Europe, we do not have data on

how these differences are reflected in the success of the VCs. Existing research suggests that US-American VCs are on average more successful than their European counterparts (Hege et al. 2003). However, in the specific context of the life science industry, no data are available so far. Moreover, the specificities and different development stages of the life science sectors in the USA and Europe may make different investment strategies for European and US-American VCs necessary in order to achieve high returns. Future research may analyse this certainly interesting topic.

The findings we present in this study have implications for life science entrepreneurs. Specifically, they suggest that VCs have preferences for supporting investees developing different life science technologies depending on the home continent and internationalisation strategy of the VC firm. Medical technology and healthcare/IT ventures appear to be more likely to attract VC in the USA than in Europe. It is therefore advisable for European ventures developing these technologies to early enough internationalise into the USA in order to access the US VC market. This strategy has been followed by European life science ventures in the past to access public capital markets via a listing on the NASDAQ (Ernst & Young 2001), and our results suggest that it may also pay off for ventures depending on the private capital markets. Therapeutics and diagnostics companies in the USA, on the other hand, may find good opportunities to raise VC in Europe. These companies may also more likely get funding when approaching globally investing VCs in the USA than when approaching their continentally focused counterparts.

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Tables and figures

Table 1: Venture capital and life sciences in the USA and Europe

		USA	Europe
VC industry	First company (foundation)	ARD (1946)	TDC (1962)
	Funds raised in 2004	17.9 billion $US	35.8 billion $US[1]
	Invested capital in 2004	21.1 billion $US	13.4 billion $US
	Life science investment in 2004	3.5 billion $US	1.6 billion $US
Life science industry	First company (foundation)	Genentech (1976)	Celltech (1980)
	Total companies in 2004	1.444	1.815
	Public companies in 2004	330	98
	Revenues in 2004	42.7 billion $US	7.7 billion $US
	Employees in 2004	137.400	25.640

[1] Please note that this number includes also late stage private equity funds, which are not included in the US figure.

Table 2: Characteristics of US-American and European life science VCs

VC characteristics	VC Location	Mean	Std. Dev.	Mann-Whitney test statistic
Capital under management (million $US)	USA EU	1349 1181	1479 2282	681
Portfolio companies	USA EU	20.2 24.5	10.5 14.0	584
Life science team size	USA EU	8.8 10.7	4.8 5.2	550

Asterisks relate to results of the Mann-Whitney-U test for differences between the two groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance.

Table 3: Characteristics of life science VCs which invest either in their home continent or globally

VC characteristics	Geographic scope	Mean	Std. Dev.	Kruskal-Wallis test statistic
Capital under management (million $US)	USA continental EU continental Global	1034 381 1789[c]	1209 172 1534	0.000***
Portfolio companies	USA continental EU continental Global	18.2 18.1 27.0[c]	9.6 5.2 13.6	0.002***
Life science team size	USA continental EU continental Global	8.1 9.1 11.2[b]	4.30 1.81 5.88	0.027**

Asterisks relate to results of the Kruskal-Wallis-test for differences between the three groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance. Superscript letters in Mean column indicate a pairwise Mann-Whitney significant difference (p < 0.05) for VCs with (a) USA continental vs. EU continental, (b) global vs. USA continental, and (c) global vs. EU continental geographic scope of investees.

Table 4: Portfolio strategies of US-American and European life science VCs

Binary variables	VC Location	Number (of total)	Percentage	Chi-square
Early stage focus	USA	30 (65)	46.1	0.731
	EU	13 (23)	56.5	
Stage diversification	USA	32 (65)	49.2	0.225
	EU	10 (23)	43.5	
Continental focus	USA	49 (65)	75.4	12.274***
	EU	8 (23)	34.8	

Asterisks relate to results of the Chi-square test for differences between the two groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance.

Table 5: Portfolio strategies of US-American and European life science VCs (life science fields)

Variables	VC Location	Mean	Std. Dev.	Mann-Whitney test statistic
Therapeutics	USA	0.39	0.26	409***
	EU	0.57	0.19	
Diagnostics	USA	0.04	0.05	554**
	EU	0.03	0.04	
Service/Supply	USA	0.13	0.11	654
	EU	0.14	0.09	
Medical technology	USA	0.34	0.24	454***
	EU	0.18	0.15	
Healthcare/IT	USA	0.10	0.13	503**
	EU	0.04	0.07	
Others	USA	0.03	0.03	723
	EU	0.02	0.06	

Asterisks relate to results of the Mann-Whitney-U test for differences between the two groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance.

Table 6: Portfolio strategies of life science VCs which invest either globally or exclusively in their home continent

Binary variables	Geographic scope	Number (of total)	Percentage	Chi-square
Early stage focus	USA continental	24 (49)	49.0	2.783
	EU continental	6 (8)	75.0	
	Global	13 (31)	41.9	
Stage diversification	USA continental	22 (49)	44.9	3.141
	EU continental	2 (8)	25.0	
	Global	18 (31)	58.1	

Asterisks relate to results of the Chi-square test for differences between the two groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance.

Table 7: Portfolio strategies of life science VCs which invest either globally or exclusively in their home continent (life science fields)

Variables	VC Location	Mean	Std. Dev.	Kruskal-Wallis test statistic
Therapeutics	USA continental	0.35[a]	0.26	0.001***
	EU continental	0.51	0.20	
	Global	0.55[b]	0.19	
Diagnostics	USA continental	0.03[a]	0.05	0.003***
	EU continental	0.08	0.04	
	Global	0.02[c]	0.03	
Service/Supply	USA continental	0.12	0.11	0.636
	EU continental	0.14	0.10	
	Global	0.14	0.11	
Medical technology	USA continental	0.37	0.25	0.008**
	EU continental	0.22	0.15	
	Global	0.21[b]	0.17	
Healthcare/IT	USA continental	0.11[a]	0.14	0.040**
	EU continental	0.01	0.02	
	Global	0.06	0.09	
Others	USA continental	0.02	0.03	0.369
	EU continental	0.05	0.08	
	Global	0.01	0.04	

Asterisks relate to results of the Kruskal-Wallis-test for differences between the three groups of VCs, with *p < 0.1, **p < 0.05, and ***p < 0.01 level of significance. Superscript letters in Mean column indicate a pairwise Mann-Whitney significant difference (p < 0.05) for VCs with (a) USA continental vs. EU continental, (b) global vs. USA continental, and (c) global vs. EU continental geographic scope of investees.

Table 8: Summary of propositions and results

Hypotheses	**Prediction**	**Result**
US-American vs. European life science VCs		
H1a (early stage)	USA = Europe	Support
H1b (stage diversification)	USA = Europe	Support
H1c (traditional life science fields)	USA < Europe	Support
H1d (new life science fields)	USA > Europe	Support
H1e (global investments)	USA < Europe	Support
Home market focus vs. global investment strategy		
H2a (early stage)	Global < USA, Europe	No support
H2b (stage diversification)	Global, Europe < USA	No support
H2c (traditional life science fields)	Global, USA < Europe	Partial support
H2d (new life science fields)	Global, USA > Europe	Limited support