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PORTFOLIO STRATEGIES AND PERFORMANCE IN THE VENTURE CAPITAL INDUSTRY

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Introduction

Venture Capital Funds invest in new (generally small) ventures with high risk exposure and high growth potential, thus playing a fundamental role in fostering national innovation and economic growth (Gompers and Lerner 2001, Kortum and Lerner 2000, Callahan and Mueggue 2002). Academic studies on Venture Capital have investigated over time a number of related topics. This research examines the many strategies which Private Equity and Venture Capital Funds (hereinafter VCs) may use to diversify their investment. I analyse the relationship between portfolio strategies and the performance of a VC.

There is a large and growing literature analysing the return of venture capital investments (Jones & Rhodes-Kropf 2003, Ljungqvist & Richardson 2003, Kaserer & Diller 2004, Cumming & Walz 2004, Cochrane 2005, Kaplan & Schoar 2005). The majority of these articles study the relative performance of VCs compared to public markets. However, there is much less understanding about the impact of portfolio strategies on the performance of VC. In this paper, I try to fill this gap by examining the impact of diversification on the rate of positive return of VC funds.

Portfolio diversification is a particularly interesting issue in the Venture Capital industry, where "generalist" funds (involved on many different markets) work alongside funds concentrating their portfolios on specific industries, geographical areas and stage of development (Cumming 2004, EVCA 2005, The Economist 2004). Among the many possibilities of action, it has been seen that some large funds tend to circumscribe their

activities by accurately choosing industries to include in their portfolios (EVCA, 2005; The Economist, 2004), whereas other funds divide their organizational structure into separate units devoted to specific business categories or industries within which to develop and exploit specific expertise as a competitive advantage (Harper and Schneider, 2004).

Although finance and strategic management researchers have increasingly widened the scope of research on VCs, the latter's portfolio strategies have been rarely investigated (e.g. Norton and Tenenmbaum, 1993). Though, even if some previous studies showed the existence of heterogeneity in the VC market relatively to managerial approaches, preferences for particular stage of development of the supported deal, business selection criteria (Robinson 1987, Norton e Tenenbaum 1993, Elango et al. 1995, Wright and Robbie 1998, Manigart et al. 2002), little attention has been paid on how VCs cope with the composition of their portfolios. Surprisingly, little knowledge exists as to how VCs develop their investments portfolio, even if the decisions regarding investment scope are key issues for corporate strategy (Hofer and Schendel 1978). This research advances that VCs performance is influenced by the choices of composition of their portfolio, along three possible dimensions: geographic dimension (i.e. the geographic origin of the investee companies); the stage of development of selected deals; the industry or technological field of the backed ventures.

This study suggests that VCs performances are contingent on their choices as to the composition of their investment portfolios. Also, the decision determining the composition of a fund and thus the level of diversification, plays a crucial role in its

development, since it is a long-term strategic decision that is difficult to change. The maximum amount a fund is allowed to invest in a single company as well as in certain financing stages, industries, or countries is fixed in the partnership agreement with the limited partners, i.e., the investors. A deviation from this agreement is only possible if all limited partners approve. Hence, since the portfolio decision are difficult to change, and have a deep impact on the VCs funds, we address the following question: does portfolio-diversification lead to higher performance than portfolio-specialization?

This research aims at contributing to the literature dealing with the strategic decisions and performances of VCs, calling into play the debate on whether a diversification strategy is more or less effective than specialization. Exploring this question may also contribute to the literature on corporate strategy in that it expand the breath of corporations that are included in the analysis of how diversification and specialization strategies affect performance. Understanding these issues contributes to the debate on VC strategy and performance, by analyzing the different behaviours and determinants of success of VCs, by comparing different stream of theory supporting two competing strategies: portfolio diversification versus specialization.

The rest of this Thesis is organized as it follows:

Chapter I introduces the venture capital context and the relevant literature which assessed the issue of portfolio strategy and venture capital performance.

Chapter II will directly address the question of factors affecting venture capital performance, the difficulties in finding reliable proxies for evaluate funds' return and the solution offered from previous literature.

Chapter III will present the analytical framework suggesting two competing hypotheses relatively to the relationship between portfolio strategy and performance, which are supported by two separate theoretical approaches: Financial Intermediation Theory, support the idea that portfolio diversification is associated with better VCs performance, while the Resource-based approach applied to the venture capital context suggests that portfolio specialization should lead to higher performance.

Chapter IV firstly is dedicated to display the setting of the analyses, the UK venture capital industry. The rest of the chapter discuss the methodological issues. Sample selection, variables and statistical methods will be presented here.

Chapter V reports the analyses and results on the relationship between portfolio diversification and performance. The first section of the chapter will show the dynamics of sample funds and the emerging trends. Then the results and implication from regressions will be presented. Also, robustness check will be reported to strengthen the findings.

Chapter VI concludes the thesis and discuss possible avenues for future research.

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CHAPTER I

Relevant literature on Venture Capital portfolio strategies and their performance.

In this section I will provide a synthetic review of the relevant literature dealing with the portfolio strategies of VCs. First I will briefly describe what venture capital is and how venture capitalists operate. Second I will discuss the literature which is most related to the topic of this research, investigating on VCs' portfolio strategies and preference for particular type of investments. Then I will discuss later works that tried to shed light on the relation between these decisions and VCs performance. For each of these two groups of papers I will point out their findings and conclusions, as well as their limitation and the paths of future research they have suggested. Finally I will review the main literature on the performance of VCs. As it will be shown, this is a very complicated issue, due to the general lack of available data on private transaction and to the need to choose a robust proxy of the measure.

1.1. The Definition of a Venture Capital Investment.

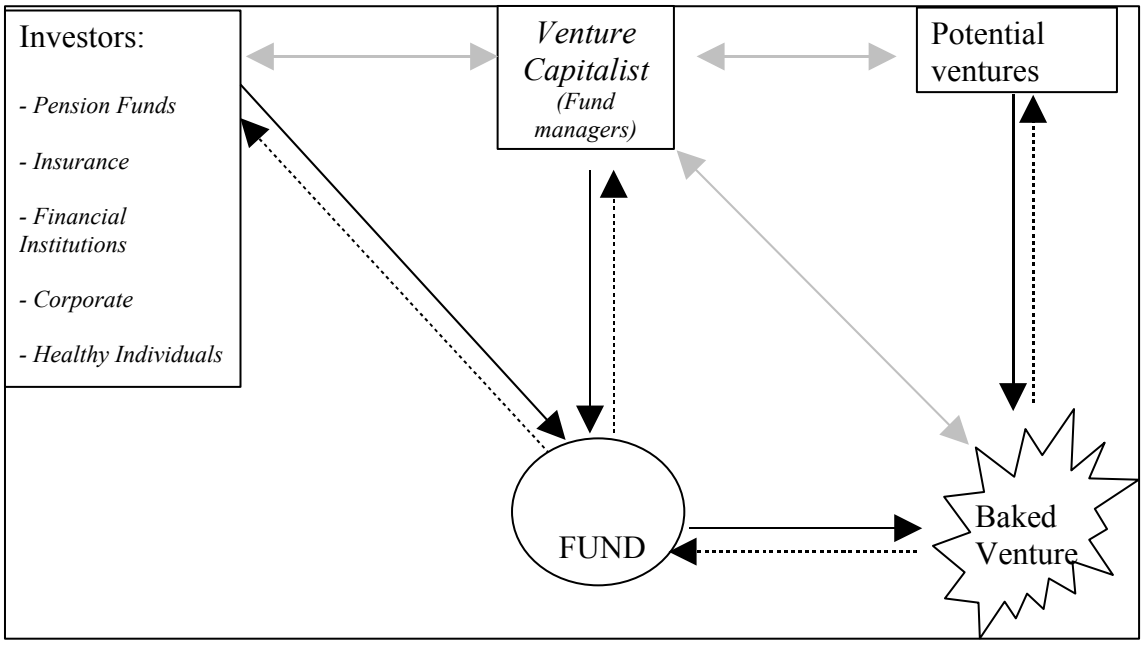
A number of different definitions have been given for venture capital investments, depending on the characteristics of the various parties involved. This prolificacy of definition can be sometimes misleading: for instance in the United States (US) "venture capital investment" refers only to investment in the shares of privately held companies at an early stage of a company's development, whereas in the United Kingdom and continental Europe it refers to investment at all stages of a company's development. In this dissertation the UK and European connotation is used.

Venture capital investment consists in the purchase of shares of (young) privately held companies by outsiders for the primary purpose of capital gain (Cressy 2005). Indeed venture capital is considered as a solution to financing high-risk, high reward projects. Figure 1.1. represent the venture capital cycle.

A Venture Capital Fund (hereinafter VC) fund is a collector of financial resources an a basket of funded companies (MacMillan et al. 1985). The creation of a fund involves several entities (Murray and Marriott, 1998), being grounded on the participation of two parties: on the one hand, the funded companies or entrepreneurs and, on the other, a partnership between institutional entities (so-called: Limited Partners) providing financial capital, and a venture capital managing firm (so-called: General Partner) which professionally manages the fund (Bygrave et. al, 1989; Chiampou and Kallett, 1989). It is very common that a fund is participated by a number of limited partners and it is syndicated and run by a number of different general partners

(so-called syndication of funds). Hence the funds involves multiple stakes and interests which not only are difficult to disentangle but which also affect the partnership itself.

Figure 1.1. The Venture Capital Structures



The Primary goal of a fund manager is to provide returns to investors, by enhancing the value of backed companies which entered the fund. In order to realize capital gains, the funded companies are exited from the fund and sold to third parties or public market. In order to do this, fund managers offer a variety of service to funded companies. Early studies on this topic (Sahlman 1990, Sapienza 1992, Sapienza and Korsgaard 1996) have underlined the role of VCs in the management of backed ventures. A role which goes beyond that assumed by traditional financial intermediaries. Yet, it is only relatively recently that the role of VCs has been subject of thorough

investigation, examining whether they act as mere intermediaries or as managing companies capable of adding value to backed companies through their own expertise and resources (Gompers and Lerner 2002, Hellmann and Puri 2002). It has been shown that VCs provide assistance to new ventures by monitoring their financial and operational performances (e.g. Gompers and Lerner 1999, Kaplan and Stromberg 2001); moreover, they are highly involved in recruiting management teams (e.g. Elango et al. 1995, Hellmann and Puri 2002, Bottazzi et al. 2004), and in finding resources and competences complementary to those of funded ventures (e.g. Brander et al. 2002), both in terms of physical and relational capital and human resources (Sorenson and Stuart 2002); furthermore, they create incentive schemes connected with the economic performances of funded companies' managerial teams (e.g. Reid et al. 1997, Kaplan and Stromberg 2003) and substantially contribute to the improvement of the latter's professional standards (e.g Kaplan and Stromberg 2003).

These are some of the strategies VCs display in order to make profit from the companies they hold in their portfolios. Managing the portfolio of companies imply at first the ability to create, select and develop a set of assets so that the VC partnership can provide a remuneration to the investors for the risk they bear and the resources they put at stake.

Hence portfolio management and VCs strategies relatively to portfolio decisions is strongly related to their ability of adding value to their funded companies by having access to complementary resources, sharing financial risks, getting access to a network of managers, investors and investment opportunity (Brander et al., 2002).

In this sense, special attention has been given to the managerial competences developed by VCs, assessing their role and level of participation in the management of funded companies (Sapienza 1992, Hellman and Puri 2000, 2002). Such studies have essentially subscribed two approaches: on the one hand, attention has been given to the creation of adequate structures for the governance of relationships between venture capitalists and backed companies; on the other, focus has been placed on a number of processes for the management of different activities (Wright and Robbie 1998).

In the first case, the pioneering work of Sahlman (1990) has paved the way for a theoretical approach essentially concerned with the screening and the evaluation of business plans, and with the preparation of pay-off structures and contractual clauses reducing VC firms' risk exposure.

This dissertation, instead, is more in line with the abovementioned second theoretical approach, which focuses on the strategic approaches displayed by VCs to select and support funded companies (e.g. Bygrave and Timmons 1992, Fried and Hirsh 1994, Tybejee and Bruno 1994). This theoretical approach comprises different studies which have examined the reasons behind the heterogeneity of VCs which affect their managerial styles, their preferences for specific development stages of supported ventures, and their strategic differences in selecting their operational scope in terms of technological sectors and preferred countries in which to invest.

Although some studies have examined VCs' strategic choices as to which development stage is to be preferred when making investments (see e.g. Norton and Tenenbaum 1989, Gupta and Sapienza 1992), little attention has so far been paid to how

VCs cope with different dimension along which they can choose between an investment diversification or investment specialization strategy.

1.2. Portfolio strategy of Venture Capitalists: the early studies on Diversification versus Specialization.

Dealing with the competition in the venture capital industry, the literature on VCs has taken into account the variety of portfolio investments strategies (Elango et al. 1995, Wright and Robbie 1998). Given the heterogeneity of the field, some studies have examined different kinds of VCs, identifying multiple managerial styles, investment profiles, preferences for given fields and development stages of enterprises or ventures requiring financing (Robinson 1987, Florida e Kennedy 1989, Elango et al. 1995, Wright and Robbie 1998).

On the basis of such studies, some researchers have dealt more directly with VCs' choices in terms of diversification or specialization of their portfolio of investments. Nonetheless, there still remains a relatively small number of studies investigating the many differences between VCs portfolio strategies.

Moving from the recognition of a wide variety of strategies followed by VC firms, some seminal papers started to analyse factors that might explain variations in preferences in industry diversity, stage of development and geographic scope of portfolio investments.

The finding of this early studies suggest that VCs focusing on early stage investment tend to have a narrower industry and geographic scope of their portfolio than VC firms involved in later stage investments, in order to accumulate specialized knowledge and guarantee a greater involvement and assistance to the investee companies (Gupta and Sapienza 1992).

Another important finding is that VCs managing larger funds tend to diversify their portfolio much more than smaller firms. Furthermore the need to collect detailed information in order to reduce uncertainty induces VCs to concentrate on industries they are most familiar with. In particular, the high uncertainty characterizing early-stage companies induces VCs to include a small number of companies in their portfolio and to specialize in given industries (Norton and Tenenbaum 1993, Elango et al. 1995).

VC firms tend also to specialize in specific development stages, in which their acquired expertise can produce greater value (Carter and Van Auken, 1994).

This initial stream of literature on VCs choices relatively to portfolio composition faced for the first time the issue of heterogeneity between VCs. In particular these scholars focused on the heterogeneity of VCs, by looking at their strategic approach relatively to the management of their portfolio of assets, the availability of resources and the their role in adding value to investment companies.

Gupta and Sapienza's work (1992) examined the investment strategies of 169 US based VCs between 1980 and 1989 in order to identify factors that might explain variations in preferences regarding the industry diversity and the geographical scope of

their investments. More interestingly this study is one the first attempt to explore the portfolio strategies on a multiple level basis. Gupta and Sapienza investigate on how the risk-lowering pressure induces VCs to implement different strategies to their investment portfolio composition, relatively to their preferences regarding the stage of development of selected deal, the industry spread of investee portfolio companies and the geographic breadth of VCs operations.

Their basic assumption is underpinned on the hypothesis that variations in VCs preference regarding portfolio composition of their investment along the industry and country dimensions are a function of the preferred stage of development at which to make the initial investment.

Their main findings suggest that VCs that specialize in early-stage development investments are more keen to lower levels of industry diversification and tend to prefer narrower geographic scope, relatively to those who invest in later-stage of development ventures.

The importance of this findings is much more in what can be conclude on the strategic behaviour of VCs. Indeed the fact that the effect of stage-of-development decisions have on preferences regarding industry and geographical scope of VCs portfolios is of particular interest as it sheds light on what value VCs might add to their role as conduits of investors capital to investee companies. The authors assumes that, because of the high risk-specific nature of the VC investing activity, the first decision in order to control for the risk of their activity has to be taken along the stage of development dimension. Then, given that VC who specialize in early-stage deals show

their keenness for narrower industry and geography scope, the authors also suggest that their findings reinforce the notion that VCs are more than just providers of financial capital. On the opposite, they add value to portfolio companies and thus increase VC performance.

They also propose two possible explanations about the value-added hypothesis. VCs may have superior selection capabilities. VCs who focus on early stage ventures possess specialized knowledge, which enable them to make more effective decisions regarding the selection of ventures to be funded. Hence the value added by VCs is much more embedded in their "picking the winner" abilities (Baum and Silverman 2004) then in their development skills. The other explanation also involves the ability of VCs to improve risk-return characteristics of their backed companies.

Hence, VCs who focused on early-stage investment prefer narrower industry and geographic scope, for they can thus provide industry-specific knowledge, external contacts and strategic and management advices to the investee companies thereby improving their risk-return characteristics.

Adopting Baum and Silverman words, some VCs might be able to show better results by acting both as "scouts" of potential profitable companies, in recognition to their ability to identify growing ventures which are more likely to show increasing future value; and as "coaches", in recognition to their ability to provide funded companies bundle of assets and resources that encourage and trigger their growth.

Norton and Tenenbaum (1993) achieve similar conclusions. By using data collected by means of postal questionnaires, the authors evaluated a number of suggestions on the many strategies orienting VCs' choices as to the composition of their portfolios in order to assess how risk exposure is managed thereby.

They argue that essential to VCs' performance is the control and management of portfolio risk. VCs have hence developed multiple instrument for controlling risk, as for instance by structuring the financing in different and subsequent stages and by relying on very strict and detailed ex-ante covenants (see also Kaplan and Stromberg 2001). The authors suggest that a powerful tool VCs have to control for risk exposure, include portfolio diversification. Spreading the risk by investing in different markets and countries VCs can minimize investment specific risks. On the other hands, they also showed that many VCs seems to rely on specialization into particular investment types, so that information sharing, gaining access to networks and deal flows, acquiring reputation in the investing community can also be used to control for unsystematic risk.

Their analysis conducted on 98 enterprises suggests that the need to collect information so as to reduce uncertainty induces VCs to concentrate on industries they are most familiar with. In particular, the high uncertainty of the early growth stages of deals induces VCs to include a small number of companies in their portfolio and to specialize in given industries. Conversely, VCs engaged in later development stages prefer to spread out their involvement across different industries.

The fact that investors in early-stage deals seems less diversified across industry and country lead the authors to conclude that the assumption of complete diversification

is not appropriate in the context of VCs. In this circumstances of high uncertainty, VCs are more likely to rely upon their expertise to specialize in certain technical and product areas. Due to their information advantage in said technologies and markets, and the high fixed costs of gaining expertise in other domains, it does not make economic sense for them to seek portfolio diversification.

Other scholars were involved in researching on the heterogeneity of VCs. Elango et al. (1995) study the source of heterogeneity among VCs.

Through a questionnaire-based data gathering method, they obtain data from about 150 VCs in Nothern America, and point out that VC differ on several dimension, which they group into four different areas: venture stage, staff assistance, size and geographical heterogeneity.

The authors asked to a number of US based VCs information on these four dimension until the year 1989. Relatively to this present dissertation more interesting are above all the dimensions regarding the stage of ventures in which VCs invest, and the geographical scope of operation.

Consistently with prior studies, Elango et al. found that earlier stage investors are much more interested in focusing on smaller number of ventures within similar product characterized by technological novelty and with high growth potential, while later-stage investors look for companies that offer market-proven product, regardless to the type of market relatedness between backed companies' businesses.

At the same time, VC that are more concerned with later stage and buy out deals, are also more likely to open subsidiaries in other parts of the US in order to search for potential investment in other geographical areas rather than focusing on their domestic territory, while for instance VC focusing in early-stage high-tech investment in the Silicon Valley.

In other words, Elango et al. reach similar conclusion of previous work, where it seems that VCs who specialize in early stage ventures tend to prefer less diversity in terms of industry and geographical scope of their investment portfolio.

Also Carter and Van Auken (1994) are interested in investigating on the importance of companies' stage of development in investors choices.

In particular, while previous works have examined the relative significance of various evaluation criteria for venture capital projects, there has been no attempt prior to Carter and Van Auken study to investigate on the relationship between evaluation criteria and the investment preference of the VC.

The authors argue that one of such preference involves the stage of development of founded companies. They look at the stage of development of backed companies as one key criteria VCs employ when selecting the deals they are willing to invest in. They used a postal questionnaire approach and collected information on 69 US based VCs during the years 1980-1989.

Their findings reports that VCs prefer to invest in business prior they reach a mature phase, and that VCs investing in earlier stage of development declare to be more

involved as active manager in their companies, than those preferring later stage investments.

As an explanation for this pattern of strategic choices, the authors employ the same rationalization scheme of Gupta and Sapienza (1992) and Norton and Tenenbaum (1993), supporting the view that specialization strategy is an important strategic means that VC can display in order to control for unsystematic risk and uncertainty. In other words, since the information on funded companies and market expectations are likely to be a function of the company's stage of development, it is reasonable to expect that investors might specialize in specific stage of development where expertise in evaluation may be more valuable.

Carter and Van Auken found evidence suggesting that the stage of development of the companies in which the VC invests is of absolute relevance to investors. Moreover investors who appear to prefer investments in their early stages are less interested in the management of risk and of the endeavour than later stage investors, and more willing to exercise control over the project by employing an active management approach, for instance by spending more time in the selection process and by replacing management as the need arise.

Finally and very important for the purpose of this dissertation, Carter and Van Auken's paper is one of the first attempt to look at the impact that strategic choices of VCs have on their ability to perform. Their work suggest that preferences about the stage of development of investee companies are also related to the investor's strategy to realize value from its investments.

Since the ultimate goal for the investor is to find a profitable exit from the venture, VCs can be very concerned about the probability of success of this effort. This probability is linked to the future prospect of liquidity of the investment.

In other words, the probability for a VC to experience a favourable exit has a direct relationship with the probability to cash-out the investment. On the other hand, since a positive exit can be made only via third sale of the backed company to another investor and/or another organization, or by taking the founded company into the public market via initial public offering (IPO), the probability to liquidate the investment is also affected by the stage of development of the investment. Using responses from their sample questionnaire, the authors thus shows that later stage investors pretend to be much concerned about liquidity then their early stage investor peers. Also early stage investors seem to favour the IPO as a means of exiting the project, than later stage VCs.

Two basic assumption are suggested here: the first one is that the probability of positive exit through third sale are higher than the probability of positive exit from IPO (Kaplan and Stromberg 2001). The second one is that the probability to obtain bigger excess return from investee companies is higher if the companies are taken to the public market than if the they are sold to another (private) counterpart (Gompers and Lerner 2001).

1.3. Conclusion and limits of early research.

These papers are the first attempt to tackle the issue regarding the way VCs cope with their portfolio strategies, in order to deepen the understanding of the heterogeneous strategic behaviour of VCs relatively to the managing of their companies in relation with the decisions on the composition of their portfolio. These scholars have linked the topic of investment strategy of VCs and the problem of portfolio management.

Interestingly, one can track several common themes which characterise the early research. First of all, from all of these studies it emerges a tangible utility which explain the need and the purpose of investigating this issue, that is: VCs have to employ and display portfolio strategies in order to face and manage the risk-return issue of their investments.

Moreover, it is generally reckoned that there are two possible theoretical approaches among which a VC can choose in order to mange the risk-return issue: by focusing the portfolio of investment along some strategic dimension, either spreading the number of investments along these dimensions. In almost all of these studies the strategic variables along which a VC can gauge their portfolio strategies and success are the degree of specialization/diversification relatively to the stage of development of their portfolio, the industry and geographic scope of their basket of investments.

Relatively to the specialization versus diversification approaches, the first one apply to the benefit of specialization, that is the possibility of information sharing and

replication, the development of expertise and key resources and capabilities that can be redeployed on a number of subsequent or contemporary investments.

The second approach rely on the benefits of portfolio diversification, which apply on financial theory and address the issue of risk-return of a portfolio of investment arguing that by diversifying the asset of a portfolio, the unsystematic risk can be reduced with, benefiting the performance.

The pattern of portfolio decisions for VCs are modelled by these authors with a common strategic starting point, or priority strategic dimension, which is the choices regarding the preference for the stage of development of target companies, as if the core feature which distinguishes the VC business from other type of economic activity is concealed within the particular choice of the stage of development. It seems like this early stream of research considers that the choice of regarding the stage of development in which a VC operate is taken for granted by VCs. I suggest that this is because of the undeniable difference which the stage of development of a venture entails. For instance, an investment in the seed stage typically involve a start-up with no track of previous activity, generally developing concept-products or offering or producing new products and services in new markets, and unable to predict future steadily flows of sales neither of profits (Tyebjee and Bruno 1984).

On the other hands, an investment in the buyout stage typically concerns a developed company as deal target, with a track record of sales and a history of profits, which needs to finance its growth and development plans. One can easily think about differences in risk and needs that such different stages of development required from a

VC to be managed. The important point is the following: as it appears from these mentioned seminal studies, because of the intrinsic difference in risk and abilities needed to operate in diverse stage of development deals, once a VC decide how to position itself along this dimension, the particular chosen stage demands subsequent patterns of choices regarding the degree of specialization of diversification along the industry and geographic dimensions.

Finally, these seminal contributions achieve common findings. It is commonly acknowledged the view that early stage investors tend have more focused investment portfolios along the industry and the geographical dimensions, than the later stage ones.

These seminal contributions opened an important and interesting avenue of research regarding the understanding of VCs strategic behaviour and the different approaches they display relatively to portfolio management.

One of the limits of these first studies is that their findings rely upon small sample, drawn from only US, in the early years of Venture Capital. Gupta and Sapienza perform their analyses on a sample of 169 US-based VCs, while Norton and Tenenbaum's sample counts for 98 respondent US-based VCs; Elango et al. perform their study based on 149 responses; Carter and Van Auken rely on 69 VCs. This suggest caution on generalization of their findings: for instance the papers look at the phenomenon only in US. Yet it worth to say that during the '80s, the Venture Capital industry was much more active in US than in the rest of the world. But more recent research show that the bulk of VC raise is to be set in the '90s, where not only the US

players have enormously grown in terms of numbers and volume of activities, but some scholars talk about a real boost in the Venture Capital industry (Gomper and Lerner 2001, Bottazzi et al. 2004) thanks to the huge development of these industry in Europe and in the Far-Eastern markets.

Hence, we might have a limited perception on what is the behaviour of VCs from these later works, since many years have passed from this early contributions, the Venture Capital market developing worldwide and shaping its features.

Moreover, given the severe limitations on the public availability of data on VCs, these studies used survey-based data. In any survey there is a trade-off between the eliciting of responses and collecting sufficient information (Carter and Van Auken 1994). These studies focused on the investment preferences rather than the actual patterns of VCs (Gupta and Sapienza 1992). While we can expect a high correlation between investment preferences and actual strategies there is an empirical need to support this expectation. Some of the authors point out that from their responses it emerged different preferences relatively to the industry and geographical scope of their investment, from companies which showed similar preferences regarding stage of development (Elango et al. 1995). Some VCs focus on specific industries, whereas others do not, and this seem to be a significant factor although not tested (Bygrave and Timmons 1992). This is a call for the need to investigate on the actual portfolio strategies of VCs, not only on their past preferences, and to model the interaction of the possible variable along which a VC can choose its diversification or specialization approach relatively to its portfolio strategies.

Finally, Norton and Tenenbaum (1993) claim for the need of additional work to be done in order to better understand the theory and process of VCs on risk control. For instance, none of these works have taken into account the impact of different portfolio strategies on VCs' performance. This is an issue of primary importance, if the ratio which is used to explain the need for VCs to manage their portfolio of investments is the need to cope with the issue of risk-return. The focus of these studies had been mainly on the antecedents of VCs' investment preferences and it would be important to take a look at the impact of this choices on the ability of VCs to perform (Gupta and Sapienza 1992, Elango et al. 1995). The comparison of performance between VCs specializing and/or diversifying along different dimension could also be very interesting to shed light on the heterogeneous behaviour of VCs (Carter and Van Auken 1994).

1.4. Recent studies on the VCs portfolio strategies.

Venture capital has in recent years become a substantial and growing area of academic research. This florescence has emerged from the pioneering works mentioned above together with the build-up and final bursting of the stock market bubble of the 1990s, regarded by many as fuelled by venture capital (See Gompers and Lerner, 2001).

Recent research showed that while some VCs specialize only in certain technologies and stage of development and geographical markets, keeping their

investment strategy very focused, others tend to display a diversification strategy along the above mentioned dimensions (Cumming 2004).

Latest reports on VC industry point out that many players are defining their operative area by accurately selecting industrial fields (EVCA 2005, The Economist 2004), while some others ramify their organizational structure in industry and/or country-specific units in order to develop a context-specific knowledge as a competitive advantage (Harper and Schneider 2004).

Most recent academic papers try to shed light on VCs heterogeneity, suggesting that specialized organizations might be more successful then diversified VCs (Bottazzi et al 2004), while other produce first evidence that a diversification approach can improve fund performance (Knill 2005). Research community claims the need to deepen the understanding of the linkages between VCs' performance and their degree of specialization.

These few studies emphasize also the importance of other factors which might affect portfolio investment strategies, such as the country of origin, the source of funds and the degree of experience of the VC. In a study of the Finnish venture capital industry, De Clercq et al. (2001) point out that VCs develop their investment strategies over time, through subsequent decisions regarding the type of companies they invest in. More experienced VCs were slightly more specialized in terms of industry then less experienced VCs (although the difference was not significant at conventional levels), whereas the former were found to be more geographically diversified.

Bottazzi et al. (2004), analysing the European VC Industry found that knowledge and human capital specialization at the level of the VC firm is a fundamental driver to understand VCs' strategies: specialized VCs are more active and more involved with their portfolio companies. Gompers et al. (2004) studying the reactions of US VCs to shifts in public market signals, found that the most successful were the VCs exhibiting a higher level of industry-specific focus of their investments portfolio.

These works stress on the importance of knowledge and resources accrued by VCs and on the constraints of diversified firms in redeploying their resources among investments pertaining to different business areas. Thus a greater industry focus should reduce the inefficiencies associated with spreading the VC's resources across portfolio companies (Fulghieri and Sevilir 2005).

The study of De Clercq et al. (2001) is the first attempt to identify realized strategies of venture capital firms when undertaking portfolio investments. Their units of analysis are not the declared preferences of Finnish VCs. More directly they focus on portfolio of investments of these VC. They gathered data for the period 1994 through 1997 on 1160 investment from 28 Finnish VCs representing virtually the entire population of the Finnish venture capital industry. The purpose of this study is to examine the realized strategies of Finnish VCFs as determined by their portfolio investments. The study builds on prior research on diversification, specialization, and knowledge acquisition, as it pertains to venture capital investments.

They analysed the underlying patterns in the venture capitalist's selection of portfolio companies. More specifically, they focused on the characteristics of portfolio companies, in terms of their industry, company stage of development and geographical location, as strategic variables that guide the VCs' decision process.

They built on Gupta and Sapienza, Nroton and Tenenbaum quoted research, in that it should be expected that VCs' strategic decisions are based on maximizing risk-returns combination of their investment portfolios. Moreover, they argue that these decisions may follow a specific pattern as VCs gain experience over time. VCs then use their experience to control investment risk while maintaining high returns. They start proposing that VC can control for risk by taking two possible approaches: (1) reducing risk through specialization, with a VC developing knowledge by focusing on a specific industry, company stage of development, and geographic location; or (2) spreading risk through diversification across industries, company stages of development and geographic locations. They modelled three independent indexes measuring the VC's relative degree of diversification along the dimension of industry scope, geographic location and stage of development of their investments.

They looked at bivariate correlation coefficients of the three indexes above mentioned and other control variables, including measures of the experience of the VC, performing then a one-way ANOVA and t-test which informed about how the investment patterns changed from year to year, and whether a general investment pattern existed over the 4-year period.

They found that over time, VCs tend to specialize the industry scope of their portfolio. Further, VCs consistently diversified geographically throughout the 4 year period of the study, and they diversified their portfolio in terms of stage of development by investing in increasingly later stage companies through the first years of the study, before entering a period of equilibrium in which this degree of stage of development diversification held relatively constant. Finally, the importance of accumulated experience was illustrated by the finding that less experienced venture capital firms showed a time lag in these investment patterns compared to more experienced firms.

An important contribution of their study concerns their approach to the analysis of portfolio strategies of VCs. Their study focuses on how VCs develop their portfolios through subsequent decisions regarding the types of companies they invest in. Instead of looking at VCs' preference regarding possible dimensions of diversification or specialization, they modelled these dimensions employing independent diversification indexes for the industry scope, the geographical breadth and the stage of development spread of the companies VC hold in their portfolios.

Another important contribution of this study concerned the relationships identified between different types of risk and specific portfolio investment patterns, and suggesting that further understanding of the VCs' decision making process may arise when considering whether different factors become important during different stages of evaluation. In particular, they propose that private investors are willing to accept higher-than-market risk in order to receive higher-than-market returns. Therefore, a VC's performance is a function of how well it manages this risk. Specifically, its performance

reflects the quality of its investment decisions and the effectiveness of its management advice and services subsequent to the investment decisions (Zacharakis and Meyer 1995).

Bottazzi et al. (2004) investigate on the role that VCs play in financial intermediation. They found that specialization is key to VC activities in the sense that choosing a specialization approach, VCs can be more active in the management of funded companies.

This is one of the first comprehensive studies looking at the Venture Capital in Europe, underpinning the analysis on a hand-collected dataset of European venture capital investments. The data covers the period 1998-2001, and consists of a sample of venture capital deals in all the members of the European Union (in the period under study), plus Norway and Switzerland. Their primary data source is a comprehensive survey of all the venture capital firms in these countries, plus various other sources of commercial available data, resulting in a final sample of over 120 VCs, over 500 partners, and over 1,600 portfolio companies. A first important feature of this paper is that is Europe-focused studies, and that the data collection is one of the first significantly larger than other previous hand-collected datasets on venture capital.

Bottazzi et al. main conceptual frame is based on the belief that specialization can help us better understand the nature of financial intermediation, since it is the key variable that drives the degree of involvement of VCs in managing of backed companies. Hence, they collocate their paper in the debate whether VCs can be

conceived as mere financial intermediaries, providing no more than financial capital and few other pure financial services to the founded companies, or VCs can be considered as corporate manager, actively managing the companies they fund, through the provision of other type of capital (resources, human capital, knowledge and expertise, networks and social capital).

They look at whether more focussed and specialized VCs become more involved with the companies they finance. More specifically, they look at two dimensions of specialization. First, they consider specialization at the level of the organization. Second, they posit that financial intermediation is performed by people and look at specialization at the level of human capital. Then they also look at the interaction of these two levels of specialization, and ask whether the decision to be active resides at the level of the organization or whether it is individuals within the financial intermediaries who drive this choice.

Relatively to the organizational level, they found that an active investment style is strongly related to a financial intermediary's specialization. Independent VCs (those VCs who are mainly dealing with VC kind of operations) are significantly more likely to get involved with their companies, than subsidiaries VCs (those as for example financial entities who occasionally are involved at some level in venture capital deals).

Further more, and consistently with prior research, VCs that specialize their investment activities to doing only early stage deals and those which concentrate on relatively few deals in absolute numbers, tend to be much more involved in the

management of funded companies than VCs who pursue later stage investments or that are involved within a larger number of deals.

Beyond specialization at the organizational level, they also found that human capital is associated with a more active investment style. In particular, VCs with prior business experience are significantly more involved with the companies they finance.

Another important contribution of this paper comes from looking at the interaction between these two dimensions of specialization, and finding that human capital augments, rather than replacing, organizational characteristics. In other words it seem more likely that variations in human capital across VCs has more explanatory power than variation among partners within the same deal.

Fulghieri and Sevilir (2005) take a portfolio approach to analyse VCs investment strategies, and investigates the optimal size and scope of a VC's portfolio. They studied how the composition, in terms of size and focus, of the VC's portfolio affects the incentives of the VC and of the entrepreneurs in his portfolio, as well as portfolio performance.

They address the questions relatively to the determinants the size of a VC's portfolio; they investigate on the costs and benefits of having a small versus a large portfolio. They also examined the strategic aspects of managing a portfolio of start-ups rather than a single start-up.

Their basic concern is to model how VCs take the decision of having a diversified portfolio of companies or a focused one, assuming that size and focus of portfolio of investment is an important variable affecting VCs' performance.

Also Fulghieri and Sevilir's starting hypothesis is that VCs add value to investee companies by acquiring knowledge, human capital and skills that are very often specific to their portfolio companies. These investments lead to specialization in the VC industry, where different VCs invest in different sets of skills. For example, some VCs specialize only in certain technologies and industries and keep their investment strategy focused, whereas others diversify into different industries.

The authors build a model which explains the composition of VC's portfolio, relatively to its optimal size and focus of investments. They argue that the degree of portfolio focus affect the trade-off between having a large or a small portfolio. A high level of relatedness between portfolio companies allows the VC to reallocate resources more efficiently from one start-up to another.

The VC benefits from a high level of focus in two different ways. First, when one of the start-ups fails, the VC transfers his resources and human capital to the successful start-up. The higher the level of focus, the higher the efficiency of the reallocation of resources. This implies that a greater level of focus reduces the inefficiency associated with spreading the VC's initial investment across several start-ups, increasing the benefits of the resource allocation effect. This issue was already suggested by Norton and Tenenbaum, who suggested that in this circumstances of high uncertainty, the high fixed costs of gaining expertise in other domains, it does not make

economic sense for them to seek portfolio diversification. In other words, Fulghieri and Sevilir built a mathematical model which hypothetically replicates this relationship between scarceness of resources, uncertainty and the probability for VCs to focus their portfolio. Fulghieri and Sevilir's paper also suggests that larger and more focused portfolios are optimal in the case of risky start-ups investing in related technologies with high uncertainty and failure rates.

Another benefit of focusing the portfolio of investments is that it allows the VC to perform better. The authors' opinion is that this happens because, looking at the relationships between VC and entrepreneurs as a bargain in which both of the two side aim at having the highest number of options to perform a favourable exit in the future, a high degree of focus increases the value of the VC's outside option while he bargains with the entrepreneurs.

The authors conclude that a greater level of focus reduces the ex-post inefficiency associated with spreading the VC's resources across several start-ups, and increases the benefits of ex-post resource reallocation. This implies that focused portfolios are more desirable (all else equal) in the case of risky start-ups that invest in technologies with high uncertainty and failure rates.

Gompers et al. (2005) document that VCs with the most industry specific human capital and experience react most to an increase in investment opportunities in the sectors of their specialization. The evidence is explained by the view that it is more difficult for diversified and less specialized VCs to re-deploy their human capital from

the sectors of their investment to the sector experiencing an increase in investment opportunities. Their analysis covered all US venture capital investments during the period 1975-1998, thanks to the availability of Venture Economics commercial datasets, resulting in a final sample of 42559 observations.

They build on the idea that more experienced VCs achieve better performance than less experienced peers (Sorensen 2004). They modelled VCs' experience in three different ways. They called "General Experience" of a VC its total number of investments prior to the time of the investment in question. This measure represent the VC's experience accrued in the venture capital business.

The second type of VC's experience relates to the "Industry Experience," constructed similarly to the "General Experience" measure, but including only investments in the same industry as the investment in question. In other words they built class or industry categories of investments and measure the industry specialization of a VC in these classes. The third type of experience measure, "Specialization", measure the fraction of all previous investments that the VC made in a particular industry. In other words they built the specialization measure as the ratio of "Industry" to "General" experience.

Their findings suggest that the three kind of VC's experience are important channels through which the VC influences its reactions to shifts in public market signals. Indeed VCs tend to increase their investments in years and industries in which IPO activity increases. Also The results also indicate that industry experience have higher level of investment then less industry experienced peers. Moreover General and

Industry experience is positively associated with greater investment sensitivity to IPO activity.

Relatively to the industry-specialization kind of experience, Gompers et al. showed evidence that more specialized VCs tend to increase their industry investments more than less specialized firms when IPO activity increases, consistently with their findings on industry experience.

Finally Gompers et al. looked at the performance of the companies in which the VCs invest, measuring their performance by determining whether the investment resulted in a profitable exit for the VC. This is most likely the case if the company went public, registered for an IPO, or was made object of a third sale (i.e. the company was acquired or merged). The authors argue that investments they categorized as successes in that way, are likely to have generated higher returns that the investments that have not yet exited or have been characterized as bankrupt or defunct. Preliminary results seem to indicate that investments made by venture capital firms with more general and industry experience are more successful. The patterns with specialization are non-linear, but the least specialized organizations appear to be the poorest performers.

Then they repeated their analysis introducing new control variables such as the stage of development of funded companies and the capital inflow in the market during the year of the investment. This time, results showed that VCs do somewhat worse on the investments they take when there is a lot of IPO activity. However, the more experienced venture capitalists exhibit less degradation in their performance than do the less experienced venture capitalists.

This is an important paper in the stream of research involved in the investigation of the impacts of VCs' specialization or diversification portfolio strategies on their performance. Their general findings support the view that VCs are concerned with the decisions relatively to specialize or diversify their investment portfolios. Moreover, experience and especially industry-specific experience is shown to be a key driver in the process of investment strategy. They also found hints that investments for specialized VCs tend to be more successful in terms of probability of positive exits from the founded ventures, although the authors themselves call for further need to deepen this last issue, since the linkages between performance and specialization versus diversification choices remain ambiguous

Finally, Knill (2005) investigated on the trade-off between two different types of strategies a VC is looking to implement in order to achieve portfolio optimisation. She distinguished between the "pure play" strategy, characterizing the willingness of a VC to get actively involved in the management of backed companies, and the "generalist" strategy carried on by the VC while pursuing a diversification approach in order to minimize the overall risk of their portfolio.

Her strong basic assumption is that every VC plays at the same time two different roles: the role as general manager of each of the companies the VC invests in, and a role as fund manager concerned about the overall risk-return profile of the fund it manages. Knill argue that these two different roles entails opposite investment philosophy which have the potential to lead the VC to a dilemma. In other words, in

their role as company managers VCs should seek for specialization in the particular business concerning the company they run or support. On the other hand in their role as fund managers, they should look for the overall portfolio considerations and think about the level of diversification potential investors practice, in order to take control and to reduce portfolio risk.

This paper specifically built on Norton and Tenenbaum (1993) in that this paper also examines how VCs reduce risk through stage diversification, information sharing, networking and/or specialization. The underling assumption is that a VC determines whether an investment is worthy based on the likelihood of its profitability and on prospect of medium/long term portfolio risk.

This paper also differ from Norton and Tenenbaum approach in several aspects. First of all, Knill examines more than 38000 observations relatively to US based VCs, collected from a commercial dataset on the period 1998-2003, and thus providing a larger sample than Norton and Tenenbaum's one from which deriving conclusions.

Also Knill look more directly at the relation between VCs' portfolio strategies and their performance, although instead of a direct measure of fund profitability she uses an indirect measure of growth relatively to the amount of asset under management of the General Partner[1]. She also look at the performance of backed companies, because she is also interested in knowing which of the said different approaches (the "generalist" versus the "pure play" roles) is the best from the company point of view. She used the

[1] Knill argue that, due to lack of available data it is virtually impossible to collect direct measure of performance. She then decided to rely on a proxy of performance measured, which is usually strongly positively correlated with more direct level of performance. I will discuss the problem good measure of performance in later sections of this dissertation.

probability of getting through an IPO or being sold via merger or acquisition as a proxy to measure the performance of backed companies profitability.

Interestingly, as I will discuss in detail in next sections of this dissertation, these types of performance measures are usually employed by researchers to measure the performance at the fund level.

Similarly to De Clercq et al (2001), Knill built three dimension of portfolio diversification relatively to the industry, geographical and stage of development diversity of backed company, based on modified Herfindahal indexes[2]. She then studied the effect of these indexes on the performance variables.

Looking at the impact of VCs' levels of diversification along the industry, the geographic and the stage of development dispersion of portfolio companies to their performance, her findings showed that the impact of VC diversification are quite different for the performance of VCs themselves and the performance of backed companies. In other words her data shown that a diversified approach seems to be more beneficial at the VC level then at the backed company level questioning the misalignments of incentives in the VC-backed company relationship.

Interestingly the results showed that the geographic diversification seems to have the a positive impact on measure of performance at the fund level, while industry and stage of development diversification strategies seems to have only a smaller marginal impact.

[2] I will discuss the diversification measures more in depth in the section dedicated to the measurement of variables.

1.5. Conclusion and limits of recent studies

Based on the findings of earlier literature, these recent papers push forward the understanding of VCs' portfolio strategies and their relationship with performance.

These later studies appear some ten years after the earlier ones, benefiting for quite a long time for the venture capital market to develop and expand from United States to United Kingdom first, and then Continental Europe and Far East.

First of all, indeed, these later studies can count on more reliable samples from which they can derive conclusion, thanks to the growing volume of venture capital operation and the great importance of the venture capital in fostering economic growth and innovation (see Hellman and Puri 2001), as it is witnessed by the proliferation of commercial database set-up by organization conceived with the purpose of tracking VCs operations over time.

Second, a number of new and unresolved issues are addressed relatively to the relationships between VC basic concern about the risk-return profile of their portfolio and the strategies they display in order to cope with it. These latest works start to be interested not only in the preference of VCs for particular stage of development, technological sectors or geographical markets, but in the actual strategies VC implement along these dimensions. Also, multiple level of strategic assets should be considered in relation to the various possibility for a VC to leverage on while setting up their specialization or diversification approach: human capital, organizational level,

networks an alliances, industry-specific knowledge are some of the possibilities along which a VC fund can diversify its portfolio of investments.

Furthermore, these works start to investigate on the impact that these strategies have on performance. Since the VC partnership involves several entities each one carrying its own stakes and interests, it is important when talking about performance to specify who the performance are related to[3].

Central to this group of research is also the idea that the accumulation of different kind of experience is a key concept that deserve further theoretical development and empirical investigation at different levels, in order to explain the roles VCs plays in modern economy and in fostering the development of new companies. For instance, as Fulghieri and Sevilir (2005) pointed out specialized VCs will manage portfolios with a small number of companies, while less specialized VCs manage larger portfolios. Also Bottazzi et al. (2004) suggested that specialized VCs, since they hold portfolios with a small number of companies, are able to take a more active role in the direct management of their portfolio companies, leveraging on the development of greater human-capital-specific resources and with a more active investment style relatively to their portfolio companies. From this point of view, VCs should seek for the specialization of their portfolio, since specialization should specialized VCs refrain from investing in start-ups that are not related to their core business (De Clercq et al. 2001). Conversely, as Gompers et al. (2005) pointed out, investment activity by VCs with more general expertise is more sensitive to the overall business cycle conditions of

[3] This is a very important issue since the VC partnership represent a different number of separate entities. I will dedicate a specific section to discuss this fundamental issue

the economy since it is more difficult for diversified VCs to re-deploy their human capital and other resources from the areas of their investment to the area experiencing an increase in investment opportunities.

On the other hands there is also contradictory evidence that diversification can also benefit can also create value to investors and VCs, as far as a diversified portfolio allows for the reduction of risk without reducing performance. So far there has been no attempt to directly measure the impact of diversification strategy versus a specialization approach on performance. This issue call into question also which level of performance one is considering. As Knill (2005) pointed out, it could be a misalignment between the incentives for the investors to diversify the fund portfolio and the incentive of the backed company to be supported by a VC which has well developed skills in the same particular field and markets of the backed company.

The existing literature reveals some limitations that deserve further investigation. There is limited research on the determinants of VC success in relation with portfolio strategy. This issue is deeply linked to the lack of understanding on the precise mechanisms behind the relative performance of specialized or diversified VCs

As a final consideration, these latest studies appeared some ten years after the earlier ones, which suggest that the portfolio strategies of VCs are far from being completely understood and further research is to be exhaustive. Apart from such papers, VCs portfolio strategies and the question whether implement a diversification versus specialisation approach in order to achieve better performance, has so far been the object of a few studies. Surprisingly, little knowledge still exists as to how VCs develop

their investments portfolio, even if the decisions regarding the scope of firms' activities are key issues for corporate strategy (Hofer and Schendel 1978). To my knowledge, there are virtually no empirical studies on the impact of diversification (or specialization) investment strategies on VC fund performance, the issue we will discuss in the next section.

CHAPTER II

The performance of Venture Capital.

In what terms should venture capital performance and related success be measured? The answer is that it depends on the observer. From a political macro economic perspective, contributions such as employment growth, number of new companies or technological breakthroughs, are of significant importance. Several academic VC studies claim for example that entrepreneurial activity fosters innovation, patenting and growth performances (e.g. Kortum and Lerner 1998, Engel 2002, Hellman and Puri 2002, Romain and van Pottelsberghe de la Potterie, 2004). From an entrepreneurial perspective VC firms' performances might be measured in terms of their ability to add value, in addition to capital infusions. Earlier research show e.g. that VC firms play an important role in professionalizing the firms in which they invest; connecting them with potential clients and suppliers; and attracting additional funding (e.g. Sapienza, 1992; Rosenstein, Bruno, Bygrave and Tylor, 1993; Barney, Busenitz, Fiet and Moesel, 1996).

A number of studies has examined the performance of venture capital, some of them concentrating on the performances of funded enterprises (see e.g. Robinson, 1998; Hege et al. 2003) whilst others focusing directly on VCs' performances (see e.g. Brophy and Gunter, 1988; Bygrave, 1989; Chiampou and Kallett, 1989; MacMillan et al., 1985;

Cochrare, 2001). From an investor perspective the most important measurement, however, is financial returns from venture capital fund investments. A longer-term lack of competitive returns will force investors to avoid VC investments, or only invest in funds with proven track records. A vital VC market with satisfactory financial returns is thus the guarantee for its future survival.

For the purposes of this research, I will focus on the impact that diversification has on VCs' performances, i.e. the performance at the fund level. What is more important, therefore, is to define a performance index to be used in assessing VCs performances.

Reliable performance indexes are hard to be found (MacMillan et al., 1989; Cochrare, 2001; Hege et al., 2003) essentially because of the "private" nature of VC firms, these not being subject to the transparency and divulgation standards which listed companies have to comply with. It thus appears particularly difficult to collect data on the economic and financial performances of VCs.

More importantly, the performance of venture capital should be understood in the context of a set of investments forming a portfolio and to which the concepts of risk and return can be applied. Firm-specific risk of a portfolio can in general be virtually eliminated if the size of a portfolio is sufficiently large and diversified. The VC would then choose a risk-return combination that best suited the investors whose money are invested. The only risk such investors would be subject to would be the un-diversifiable risk, associated with the market as a whole (Cochrane 2001). But as we have seen from previous literature VCs do not necessarily build their portfolios in order to diversify all

the company-specific risk, being concentrated in particular markets, industries or stage of development. VCs portfolio are substantially illiquid to boot making valuation, particularly difficult and adding a dimension to risk[4]. Furthermore even if commercial dataset tracking several measure of performance, are now available for research purposes most of them provide this data only on aggregated form, that is relatively to the return to particular segment of class of VCs as a whole. Thus researchers have so far built a number of proxy to resolve this impasse.

Traditionally, attention has been paid to the return rates yielded by VC funds on the invested capital (Brophy and Gunter, 1988; Bygrave, 1989; Chiampou and Kallett, 1989). Studies based on this approach, however, have faced both biases and lack of data on the internal rates of return (IRR) of said funds. The lack of univocal and objective data has been essentially resolved in two ways, i.e. by directly requiring VCs (through postal questionnaires) to provide performance data (e.g. MacMillan et al., 1989; Manigart et al., 2002) or by using secondary indexes (Gompers and Lerner, 1999; Hege et al., 2003), e.g. by looking at VCs' exit strategies: since the ultimate goal is to get out of their investments and have a return on their invested capital, many studies have used VCs' exit strategies (e.g. IPOs or sale of the companies to other entities through merger or acquisition) as a performance index.

The recent foundation of monitoring organizations and instruments (i.e. EVCA, NVCA, TVE) which periodically gather and elaborate (through standard procedures) information in the field on an international level, has widened the methods available to

[4] Firm-specific risk (assumed to be eliminated by the investor in the CAPM model) will in practice play a role in pricing of such portfolios and so the CAPM cannot strictly be applied to price them. See Cochrane (2004).

evaluate VCs performances by using historical data on investments' (incoming and outgoing) cash-flows during the latter's "life-time" (Murray and Marriot, 1998; Karaser and Diller, 2004). Yet assessments through IRR indexes are not free from distortions (Cochrane, 2001), this measures are bias for the remuneration of fund managers which are generally based on an yearly fee for their management of funds, plus a percentage fee for contributing to the latter's increase in value (Murray and Marriot, 1998). Agreements on fund managers' remunerations may be differently renegotiated for each fund they work on, and may be affected both by the timing of decisions relating to the disinvestments of the fund and the return of capital, and by the terms of payment of investors, through e.g. shares or liquid assets (Chiampou and Kallett, 1989). Such circumstances affect the way the IRR indexes are calculated; not surprisingly, international associations representing the VC field are involved in trying to unify and standardize guidelines and criteria for the assessment of VCs returns (EVCA, 2005).

2.1. Factors affecting VC performance

There is a large and growing literature analysing the return of venture capital investments, showing the impact of several factor on the profitability of venture catpial investments (Jones & Rhodes-Kropf 2003, Ljungqvist & Richardson 2003, Kaserer & Diller 2004, Cumming & Walz 2004, Cochrane 2005, Kaplan & Schoar 2005). In this paragraph I present the most relevant factors affecting VC performance.

Empirical data show that high returns to VC are directly associated with the *size* of the fund, and with the expertise of the fund managers. Laine and Torstila (2004) found that large funds have significantly higher exit rates. Kaplan and Schoar (2005) found that for US funds the relation between size of fund and performance is concave, that is the larger the fund the better it perform, until the size reach a certain threshold after which the size has a negative influence on VC performance. Cumming (2005) explain this phenomenon as evidence of the trade-off between VC assistance to entrepreneurial firms in the VC's portfolio and the size of the portfolio. Consistent with recent developments in the banking literature (Hughes et al. 2001), fund size in venture capital is affected by risk taking, capital structure, and a number of other factors related to agency costs, costs of investing and monitoring, and the potential for value maximization, so that after a certain threshold increasing fund size is not cost efficient.

Furthermore, it has been shown that the size of the found not only have impacts on performance in terms of scale effects, but also in terms of reputational capital. Those fund manager that are able to attract greater amount of capital from investors are considered to be the most skilled managers (Barktus and Hassan 2003), showing formidable track of records of positive returns in the past; being better prepared to evaluate the potential of profitable ventures (Baum and Silverman 2004) and thus having better chances to gain positive returns. Accordingly, larger funds presumably have greater expertise and reputation and thus have better performances (Laine and Torstila 2004).

Another important positive effect on VC performance it has shown to be the expertise of the VC. Kaplan and Schoar (2005) found that *first-time* funds (i.e. funds that are raised for the first time) tend to raise bigger amounts of capital when the private equity industry performs well, which they find interesting in the light of that first time funds perform markedly worse than *follow-on* funds. Hocberg et al. (2005) also found that funds raised subsequently to previous founds tend to perform significantly better than *sole* or first-time found[5].

The *experience* of the fund manager is also positively related to performance of VC. Rosenstein et al. (1993), Sapienza et al. (1996) and Manigart et al. (2002) all found that experienced VC managers are perceived to add more value than inexperienced VC managers to their portfolio companies. Gompers et al. (2004) show that the VC managers with the strongest hands-on industry experiences increase their number of investments the most when industry investment activity accelerates. Gottschalg et al. (2004) found that more experienced and skilled private equity managers have higher survival rates and offer higher returns. Diller and Kaserer (2005) showed that VC returns are positively associated with VC managers' skills. It has often been noted, however, that VC managers are intuitive decision makers, and that this intuition develops after making numerous venture investment decisions (e.g. Zacharakis and Shepherd 2001). This support the idea that, by the time VC managers accrue their

[5] In the venture capital industry is common for a fund with good returns at the end of its life to replicate itself by raising a new fund with the same characteristics – and very often calling the new fund with the same name of previous one, followed by the subsequent number. Venture Expert defines *sole* funds as the funds that were raised for specific declared purposed and that will not have the possibility of a subsequent fund; *follow-on* funds are those raised for pursuing the same type of investment of previous one; First-time funds are those raised without a positive experience of funds behind them.

expertise in a larger number of investment, they became able to enhance fund returns (Kaplan and Schoar 2005)

A further variable which affects VCs' performances is the allocation and level of *capital inflows* in the venture capital market. Gompers and Lerner (2000) show that portfolio firm valuation in a financing round is higher the more money poured into the venture capital market over the year before the deal closed. An overheated market was according to the authors' one of the reasons for the very low returns generated by VCs during the period of 1985-1990[6]. They argue that there is a limited number of favourable investments in the private equity industry giving way to the so called "money chasing deals" phenomenon, which has been supported by several researchers (e.g. Ljungqvist and Richardson 2003, Hochberg et al. 2005, Diller and Kaserer 2005). Diller and Kaserer (2005) find this especially true for early stage VCs, as they are more affected by illiquidity and segmentation than buyout funds. Kaplan and Schoar (2005) conclude that market entries are cyclical, whereby funds that are raised in boom times are less likely to raise follow-on funds, implying that these funds are likely to perform poorly. They show that an increase in the allocation of money towards a particular fund has a significant negative impact on the performance of this fund. Hochberg et al. (2005) also found that funds subsequently perform significantly worse the more money flowed into the VC industry in the year they were raised. Another effect of a overheated venture capital market is that VCs are unable to invest up to their capacity, according to Mason and Harrison (2004). This arises for two main reasons; (1) there is a high level of

[6] And then, most likely, also for the period after the Internet bubble, which has had a major negative impact on the returns of VCs.

venture capital aversion amongst entrepreneurs, attributed to their failure to understand the role of VC firms as well as reluctance to surrender ownership and control, and, (2) many of the businesses which do seek venture capital are not investment ready.

VCs frequently engage in collaborative relationships with other peers. *Syndication* is common in the venture capital industry. Syndicates are typically formed by a lead investor who contacts other potential VCs and records their commitments to invest. Syndication has turned out to have a positive impact on performance, since it serves multiple aims: (1) Risk diversification and Information sharing: through syndication each VC can invest in more projects and thereby better diversify the portfolio and reduce firm-specific risks (e.g. Gompers and Lerner 1999, De Clercq and Dimov 2003, Hege et al. 2003). Furhtermore VCs tend to have investment expertise that is both sector-specific and location-specific where syndication helps diffuse information across sector boundaries and expands the spatial radius of exchange (e.g. Sorenson and Stuart 2001). (2) Identify profitable investments and accruing deal flow: in evaluating ventures' potentials the involvement of another VC provides a second opinion (e.g. Lerner 1994). By checking each other's willingness to invest in potentially promising deals, VCs can pool correlated signals and thereby may select better investments in situations of often extreme uncertainty about the viability and return potential of investment proposals (Sah and Stiglitz 1986). VCs invite others peers to co-invest in their promising deals in the expectation that such invitations will be reciprocated in the future (e.g. Lerner and Schoar, 2004). (3) Portfolio value add: Syndication networks may also help VCs add value to their portfolio companies, where syndication networks

facilitate the sharing of information, contacts, and resources among VCs (e.g. Hellman and Puri, 2002; Lindsey, 2003)[7].

As a final remark, it has been shown for *institutional* and *environmental* factors[8] only indirect effects on VCs performance. However it has been highlighted the importance of such factors as the presence of developed stock markets, supporting institutions and the existence of efficient legal and tax structure in order to create and keep the venture capital industry alive. Megginson (2002) support the need to increase the sources and occasion of collaboration between Universities and research institution in order to create a supportive culture fostering the links between innovative ventures and VCs. The most important factors for VC fund managers appear to be to reduce geographical and industrial obstacles through syndication, avoid raising funds in boom times. For policy makers the most significant measures are to nurture a deep and liquid local stock market, establish efficient legal and tax structures, increase incentives for investing by private investors, and reduce labour market rigidities. In particular the UK, although still lagging behind the US NASDAQ stock exchange, seems through AIM to be in the process of developing a competitive and efficient stock market for high technology companies. The UK also appears to have a large informal Venture Capital

[7] Other motives for syndication have been advanced. For instance, by syndicating deals with more experienced VCs helps in gaining reputation and certification, enabling further capital to be raised. (e.g. Hsu, 2004). Furthermore the some authors found support for the "Window dressing" hypothesis (Lakonichok et al. 1991) as a motive for syndication: VCs may syndicate investments even if the financial returns to such investments are relatively low in order to show potential investors an exit record (Lerner 1994, De Clercq and Dimov 2003).

[8] For influence of government programs see i.e. Megginson (2002); for regulatory changes see i.e. Cumming and Walz (2004); for tax and legal structures within different labour market see i.e. La Porta et al. (1998) and Jeng and Wells (2000); for the role of stock markets see i.e. Gompers and Lerner (2000) and Black and Gilson (1998).

market and is considered to have one of the most favourable legal and fiscal environments in Europe (Black and Gilson 1998).

2.2. Studies of returns

Although the majority of reports from the VC industry seems to suggest that the returns to venture capital exceed well-known benchmarks (like the NASDAQ and the FTSE All Share indices), little was known about the returns to venture capital until the first years of 21st Century. In the earlier studies returns were often not measured in cash flow terms (as would be economically appropriate) and were not measured net of management fees (thus creating an upward bias in the figures).

The academic literature seemed to assume that since venture capital is 'special' it should attract higher than average returns from the stock market. However, in the first academic contribution to measuring the returns to venture capital Moskovitz and Vissing-Jorgensen (2002) impugned this assumption. Using two large representative US datasets for private equity covering the periods 1989 to 1998 (without unincorporated businesses) and 1952 to 1999 (including proprietorships and partnerships), their findings are remarkable. Firstly, they find that the scale of venture capital in the US is huge and competes with public equity in importance. The total value of venture capital in the period 1989-1998 was in fact about the same as that of public equity (equity of quoted companies). Secondly, they found that investment in venture capital was

extremely concentrated with about 75% of all PE owned by households for which it constitutes at least half of their net worth. Moreover, such households invest more than 70% of their holdings in a single private company in which they have 'an active management interest', that is they are employed in it or run it. Finally, despite the obvious risk of such a typical portfolios the returns offered by venture capital is on average no higher than the market return, the return to a highly diversified index of quoted (and mainly highly liquid) securities. The authors argued that economic logic, based on the well-attested concept of risk aversion would dictate a risk premium to venture capital investment (so-called the "Private Equity Premium Puzzle").

Cochrane(2004) adopts a very different, econometrics-based, approach to examining the returns to venture capital which focuses on solving the sample selection problems that had determined previous efforts in the area. Despite this difference in approach, his results are broadly in line with Moskovitz and Vissing-Jorgensen. Cochrane argues that there are mainly three reasons why the risk and return of venture capital should differ from that of traded stocks, holding their betas (measures of systematic or market-wide risk) or other characteristics (e.g size and industry) constant. These are (1) *Liquidity*: a higher return may be required by investors to compensate for the lack of trade-ability of private equity (i.e. opposite to public equity); (2) *Diversification*: private equity has typically been a high proportion of an investors net wealth implying that they do not hold fully diversified portfolios and hence have high firm-specific risk associated with them; (3) *Costs of monitoring and governance*: fund managers often provide services of monitoring and control over investments made on

behalf of their clients (i.e. the investors) and this additional cost must be accounted for in the returns these investments yield. Cochrane finds, however, that VC returns, even when the lower risk of the VCs portfolio approach is ignored, are little different from those of similar traded stocks and moreover are highly volatile. Returns are estimated to be about 15% per annum with a volatility of about six times this figure. This finding is confirmed in a recent study of VC returns to companies going to IPO in the UK (Cressy and Lembergs, 2006).

Kaplan and Schoar (2005) investigate the performance of and capital inflows to VC partnerships in the United States. Using cash flow data for the period 1988-1999 they address the following questions: (a) What are the returns to early and later stage VC funding? (b) Do these returns exceed market benchmarks? (c) Are some VCs better than others? (d) Do returns to PE persist over time? They found that the returns to early stage funding were higher in the 90s boom but otherwise more variable and lower than those to late stage funding. However, the average figures concealed a great deal of heterogeneity amongst VCs with top quartile funds posting a premium of 10-20% over bottom quartile funds. The level of returns is largely independent of the weighting scheme employed. Weighting funds equally, Kaplan and Schoar found the returns are slightly below the relevant benchmark (here the S&P500 index) and offer an IRR of 17% per annum. However, weighting funds relatively to the committed capital, they found returns are slightly above the benchmark and offer an IRR of 18% per annum. Dispersion of performance amongst VCs is however strong in both cases. One of their most interesting findings relates to question concerning the heterogeneity of VCs and

whether and why there are VCs performing better than others. They found a considerable persistence in fund returns through time, making past performance to a significant degree a guide to future performance. This also support the evidence that those who manage a fund that performs well are more likely to be able to raise future funds as a result.

There are also issues of selection bias (non-randomly omitted observations) with these studies (Hege et al. 2003). In finance, the typical measure of performance is the return on a quoted security, consists of both a dividend yield (dividends expressed as a proportion of the current value of the stock) and a capital gains, which are the most relevant part of VCs returns on venture capital. However it is not possible to observe the value of a venture capital investment much of the time (Cochrane 2004) but in three occasions: if the backed company receives a further round of investment from a VC; if its shares become part of an IPO; if the company is sold to another organization through merger or acquisition. If on the other hand, the company does not receive more money in the current period but remains on the VCs portfolios, or becomes bankrupt and disappears, no such value is typically observed. This presents the econometrician with a potential sample-selection problem since the sample of observed values is generally unrepresentative of the population of values.

As Cochrane (2004) pointed out, potential biases do not stop at selection however. For example, consider the relationship between one source of observation of value, the IPO, and the true value of the firm in any period. It turns out that empirically the chances of an IPO increase with a firm's value (Cochrane, 2004). This means that if

we include in our estimate of returns only those investments with high (and hence observable values) we end up with a potentially gross overestimate of the returns to venture capital – gross because IPOs are a small proportion of the total number of VC investments and make up a disproportionately large fraction of total value. If one were to ignore the fact that the true distribution of VC returns is highly skewed (approximately lognormal according to Cochrane, 2004) and were to take arithmetic mean returns rather than geometric mean returns as our measure, this would again overstate the returns to venture capital. Both these errors have unfortunately been perpetrated in the academic and practitioner literature in this area[9]. Cochrane suggest to deal with this problems by estimating a joint distribution of company returns and IPO status (defined as reaching IPO or not).[10] The estimated joint distribution will then give him the returns to venture capital as a whole, including the return to those investments that never reach IPO. Previous studies simply estimated the returns to IPO (and sometimes trade sale) treating these as the returns to venture capital as a whole, thereby providing a very rosy picture of industry profitability.

Other recent studies broadly confirm Cochrane's findings even if they do not control as accurately as he for selection biases. Thus Hege et al. (2003) found that in their sample of European and American companies the average log(1+IRR) in 1997 is 18% per annum rising to 29% in 1999 and falling to -12% in the year 2000. Cressy and Lembergs (2006) on a sample of UK based VCs from the Private Equity Intelligence

[9] Early empirical studies of the returns to venture capital include Moskowitz and Vissing-Jorgenson(2000), Reyes(1997), Gompers and Lerner(1997), Smith and Smith(2004).
[10] More generally, sale status, since a company may be sold either through a trade sale or an IPO. However, we shall refer to IPO status rather than sale status here.

and Venture Economics databases find an average fund IRR of some 15%. The latter, like Cochrane, find that the distribution of returns is Lognormal, but because their sample is of IPO companies only (companies much less likely to fail), it has a much smaller standard deviation.

2.3. Analysis of success rates

Another way to examine the performance of venture capital investments is to look at the determinants of the chance that one of them will end in a sale (trade sale or IPO) rather than bankruptcy etc. Several studies have used this empirical approach which has the obvious advantage that it does not presuppose a market model to value companies – the choice of which offers no consensus. As Jaaskelainen et al (2003) suggested, although the performance of a venture capital fund can be defined straightforwardly as the return on investments, the observation of the performance of VCs is hard for an outsider due to secretive behaviour of the venture capitalists concerning their profits. However, as the largest valuations and returns to venture capitalists are most often realized in IPO and trade sales (Bygrave and Timmons 1992), it is possible to use the number of IPOs and third sales (controlling for the number of investments) as a proxy for the VCs performance.

For example, Hege et al (2003) examined the determinants of success in a large sample of European venture capital investments. They combine a database

(VentureXpert) with a questionnaire approach to VCs and use both discrete measures of success (high, medium and low represented by IPO, Trade Sale and Bankruptcy respectively) and continuous measures (reported valuation data). Three main findings emerge from their study. Firstly, VCs in the United States are more likely than those in Europe to use control rights in their contracts and to enforce them when the need arises. For example, United States VCs make greater use of convertible securities which in the event of bankruptcy is associated with a shorter time to liquidation[11]. Control also appears in the statistic that American VCs are three times as likely to replace an underperforming manager as their European counterparts and this reduces the time to liquidation in the event of bankruptcy[12]. Secondly, a higher proportion of total investment in America is invested in first rounds; Europeans seem to have a preference for later rounds (buyouts etc). However, Hege et al. results show that these investments are also more likely to fail. Controlling for post-investment monitoring (another significant function of the VC) along with other factors, the negative informational deficiencies associated with first round investments may reduce their chances of success below those of later stage investments. Another important control introduced by the authors which should impact on VCs performance is the syndication of investments (Brander et al 2003). Comparing US and European VCs, the American syndicates are on average significantly larger than those in Europe. This is apparently not because larger syndicates are associated with greater success, since the authors' findings show that greater syndicate size has no impact or even a negative impact on IPO success. This

[11] In the United States according to Hege et al (2003), of VCs' investments make use of convertible securities at the median 68%.
[12] An American VC is three times more likely to replace an owner-manager than a European VC.

results contradict the literature on VC syndication, which sees the rational of syndication in the advantages of resources complementarities and risk diversification which should be reflected in superior performance (Lockett and Wright 1999, Manigart et al. 2002).

Remer (2005) has a possible explanation for the seemingly paradoxical outcome on syndication. Examining the outcomes of specifically biotech investments in three countries, the US, the UK and Germany in a sample of about 1700 biotech ventures funded between 1970 and 2002 he finds, that controlling for industry, economy-wide and financial factors the probability of syndication is negatively related to the experience of the VC. However, he also finds this is in turn positively related to performance, measured here by the probability of an IPO. The experience-IPO relationship is also stronger the better matched is that experience to the project under consideration[13].

Some other studies employ more comprehensive count-data on performance, considering the exit or success rates experienced by VCs. IPOs are often considered as the preferred exit vehicle of the most venture capital firms since, although only a fraction of venture capital investments reach the IPO, most of the total value to the investors is created in these exits (Bygrave and Timmons 1992, Gompers and Lerner 1999). However it has been shown in the US market and in UK as well, that IPO is a

[13] This suggests that a motivation for syndication is partly to gain experience: less experienced VCs therefore tend to syndicate, and such VCs are more likely to be associated with failure than success presumably because the Lead VC has compensatingly large experience on which the Follower VCs can draw. In the longer run, the followers will presumably reciprocate the 'generosity' shown them by the leader. (Lockett and Wright, 1999).

feasible alternative for only few small businesses[14]. VCs may rely on the IPO markets to a widely different extent depending on their strategy. Advantages of a non-IPO exit could be related to greater privacy or lesser external pressure on operating performance. Often a trade sales provide more immediate liquidity than IPOs: a trade sale of a 100% stake liberates capital immediately, while only a part of the company is sold in an IPO (Schwienbacher 2002).

Hence the drawback with using only the number of IPOs from new company investments is that performance measure would be biased upwards, since it counts only for the value of very positive exits. One can circumvent this issue by calculating a total number of positive exits, i.e. including also the trade sales (Laine and Torstila 2004). Measures of exit rates are interesting not only as a proxy of investment success; they also have value to practitioners as they evaluate whether their investment memoranda are realistic. Studying a sample of 138 US-based VCs between the period 1990-2000 consisting in 4500 portfolio companies, Laine and Torstila (2004) suggest that the exit rate may be affected by such factors as the size and the portfolio composition of the fund, including industry preferences and the focus on early or later stage investments, these latter measured with dummy variables. Their findings are consistently with Kaplan and Schoar (2005): large VCs have significantly higher rates of exit success, perhaps due to a better reputation as quality certifiers, consistently with the findings of Sahlman (1990) relatively to those VCs which may have a larger investment universe

[14] For instance Schwienbacher (2002) reports the following exit frequencies from a survey of 67 U.S. funds: IPO (+ sale of quoted equity) 29.9%, trade sale / acquisition 30.3%, management buyout 2.0%, secondary sale / refinancing 5.0%, and finally liquidation (write-off), 32.8%.

than smaller one. Sole funds, i.e. funds that receive no follow-up have significantly lower exit rates. This is probably due to reverse survivorship bias: VCs who perform badly never are not likely to have the chance to raise another fund. Finally, the stage and industry focus of the fund seem to matter less than thought, although expansion stage funds had larger exit rates in this sample.

There appears to be a need for further research into VCs performance as measured by exit rates, where future uncertainty no longer clouds the results. the question is: can we use exit rates as a reliable proxy for VC investment success? Some steps in this direction have already been made. Hocberg et al. (2005) replicated Kaplan and Schoar's (2005) VC fund-level performance model, which relates performance to log fund size and log fund sequence number (each included in levels and squares) and a set of vintage year dummies, using exit rates instead of direct fund return as measures of performance. Like Kaplan and Schoar, they found only weak evidence that more mature funds perform better, and strong evidence that larger funds perform significantly better. Furthermore the relation between fund performance and fund size is increasing and concave, consistent with diminishing returns to scale. The authors finally repeated their analysis for a subset of their sample VCs for which they were able to find individual fund return, and show that IRR measures and measure based on the fraction of companies that exit are very high correlated.

2.4. Conclusions: what measure of performance should be used?

Given the generally accepted importance of the VC industry as such and the large amount of literature about venture capital, it may seem surprising that there are only a few papers analysing the returns of VC. However, an analysis of the profitability of investments in private equity is no easy task since information within the private equity industry is by definition "private", compared to e.g. public markets, and transparency requirements are limited. The common use of fund valuation data provided by two commercial vendors Venture Economics and Venture One, has been criticised by e.g. Ljungqvist and Richardson (2003) for having three principal shortcomings: (i) the data is available only in aggregate rather than in fund-by-fund format; (ii) returns data is largely provided by VC firms on a voluntary basis and thus potentially subject to selection biases; and, (iii) the data is based on unrealised as well as realised investments, which introduces noise and potentially biases due to subjective accounting treatment. Ljungqvist and Richardson (2003) show that the IRR of the average fund does not turn positive until the eighth year of the fund's life (the so called "J-curve effect"), which means that it is only at the very end of a fund's life that excess returns are realised. In addition, external valuations of portfolio companies only exist in the events of IPO's, trade sales based on tradable securities or cash, additional financing rounds including third parties or if the company files for bankruptcy. Therefore, according to Ljungqvist and Richardson (ibid), the calculations of interim IRRs

computed before a fund reaches maturity are not very informative. Cumming and Walz (2004) show that there are systematic biases in the reporting of interim IRRs which is explained in terms of cross-country differences in accounting standards, legality and proxies for information asymmetry between VC managers and their institutional investors. In addition, Woodward and Hall (2004) argue that reported returns from VC firms are too low in a rising market but too high in a falling market. Cumming and Walz (2004) show that experienced VC firms tend to report significantly lower valuation than their younger, especially early stage and high technology focused, counterparts. A final example of challenges when evaluating and comparing IRRs, is the unclear and inconsistent use of net and gross returns, i.e. whether the reported results include or exclude fees to the VC firms.

Comparing results from different analyses on VC performance is thus complicated. Having said that, now it still remain to decide which measure of performance is the more appropriate for this study. A number of studies has examined this specific issue, some of them focusing on the performances of VC-backed companies whilst others focusing directly on VCs' performances (see e.g. Brophy and Gunter, 1988; Bygrave, 1989; Chiampou and Kallett, 1989; MacMillan et al., 1985; Cochrare, 2001). In our case, we wish to concentrate on the impact that diversification has on VCs' performances, thus choosing a performance measure at the fund level.

We have seen that the secular returns to venture capital seem to be rather low given the very high risks associated with it. We have also noted that returns to venture capital overestimate the true returns since they are (a) individual rather than portfolio

returns and (b) they ignore the costs of VC salaries and carried interest (Cochrane, 2004). It is conceivable that the correct estimates of these returns will find them to be below those of the relevant risk-adjusted benchmarks.

Ideally, one would measure fund performance directly, using the return a fund achieved over its ten-year life. However, returns for individual funds are not systematically available to researchers as VC funds generally disclose their performance only to their investors and Venture Economics only makes fund returns publicly available in aggregate form. Some researchers have recently had access to disaggregated performance data from Venture Economics, but only in anonymous format (see Kaplan and Schoar 2005, Jones and Rhodes-Kropf 2003). Absent a facility for identifying individual funds and thus matching their returns to their portfolio strategy characteristics and other cross-sectional variables, these anonymous data would not help in examining the effect of VCs portfolio strategies on performance.

This latter concern raises the following question: can we then use exit rates as a proxy for investment success? Exits will differ widely in their terms and the price obtained. We should certainly be careful in making inferences based on, say, the IPO exit rate only. Although IPOs have often been a high profit exit method, there may be characteristics of the portfolio companies or market situations in which a particular fund would find other exit methods more optimal.

The total rate of successful exits, however, while not a perfect proxy for performance, presents fewer problems. We can in most cases safely assume that a venture capitalist will prefer almost any kind of exit to liquidation. The exit rate can

mostly be more clearly observed from the outside than the actual cash flows of the fund. In contrast, the calculation of performance through internal rates of return (IRR) is tricky in terms of both data availability and measurement problems. As an example of the latter, in IPO exits, venture capitalists typically keep a large stake for a certain period after the IPO and exit piece by piece (see Cumming and Macintosh, 2003, for partial exits). The difficult part for an outside observer would be to track all the actual cash flows the venture capitalist receives from selling portions of its ownership after the IPO.

CHAPTER III

Research Framework and Hypothesis

This research examines the many strategies which VCs may use to cope with their investment portfolio. The focus is on the analysis of relationships between portfolio strategies and the performance of a VC. There is a large and growing literature analysing the return of VCs' investments (Jones and Rhodes-Kropf 2003, Ljungqvist and Richardson 2003, Kaserer and Diller 2004, Cumming and Walz 2004, Cochrane 2005, Kaplan and Schoar 2005). The majority of these papers study the relative performance of VCs compared to public markets. However, there is much less understanding about the impact of portfolio strategies on the performance of VCs. In particular this research's aim is that of filling this gap by examining the impact of portfolio diversification versus specialization strategies on the rate of positive return of VC funds.

Portfolio diversification versus specialization is a particularly interesting issue in venture capital, where "generalist" funds (involved on many different markets) work alongside funds focusing their portfolios on specific stage of growth, industries and geographical areas (EVCA, 2005).

Although finance and strategic management researchers have increasingly widened the scope of research on VCs, the latter's portfolio strategies have been rarely

investigated (e.g. Norton and Tenenmbaum 1993). In the light of increased importance of the Private Equity and Venture Capital markets within Western economies, researchers have been recently paying more attention to this issue (Hellmann and Puri 2002).

Since this study examines the relationship between specialization versus diversification strategies and the performance of VCs, it applies to the management and finance theory which empirically supported the linkages between the industrial composition of a portfolio of investments and its performance. Though, even if some previous studies showed the existence of heterogeneity in the VC market relatively to managerial approaches, preferences for particular stage of development of the supported deal, business selection criteria (Robinson 1987, Norton e Tenenbaum 1993, Elango et al. 1995, Wright and Robbie 1998, Manigart et al. 2002), little attention has been paid on how VCs cope with composition of their portfolios. On the contrary, recent research showed that while some VCs specialize only in certain industries, stage of development and countries, keeping their investment strategy very focused, others diversify into different markets (Cumming 2004). Recent reports on the European VC industry point out that many players are defining their operative area by accurately selecting their investment scope along different dimensions – i.e. industry, geographic origin of investee companies and stage of development of deals – (EVCA 2005, The Economist 2004), while some others ramify their organizational structure in specific fields in order to develop a context-specific knowledge as a competitive advantage (Harper and Schneider 2004).

Surprisingly, little knowledge exists as to how VCs develop their investments portfolio, even if the decisions regarding investment scope are key issues for corporate strategy (Hofer and Schendel 1978). By examining the activities of UK Private Equity and Venture Capital funds issued from 1981 until 2000, this research advances that VCs performance is influenced by the choices of composition of their portfolio, along three possible dimensions: geographic dimension (i.e. the geographic origin of the investee companies); the stage of development of selected deals; the industry or technological field of the investee company.

It is important to examine factors influencing these decisions and the consequences on VCs performance. Our study suggests that VCs' performances are contingent on their choices as to the composition of their investment portfolios. Also, the decision determining the composition of a VC's portfolio of investments and thus the level of diversification, plays a crucial role in the creation of a fund. First these are long term strategic decisions that are difficult to change. Second the maximum amount a VC fund is allowed to invest in a single company as well as in certain financing stages, industries, or countries is fixed in the partnership agreement with the limited partners, i.e., the investors. A deviation from this agreement is only possible if all limited partners approve.

Hence, since the portfolio decision are difficult to change and have a deep impact on the development of the fund it-self, we address the following question: does portfolio-diversification lead to higher performance than portfolio-specialization?

This research aims at contributing to the literature dealing with the strategic decisions and performances of VCs. The suggested research question also calls into play the debate on whether a diversification strategy is more or less effective than specialization of portfolio investments. The literature on strategic management dealing with diversification has recently convened that when a VC firm has a portfolio of correlated companies, its performances are better - due to the strategic fit between the logic dominating its core business, its distinctive competences and the enterprises included in its portfolio – than those produced by a firm implementing a "pure" diversification strategy centred around the portfolio effects connected with diversification in different industries, markets and stage of development (Robins and Wiersema 1995, 2003, Palich et al. 2000). VCs invest in highly risky ventures with the hope of obtaining a profit in return. While, on the one hand, the traditional financial approach suggests that diversification eliminates non-systematic risks (Scharpe 1964, Brealey and Myers 1996), on the other, the competence-based approach seems to support greater specialization of VCs portfolio as a means of reducing uncertainty (Bygrave 1987, Lubatkin and Rogers 1989, Manigart et al. 2002).

Although the existence of a huge literature from both management and financial fields, the answer to the question whether diversified or focused firms perform better still remain ambiguous (Robins and Wiersema 2003). Exploring this question in the UK market is important for several reasons. Venture Capital has become an important part of the economic and financial system in Europe, having grown enormously in the last decade (Bottazzi and Da Rin 2004). UK have been representing 50% of all Private

Equity and Venture Capital operations hold in Europe since the late Nineties and even far more during the previous years, thus representing the ideal setting where conducting analyses and examines the said phenomenon.

Exploring this question may contribute to the literature on corporate strategy in that it expand the breath of corporations that are included in the analysis of how diversification and specialization strategies affect performance. Understanding these issues contributes to the debate on VC strategy and performance, by analysing the different behaviours and determinants of success of VCs, by comparing different stream of theory supporting two contrasting point of view: portfolio diversification versus specialization.

After supporting the need and relevance of doing research on this topic, I will discuss two different theoretical frameworks, one supporting portfolio diversification while the other leading to strengthen portfolio specialization. The first approach apply to the financial intermediation and portfolio theory, while the second one rely on the assumption of the resource/knowledge based view. I will show that many studies who refer, more or less explicitly, to one of these two theoretical arch-frames, tend to suggest that portfolio diversification either specialization is the better strategy for a VC coping with risk-return of its portfolio. This will help me introducing the thesis I will advance in the hypothesis sub-section.

3.1. The importance of portfolio strategies to Venture Capital

VCs invest in new ventures with high risk exposure and high growth potential. Academic studies on VC have over time investigated a number of related topics. In particular, special attention has been given to the managerial competences of VC firms, assessing their role and participation in the management of funded enterprises (Sapienza 1992, Hellman and Puri 2000, 2002). Such studies have essentially subscribed two empirical approaches (Wright and Robbie 1998): on the one hand, attention has been given to the creation of adequate structures for the governance of relationships between venture capitalists and funded enterprises; on the other, focus has been placed on a number of processes for the management of different activities. In the first case, more attention have been given to the means and practical instruments available to VCs in order to control for the business run by funded companies, through screening and evaluating business plans, and with the preparation of pay-off structures and contractual clauses. The final goal for VCs is obviously the control and reduction of risk exposure when deciding to invest in a new portfolio company.

The abovementioned second empirical approach focuses on the managerial processes used by VCs to support funded companies, and on the running of their own activities (e.g. Bygrave and Timmons 1992, Fried and Hirsh 1994, Tybejee and Bruno 1994). Said approach comprises different studies which have examined the reasons behind the heterogeneity of VCs which affect their managerial styles, their preferences for specific development stages of ventures, and their strategic differences in selecting

the latter. Given the heterogeneity of venture capital, some studies have examined different kinds of VCs, identifying multiple managerial styles, investment profiles, preferences for given fields and development stages of enterprises or ventures requiring financing (Robinson, 1987; Florida e Kennedy 1989, Elango et al. 1995, Wright and Robbie 1998). On the basis of such studies, some researchers have dealt more directly with VCs' choices between diversifying and concentrating their investment portfolio. Although many studies have examined VC firms' strategic choices as to which development stage is to be preferred when making investments (see e.g. Norton and Tenenbaum, 1989, Gupta and Sapienza, 1992, Manigart et al. 2002), little attention has so far been paid to such VCs' diversified investments.

In the previous literature-review section I tried to show how the issue of portfolio diversification or specialization is important, since it casts light on the way VCs cope with the strategic decisions about the management of portfolio companies having a direct impact on VCS performance. By using data collected by means of postal questionnaires, Norton and Tenenbaum (1993) have evaluated a number of suggestions on the many strategies orienting VCs' choices as to the composition of their portfolios in order to assess how risk exposure is managed thereby. Their analysis suggests that the need to collect information so as to reduce uncertainty induces VCs to concentrate on industries they are most familiar with. In particular, the high uncertainty of the early growth stages of deals induces VCs to include a small number of companies in their portfolio and to specialize in given industries. Conversely, VCs engaged in later development stages prefer to spread out their involvement across different industries

and/or different countries. Gupta and Sapienza's work (1992) have a similar idea and find very similar evidences. In particular, their work suggests that VCs investing in early stage companies are generally more involved in managing funded enterprises than VCs investing in later stage enterprises. Some VCs even specialize in specific corporate development stages, in which their acquired expertise produces greater value (Carter and Van Auken 1994). Moreover, it appears that large VCs with large funds diversify their portfolio much more than small firms (Gupta and Sapienza 1992). Recent works try to shed light on VCs' heterogeneity, suggesting that industry-specialized organizations should be more successful then diversified VCs, and claiming the need to deepen the understanding of the linkages between VCs' performance and their degree of diversification. Bottazzi et al. (2004), analysing the European VC Industry found that knowledge and human capital specialization at the level of the firm is a fundamental driver to understand VCs' strategies: specialized VCs are more active and more involved with their portfolio companies. Gompers et al. (2005) studying the reactions of US VCs to shifts in public market signals, found that the most successful were the VCs exhibiting a higher level of industry-specific focus of their investments portfolio. These works stress on the importance of knowledge and resources accrued by VCs and on the constraints of diversified firms in redeploying their resources among investments pertaining to different business areas. Thus a greater industry focus should reduce the inefficiencies associated with spreading the VC's resources across portfolio companies (Fulghieri and Sevilir 2005). On the other hand, Knill (2005) found that industry and stage-of-development levels of diversification are positively related to VCs' growth, in

the US market. The author found that, by playing a "pure diversification strategy", VCs can minimize portfolio risk, thus accruing the amount of capital under management.

Literature on VCs has so far taken into account the wide variety of investments in venture capitalists' portfolios (Elango et al. 1995, Wright and Robbie 1998). Nonetheless, there still remains a relatively small number of studies investigating on the impact these decisions have on VCs performance.

Many studies look at what VCs do and how they are different from more traditional investors (Morris 2001). Previous literature approached the VCs portfolio strategy issues as a means to manage risk/returns (Gupta and Sapienza 1992, Norton and Tenenbaum 1993, De Clerq et al. 2001), emphasizing two opponent strategies: diversification or specialization of their investments portfolio. Most of these studies, explicitly or implicitly, refer to relevant theoretical concepts that have been used outside the venture capital context. Those concepts provide some insights into answering my guiding question. At the same time though there are few empirical studies that simultaneously touch upon this question and use these theoretical concepts. In particular one can retrieve two main stream of theoretical approach which apply to the debate on diversification versus specialization of VCs portfolio. The first one pertain to the financial intermediation theory and financial portfolio theory, which look at VCs as, on the one hand, provider of financial capital to investee companies, on the other hand as resource "allocators" for their investors (Chan 1983); the second one is deeply rooted in the concepts of the resource/knowledge-based perspective, which emphasizes the relevance of VC-specific capabilities and knowledge in certain business fields

(industries, countries and/or stage of development) relatively to their investment approach.

Also this issue calls into question the role of VC as financial intermediaries or active managers relatively to their portfolio companies. The academic debate on the greater effectiveness of diversification versus specialization on VCs performance is intertwined with the debate on the role of VC firms, i.e. whether they are mere financial intermediaries or, rather, managing companies highly involved in the management of backed firms. According to the former perspective, a well-diversified portfolio may thus reduce the overall risk without reducing its results (Markovitz 1970). If, instead, VCs are perceived as being actively involved in the management of backed companies, providing both financial capital and human capital, relational resources, know-how and professional skills, a portfolio focused on the business domains where VCs are most likely to increase the value of their portfolio companies should lead to greater performance.

3.2. The Financial Intermediation Perspective

Starting with Spence (1974), there is a sizeable theoretical literature regarding VCs as intermediaries for equity investors seeking profitable business in which to allocate their resources, and for potential growing companies who need capital to implement their development projects. In this regard, VCs have been studied from and

agent/principal perspective (e.g. Jansen and Meckling 1976, Busenitz et al. 1997) and/or applying the concept of the *signalling* theory[15], which look at VCs investments who correlate the development of VCs to their ability to stay in the market as repeat players (Booth and Smith 1986) by signalling good investments and accrue their reputation as providers of venture opportunities and/or capital ready to invest.

Following this perspective, VCs function as intermediaries between investors and entrepreneurs, drawing funds from the former to invest in the latter. Why don't entrepreneurs simply do directly to the investors? Because VCs have an important role in managing the investments that investors lack and their relationship to the entrepreneur helps to resolve information asymmetries that would otherwise exist (Chan 1983). Building upon this literature some authors developed a theoretical model that shows the general value of VCs as intermediaries - in a market with imperfect and costly information – for resource allocation and welfare of investors. According to this model, when all investors are uninformed, entrepreneurs are induced to undertake inferior projects, offering low returns, and investors consequently will not enter the market. However, the presence of some zero-cost, perfectly informed investors, as VCs are assumed to be, induces entrepreneurs to select projects with higher investor returns.[16]

[15] In addition to these two theoretical theorys, a few studies also refer to other concepts, such as 'Procedural Justice Theory' (e.g Busenitz et al. 1997, 2004, Sapienza and Korsgaard 1996, Sapienza et al. 2000). However, I will not review those concepts in detail since they have not been widely used/mentioned and/or don't seem to provide much additional insights with view to our guiding question.

[16] Here, Chan (1983) argues that VCs can be considered zero-cost agents, since the clients pay their costs. Furthermore, as information about firms is reusable for different clients, there are economies of scale in the intermediary's operations, even if the intermediaries' information cost is assumed to be the same for investors and intermediaries.

An important valuable role played by VCs as intermediaries, is particularly evident for ventures going public. Megginson and Weiss (1991), for instance, highlighted the role VCs have in certifying the quality of entrepreneurial ventures at IPO to outside investors in the markets, since many VCs bring companies to market on an ongoing basis, and therefore should have a very strong incentive to establish a trustworthy reputation in order to retain access to the IPO market on favourable terms. Furthermore, the value of VCs' reputational capital is likely to exceed the maximum possible benefit from certifying falsely – because successful fund managers who are able to establish profitable 'follow on' funds, are also able to achieve an enhanced deal flow from entrepreneurs, and are more likely to retain/attract high-quality staff. Similarly, Sahlman (1990) pointed out that successful VCs bring instant credibility associated with their capital; their contacts in the financial community can make it easier to raise capital from other sources including IPO. Therefore, all else being equal, investors may be willing to pay more for companies brought to market by VCs perceived to be better able to oversee and guide new enterprises, resulting in a less under-priced issue (Barry et al. 1990).

Moreover, VCs' role as intermediaries might not only be relevant with view to the financial markets. Instead, VCs act as good agents reducing uncertainty and information asymmetry by facilitating ventures' access to non-financial resources such as personnel, suppliers and customers, network position (Manigart and Sapienza 1999, Stuart et al. 1999). Because VCs are active in a range of activities and functions that span industrial segments, they can act as information intermediaries, providing

privileged information access and reducing search costs for start-ups seeking appropriate cooperation partners and for investors seeking good investment opportunities. Indeed since investor may face with great uncertainty about the quality of young companies, they rely on the prominence of the affiliates of those companies to make judgements about their quality (Hsu 2004).

Whilst developed in the context of the mature firm, the logic of the agency theory also appealed to researchers examining the VC-entrepreneur relationship - where the VC is usually assigned the role of the principal, and the entrepreneur the role of the agent.[17] In fact, this theory arguably is the most commonly employed concept in research on venture capital.[18]

Most agency models are based on a set of common assumptions (Eisenhardt 1989, Petersen 1989) relatively to the relationship between the VC (principal) and the backed-company (agent): 1) VCs face situations of uncertainty with respect to the task to be undertaken by the agent, 2) VCs have different risk preferences over the returns they will receive from the contract, 3) principal and agents pursue different goals, or 4) maximise different utility functions, 5) VCs are boundedly rational, and 6) VCs and backed-companies have different information sets in that the principal cannot fully observe the outcome and quality of the agent's action.

[17] In addition, there is also sometimes said to be another principal-agent relation, where the VCs serve as agents to their investors (e.g. Amit et al. 1990, Bergemann and Hege 1998, Brettel et al. 2001).
[18] Authors that have either explicitly or implicitly referred to this concept in the venture capital context are, for instance: Admati and Pfleiderer 1994, Amit et al. 1998, Arthurs and Busenitz 2003, Barney et al., 1989, Barney et al. 1994, Barry et al. 1990, Bruton et al. 2000, Busenitz et al. 2004, Fiet et al. 1997, Gompers, 1995, Gompers and Lerner 1999, Gorman and Sahlman 1989, Hellmann 1998, Kaplan and Strömberg 2001, 2002, 2003, Lerner 1994 1995, Ruhnka and Young, 1991, Sahlman, 1990, Sapienza et al. 1996, 2000, Sapienza and Gupta 1994.

Agency models show that that information asymmetry gives rise to two main problems: adverse selection and moral hazard. *Adverse selection* might be due to 'hidden information'. The principal might be able to observe the activities of the agent, but the agent might have private information (e.g. about his own capabilities or certain details of his project) that is not available to the principal. This, in turn, might lead to a misinterpretation by the principal regarding the agent's ability, and, as a result, to a suboptimal contract, at least from the principal's perspective. *Moral hazard*, by contrast, might be due to 'hidden action'. Specifically, it refers to unobservable behaviour by the agent, such as low effort or shirking, which impacts negatively on the principal's welfare. Since the principal often cannot observe the agent's activities, it is difficult for him to differentiate a negative outcome of an activity due to factors under the control of the agent (e.g. inadequate effort) or due to factors outside the agent's control. Thus, the agent can 'explain' unsatisfactory outcomes by exogenous factors and act – without sanctions – against the interests of the investor. Clearly, both types of problems are likely to lead to conflicts that have a negative impact on the performance of a fund.

Indeed, the suitability of the financial intermediation theory in the context of venture capital seems obvious. Firstly, there is no doubt that uncertainty is a characteristic of all VC investments. Secondly, both VCs and entrepreneurs can be assumed to be rational individuals who might have different risk preferences and different utility functions and try to satisfy different self-interests. (For instance, most VCs will be primarily interested in the maximization of their internal rate of return of their investments; but whilst most entrepreneurs will also be interested in the monetary

outcome of their projects, they might have additional intentions such as 'on the job consumption', 'independence', and/or 'developing a track record'). Thirdly, in VC-backed ventures conflicts of interest are likely to emerge over specific issues such as valuation, exit timing, and the allocation of resources and efforts (Sapienza et al. 2000). Fourthly, information asymmetries are likely to exist between the VC and the entrepreneur because of the difficulty and costs of day to day monitoring and the technical nature of the activities conducted by the entrepreneur (Amit et al. 1998). The entrepreneur is likely to know more about his project and its likely success, or failure; and he is also likely to know more about his own ability and motives than the investor (Bygrave 1988, Gompers and Lerner 1999)[19]. At the same time, as mentioned before, principal-agent theory strives to identify not only causes of potential conflict between principal (VC) and agent (entrepreneur) but also suitable means to prevent or deal with their negative consequences. Kaplan and Stroemberg (2001) point out that theory has identified three primary ways for the VCs to mitigate possible agency risks: pre-investment screening, financial contracting, and post-investment monitoring and advising.

[19] The VC literature has discussed some of the reasons for possible manipulations of information by entrepreneurs. For instance, the entrepreneur might be afraid that negative information makes the VC decide against (further) investments in the venture. Similarly, the entrepreneur might be afraid that negative information makes the VC replace the management team completely or reduce its rights (Macmillan et al. 1988, Fried and Hisrich 1995). In both cases there is an incentive for the entrepreneur to keep back negative information and to present himself to the VC in the best possible way (Wright and Robbie 1998). This in turn, might lead to the problem of adverse selection of 'low-quality' projects, because it is hard for investors to distinguish between good-quality and poor-quality projects (Amit et al. 1999). Similarly, the problem of moral hazard (due to hidden action) might result in the entrepreneurial setting because the investor is not able to observe whether the entrepreneur is working hard and making sensible decisions, or whether he is planning to 'take the money and run' (Amit et al. 1990, Brettel et al. 2001).

Building upon the principal-agent theory, there is large academic literature on financial contracting that looks at the possibilities of avoiding conflicts between principals and agents in the first place, or at mitigating their negative consequences should they occur. The focus of this literature is on contractual arrangements aimed at aligning the principal's and the agent's interests, and to incentive the agent[20], as well as on the possibility to limit the VC risk exposure by accurately building a portfolio of investment companies that shield the VC from company-specific risk. This strategy explicitly apply to Markovitz portfolio theory (Markovitz 1970). Modern portfolio theory states that rational investors will use diversification to optimize their portfolios.

Basic concepts of the theory are Markowitz diversification and capital asset pricing model, which represents portfolios of assets a weighted combination of investments and assets' returns as random variables. The return of a portfolio is thus the weighted combination of the assets' returns and portfolio risk is the standard deviation of the portfolio returns. The model assumes that investors are risk averse. This means that given two assets that offer the same expected return, investors will prefer the less risky one. Thus, an investor will take on increased risk only if compensated by higher expected returns. Conversely, an investor who wants higher returns must accept more risk. The exact trade-off will differ by investor based on individual risk aversion characteristics. The implication is that a rational investor will not invest in a portfolio if a second portfolio exists with a more favourable risk-return profile - i.e. if for that level of risk an alternative portfolio exists which has better expected returns. An investor can

[20] This might involve, for instance, the appropriate allocation of cash-flow-rights (so-called cash-flow models), voting- and board-rights (so-called control-models), and/or liquidation-rights (so-called debt-models) (Hart 2001, Kaplan and Stroemberg 2001, 2003).

reduce portfolio risk simply by holding instruments which are not (perfectly) correlated. In other words, investors can reduce their exposure to individual asset risk by holding a diversified portfolio of assets. Diversification will allow for the same portfolio return with reduced risk. For diversification to work the component assets must not be (perfectly) correlated. Asset-specific risk - the risk associated with individual assets - within a portfolio can be reduced through diversification. Systematic risk, or market risk, refers to the risk common to all assets. Systematic risk cannot be diversified away (within one market). Within the market portfolio, asset specific risk will be diversified away to the extent possible.

Academic studies on diversification are not only finance-related, but come also from other disciplinary areas. Industrial Organization economists have examined the performances of diversified or specialized businesses since the 1960s (Arnould 1969, Gort 1963, Markham 1973, Lang and Stulz 1994). Scholars focusing on the development of management capabilities have looked at the potential applicability of managerial expertise to a variety of different businesses (Andrews 1969, Drucker 1955, Koontz 1961). Since the late Seventies it has sparked a lively (yet unsolved) debate on the effectiveness of diversification in completely different ventures (Levy and Sarnat 1970, Higgins and Schalls 1975) as opposed to more focus on interconnected ventures (Bettis 1981, Rumelt 1982, Markides and Williamson 1996, Goold and Luchs 1993).
In short, whilst acknowledging the positive impact of diversification on performances, attention is shifted to its potential extension. In other words, to what extent can the incorporation of different activities improve a firm's performances?

Advocates of "pure" diversification insist on the financial advantages resulting from the so-called "portfolio effects", thanks to the reduction of risk exposure through the combination of ventures whose financial flows are not correlated (Madj and Myers 1987, Berger and Ofek 1995).

As a matter of fact, the specific risk of an investment may be reduced by increasing the industrial diversification of the portfolio (Kim et al., 1989). Finance researchers have underlined further advantages, such as the link between risk reduction and increased debt capacity whose interests, being fiscally deductible, entail notable resource savings (Amit and Livnat 1988). According to such a theory, diversification allows for resource and competence surpluses to be used in different territorial, market o technological scope; diversification is thus much more than a mere opportunity to reduce risk exposure by allocating completely fungible resources (Barney 1997).

3.3. Conclusion on the financial intermediation perspective

In sum, the literature that takes a financial intermediation perspective on the VCs focuses on the VCs' role in alleviating the problems resulting from information asymmetries between the ventures and third party providers of financial (and non-financial) resources. As such, this theory provides explanations not only for why VC exist as an independent type of investor but also for how VC backing might be related to venture performance.

Financial intermediation theory focuses both on the information asymmetries between VCs, investors and entrepreneurial ventures, and on agency problems resulting from likely information asymmetries (i.e. the VC's lack of knowledge compared to the entrepreneur) and opportunistic behaviour by the entrepreneur, which have the potential to result in severe problems for the venture and suggests means to alleviate these problems, such as contractual arrangements and portfolio diversification.

However, in this context a major *assumption* is that VCs are able to overcome information asymmetries and uncertainty – and, by this, ensure the quality of the ventures they back and 'certify'. But the intermediary/signalling literature hardly looks in detail at how VCs actually deal with those issues.

There is a growing body of literature that suggests that the principal-agent theory neglects important aspects of the VC-entrepreneur relationship. For instance, it is argued that it is a one-dimensional view of the relation between the VC and the entrepreneur. Sahlman (1990) for example, notes that, although VCs seem to retain much of the power in the relationship with entrepreneurial ventures, there are in fact checks and balances in the system: VCs who abuse their power will find it hard to attract the best entrepreneurs, who have the option of approaching other VCs or sources other than venture capital. Forbes and Milliken (1999), furthermore, point out that an agency theory – although identifying problem areas and suggesting possible means to deal with those problems - does not take into account how decision-making processes themselves can affect the perception and resolution of problems.[21]

[21] As a consequence, an increasing number of scholars recommend alternative/additional theoretical theories and models. For instance, a recent stream of literature suggests that there might be a 'double-sided moral hazard' problem (e.g. Casamatta 2000, Dessi 2000, Inderest and Mueller 2001, Repullo and

On the other hand, the agency theory and the related contracting theories fall short of explaining two, arguably even more important, issues in the venture capital context. Firstly, agency theory focuses mainly on the VCs' role as financiers, and on contractual arrangements to mitigate VCs' downside potential when investing in entrepreneurial ventures. But it has little to say about other key contributions of VCs to their investee ventures: the provision of non-financial, value-added resources. Hellmann and Puri (2002), for instance, argue that – although the traditional financial theory tends to focus on the information-based roles of financial intermediaries, dealing with the alleviation of moral hazard or adverse selection, and emphasizing the monitoring role of VCs, who gather information about the firms they finance - the role of VCs extends beyond that of traditional financial intermediaries like banks; they play a broader role in the professionalization of the companies they finance.

Also, the portfolio diversification theory clashes with some particular features of venture capital. Financial portfolio theory states that systematic risk is equated with the risk (standard deviation) of the market portfolio. Since an asset will be purchased only if it improves the risk-return characteristics of the market portfolio, the risk of a security will be the risk it adds to the market portfolio. In this context, the volatility of the asset, and its correlation with the market portfolio, is historically observed and is therefore a

Suarez 1998, Schmidt 1999). Some scholars also argue that a 'prisoner's dilemma' model is a more appropriate conceptual lens for understanding the VC–entrepreneur relationship than agency theory, which emphasizes their potentially competing interests and monitoring costs (e.g. Cable and Shane 1997). Others furthermore point out that while the agency theory might provide a good fundament for explaining structural and compositional elements of control, it has limited ability to explain how the parties behave in their ongoing and reciprocal relationship - where aspects of cooperation might be at least equally important than aspects of competitive. As a consequence, some scholars recommend concepts such as 'Procedural Justice Theory' to ground research on venture capital (e.g. Busenitz et al. 1997, 2004, Sapienza and Korsgaard 1996, Sapienza et al. 2000).

given. Unfortunately, the venture capital market is far from being an efficient market, and the several approaches to asset pricing that attempt to price assets by modelling assets' returns cannot be applied, for at least 3 reasons: (1) venture capital is private in nature, characterised by information asymmetries and lack of information which make it not possible to rely on market returns with the specific aim of pricing; (2) venture capital is illiquid so that assets (i.e. the backed ventures) can be sold to only a limited number of potential buyers, and often at a great discount to their purchase price. (3) venture capital has very volatile floatations, and hence one can observe valuation and returns only when and if an asset is sold, which is not as common as it comes for securities. As a matter of facts, portfolio theory rely on the possibility for (maximum) prices paid for any particular asset, and hence the return it will generate, to be determined based on its relationship with the market portfolio. But for the said reasons it is fairly impossible to determine the actual returns of a market-portfolio in the venture capital market[22].

These particular feature of venture capital market may limit the possible benefits a VC may gain by implementing a strategy of pure diversification of its portfolio. In particular the high-risk associated with the nature of the VC activity itself (i.e. supporting potential future growing companies) may push the VC to rely to other strategic approaches instead of a pure portfolio diversification, as I will illustrate in the Hypotheses section.

[22] Relatively to the discussion on the applicability of financial theory and portfolio diversification in the contest of Venture Capital I owe a special debt of gratitude to Professor Robert C. Cressy, whose speeches, lessons and private conversations on said topic gave me insight and inspiration.

The deficiencies of agency theory are addressed, to some extent, in the final strand of theoretical oriented literature we shall discuss, namely the resource-based theory, which follows in the next section.

3.4. Resource-based theory

The intermediation perspective treats VCs as a homogenous group, without acknowledging likely differences between them (Hsu 2003). As such, it cannot explain the apparent differences in the performance of VCs. When a group of competing firms choose similar (contractual) approaches to agency problems, these approaches cannot be sources of competitive advantage for any one firm (Barney and Hesterly 1996).

The *resource-based theory* views the firm as a unique bundle of heterogeneous resources (Barney 1991, Penrose 1957, Wernerfelt 1984), and builds on two basic assumptions about a firm's resources: 1) that they can vary significantly across firms, and 2) that such differences can be sustained due to resource immobility. Thus, no two companies are alike; and a firm will have a competitive advantage if it possesses unique bundles of resources that are valuable, scarce, hard to imitate, hard to replace, and that enable the firm to perform better activities more efficiently or effectively than competitors (e.g. Amit and Shoemaker 1993, Barney 1986, Conner 1991, Dierickx and Cool 1989, Penrose 1968, Peteraf 1993, Spender 1993).[23]

[23] As Teece (1997) notes, the resource-based theory has much in common with the work on organizational ecology and commitment, as it sees firms as heterogeneous because of their different resource

In this theory it is common to distinguish between two main groups of resources: *tangible resources* (e.g. financial resources, physical assets, infrastructure) and *intangible resources* (e.g. knowledge, reputation, human resources, culture ad networks). It is also common to distinguish two main types of knowledge: explicit and tacit (Nonaka and Takeuchi 1995, Polanyi 1962, Von Hippel 1986). *Explicit knowledge* can be observed, communicated, transferred and imitated relatively cheaply and quickly. Similar to 'information' explicit knowledge is often considered a public good that is not relevant to individual wealth creation. *Tacit knowledge*, on the other hand, is observable but is difficult to communicate and transfer, and can be imitated, if at all only in a costly and prolonged process, and is thus considered by many as most important resource of a firm (Barney 1991, Spender 1996).

In this context, the related concept of a firm's *(core) competencies* or *capabilities* must be mentioned. This concept assumes that resources are not normally productive on their own (Hamel and Prahalad 1992). Instead, most tasks require that several resources collaborate closely together to form competences that differentiate it from its competitors. Thus, the interest is not in resources or capabilities per se but in those capabilities that provide a competitive advantage relatively to other firms; and, as Grant (1998) pointed out, it is the management's core task to match a firm's unique resources or capabilities to the opportunities that arise in the external environment.

endowments and because those resources are 'sticky'. This is distinctive from previous dominant approaches as advocated, for instance, by Michael Porter, who emphasized the importance of industry characteristics to explain performance differences of firms, arguing that any competitive edge achieved by firms in an industry will be short lived due to the high mobility of their rent-producing resources that can be bought and sold in factor markets.

However the resource-based theory has been mentioned explicitly only by a few scholars respect to research on venture capital. Bygrave (1987) emphasized the importance of VC's knowledge as its distinctive capability, including innovations, technology, and people in specific industry segments. Even more explicitly, Locket and Wright (1999) argue that although the VC has been traditionally viewed as a financial intermediary it may also be thought of as a "collection of productive resources".

The applicability of the resource/knowledge-based perspective to the venture capital context can be understood with view to the ventures particularly so when referring to another resource-centred concept, the *resource-dependence theory*.

This concept emphasizes the constraints on the organization's strategic choice especially in situations of resource scarcity and environmental turbulence (Pfeffer and Salancik 1978). According to this theory many firms do not control all the resources they need. This might be, for instance, because environmental uncertainty makes it impossible to own all relevant resources (Thompson 1967). Also, a firm's strategy might be particularly resource demanding such as is the case with fast growth, high-innovation that aim for an IPO. For those companies acquisition of resources and reduction of resource dependence becomes a vital activity.[24]

To explain this the resource-dependence theory suggests inter-organizational association strategies are key. Among those strategies the adequate choice and composition of the board of directors is said to be particularly efficient for small firms, which cannot devote huge amounts of time and money to inter-organizational relations

[24] In this context, a peculiarity of resource dependence theory, as opposed to neo-institutional theory, is its reliance on the effectiveness of managerial action and on inter-/organizational practices, which is seldom recognized as having an impact by neo-institutional scholars.

strategies (Aldrich 1979, Daily and Dalton 1992, 1993, Huse 1995, Pearce and Zahra 1992, Pfeffer and Salancik 1978).

The applicability of the resource-dependence theory in the venture capital context is straightforward. Aldrich (2001), for instance, emphasizes the importance of 'social capital' that allows firms to obtain resources that are otherwise unobtainable to them, such as knowledge, capital, clients, and access to suppliers, networks; and he notes that VCs can be seen as one important part of the social capital for entrepreneurial ventures. Fried et al. (1998) highlight that the board of directors of VC-backed ventures - as suggested by the resource-dependence theory – plays an important role in the acquisition of resources because. VC-backed firms are usually young and small, so that board members, if sufficiently knowledgeable about the firm's business, could make a substantive contribution. Also the fact that both inside directors (founder-managers) and outside directors (VCs) have significant ownership in the firm could provide an incentive for the two parties to work closely together to ensure the success of their venture.

Similarly, Jääskeläinen et al. (2003) note that there are two perspectives that look at why VCs get involved in their portfolio ventures: monitoring needs and value-added assistance/support. Monitoring needs result from agency risk, which gives rise to the VCs' governance with a need to monitor the activities of the ventures to ensure that the conduct of the management is aligned with the interests of the VC. However, while the governance of ventures concentrates on the value of reduced risks and prevention of

undesired outcomes, the assistance/support perspective considers the VCs' involvement as a valuable resource for the focal ventures.

In the same vein Busenitz et al. (2004) note that VC information may be more valuable to start-up companies than to more later stage ones, because VCs bring previous relevant expertise and experiences with them from earlier investments. Theoretically, therefore, input from VCs – for instance on strategic issues - should lead to decisions that are better than those that a start-ups could have generated otherwise. Furthermore, VCs may even serve as intermediaries on behalf of essential factor providers. Those VC-provided contacts have the potential to provide start-ups with a more informed view of their business options. Thus, to the extent that VCs provide information to start-ups on strategic issues, one might expect that it would be related positively to improvements in venture performance (Busenitz et al., 2004).

3.5. Conclusion on Resource-based view

The resource/knowledge-based theory has been referred to by a number of empirical studies, which indicate that VCs differ in their ability to identify and/or develop successful companies.

Indeed, the applicability of this concept in the area of venture capital in general and with a view to answering our own guiding research question is obvious. To begin with it is plausible to argue that VCs – as all other companies - need certain resources to

develop *(core) competences*, which help them to differentiate themselves not only from the more traditional investors but also from their peers. For this purpose, tangible - financial - resources might be considered as one part of the bundle. After all, the VC's main activities are attracting financial resources from investors (or generating them internally) and investing those funds into promising projects to generate profits. But taken alone, financial resources are clearly insufficient for VC success since such resources need to be managed effectively. They are often scarce (depending on the stage of the cycle and the nature of the venture) but usually not 'unique'.[25] Instead, they are transferable between firms at low costs, and as such 'imitable'. As equity resources they have (unlike debt) no time dimension and hence can be considered 'durable'. Of course they are always at risk when invested in a business with a view to earning profits. Thus, financial resources are not sufficient to provide a competitive advantage to a VC.[26]

Relating this view to what it has been shown in the previous section, while discussing venture capital literature on portfolio decisions, the resource-based theory seems to support the empirical findings on the specialization of VCs' portfolio in those particular industries, stage of development and geographic markets, where VCs have mostly accrued their capabilities and bundle of unique resources, leveraging on them in order to built their own competitive advantage. Their particular knowledge and

[25] In other words, these resources are not specialised to a particular company or VC.

[26] In this context, it should also be noted that if financial resources were the main determinant of investors' success, there should be little reason for large investors to involve any third parties such as VCs, and to pay fees and to share potential profits whilst – in most cases – even bearing the full risk. Instead, large investors should safeguard against risk associated with investing in high-risk/-return ventures via contractual arrangements and/or diversification; and their success might be mainly due to economies of scale. But the fact that large investors are willing to do so, and the sheer fact that VCs exists as intermediaries in the financial markets suggests that, in many cases, there will be more to the investor's success than just money.

capabilities allow VCs to differentiate themselves from more traditional investors but also successful VCs from their less successful peers. This might happen, for instance, because specialized knowledge and capabilities make them more capable of dealing adequately with the risks, uncertainties, and information asymmetries associated with investment opportunities.

Furthermore, the mentioned studies who stress on the active management role of VCs, implementing those "hands-on" practices such as such as monitoring, corporate governance, as well as a number of information-based advice and support services also say that the these practices are time- and resource-consuming (Bottazzi et al. 2004), hence limiting the number and range of portfolio companies on which these activities are applicable. The assistance provided by venture capitalists to their portfolio companies is largely based on the experience and information of the venture capitalists (Barney et al. 1996, Bygrave and Timmons 1992).

Stretching over this idea under the resource/knowledge based lens, this might entails that, in order to build a sustainable competitive advantage the VCs has to develop unique capabilities that can be re-deployed to most of their portfolio companies. Since time and resources are constrained, and uncertainty particularly high in venture capital, VCs may specialize in particular areas of business (in terms of preferred industries, countries and/or stage of development of selected deals). In other words, VCs may decide to manage the uncertainties relatively to portfolio companies, by accruing their capabilities in specific domains where selected companies pertain, opting for a focused portfolio, as a means to control for risk-return. Specialized

resources are thus exploited to maximize the value of funded companies through the creation of synergies between businesses (Brander et al. 2002).

Advocates of specialization in corporate strategy literature believe that multi-business firms benefit from resource and competence sharing, only as far as such benefits derive from the creation of synergies between correlated ventures (Grant 1988, 1991, Kanter 1989, Trautwein 1990, Goold and Luchs 1993), by means of which the performance of a given portfolio is better than the sum of each single venture (Panzer and Willig 1981, Prahalad e Hamel 1989, 1990). Attention is thus paid not only to the portfolio of activities that can be managed contemporaneously, but also to the portfolio of competences developed by the firm. The more each competence can be redeployed to portfolio companies, the more it is convenient to keep said ventures in the VC's portfolio and to invest in the development and sharing of competences crucial thereto (Campbell 1992, Stalk et al. 1992, Barney 1997).

In other words, the portfolio strategy is shaped by the way the VC conceptualises its business and takes key decisions regarding the allocation of resources and attention in similar technologies, product development stages, markets contests etc. (Goold and Luchs 1993). Studies from corporate management largely agree that the performances of a firm managing a portfolio of activities hinge on its capacity to "fit" each single business with its dominant logic (Goold and Campbell 1991).

It should however be mentioned that from a resource-based perspective, the characterization of a valuable resource tends to be ex post (Foss et al. 1993); and the resource-based literature has far less to say about the emergence of these distinctive

capabilities (Levinthal and Myatt 1994). In other words, such resources tend to be taken as given and their emergence is not explained. Furthermore, as Teece (1997) points out, the resource-based theory recognizes but does not explain the nature of isolating mechanisms that enable rents and competitive advantage to be *sustained*.[27]

In sum, from a resource (-dependence) perspective it seems reasonable to assume that (at least some) VCs could have develop certain competences that distinguish them not only from more traditional investors but also from each other by allowing them identify and realistically assess the most promising investment opportunities, to deal more appropriately with the risks and uncertainties associated with investments in high risk-return ventures, and to provide missing/complementary resources to them. This might not only become manifest in different investment approaches by VC with different knowledge, but it might also translate into different performances of VCs and/or their investments.

Thus, one might further argue that under the resource/knowledge-based view, specialization is an alternative strategy, if not complementary, to the previously discussed diversification approach to portfolio composition (i.e. the financial intermediation/signalling and the principal-agent theories) in that having superior resources or competencies should help a VC to better fulfil his role as a financial intermediary and to deal with possible information asymmetries more appropriately.

[27] Also more recent developments of the resource-based theory do only partially address this issue. For instance, the concept of *dynamic capabilities* extends the resource-based view by incorporating evolutionary theory; and it emphasizes the need of many organizations to adapt to rapidly changing environments. However, for this purpose, the concept focuses primarily on the exploitation and (re-) deployment of *existing* internal and external firm specific competences, but not on the development of (new) knowledge or competencies (Teece et al. 1997, Teece 1998).

3.6. Hypotheses

Previous literature approached the VCs portfolio strategy issues as a means to manage risk/returns emphasizing two opponent strategies: diversification or specialization of their investments portfolio. Now I will turn to examine which of the two said approaches lead to better VCs performance. This question has never been directly addressed before, and its implication are very important since they call into question the very nature of the VCs. Indeed we have so far seen the said two strategic approach received support from different stream of literature, one relying on the concepts of financial intermediation and agency theory, the other looking at VCs under the lens of a resource/knowledge based perspective.

The assessment of such assumptions shall significantly contribute to the debate on the role of VC firms as mere financial intermediaries providing capital to funded firms or as major players in the development of such companies, providing resources, managerial competences, relational capital and actively guiding their growth. In doing such an assessment I will look at three different strategic dimensions along which VCs can decide whether to diversify or specialize their portfolio of companies. These key variables are the *geographic* span of portfolio companies, their *industry* field and the *stage-of-development* they are involved with when the VC decide to invest in. For each dimension I will provide conflicting hypotheses regarding the theoretical advantages

associated with the implementation of a diversification strategy versus those of a specialization strategy.

The strategy that VCs use to manage the investment risk/return relationship is approached here as a multidimensional construct. Three key variables that have been identified to affect this risk/return relationship are industry scope of portfolio company investments, stage-of-growth scope of portfolio company investments, and geographic scope of portfolio company investments. I thus assume that VCs are able to diversify or specialize their portfolio mainly across these three dimensions or characteristics of investee companies.

For each strategic dimension, a rationale will be given for using either a specialization or a diversification strategy, depending on the type of risk that is most pertinent to be controlled. Holding that the different types of risk are intertwined, it is difficult to propose which polarizing force of risk will prevail. Therefore, I will then advance two rivalling hypotheses.

Funds are able to decide on their degree of portfolio diversification by selecting the *geographic* markets where they will go to invest. This strategy will determine the location of their investments and thus the physical proximity of the investments within a VC's portfolio.

By broadening the spectrum of countries where they can fish for investee companies, VCs can enlarge their basket of opportunities. A larger geographic horizon will increase the chances and capabilities to identify higher-return investments.

Moreover, by spreading their portfolio in different geographic areas, they can minimize country-specific risk and mitigate the impact on their portfolio performance of factors negatively affecting the economic outcomes of a specific geographic region.

On the other hands, the possibility to invest in different countries involves time- and resource-consuming activities of screening and analysing the different markets, effectively supporting and running backed companies in heterogeneous domains each with its different constraints and problems. It requires knowledge of different markets, while by focusing on few similar regions, a fund can benefit from accruing the country-specific knowledge from may point of view (legal issues, economic trends, screening and selecting deals). A limited geographic scope of portfolio investments facilitates control over the management of these companies. Indeed geographic proximity enable VCs to maintain significant contact with the management of investee companies, and provide homogeneity over several strategic aspects such as rule, regulations, Institutional actors, other investors, geographic key factors. As a result, VCs who specialize their portfolio of investment in few geographic regions can build on experience to control for better evaluate environmental resources and constraints, for both agency risk and business risk and, thus maximize their risk/reward returns.

The second dimension along which VCs can pursue different degree of diversification is the range of *industries* in which to invest.

Applying to financial portfolio theory (Markovitz 1970, Sharpe 1964), VCs may prefer to diversify across industries in order to reduce their risk exposure in a specific industry

or technology. A greater variety of industries in which to invest increases investment opportunities.

The increased range of opportunities will provide the capability for the VCF to more selectively identify higher-return investments. Agency and business risks could be strongly reduced by decreasing industry-specific risk through the spreading of investments across several industries.

On the other hand, investors who specialize in a tight number of technological fields can control for business risk by providing more competent strategic and operational support to deals they funded (Barney *et al*. 1989). Specialization may help VCs to protect from information asymmetry (Eisenhardt 1989), by enhancing control over the management of these companies by the VC. For example, it is more difficult for portfolio companies to hide issues of management incompetence or other crucial information regarding company performance due to the VC's more in-depth understanding of the industry.

Also VCs can develop a more specialized understanding of the complexities of these industries, and control for business risk by accruing specific-knowledge which can be horizontally applied across portfolio companies, as well as by enhancing skills to better evaluate environmental resources and constraints affecting their portfolio of investments.

A third dimension along which VCs can diversify or specialize their portfolio of investments is the stage of development of selected deals. This strategy will determine

the degree of portfolio company diversity based on stage-of-growth within a VC's total portfolio of company investments.

It has been shown that different growth-stages of investee companies require a number of different supporting skills and capabilities to be implemented by the investor (Carter and Van Auken 1994; Chang 2004). Heterogeneity among portfolio company growth stages will require the development of more general management skills at the expense of particular stage-specific abilities (De Clercq et al. 2001). As a result, the management team of VCs will be less able to take a more active role in decision making processes at the portfolio company level (Bottazzi et al 2004). A diversified development stage scope of portfolio company investments decreases VC control over the management of these companies (Kaplan and Stromberg 2004). However, a greater variety of growth stages in which to invest will offer increased investment opportunities for the VF, offering more chances to selectively identify higher-return investments since the fund will be less restricted by the stage-of-development variable. Furthermore agency and business risk associated with specific stage of development will be minimized through the spreading of investments across several growth stages.

On the opposite side, a focused stage-of-development portfolio strategy facilitates control over the management of these companies by the VC (Zacharakis and Shepherd 2001). By limiting the number of portfolio company stages of development upon which to invest, fund managers can develop a more specialized knowledge of the complexities inherent in these particular stages, and therefore, control for both agency and business risk. The homogeneity among the investee companies, allow for an

effective sharing of specialized knowledge across portfolio companies, which enables the VC to become more directly involved in the key decision making processes of their portfolio companies as well as better evaluate environmental resources and constraints associated with a specific stage-of-development.

So far I tried to set into opposition two theoretical frameworks which try to explain the advantages in term of superior performance by following the portfolio diversification strategy or the portfolio specialization approach.

According to the former perspective, since VCs mainly provide financial capital to ventures with a high growth potential, a well-diversified portfolio may reduce the overall risk without reducing its results. If, instead, VCs are perceived as being actively involved in the management of backed firms, providing both financial and human capital, relational resources, know-how and professional skills, the creation specialized portfolio could greatly enhance portfolio performance by the research and exploitation of synergies between similar businesses (Brander et al. 2002).

Following the works insisting on a "resource-based" rational, it is reasonable to expect that:

H1,a: *VC firms pursuing* diversification *as an investment strategy show higher performance than VC firms following a* specialization *strategy.*

Following a financial portfolio logic, it is thus reasonable to expect that:

H1,b: *VC firms pursuing* specialization *as an investment strategy show higher performance than VC firms following a* diversification *strategy.*

Despite a recently growing academic interest on this topic, there is still no clear understanding on the relationship between performance and the portfolio strategy of VCs. If some latest work tend to suggest that specialization and diversification should affect performance, there is a lot of room to deepen this avenue of research (De Clercq et al 2001, Bottazzi et al. 2004, Gompers et al. 2005, Knill 2005).

CHAPTER IV

Setting and methods of analysis

This Chapter is dedicated to the description of the setting and of the methodological approach I used in order to analyse the impact of portfolio diversification on the performance of VCs.

I decided to empirically address my research question in the United Kingdom (UK) since it is the most developed venture capital market in Europe and second only to United States worldwide, providing an ideal setting where to gather information and perform analyses. Hence the first part of this section is dedicated to a brief introduction to the UK venture capital industry with the aim of describing the analysis setting.

Then I will turn to the description of the variables derived from the literature described in previous chapters, their operalization and the statistical approach to perform the analysis.

4.1. The raise and growth of Venture Capital in the UK.

Venture capital did not become established in the UK until the 1980s[28]. Indeed, prior to 1979 there were just a handful of venture capital firms - of which the most significant was ICFC, the predecessor of 3i plc (Clark 1987, Coopey and Clark 1995)[29]. However, from the early 1980s an enormous expansion occurred in the number of venture capital firms.

The private equity industry in the UK has grown rapidly from the mid 1980s and is second only in importance globally to the USA. This rapid expansion in the UK can be attributed to several factors, particularly the growth of the US venture capital industry in the mid 1970s which provided a role model and information for the UK counterpart (Bank of England 1982), the global economic boom during the 1980s and the general encouragement through this period of new enterprises and small businesses by the UK Conservative government.

Key influences were government policy and changes in financial markets. The Conservative Government under Mrs. Thatcher stimulated a more entrepreneurial economy, resulting in a higher quality and number of managers and businesses to be

[28] The early stirrings of a UK venture capital industry began in the UK in the 1930s (Lorenz, 1989), but it was only in the early 1980s that it really began to develop and expand. At the foundation of the British Venture Capital Association in 1983, there were only 36 members. Six years later in 1989, the industry had grown to a peak of 124 venture capital firms (BVCA, 2000).

[29] Most notably, in 1945, the Bank of England, together with the major national clearing banks, established the Industrial and Commercial Finance Corporation (ICFC) (Coopey and Clarke, 1995). ICFC eventually evolved into 3i, which became the main equity provider in most of the regions of the UK, moving into venture capital from the late 1970s. In 1994, however, 3i went public and, driven by the need to make returns for its shareholders, it closed several of its UK regional offices and in 1998—99 it announced that it was adopting minimum deal sizes of 1 GBP million for technology deals and 3 GBP million for general investments. This regional rationalization and upward shift in deal size have reinforced the perception among many actors that there is an equity capital gap for small high-risk companies (Robbie and Murray 1992).

backed. The Business Start-Up Scheme, later extended and renamed the Business Expansion Scheme, which provided tax incentives for private investors who invested in unquoted companies, led to the establishment of collective schemes to manage these investments. This gave a significant boost to the development of a venture capital experience. The introduction of the Unlisted Securities Market in 1981 made it easier for smaller firms to achieve a flotation and in the process provided venture capitalists with a potential exit route for their shareholdings. Another important influence was the economic turbulence of the 1980s, which created opportunities for management buy-outs (MBOs) and management buy-ins (MBIs), influenced in part by the US experience, which showed how investing in high tech companies was very profitable for the investor, which actively sought investment opportunities and played an important role in expanding the market in which it operated (Coopey and Clark 1995, BVCA 1998).

The total amount of funds invested grew rapidly from the early 1980s, peaking at 1.4 GBP billion in 1989. This was followed by a period of decline and stagnation between 1989 and 1993 when various financial institutional investors withdrew from the industry. Between 1993 and 2000 there was a rapid growth in the amount invested: the amount invested in 2000 was nearly 6.4 GBP billion, more than five times higher than the annual amounts invested in the early 1990s (Figure 4.1.). However, despite the increasing amounts invested by venture capital firms, the number of investments has remained stable throughout the 1990s at just over 1000 (1182 in 2000), and is lower than the 1988 total (Figure 4.2.), which reflects increasing deal sizes.

Robbie and Murray (1992) described the UK venture capital industry in the 1990s as having entered a stage of maturity, signified by declining profitability and

growth, concentration of market share, and increase in market information and buyer/supplier power.

Figure 4.1.: Funds Invested in the UK

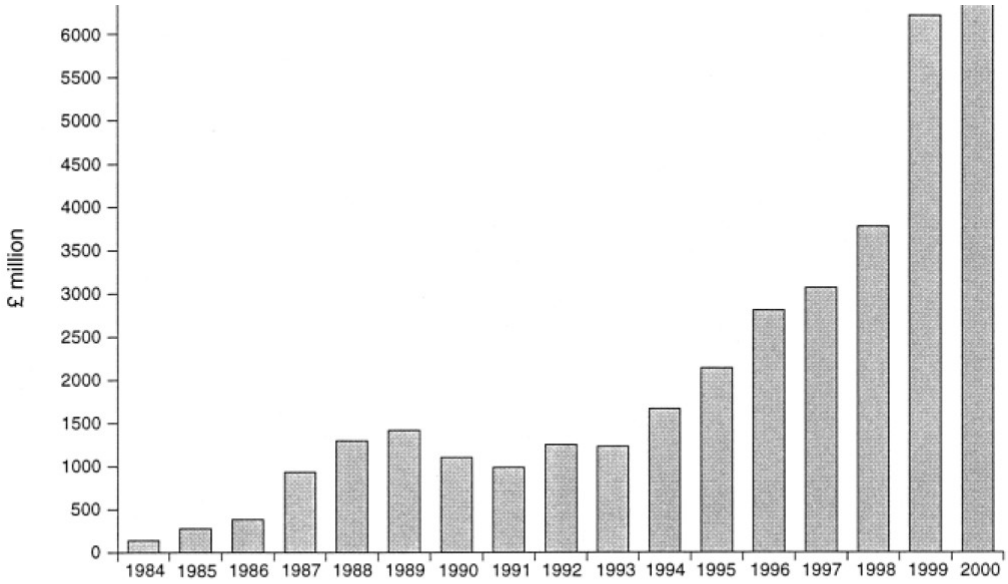
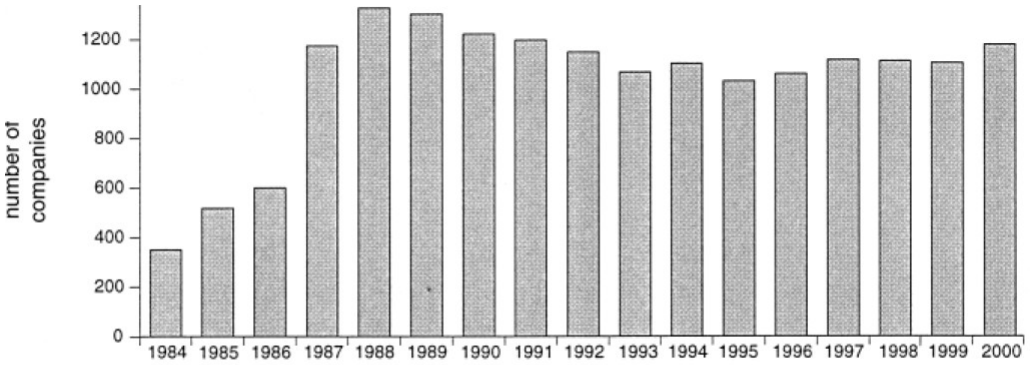


Figure 4.2.: Number of companies backed in the UK



Source: Adapted from Mason and Harrison (2002)

UK venture capital activity experienced a significant downturn in 2001, in line with global trends. Although the number of companies financed increased by 10% on

the previous year, the amount invested declined to 4.8 GBP billion, significantly down on the record levels in 1999 and 2000, but still higher than for 1998 and previous years (BVCA 2002a).

These trends reflect the cyclical nature of venture capital investment that arises from fluctuations in the willingness of investors to provide money to VCs that are driven by their return expectations. Successful exits in the early 1990s, which provided evidence of attractive returns, encouraged many investors to return and has attracted new investors. There has been a particularly significant flow of money from large North American investors seeking diversification from their domestic market (Financial Times 1999). These investors accounted for 41% of the funds raised by UK VCs in the period 1997-2000 (BVCA 2001a). This current downturn in venture capital investing in 2001 is the outcome of the over-funding in the late 1990s, the bursting of the technology bubble and specifically the collapse of various venture capital-backed *dot-com* businesses, the combined effect of which has been to drive down returns, and the end of the bull market which has prevented investors from achieving profitable exits from their investments.

This growth in venture capital investment activity during the 1990s has been accompanied by a significant change in the nature of venture capital investing. Since the late 1980s, the UK venture capital industry has become progressively more geared to investing in MBOs and MBIs (Table 1). This reflects several factors (Wright et al. 1998), notably the preference of institutional investors to invest in MBO funds rather than early stage funds, the superior returns achieved by MBO funds, and the shortage of classic venture capital skills. MBOs and MBIs represented 56% of the amount invested in 2000, compared with only 21% in 1984. However, this represents a decline

compared with the late 1990s, when MBOs/MBIs were attracting over 70% of venture capital investments.

Table 4.1. Venture capital investment in UK by stage and type of exit

	1984	1985	1986	1987	1988	1989	1990	1991	1992	199	1994	1995	1996	1997	1998	1999	2000
A: amount invested (£m)																	
Early stage	38	50	86	120	130	213	128	58	82	69	76	87	131	159	288	347	703
Expansion	73	120	124	301	435	338	396	387	362	393	480	493	592	907	822	1156	2122
MBO/MBI	29	107	174	313	733	867	582	544	807	769	1112	1560	2083	2000	2665	4666	3546
Total amount invested	140	277	384	934	1298	1420	1106	989	1251.	1231	1668	2140	2806	3066	3775	6169	6371
B: percentages																	
Early stage	27.1	18.1	22.4	12.8	10.0	15.1	11.6	5.9	6.6	5.6	4.6	4.0	4.7	5.2	7.6	5.6	11.0
Expansion	32.1	43.3	32.3	32.2	33.5	23.8	35.8	39.1	28.9	31.9	28.8	23.1	21.1	29.6	21.8	18.7	33.3
MBO/MBI	20.7	38.6	45.3	54.9	56.5	61.1	52.6	55.0	64.5	62.5	667	72.9	74.2	65.2	70.6	75.6	55.6

Source: BVCA (2000)

The increase in MBO/MBI investments has been at the expense of investments in seed capital, start-up and early stage ventures: although the actual amount invested in early stage ventures has increased substantially since the early 1990s and doubled between 1999 and 2000, it accounts for a smaller proportion of investment activity than in the 1980s. It is therefore the increasing significance of MBO/MBI investments that has been responsible for the rising average size of investment.

Although the gap has narrowed considerably in recent years, the UK private equity market is regarded as more mature compared to its continental European counterparts (Tannon and Johnson, 2005). The UK accounts for some 40% of the whole of the European market and as a percentage of GDP, the UK is the most significant private equity investor in Europe at a level of 1.10%. Out of this, however, only 0.21% goes into venture capital financing while the rest is invested in the buyout sector

(EVCA, 2005b). The US is the predominant VC nation[30]; in 2003 74% of all venture capital investments among the G7 nations was made in the US, and VC financing as a percentage of GDP was at least twice as high in the US as in the UK (Bygrave and Hunt, 2004). The invested amount per company is also higher in the US than in any other country. In 2003, US VCs invested on average $8.1 million per company, compared to $1.19 million per company in the UK.

During 2004 the total amount of raised funds in Europe reached €27.5 billion where the UK contributed to 37% of these funds, i.e. €10.1 billion. Pension funds are the largest contributors to UK funds, representing 23 to 26% of raised capital during 2002-2004. Second largest contributors are fund of funds with 15 to 20%, followed by banks, contributing 15 to 16%. The UK private equity industry is highly international; around 50% of the private equity investments done by UK investors during 2002 through 2004 were allocated to investments outside the UK (EVCA, 2003; EVCA, 2004b; EVCA, 2005b).

The UK venture capital and private equity investors tend to invest more in established businesses rather than in new technology ventures, as evidenced by the dominating buyout sector. Over 70% of all private equity goes into this segment (Martin, Berndt, Klagge, Sunley and Herten, 2003; EVCA, 2005b). Furthermore, early stage investments have decreased substantially in the UK, where VC allocations to seed and start-up phases during the last few years account for only around 5% (EVCA, 2005b). And even though the volume of investments in high-technology companies in the UK increased tenfold between the early 1990's and 2001 (Martin et al. 2003), the

[30] Institutional venture capital originated in the USA in the early post-war period, although rapid growth only occurred from the early 1980s following reductions in the rate of capital gains tax and new rules which explicitly allowed pension funds to invest in venture capital funds (Bygrave and Timmons 1992, Gompers 1994).

technology VC investments as a percentage of GDP was only 0.08% in 2004 (BVCA, 2005b). In comparison, the US technology VC investments as a percentage of GDP in 2004 reached almost 0.15% (BVCA, 2005b). BVCA argues that the large gap in technology VC investments between the UK and the US is due to both cultural and structural differences. The US has been particularly successful in taking advantage of the positive effects resulting from clustering and university spinouts, and has found it easier to accept the risks involved in investing in technology companies. BVCA also suggests that the absence of a functioning pan-European stock exchange for early stage ventures hinders the development of early stage VC in Europe. About 22 to 38% of the investments in the UK were syndicated, i.e. when a group of VCs jointly invest in a portfolio company, during the 2002 to 2004 period. Out of these, the international syndications represents around 6 to 10% (EVCA, 2003; EVCA, 2004b; EVCA, 2005b).

Regarding the realisation of private equity investments, industrial trade sales has been the most common exit route for the UK VC firms during the last two to three years period, representing 20 to 27% of all exits. Since 2003 secondary sales, when one financial investor sells it stake in a company to another financial investor, have become the second most common exit alternative, today representing almost 15% of all exits.

The percentage of IPOs has decreased from over 20% in 2002 down to 14% of the exits in 2004. At the same time, the number of write-offs has also decreased; from 23% in 2001 to a level of 8% in 2004 (EVCA, 2003; EVCA, 2004b; EVCA, 2005b). In the UK, limited partnerships is the most common legal form of structuring VC funds (Mayer et al. 2003). According to EVCA (2004a) the UK has, at least currently, one of the most favourable legal and fiscal environments in Europe for the development of the

venture capital industry. One exception, however, is the unfortunate tax situation for university spin-out companies (EVCA, 2005b).

Finally, by taking a cautious look at the financial returns for venture capital investments in the UK, the BVCA reports that early stage and technology VC funds performed considerably worse than all the FTSE indices (BVCA 2004, BVCA 2005a). Early stage funds achieved just around -10.3% IRR in 2004 over five years, while the figure for technology funds was -9.6% IRR over the same period. This gave that the overall long-term net return to investors in early stage funds at the end of 2004 stood at -2.9% and technology investment at 0.9%.

4.2. Sample, Variable measurement and statistical approach.

In this section I will give details on the data and methods I used to perform the analysis. First I will describe the sample of this research providing details on how the sample was built and on the dataset from which I derived sample data. Then I will discuss how I operationalized the dependent variable – i.e. VCs performance, the main explanatory variables (indexes of diversification on the industry, country and stage of development dimensions); and the control variables, mainly discussed in Chapter II, while presenting the studies looking at the impacts of several factors on VCs performance. Last I will describe the statistical approach I used to assess the impact of VCs diversification on their performance.

4.2.1. The Sample

I decided to study the relationship between the scope of a VC's portfolio and its performance by focusing on VC funds established in the United Kingdom over the period 1981-2000. I decided to refer to the UK VC industry since it is the largest and most developed in Europe, accounting for nearly 40% of total annual venture capital and private equity investment, and is second only to the USA in world importance (BVCA, 2005). I used the database Venture Expert, provided by Thomson Financial, as the primary source of data on VC funds and their investee companies.

Venture Expert provides information on funds, the firms managing these funds and the portfolio companies in which the funds invest. It records the identities of the participating venture capital firms and funds as well as the portfolio company receiving the investment. It also tracks the date of the investment and usually records the amount of the investment. The database also reports outcomes of the portfolio companies receiving funding, including whether they went public, were acquired, went bankrupt, were shut down, or are still active investments. Using this information it is possible to construct measures of the performance of funds. Unfortunately Venture Expert does not provide IRR-based information at the level of the single fund.

I first identified all VC funds that were created in the UK over the period 1981-2000 according to Venture Economics. I dropped data on funds whose date of inceptions is prior the year 1981. Indeed VentureXpert database start the coverage of UK Private Equity and Venture Capital deals by the early Seventies, but information on early deals is scattered and blanking possibly leading to data biases and distortions[31].

[31] The data coverage of the UK VC industry by Venture Expert starts from the early Seventies, but information on earlier deals is scattered and incomplete, leading to possible biases. Gompers and Lerner (1999) show that the Venture Expert coverage is very reliable and consistent starting from 1980 to present, covering up to 90% of Venture

The initial sample consisted of all UK funds that were created starting from 1981 and including all the funds created in subsequent years until those created in year 2000, but gathering information on fund characteristics, backed companies and performance until December the 31st of 2006. I followed previous studies (Kaplan and Schoar 2005, Jones and Rhodes-Kropf 2003, Hochberg et al. 2005) and considered all funds raised up including 2000, in order to have at least six-year of observations for the youngest funds, using year 2006 as the latest year to measure fund performance. Indeed funds are structured as closed-end, 10 years limited partnerships (Hocberg et al. 2005, Kaplan and Schoar 2005). They are not usually traded, nor do they disclose fund valuations (Ljungqvist et al. 2005). Generally, the first half of the fund lifecycle is dedicated to the selection and financing of portfolio companies, whereas the second half is generally devoted to the search of a positive exit (through IPOs or trade sales) for the investee companies, in order to generate positive inflows. Due to this investment cycle, relatively recent funds have not yet operated for long enough to measure their lifetime performance. But since the fund has a predetermined limited life (10 years) I can easily track the exit of the backed companies over the whole period until year 2006.

According to Venture Expert 689 funds were raised and 5329 companies were backed over the period 1981-2000.

From this sample I eliminate "Undisclosed funds" which contain no information at all. Also I dropped from my data set funds with incomplete data on the amount raised or the composition of investee companies, and funds which were Evergreen funds or Funds of Funds, following the approach of Kaplan and Schoar (2005) and Hocberg et al

Capital and Private Equity deals in more mature markets such as the U.S. or the UK. For this reason, we decided to start our data collection in 1981 since information on VC funds created in the UK before 1980 is present in Venture Expert on a very limited base.

(2005). Indeed Evergreen funds and Funds of Funds follow investment patterns and structures that are far from the Private Equity and Venture Capital Industry.

My final sample thus consists of 649 Funds that were raised between 1981 and 2000, and 4751 backed companies. For each fund, I constructed its portfolio of investment, so that each counted variable is referred to the single found. This is a cross sectional sample, constructed in order to allow for each variable one observation for the whole period 1981-2000. For each fund portfolio I included all the companies it has invested in. For each fund I continued to collect data on portfolio of investment and on performance of portfolio deals until the 31st of December 2006.

For each fund, I collected the following information based on Venture Expert data: VC fund name, vintage year, managing VC firm, total amount raised, number of portfolio companies. For each investee companies, I collected the following information: stage of development, country, main industry (according to the Venture Expert Industry Classification), corresponding VC fund, year of the first stage of investment and of the following stages, status. Based on these data I built the variable of analysis, which I detail in the following paragraph.

4.2.2. The operationalization of the dependent variable: VC performance

In Chapter II it has been pointed out that the ideal performance measure for VCs would be the financial returns from VC investments. However, analysing the profitability of VCs' investments is a hard task since information is by definition "private", and transparency requirements are limited. The common use of fund valuation data provided by two commercial vendors Venture Economics and Venture One, has been criticised by some studies (e.g. Ljungqvist and Richardson 2003, Cochrane 2005) for having three principal shortcomings: (i) the data is available only in aggregate rather than in fund-by-fund format; (ii) financial returns are largely provided by VC firms on a voluntary basis and thus potentially subject to selection biases; and, (iii) the data is based on unrealised as well as realised investments, which introduces noise and potentially biases due to subjective accounting treatment. A final example of challenges when evaluating and comparing IRRs, is the unclear and inconsistent use of net and gross returns, i.e. whether the reported results include or exclude fees to the VC firms (Cumming and Walz 2004). Comparing results from different analyses on VC performance is thus very complicated.

In Chapter II we have also seen that literature offered a reliable proxy for measuring funds returns is represented by the successful companies exit rates, since the capital gain VCs earn is made out of the subset of portfolio companies which experience a positive exit through IPO or a third sale (Laine and Torstila 2004, Hochberg et al. 2005)[32]. Following this approach I computed fund performance as the share of companies in the portfolio having reached a successful exit (IPO or trade sale) at the date of the 31st of December 2006. Indeed, by limiting the computation only of companies brought to the public markets one can introduce possible up-ward biases,

[32] Hochberg et al. (2005) also found a positive and strong correlation between exits rates and IRR measure of performance. All else equal, the more successful exits has a found, the larger will be its IRR.

since the performance measures include only the 'most promising' ventures, but also enhances a VC firm's reputation within the investment community. Furthermore statistics from EVCA (2003) show that the number of IPO in the UK is relatively low, which also introduces possible distortions if one include only IPO-based measures.

Venture Expert reports the current status of each backed company, showing if the company went public (IPO), was acquired (M&A), went bankrupt (DEFUNCT) or is still in VC's portfolio (ACTIVE MANAGEMENT). Hence, for the purposes of this dissertation, the performance measure will be a count of the successful company-exits a fund experienced in its life (via IPO and M&A), scaled for the total number of fund investments.

$$VCPerformance = \frac{\sum M\&A + \sum IPO}{N};$$

Where:

- Σ M&A is the number of portfolio companies that exited the fund through a third sale (i.e. via merger with another company or acquired by another organization);

- Σ IPO is the number of portfolio companies that exited the fund via Initial Public Offering, being brought to public markets;

- N is the total number of companies in which the fund had invested.

For each fund I computed the number of IPO and M&A it has experienced since its inception until 31st December 2006. Thus I have 1 observation for each fund. In performing the analysis, I take into account in two ways the possible truncation bias

generated by the fact that more recent funds in the dataset can benefit of a shorter period to reach a successful exit for their investments. First, I include in the regression models dummies for each fund vintage year, in order to control for time effects. Second, similarly to Kaplan and Schoar (2005) and to Hochberg et al., 2005) in the robustness check section, I repeat the estimates by including in the sample only those funds with a vintage year prior to 1996, so that they all should have reached at least a ten-year lifetime at the 31st of December 2006.

4.2.3. The measurement of diversification strategy .

In this paragraph I present how I operationalized the diversification measure along the different dimension of fund scope identified in the literature (Carter and Van Auken, 1994; De Clerq et al., 2001; Gupta and Sapienza, 1992): diversification by industry, by country and by stage-of-development, of portfolio investments.

Firstly I recurred to the classification of Venture Expert in order to assign each company in the portfolio in a given industry, country of origin and stage-of-development. Then I needed to calculate an index of diversification relatively to the said three dimensions for each of the funds' portfolios.

Measures developed for the analysis of portfolio diversification (and/or specialization) abound in the literature, stemming from several research areas on strategy, economics, and finance[33]. Two general approaches to operationalizing this

[33] For a review of the literature on portfolio diversification, see e.g. Goold and Luchs 1993, Robins and Wiersema 1995, Palich et al. 2000, Woerheide and Parsson 1993.

concept have been particularly used: *categorical* and *continuous* measures (Palich et al. 2000). While the former approach relies on a classification of a portfolio in terms of one of several characteristic types of diversification, the latter positions the portfolio on a scale that indicate its relative degree of diversification (and/or specialization)[34]. Continuous measure have overwhelmed categorical ones, since they offer a number of advantages for quantitative research (Robin and Wiersema 1995) by (1) providing variables at a high level of measurement subjected to a wide range of technical analyses; and (2) they employ data classified according to standard categories, allowing for research to be replicable and cumulative.

the two continuous measures of diversification that are most commonly and widely used are the *Complement of Herfindahl* index and the *Entropy* index[35]. A part from the fact that these two indexes are calculated on the basis of SIC categories, they differ in several aspects.

The *Complement of Herfindal* index is a variation of the Herfindahl-Hirschmann Index (HHI), which have been developed by researchers in the industrial organization context (e.g. Caves et al. 1980) and then adapted in strategy research (i.e. Montgomery and Wernerfelt 1988) in order to calculate a measure of market concentration in a particular sector for purposes of antitrust enforcement. Its complement then became very popular in finance, as a reliable measure of portfolio diversification (Woerheide and Persson 1993). In fact HHI is calculated by squaring the market shares of each firm

[34] According to Robins and Wiersema 1995, the categorical measures are based on the typology of Wrigley (1970) and Rumelt (1974); while the continuous measures originated by the SIC (Standard Industrial Classification) system.

[35] Critics of said indexes argue that SIC classifications can hardly account for the strategic interrelations between different industries (Robins and Wiersema, 1995), since their categories are based on physical aggregation criteria (materials, products/markets). According to Robins and Wiersema (1995), the index should be based on the sharing between industries of technological and managerial resources and competences (Barney, 1986; Teece, 1986; Winter, 1987), to be measured by an estimate of the flows of technological knowledge between industries (Farjoun, 1994).

competing in a market and then summing the resulting number. The use of the complement of this index by altering the HHI index value has the advantage that it can range from 0 to 1. As such, 0 represents a portfolio with absolutely no diversification (a one asset portfolio) and 1 would represent the ultimate in diversification[36]:

$$Diversification = 1 - HHI = 1 - \sum_{i=1}^{N} W_i$$

Where:

W_i = the proportion of portfolio market value invested in category *i* (in decimal form),

And N = the number of asset (investment) in the portfolio.

Statistically derived from the thermodynamics, the *Entropy* index is a direct measure of diversification. This index has been used in corporate strategy in order to study the relation between the external growth of large corporation and their pattern of diversification from the core business (Jacquemin and Berry 1979) and to study the relatedness of portfolio assets (Hart 1970). Using the same diction for the specification of the HHI index, the Entropy measure is calculated as it follows:

[36] The use of complement of HHI to distinguish diversification indexes from concentration indexes is common also in the industrial organization literature. See Robins and Wiersema (2003).

$$Diversification = \sum_{i=1}^{N} W_i \ln(W_i)$$

By using the natural logarithm, the Entropy measure is not constrained by 0 and 1.

A number of studies have been carried in order to analyse which of the two indexes is the most reliable for measuring diversification. Studying the optimal diversification strategy for portfolios of securities, Woerheide and Persson (1993) compared five indexes aiming at finding which among them is the best in providing meaningful information about the degree of diversification of a portfolio of stocks. They found that the complement of the HHI was superior to the Entropy measure in terms of closeness of fit in regression terms between portfolio risk and the index number. In particular they found that the modified HHI is the best diversification index amongst the five considered and recommended its use also for its simplicity of calculation and interpretation.

Studying concentration and market power in several industries, Stigler (1968) and Scherer and Ross (1990) found HHI to be an appropriate measure of industry concentration, because by squaring the market shares it lessens the influence of errors due to lack of data for small firms. In contrast, they also found that the Entropy index can be misleading, in that it shows a more competitive structure than the true level. Acar and Sankaran (1999) also prefer HHI for its simplicity and its widespread use – although the entropy measure have been used in several other scientific domains (i.e. Waterson 1984). In addition they argue that the two indexes are not perfectly overlapping. In other words the two indexes are not perfectly comparable because (1)

while the modified HHI range between 0 and 1, the Entropy index is not bounded upwards; (2) the two indexes seem to measure slightly different aspects of diversification, thus their validity ultimately depends upon the theoretical concerns that drive the research. This latter idea is developed further by Robin and Wiersema (2003) showing that the academic debate on the superiority of one index over the other can be solved by looking at the appropriateness of the indexes in the specific context of the research where they are supposed to be applied. The authors argue that although they have often been viewed as alternative approaches to the common problem of measuring diversification, the measures can produce contradictory results because they differ in their sensitivity to underlying dimension of portfolio strategy. In particular they suggest that entropy index should be preferred in situations where the focus of the research is on the *relatedness* of portfolio assets (investments, stocks, etc.), because the sensitivity of the index to the dominant business could affect substantially the interpretation of the research. Conversely the concentric index should be preferred if pure *diversity* of assets in portfolio is the objective of the research.

Since the purpose of my dissertation is that of studying the impact of portfolio diversification on VCs performance, I will use the HHI approach, as it follows:

$$Diversification\ by\ Industry_i = \left[1 - \sum_{j=1}^{J} \left(\frac{N_{ij}}{N_i} \right)^2 \right]$$

where N_{ij} denotes the number of investments (in companies) of fund *i* in industry *j* (*j*=1,…, J) and N_i the number of companies in the fund portfolio[37]. Hence, the

[37] Another approach to compute the diversification index could be that of using the fraction of the fund total capital (instead of the fraction of companies) invested in each industry. However, this approach requires the full availability of the data on the value invested in each single deal. Unfortunately, in the database Venture Expert this kind of information is missing for a large number of deals, so that it is not

index takes the value 0 for a VC fund which is not diversified at all (i.e., all portfolio companies operate in a single industry) and increases for higher level of diversification, its upper limit being 1.

In a similar way, I computed the diversification by country and by stage-of-development indexes as it follows:

$$Diversification\ by\ Country_i = \left[1 - \sum_{y=1}^{Y}\left(\frac{N_{iy}}{N_i}\right)^2\right]$$

$$Diversification\ by\ Stage_i = \left[1 - \sum_{z=1}^{Z}\left(\frac{N_{iz}}{N_i}\right)^2\right]$$

where N_{iy} denotes the number of investments of fund i in country y (j=1,…, Y), N_{iz} the number of investments of fund i in stage-of-development z (z=1,…, Z) and N_i the number of companies in the fund portfolio.

4.2.4. Operationalizing control variables

A number of variables, for which previous literature found an impact on VCs performance, are used as controls.

The first control variable is *Fund Size*, measured as the log transformation of the total amount of money invested in the VC fund, in order to control for scale and reputation effects which might affect fund performance (e.g. Kaplan and Schoar 2005).

possible to use it for analysis.

A dummy variable *Follow-on*, taking the value 1 for funds representing a follow-on of previous funds, was included in order to control for the expertise accrued by VCs (e.g. Hocberg et al 2005).

VC firm experience captures the experience cumulated over time by the fund manager, measured by the cumulated number of companies supported by the lead fund manager up to the fund's vintage year (e.g. Zacharakis and Shepherd 2001).

VC inflows in fund's vintage year captures the log transformation of the aggregate amount of money raised by VC industry in the UK in the fund's vintage year, controlling for the presence of a "money chasing deals" phenomenon, which might lead to the financing of low-quality companies in periods of excess availability of VC funding (Lerner and Gompers 2000).

As illustrated in the previous part, *syndication* allows VCs to share risks and have access to their partner's information and skills in choosing and managing specific investments. Hence, the resort to syndication is positively associated with VCs' performances. This variable is operationalised for each VC as the shares of portfolio investment co-invested with other VCs, expecting a positive relationship with performance (Lerner 1994, Lockett and Wright 2001, Brander et al. 2002, Manigart et al. 2002, Hege et al. 2003).

Lastly, in order to control for time effects and for the presence of a truncation bias, as a consequence of the way I measured fund performance in terms of successful exits, I included *year dummies* controlling for fund vintage year effects.

4.2.5. Statistical Approach.

In this section I will introduce the statistical approach used to analyse the impact of VCs diversification strategies on their performance.

In general terms, I modelled the said relationship as it follows:

$$\text{VC Performance} = A + B_1(\text{Div.byCountry}) + B_2(\text{Div.byIndustry}) + B_3(\text{Div.byStage}) + \ldots + B_kX_k + e$$

With $B_k x X_k$ representing a vector of control variables and "*e*" the error term.

Since the performance of a VC (the proportion of positive portfolio exits) is fractional, taking any real value between 0 and 1, with values that tend to cluster on the extremes; the explanatory independent variables (the three measures of portfolio diversification) are also continuous, fractional and bounded between the values 0 and 1; and our control variables are both continuous and dichotomous, the OLS cannot be used. Instead I implement the method of Papke and Wooldridge (1996) for fractional response variables. These authors developed a functional form for fractional dependent variables, based on the Bernoulli quasi-maximum likelihood methods.

Papke and Wooldridge argue that multiple regression model is not applicable when fractional dependent variables arise since it assumes a linear relationship between the independent variables and the dependent variable. However, when the outcome variable is dichotomous or fractional, this assumption is usually violated, because "*the predicted values from an OLS regression cannot guarantee to lie in the unit interval"* (Papke and Wooldridge 1996, pp. 620). One way to overcome this problem is to

transform the data using the logarithmic transformation. This has the effect of making the form of the relationship linear whilst leaving the relationship itself non-linear. The logistic regression[38] is based on this principle. It expresses the multiple linear regression equation in logarithmic terms and thus overcomes the problem of violating the assumption of linearity (Field 2000).

In the Logistic regression the dependent variable is the probability of having one outcome or another based on a non-linear function of the best linear combination of the independent variables (Tabachnick and Fidel 2001). In case of two outcomes categories – i.e. if the dependent variable can assume only the value 0 or 1, the logistic regression generates the *logit* or *log of the odds*:

$$E(\ln[Y/(1-Y)|x]=X\beta.$$

That is, the linear regression equation is the natural log of the probability of being in one group divided by the probability of being in the other group, conditioned on a set of independent variables.

Nevertheless Papke and Wooldridge (1996) argue that, with fractional response variables, this approach entails some potential problems. For instance, since the log-odds ratio represent the probability for the dependent variable to take value 0 or 1, for a given set of data where the observations take the value 0 or 1 (such as in the case of the VC proportion of exited portfolio companies), some adjustment are needed[39], for example assuming a particular distribution for the response variable, given the independent variables, and then by estimating the parameters of conditional distribution

[38] Because the model produced by logistic regression is nonlinear, the equations used to describe the outcomes are slightly more complex than those for multiple regression.
[39] See for example Maddala (1983).

by maximum-likelihood. However, even when a suitable conditional distribution can be applied these adjustments can be difficult to implement or non-rosbust[40], depending on whether a non parametric or a parametric approach is adopted.

Papke and Wooldridge (1996) present an estimation method that circumvents the said difficulties and it easy to implement for independent, though not identically distributed, observations, even if the dependent variable takes the values 0 and 1. The authors demonstrate that the Quasi-Maximum Likelihood Estimator (QLME) method offer a viable alternative to linear models when the dependent variable is fractional, being fully robust and efficient under GLM assumptions and with no need of any adjustment.

Maximum likelihood estimation is an iterative procedure that starts with arbitrary values of coefficients and determines the direction and size of change in the coefficients that will maximise the likelihood of obtaining the observed frequencies. Then the residuals are tested and another determination of directions and size of change in coefficients is made, and so on, until the coefficients change very little, i.e. converge. So, as with multiple regression, one tries to fit a model to the data that allows estimating values of the dependent variable from known values of the independent variables.

Hence, I applied the QLME to the following linear function, in order to evaluate the impact of dependent variables of each *j*-VC on its performance (dependent variable):

[40] A possible distribution for fraction variables is the β-distribution, but Gourieroux et al. (1984) showed it is not robust, at least when a portion of the sample is at the extreme values of 0 and 1.

$$VC\ Performance_j = A + \beta_1 DivbyCountry_j + \beta_2 DivbyIndustry_j + \beta_3 DivbyStage_j + \beta_4 \ln(fundsize)_j + \beta_5 \ln^2 (fundsize)_j + \beta_6 \text{Dummy}(follow\text{-}on)_j + \beta_7 \ln(capitalinflows)_j + \beta_8 firmexp_j + \beta_9 Synd_j + \beta_{10} \varepsilon_j$$

STATA® provides routines for QLME method, derived from a particular application of the GLM. It allows for heterosketasticity control, providing robust standard error coefficients. Furthermore, dummies for each fund vintage-year were included in the regression models, in order to control for time effects. Also, controls for multicollinearity problems are performed for correlation amongst independent variables. To address this problem, some preliminary analyses will be performed. First, classic bivariate correlation will be calculated. Logistic regression, like all varieties of multiple regression, is also sensitive to extremely high correlations. High correlation coefficients between two variables can cause multicollinearity, reducing the predictive power of analysis. Here, values higher than 0.5 are said to be critical. However, from this it is not possible to uncover multicollinearity. Therefore statistics such as variance inflation factors (VIFs), are calculated by simply running a linear regression analysis using the same outcome and independent variables (Field, 2000; Menard, 1995; Tabachnick & Fidel, 2001).

Based on this I find highly correlated coefficients between two of the main explanatory variables, namely the index of Diversification by Industry and the index of Diversification by Stage of Development. This leads me to run separate analyses, which comprise the same baseline models (control variables) and use the same units of analysis (VCs for which I have information on all examined variables) but include only

one of the theoretical variables at a time. This both circumvents the problem of multicollinearity and allows for the specification of a model which allows for the examination of competing hypotheses. Hence I operationalized the two Diversification dimensions of Industry and Country, by calculating Diversification measures based on the complement of Herfindahl-Hirschmann Indexes (HHI). In order to take account of the stage-of-development portfolio characteristics of funds, I followed previous studied (i.e. Kaplan and Schoar 2005) and split the original sample in two sub-groups[41]: Early Stage Funds (ES) are those funds which invest (at least) 60% of their capital in early-stage deals (i.e. Seed, first-stage, second-stage, development, etc.), while Later Stage Funds (LS) are those whose 60% of capital is invested in later stage deals (i.e. Buyouts).

Analyses will be carried following this approach, which allows for simultaneously analysing the impact of different levels of portfolio diversification on VCs performance, including only those variables that are not highly correlated. Last, a number of robustness checks are performed, especially in order to consider the possible truncation bias generated by the fact that more recent funds in our dataset can benefit of a shorter period to reach a successful exit for their investments, and in order to take account of the possibility that portfolio strategies can have different impact on VC performance, depending on the different type of exit.

[41] This classification and definition is taken directly from Venture Expert.

CHAPTER V

The diversification of VCs' portfolios and the impact on performance: analyses and results

In this section we perform the analyses in order to test the two competing hypotheses presented in paragraph 3.6.. In particular the focus is on the question whether a diversification rather than a specialization strategy, relatively to the way VCs decide which companies should be included in their portfolio, has a positive impact on their performance. This issue is of particular relevance for VCs since portfolio strategies are supposed to directly affect the risk/return profile of funds.

It has been shown that different bodies of literature tend to suggest competing hypotheses about the most profitable portfolio strategy. A stream of literature following the Financial intermediation perspective seems to support the idea that a diversified portfolio should be beneficial to VCs performance, while applying a resource-based view to the venture capital context, VCs with highly specialized skills should perform better than less specialized peers.

In this section analyses on a sample of UK VCs are performed in order to shed light on the diversification versus specialization strategies and the linkages with VCs performance.

VC performance is measured as the percentage of successful exits a VC experiences in its life. Portfolio diversification/specialization strategy is conceived as a

multilevel construct, which entails at least three possible dimensions, characterized by the portfolio scope in terms of industries, countries and stage of development in which the VC invests. I operationalized the first two dimensions (i.e. Industry and Country), of Diversification by calculating modified Herfindahl-Hirschmann Indexes (HHI). In order to consider the stage-of-development portfolio characteristics of funds, I followed previous studied (i.e. Kaplan and Schoar 2005) by splitting the original sample in two sub-groups: Early Stage Funds (ES), investing (at least) 60% of capital in early-stage deals; and Later Stage Funds (LS), investing 60% of capital in later stage deals.

First, I will analyse descriptive statistics for the full sample and the splits. I will also display the dynamics of VCs during the period of analyses. Then a quantitative approach will be implemented to measure the relationship between VCs diversification strategies and their performance. Finally a section of robustness checks will be presented.

5.1. The Dynamics of Venture Capital Funds in the UK between 1981 and 2000.

This paragraph will focus on the dynamics of VCs within the sample, looking for trends and heterogeneous characteristics of sample VCs along a relevant period of analysis.

Table 5.1. summarize the characteristics of the full sample. In order to give a broad and detailed picture of the dynamics of the sample, I included a number of VCs characteristics of interest more than only the variables that will be use in the

quantitative section of the analysis, such as the number of portfolio companies of each funds and the statistics on the different type of exits.

Each fund has an average number of 9.3 companies in its portfolio, while the median is 5. The average fund size is 68.7 millions of British Pounds, while the median is around 11.04 million.

This suggest a relative small number of big funds with many companies in their portfolios and a relatively bigger number of small/medium funds with fewer companies in their portfolio.

On average, each found has performed 4.5 positive exits, with M&A that more then double the number of IPOs. In terms of percentage, each fund has experienced 45% of success, meaning that the 45% of companies they have invested in has gone out their portfolio, of which 33.2% through third-sale (merger and acquisition) and 11.9% going public. This is consistent with the EVCA (2005) findings, which demonstrate a preference for the third-sale type of exit for UK VCs.

The table allows to compare funds levels of Diversification by Industry and by Country. The mean of Diversification by Industry for British funds is 49%, with standard deviation levels of 0.29 and the median of 58%. The sample encompasses small funds, which have invested in only one company, as well as large funds which have invested in hundreds of companies.

Not surprisingly, the lower level for Industry Diversification is 0.00%, representing the Industry Diversification of a fund that have invested in only 1 company, and hence having its portfolio focused on 1 Industry field. The maximum level of the index is 0.89% representing funds that broadly spanned their invested companies through almost all the Industry categories. Considering that the sample

contains 39% of funds (255 funds) that have 3 or less companies in their portfolios, these figures tell that on average British funds tend to invest in companies pertaining to a number of different technological domains, with 363 funds upon 649 showing a degree of Industrial diversification higher then 50%.

Table 5.1. Descriptive statistics for the full sample

Variable	*Obs.*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
Div. by Country	649	0.232	0.000	0.273	0.000	0.903
Div. by Industry	649	0.490	0.581	0.289	0.000	0.891
No of Comps	649	9.279	5.000	12.415	1.000	116.000
No of M&A	649	3.382	1.000	6.174	0.000	72.000
No of IPO	649	1.114	0.000	2.152	0.000	27.000
No of Positive Exits	649	4.496	2.000	7.539	0.000	80.000
M&A/No of Comps	649	0.332	0.286	0.310	0.000	1.000
IPO/No of Comps	649	0.119	0.000	0.206	0.000	1.000
Performance (No of Positive Exits/ No of Comps)	649	0.450	0.455	0.341	0.000	1.000
Fund Size (GBP Mil.)	649	68.686	11.040	187.575	0.047	1688.110
Ln(Fundsize)	649	2.004	2.402	2.519	-3.053	7.431
ln^2(Fundsize)	649	10.353	7.070	10.849	0.000	55.225
Firmex	649	11.960	2.000	24.254	0.000	158.000
% Synd.	649	0.423	0.400	0.360	0.000	1.000
Ln(capitalinflows)	649	8.024	9.094	1.736	4.257	9.714

Diversification by Country for British funds shows lower average levels. The mean is 23.2% and standard deviation 0.27. The median is 0.00%, which means that half of the funds invest only in 1 country, and only 19% (122 funds) having a Geographic Diversification level higher then 50%. This suggests that, Diversification by Country is less likely to be a preferred portfolio strategy for British VCs, whilst these funds appear to be more active in coping with the Diversification by Industry strategy.

Looking at the same characteristics for the sub-sample of early-stages funds (ES) and for later-stages funds (LS), there is evidence of a relevant difference amongst these two groups. Table 5.2 reports the mean values, median values, standard errors, min and max values for the two groups. I also compared the mean value of each group for the most relevant characteristics. The t-test are reported in Table 5.3, which shows the significance of these differences.

Table 5.2. Descriptive Statistics for sub-samples

	Early-Stages Funds						*Later-stages Funds*					
Variable	*Obs*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*	*Obs.*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
Div. by Country	487	0.206	0.000	0.257	0.000	0.903	162	0.309	0.245	0.304	0.000	0.885
Div. by Industry	487	0.499	0.612	0.296	0.000	0.891	162	0.464	0.531	0.266	0.000	0.840
No of Companies	487	8.277	5.000	10.432	1.000	116.000	162	12.290	6.500	16.725	1.000	106.000
No of M&A	487	2.433	1.000	4.239	0.000	53.000	162	6.235	3.000	9.396	0.000	72.000
No of IPO	487	1.094	0.000	2.260	0.000	27.000	162	1.173	0.000	1.796	0.000	10.000
No of Positive Exits	487	3.528	1.000	6.059	0.000	80.000	162	7.407	4.000	10.323	0.000	74.000
M&A/No of Companies	487	0.280	0.222	0.299	0.000	1.000	162	0.487	0.500	0.292	0.000	1.000
IPO/No of Companies	487	0.121	0.000	0.207	0.000	1.000	162	0.111	0.000	0.202	0.000	1.000
Performance (Positive Exits/ No of Companies)	487	0.401	0.364	0.342	0.000	1.000	162	0.598	0.606	0.295	0.000	1.000
Fund Size (GBP Mil.)	487	27.152	6.940	73.737	0.047	1136.600	162	193.542	62.675	322.947	0.124	1688.110
Ln(Fundsize)	487	1.347	1.937	2.346	- 3.053	7.036	162	3.979	4.138	1.923	-2.091	7.431
ln^2(Fundsize)	487	7.307	5.207	7.458	0.000	49.502	162	19.513	17.122	13.904	0.001	55.225
Firmex	487	10.129	1.000	22.833	0.000	149.000	162	17.463	5.000	27.445	0.000	158.000
% Synd.	487	0.435	0.429	0.369	0.000	1.000	162	0.389	0.327	0.333	0.000	1.000
Ln(capitalinflows)	487	7.981	9.094	1.830	4.257	9.714	162	8.154	8.440	1.411	4.257	9.714

The two splits largely differ for the size of funds, LS being on average more than 7 times bigger than ES. While ES mean size is 27.2 Million of British Pounds with standard deviation 73.7, LS' mean size value is over 193 Million, with standard

deviation about 324, suggesting a great heterogeneity also within the groups. Those differences are statistically significant at 1%. The difference between the two splits is reflected in the number of companies held in portfolio, which for ES is 8.3 and for LS is 12.3. On average, LS count for 4 more companies in their portfolio than ES. This does not mean however that all the ES invest less in term of number of companies: difference between median vales are in fact lower (ES = 10.4 and LS = 12.3) and while the biggest LS invest in 106 companies, the biggest ES invest in 116 companies. Also this difference is significant at 1% level.

Table 5.2. Early-stages funds compared with Later-stages funds. Mean values by group.

	Early-stages	*Later-stages*	*T-test*	*p-value (two tails)*
Div. by Country	0.21	0.31	-3.26	<0.01
Div. by Industry	0.50	0.46	2.05	<0.05
No of Companies	8.28	12.29	-2.87	<0.01
No of M&A	2.43	6.23	-4.98	<0.001
No of IPO	1.09	1.17	-0.44	n.s.
No of Positive Exits	3.53	7.04	-4.53	<0.001
M&A/No of Companies	0.28	0.48	-7.79	<0.001
IPO/No of Companies	0.12	0.11	0.56	n.s.
Performance (Positive Exits/ No of Companies)	0.40	0.60	-7.07	<0.001
Fund Size (GBP Mil.)	27.15	193.54	-6.50	<0.001
Firmex	10.13	17.46	-3.07	<0.001
% Synd.	0.43	0.39	1.46	n.s.

Looking at the difference relatively to Diversification indexes, LS have higher levels of Diversification by Country with an average index of 31%, while ES reach 21%. This figure supports the finding of previous literature in that ES tend to prefer less degree of diversification than LS. At least at the level of Country. Indeed, when turning to the Diversification by Industry, mean values are very similar, with ES values (50%)

slightly higher than LS (46.4%). Hence ES and LS tend both to have on average a medium level of diversification by Industry. This conflicts with previous findings that ES might prefer lower level of industry scope for their portfolios than LS.

Relatively to company exits LS outperform ES with an average of 6.2 companies exited via third sale (M&A) versus 2.4 for ES. However when looking at the number of IPOs for the two sub-sample, the figures are very similar, with 1.1 companies brought to public markets for ES and 1.2 for LS. These findings are consistent with previous literature which shows that for LS third-sales may be a preferred and/or easier type of exits than IPO, since LS' portfolio include in general more stable and easy to evaluate (or in other words, less risky) companies, thus being more easy to find a third party who wishes to buy the company through MBO, MBI or other type of buyout. Also this figure support the view that ES are more keen on IPO than M&A as a way to exit portfolio companies. In fact IPO is the most promising way for ES to "cash-out" their investment (i.e. to make money from the capital invested), possibly benefiting for the huge increase of value that generally an offer to public markets entails[42].

Looking at the performance of two splits, measured as the proportion of portfolio positive exits, including both those exited via IPO and via M&A, LS shows statistically significant higher values, with an average of 60% of portfolio companies exited, while ES have an average of 40% of portfolio companies positively exited. Again, the difference reflects the number of M&A, which is higher for LS than for ES.

[42] It has been calculated that in USA for each venture a VC is able to brought to public market, 10 are failures. In this case, for a VC is vital to perform a type of exit that pay not only the capital invested in the venture exited via IPO, but also for the capital invested in the failing ventures (Gompers and Lerner 2000).

In order to understand the dynamics of British VCs, figures showing the trends of sample VCs, relatively to their size, performance and level of Diversification were elaborated. For ease of interpretation trends are displayed by dividing the period of analysis in quarters, and by aggregating the funds incorporated in the each year of the quarter.

Figures 5.1. and 5.2a. and 5.2b. explain the distributions of the funds across years and their growth in number and size, this last indicator measured both in terms of Million of British Pounds as well as by the number of companies the funds invested in[43].

Figure 5.1. shows the five-years mean of the number of new funds that were raised between 1985 and 2000. The data show an impressive increase between the years 1996 and 2000 with a number of new funds that is about 3 times higher than the previous five-year period. This means that each year the number of new funds increased of 45.6%, on average. This trend reflects a steady growth process which started in 1994, with a robust boost on the final year of our sample, consistently with the euphoria that characterized financial markets relatively to new ventures. These are also the consequences of policy measures implemented during the 1990s with the aim of enhancing investments in new ventures. As it has been shown in Chapter II, the consolidation of public market for small ventures; incentive schemes set up in order to foster investments in new technology venture; and the progressive inflows of capital also from foreign investors (i.e. Especially from US investors); created the setting and provided the factors which enhanced this growth (Mason and Harrison 2002).

[43] These figures refer to the full sample. Although not reported, same figures were elaborated for the two splits. The evidence confirms the descriptives statitics, in that on LS tend to be bigger and tend to have more companies than ES; and this trend is consistent over time.

Figure 5.1.: Five-years Mean of the number of new funds raised between 1981 and 2000

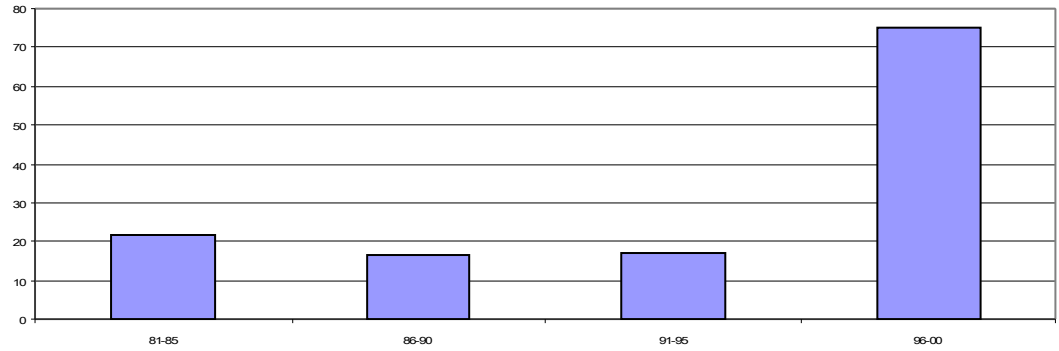


Figure 5.2a. shows the average size of new funds raised during each five-years period of analysis. Consistently with Figure 5.1., the average size of funds shows a strong growing trend. As the figure displays, while during the first five-years period the average fund size was 7.46 GBP Mil., in the next period the average size was 27.74 GBP Mil., growing to 56.77 GBP Mil in the period 1991-1995, up to 111.84 in the final quarter. Accordingly, as Figure 5.2b. shows, the number of companies in which the sample funds invested is growing for funds incorporated in more recent years, with a strong increase for funds raised during the last period of analysis, as it is displayed by an increase of 54% of the number of companies in the portfolio of later funds.

Consistently with the general VC market trend in the UK, the growth of sample funds in number and size was steady and robust, characterised by a real boost in the final five-years period of analysis. These trend are also consistent with the findings reported by BVCA and EVCA, and also reflect interventions of public policy organizations in promoting venture capital during the 1990s (Painter 2000), by creating the conditions and setting for the increase of venture capital investments.

Figure 5.2a.: Average Size of new funds raised (GBP Millions)

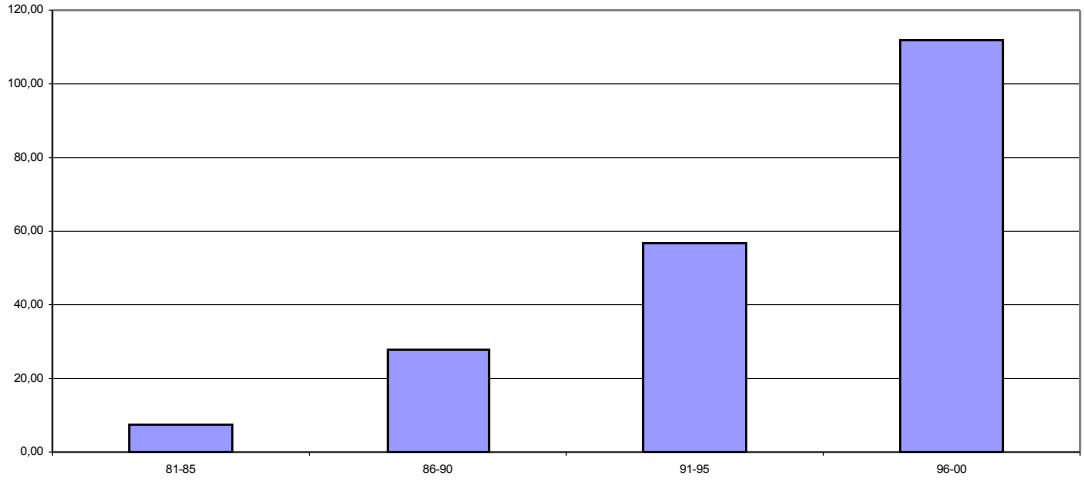
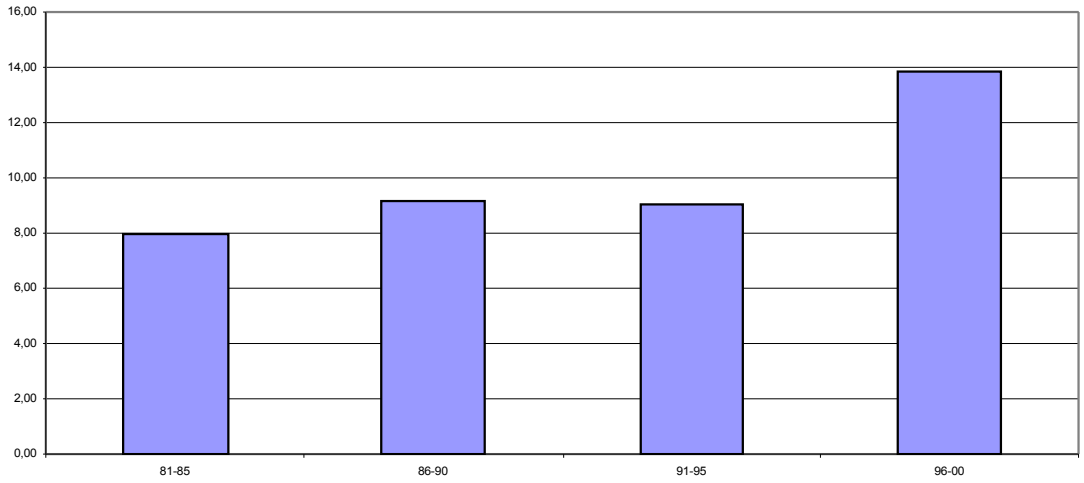


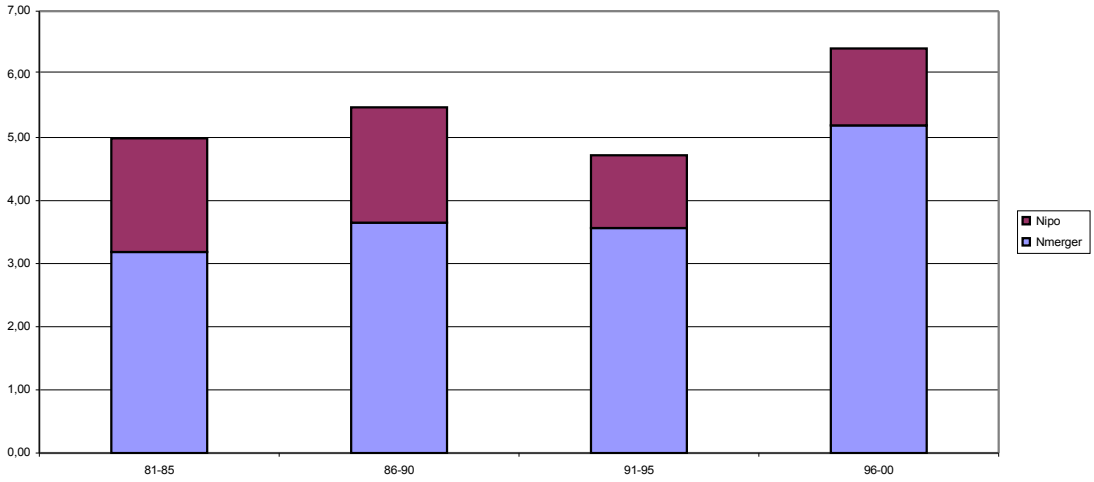
Figure 5.2b.: Average number of companies in which funds invested in



Now turning to the performance trends, Figure 5.3. displays the average number of positive exits for funds incorporated in each five-years period, in absolute terms. Each column of the graph is referred to the average total number of positive exits experienced by the funds that were incorporated in each of the five-year periods. The figure shows the number of positive exits and also the portion of exit via merger and acquisition (M&A) and via public offer (IPO) for the full sample.

As a general trend it seems that the number of positive exits is higher for more recent funds, although for a small drop for funds raised between 1991 and 1995. Not surprisingly IPOs are always lower than M&As, confirming the general finding that getting a company to public markets is more difficult that exiting it through third sale, especially for British VCs which seems to prefer M&A as type of exits, as it also pointed out by research and reports on the huge wave of buyouts (MBO, MBI, LBO, etc.) experienced by British VCs during the final years of the 1990s.

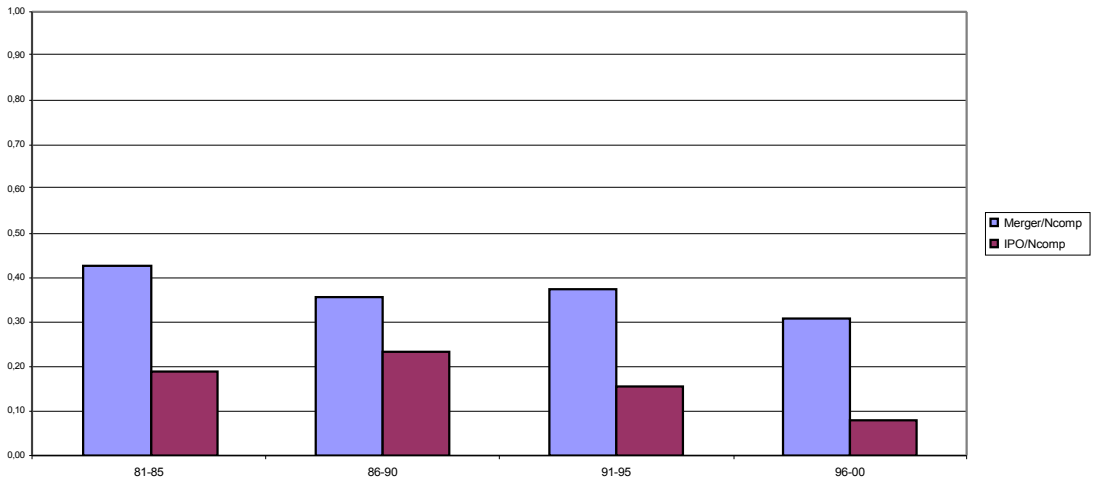
Figure 5.3. Number of Positive Exits (M&A and IPO)



More interesting is Figure 5.4. which displays funds' positive exits scaled for the number of companies they invested in, which is the our measure of performance, explaining the success rate of funds in our sample. The figure show a slightly declining trend in the first three of the five-years periods of analysis, going from an average 61% of success rate for funds raised during the period 1981-1985, to an average of 59% success rate for funds raised during the next period, and 55% during the quarter 1991-1995. The success rate in the final period declines from 55% to 39%. Considering that

the number of companies on which VCS invested in has strongly increased in the last period, this can be taken as a real fall in success rate for funds raised in the last quarter. Yet this is more likely to reflect a truncation bias, due to the shorter period of time for the latest funds have in order to exit their investments. As Kaplan and Schoar (2005) and Hocberg et al. (2006) showed, funds are likely to exit their investment in the last 5 of their 10 years life-span. In other words, while funds raised in previous years had at least 10 years to exit their companies, more recently raised funds are still active on their investment and still have some years left to perform a positive exit.

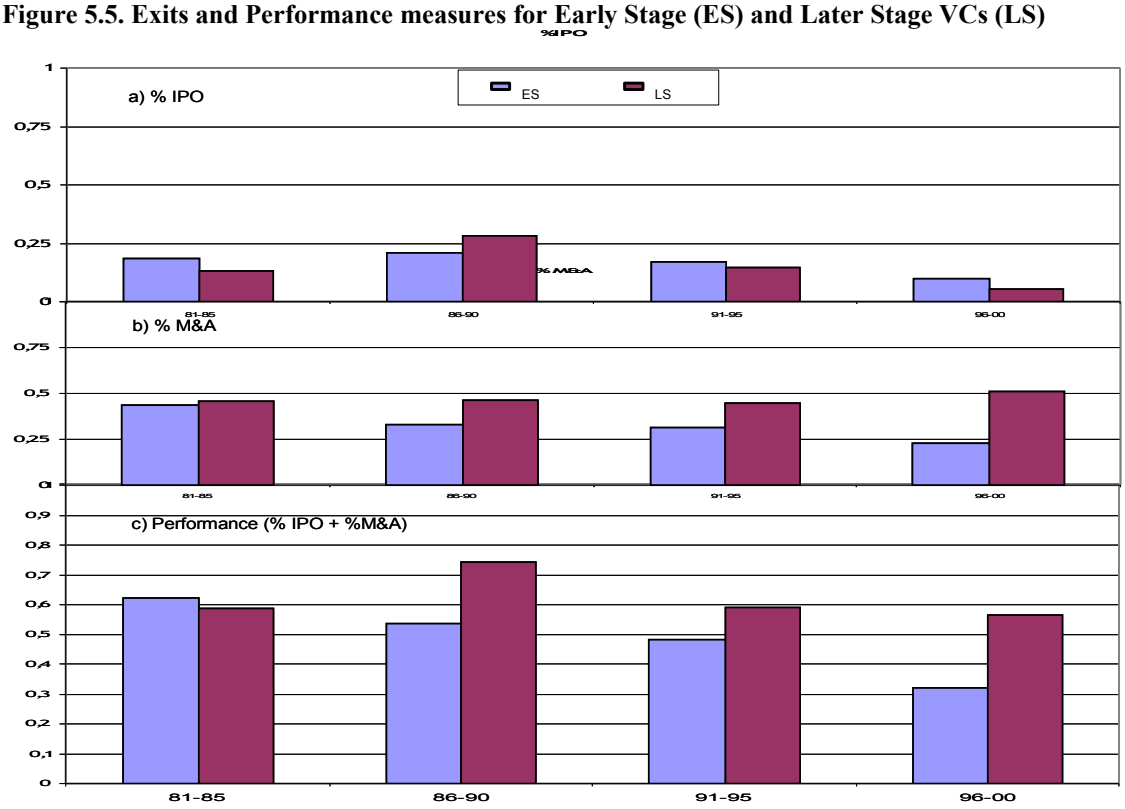
Figure 5.4. Fund Performance: number of positive exits scaled by the number of companies



Similar figures are elaborated relatively to the exits and performance measures of sub-samples (ES and LS). Figure 5.5. displays the proportions of portfolio exits. Figure 5.5a. Reports the percentage of IPO, figure 5.5b. represents the percentage of M&A, and figure 5.5c. reports the sum of the two previous ones, which is the measure of performance used for VCs. Except for the first quarter, LS have higher performance levels and this trend is kept over time. This superiority of LS is sustained by the level of

M&A (figure 5.5b.) where LS show higher values. When looking at the level of IPOs instead (figure 5.5a) ES show higher levels (but in the second quarter), suggesting ES have preferences for IPO, while LS prefer M&A as exit way.

Figure 5.5. Exits and Performance measures for Early Stage (ES) and Later Stage VCs (LS)



Finally, Figures 5.6. to 5.7b. display the variation in the indicators of Diversification by Industry and of Diversification by Country, for the full sample and for the two splits. Figure 5.6. supports the finding we described relatively to Table 1. Diversification by Industry shows higher level than Diversification by Country. It confirms that UK funds tend to invest in companies pertaining to different domains. The trend is quite flat, with a small decrease after the first quarter, which is recovered in the other three. This is particularly evident for LS than for ES (Figure 5.7a).

Figure 5.6. Diversification by Industry and Diversification by Country for the Full Sample

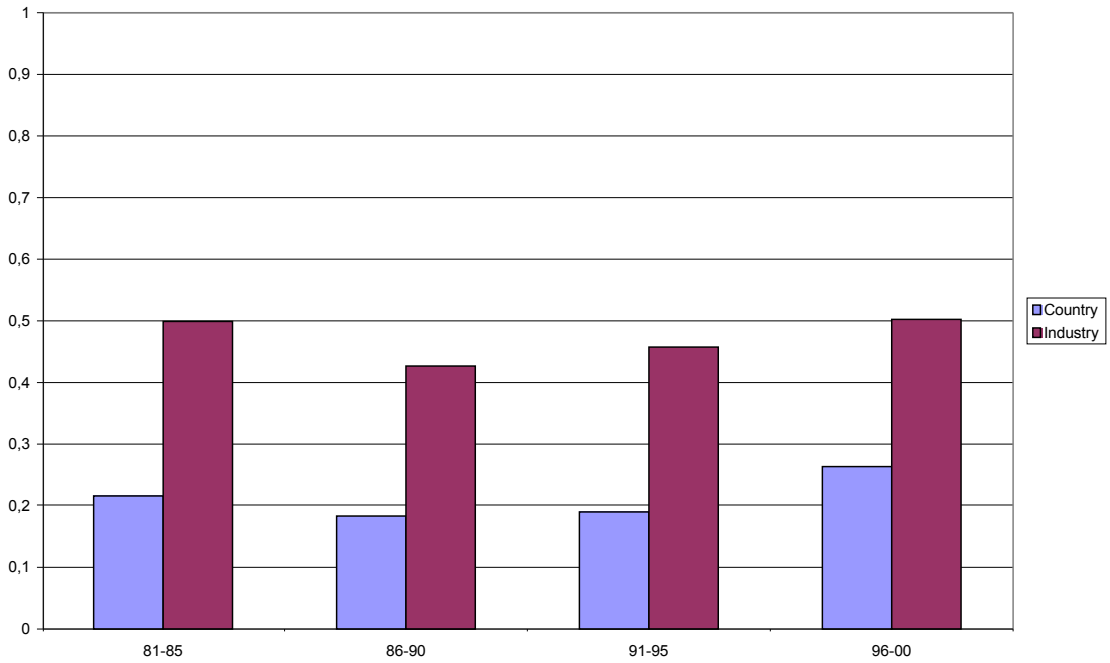
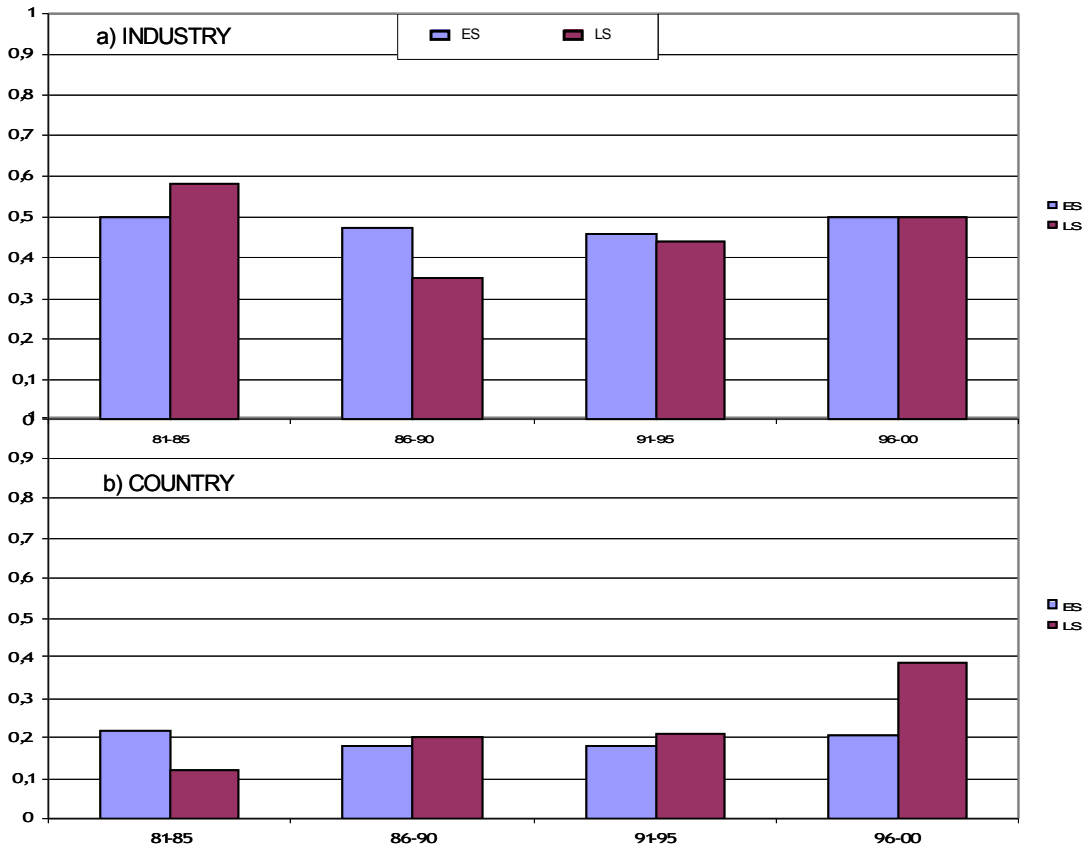


Figure 5.7. Diversification by Industry and by Country for Early Stage (ES) and Later Stage (LS) Funds.



The general trend shown for the Diversification by Country is also flat (Figure 5.6.), with a remarkable increase for funds raised in the last quarters, supported by higher levels of diversification reached by LS compared to LS (Figure 5.7a.). This is consistent with the data showed by EVCA and BVCA reports and indicating a progressive internationalisation of UK VCs (Chapter IV) in the late 1990s-early 2000s showing the tendency to increase investments abroad.

5.2. Interpretations of descriptive statistics and dynamics.

The analyses evidenced that in VCs in the UK are heterogeneous in their characteristics and apply to portfolio strategy in different ways. The distinction between ES and LS proved to be significant since the two sub-sample statistically differ in many important factors, including funds characteristics, level of performance, and diversification strategies. Overall it seems that VCs tend to have higher level of Diversification by Industry than Diversification by Country. This is consistent with the studies which analyse the allocation of efforts and attention of VCs to backed ventures and found that there is a trade off between the possibility to invest abroad and the involvement of fund managers in the activities of funded companies (Gompers and Lerner 2000, Manigart et al. 2002). In other words, the geographical distance imposes some boundaries on the possibility to oversee and control funded companies, thus suggesting that it might be easier and more convenient for VCs to follow a diversification strategy by industry than a diversification strategy by country. The latter may be more time- and resource-consuming since it requires the deployment of various

type of resources in different locations (Gompers 1995). This in particular is supported by the fact that LS have higher levels of Diversification by Country than ES. The former indeed have portfolio of companies which are by definition more easy to evaluate (Kortum and Lerner 1998) because they represent more developed business, operating in more mature stages where key success factors, such as product, markets and clients (Hellmann and Puri 2002) are better defined. The latter have to deal instead with early stage businesses, where even the product idea might be only roughly definite (Amit et al. 1998), often entailing only the potential of a future profit at the date of investment (Murray 1999, Kaplan and Stromberg 2001). These investments are those requiring the greatest involvement and support of the VC in their management, thus imposing constraints on the possibility to invest abroad or in a large number of different countries.

Surprisingly this seems not to be true relatively to the dimension of Diversification by Industry , where ES have the same average rate of diversification, if not higher, than LS. This evidence clashes with previous literature (Gupta and Sapienza 1992, Norton and Tenenbaum 1993, Carter and Van Auken 1994, Elango et al. 1995) which found for VCs involved in early stages a preference for less industry scope than VCs involved in later stage deals. On the other hands this is consistent with those who support the view of VCs as financial intermediaries, seeking to diversify their portfolio by investing in unrelated businesses.

An alternative explanation of this could be linked to the existence (or absence) of investment opportunities available to VCs in their geographical area. In particular, the need to maintain a fluid and robust deal-flow (Tyebjee and Bruno 1984), i.e. the need to constantly find profitable investment to be approached by VCs, clashes with the

possibility to find a suitable investment in the domain the VC is familiar with (Black and Gilson 1998, Jeng and Wells 2000) Indeed European venture capital is considered to be still a young market, at least compared to the more mature USA, lacking (among other things) of the investment opportunities which arise oversees. This has been used as an argument to justify the poor return European VCs gain compared to US-based peers (Bottazzi et al. 2004). Assuming this is true also for UK venture capital, VCs might have to chase profitable investment opportunities by looking at other domains than those they are familiar with. This can be especially true for VCs which are involved with new markets and/or businesses, and is typical for "State-of-the-art" technologies, where the number of investment opportunity is lower than those in more consolidate environment, explaining why also ES have to face higher levels of Diversification by Industry.

5.3. The impact of portfolio Diversification on fund Performance: regressions and analyses.

In this section I analyse whether portfolio Diversification leads to better performance for VCs than portfolio specialization in a regression framework. In order to do so, VCs performance are measured as the proportion of portfolio companies exited via IPO and M&A. VCs diversification is operationalized at three different levels: Diversification by Industry, by Country and the scope of stage of development of investee ventures. I operationalized these measures using the complement to Herfindahl-Hirschmann indexes, taking any value between 0 and 1, so that a fund with

diversification index taking value 1 is perfectly diversified, while a fund taking value 0 is extremely focused (i.e. specialized).

Table 5.3. Sample Correlation for VCs

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
1) Performance	1.00									
2) Div. by country	0.06	1.00								
3) Div. by Industry	0.04	0.32	1.00							
4) Div. by Stage	-0.10	0.30	0.60	1.000						
5) Ln(fundsize)	0.14	0.30	0.25	0.13	1.00					
6) Ln^2(fundsize)	0.15	0.37	0.17	0.07	0.79	1.00				
7) Dummy(Followon)	-0.02	0.04	0.10	0.01	0.21	0.19	1.00			
8) Ln(Capitalinflows)	-0.31	0.12	0.06	0.02	0.28	0.28	0.19	1.00		
9) Firmexp.	0.09	0.05	0.12	0.09	0.32	0.33	0.31	0.11	1.00	
10) Synd	0.07	-0.10	0.09	0.05	-0.02	-0.06	0.00	-0.1	0.03	1.00

Table 5.3. reports the correlation for sample variables. Values higher than 0.5 are reported for correlation between *Ln^2(fundsize)* and *Ln(fundsize)* (0.79) and also between *Div. By Industry* and *Div. by Stage* (0.60). In order to avoid problems of multicollinearity I dropped the squared term of the natural logarithm of fund size and followed Kaplan and Schoar (2005) approach, splitting the sample between ES and LS[44] (see paragraph 4.2.5.). I perform Papke and Wooldridge (1996) QLME method, described in section 4.2.5., in order to assess the following linear function:

$$VC\ Performance_j = A + \beta_1 DivbyCountry_j + \beta_2 DivbyIndustry_j + \beta_3 \ln(fundsize)_j +$$

[44] ES = VCs with 60% of portfolio involved in early stages; LS = VCs with 60% of portfolio involved in later stages.

$$\beta_4 \text{Dummy}(\textit{follow-on})_j + \beta_5 \ln(\text{C}\textit{apitalinflows})_j + \beta_6 \textit{Firmexp}_j + \beta_7 \textit{Synd}_j + \beta_8 \varepsilon_j$$

I tested for multicollinearity by calculating variance inflation factors (VIF). None of the VIF scores approached the commonly accepted threshold of 10 to indicate potential multicollinearity problems, the mean VIF being 1.40 with a maximum value of 3.67. These results suggest that multicollinearity is not a problem.

Table 5.4. reports the results of QLME analyses. Robust standard errors are in parentheses, in order to control for heterosckedasticity. I controlled for year-fixed effect by including year-dummies relatively to fund vintage year. The table reports the QLME for the full sample and for sub-samples of ES and LS.

In the first column the table reports the impacts of diversification strategies and control variables for the full sample. Both impacts of Diversification by Country and Diversification by Industry are statistically significant ($p < 0.05$ for Diversification by Country and $p < 0.001$ for Diversification by Industry). Diversification by Country is positively related to the performance of a fund, while Industry Diversification is negatively related to funds' performance.

Table 5.4. Regression (Dependent Variable: Fund Performance) [a, b]

	Dependent Variable: VC Performance

Variable	(1) Full Sample	(2) ES	(3) LS
Intercept	3.248***	2.184***	1.793**
	(0.60)	(0.19)	(0.57)
Div by Country	0.424**	0.290	0.567**
	(0.16)	(0.19)	(0.31)
Div by Industry	- 0.714**	- 0.363	- 1.582***
	(0.20)	(0.24)	(0.546)
Ln(Fundsize)	0.142***	0.100***	0.045***
	(0.03)	(0,03)	(0.057)
Dummy(Followon)	- 0.111	- 0.201	- 0.254
	(0.12)	(0.134)	(0.27)
Ln(Capitalinflows)	- 0.419***	- 0.337***	- 0.088
	(0.06)	(0.039)	(0.062)
Firmexp	0.004*	0.005**	0.004
	(0.00)	(0.002)	(0.358)
Synd	0.192	0.322	- 0.115
	(0.60)	(0.21)	(0.36)
Year Dummies	YES	YES	YES
Log pseudolikelihood	-328.66	-246.75	-78.19
McFadden's Adj R2	0.10	0.32	0.79
N. obs.	649	487	162

[a] Robust Standard errors in parentheses.
[b] *** = p < 0.001; ** = p < 0.05; * = p < 0.1

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This suggest that for UK funds following a diversification strategy by investing in companies differently located pays more, in terms of percentage of companies exited through IPO or acquisition, then a country-focused approach.

On the other hand, Industry diversification is negatively related to fund performance. In other words, the more the funds diversify by industry, the less they are likely to perform positive exits.

In columns 2 and 3 results for ES and LS are considered. The direction of relationships between portfolio diversification and performance are kept both for ES[45] and LS, VCs performance being positively affected by country scope of portfolio and negatively affected by industry scope of investments.

For the full sample Hypothesis 1,a is confirmed on the Country Dimension. This results seem to support the Financial Intermediation perspective, in that VCs which diversify across countries seeking portfolio risk reduction are more likely to show higher performance. Conversely, on the geographic dimension, these results disconfirm a resource-based view applied to the venture capital context. In other words VCs pursuing diversification by country as an investment strategy show higher performance than VCs following a geographic-focused approach to investments. By broadening their geographic scope of investment portfolio VCs can enlarge their investment opportunities. This will provide higher chances to identify higher-return investments. Moreover, by spreading their portfolio in different geographic areas, they can minimize country-specific risk and mitigate the impact on performance of factors negatively affecting the economic outcomes for a specific geographic region.

However, this perspective changes when looking at diversification strategy at the level of Industry. Here Hypothesis 1,b is confirmed. VCs pursuing specialization investment strategy on the Industry dimension show higher performance than those investing in several different technological fields or industries. On this dimension Financial Intermediation and agency perspectives are no more supported. The results suggest, instead, that moving along the Industry dimension, a more focused approach pays more than diversification, thus confirming the resource/knowledge-based perspective. Specialized VCs can control for business risk by providing more

[45] Although ES coefficient are not statistically significant.

competent strategic and operational support to deals they funded (Barney et al. 1989), by leveraging on knowledge and competences developed in a particular field and by spreading and redeploying these assets over a number of technologically similar ventures. Specialization may help VCs to protect themselves from information asymmetry (Eisenhardt 1989), thanks to their in-depth understanding of the industry. Also VCs' specialized industry knowledge can help VCs in more accurately evaluating and selecting ventures, thus having more potentially profitable companies in their portfolios.

Overall it appears that VCs which diversify by Country tend to have higher performance, while those who diversify by Industry tend to find more difficulties in exiting portfolio companies.

When looking at columns 2 (ES) and 3 (LS) of the table direction of effects for Diversification by Country and by Industry are steady with LS shower higher magnitude than ES in both cases, and ES coefficients being not significant. In other words, the positive impact of Diversification by Country is stronger for VCs involved in later stage investments than for those dealing with earlier ones, the coefficient for the latter being not statistically significant. On the Country dimension, this is consistent with the studies which found that LS prefer higher level of geographic scope while ES are keen to a narrower geographic scope (Gupta and Sapienza 1992, Norton and Tenenbaum 1993).

Relatively to the Industry dimension, LS show higher impact of diversification on performance. For this type of VCs industry diversification is more likely to lead to lower performance, supporting the findings of scholars which state that, by limiting the number of industries in which to invest, VCs can develop a more specialized

knowledge of the complexities inherent in these particular fields, the homogeneity among the portfolio ventures allowing for an effective sharing and re-deploying of specialized resources across them. This in turns enhance the possibility for the VC to effectively support the funded companies and, as a consequence, it enhance the probability to exit ventures via IPO and M&A.

Turning now to the other variables, the first one controls for the size of the fund measured by the logarithmic transformation of fund size in Millions of British Pounds. This measure is positively related to funds performance and significant at 1% level. Furthermore this relationships is confirmed and significant both for ES and LS sub-samples. Other authors (Hocberg et al. 2005, Kaplan and Schoar 2005, Lerner et al. 2005) found a concave relationship between funds performance and their size, highlighted by the negative impact of the squared value of the logarithmic transformation of size. I did not included the squared log term in the analysis, since it is positively correlated with the log term. Yet in an unreported regression I controlled for the squared effect finding no concave relationship between fund size and performance in the sample.

Results also suggest that when more money was raised by venture funds in the industry, performance of same-year funds declines. Controlling for the inflow of funds in Million of British Pounds in the market, I found that the fund-raising (i.e. the Capital Inflows in the venture capital industry) is negative and significantly related to funds performance. This result is not surprising; it is likely that fund inflows proxy for competition for deals. As competition increases the harder it is for new entrants to win good deals. Hence this findings are consistent with Gompers and Lerner (2000), who

were the first to capture the "money chasing for deals" phenomenon. This evidence is also supported by more recent papers (Hocberg et al. 2005, Kaplan and Schoar 2005) which show that prices VCs pay when investing in portfolio companies increase as more money flows into the venture capital industry, holding investment opportunities constant. This pattern is an evidence that increases in capital inflow produce an increase in the competition for a limited number of investment opportunities, negatively affecting the quality of investments and, as a consequence, funds performance.

The variable Follow-on is a dummy which aims to capture the effect of experienced funds on performance. Gompers (1996) shows, the possibility to raise follow-on funds is affect the chances for VCs to attract capital from investors. Thus raising follow-on funds is very important for VCs who want to show track records of performance. Results show that follow-on funds do not seem to add to positive performance, never being significant in all three studies (and showing negative coefficients). Amit et al. (1998) report that, some VCs raise follow-on funds when at the end of previous fund life, transferring old-fund companies in the new fund portfolio. Hence, if a fund at the end of its life has a portfolio of active investments it is more likely the VC raises a new fund in order to pursue the investments in the old portfolio, trying to gain more time to perform positive exits with those investments still active. In this case raising follow-on funds does not necessarily imply better performance, reflecting instead the aim of the VC to simply pursue the investments.

As expected the experience of fund managers (i.e. the variable Firmexp) is positively related to funds performance. This finding shows that managing experience matter far more than the ability to raise up subsequent funds. Furthermore, this finding is also significant for ES, supporting the view that managing experience can add more

value to early-stage ventures, because the greater uncertainty relatively to the definition of products, markets and businesses, imply a greater involvement and support from the VC (Murray 1999, Kaplan and Stromberg 2001).

Finally, I do not find statistical support for the positive relationship between the syndication of investments and VCs performance, since the coefficients are not significant in all the three studies, although reporting positive values for the full sample and for the ES sub-sample.

5.4. Robustness Checks

Two potential biases can affect previous results. In this section I display the robustness checks relatively to: sample selection and performance measurement.

5.4.1. Sample Selection bias

The sample include British VCs raised between 1981 and 2000. For each fund I gathered information of investment activities and performance until the end of 2006. Since funds have a predetermined life of 10 years, more recent funds have less years of observation. For instance funds raised on 2000 have (only) 6 years of observation, while funds raised in early 1990s have more than 10.

In paragraph 5.2. it has been displayed a decreasing trend relatively to performance of funds raised in the last quarter period of analysis. Since funds tend to exit their companies mostly in the second half of their life (Kaplan and Schoar 2005,

Hocberg et al. 2004) it might be that poorer performance trend for these younger funds[46] is not true, but instead is the effect of a truncation bias.

In order to control for this, I repeat the analyses considering only the VCs raised until 1996, each fund having at least 10 years of observation to exit its companies.

Table 5.5. reports the results of the analyses for the sample of funds raised between 1981 and 1996. The full sample counts about 52% of the old sample (335 observations were dropped) as expected, since in section 5.2. it has been shown that the number of funds experienced a strong increasing trend over time, especially in the two last quarter periods of analysis. However directions and significance of main effects keep steady. Diversification by Industry is negatively related to VCs performance, while Diversification by Country is positively related.

Also while looking at the two sub-samples, minor changes occur compared with previous regressions. For LS the size of funds is no more significant. Trends shown in previous paragraphs told that funds tend to increase their size during the last quarter period (i.e. between 1995-2000). Hence a possible explanation may be linked to the fact that the new LS sub-sample does not include bigger funds.

Moreover, the variable *follow-on* becomes significant (1% level) for the full sample and for the ES split, having a negative relationship with VCs performance. This contrasts with the findings of Gompers (1996). The explanation that follow-on funds are raised with the purpose to continue pursuing investments which are still active at the end of the fund life, is thus more reasonable.

Table 5.5. Regression for funds raised between 1981 and 1996 (Dependent Variable: Fund Performance) [a, b]

[46] In previous paragraph it has been noted that I considered year-effects by including in the QMLE regression years dummies.

	Dependent Variable: VC Performance		
Variable	(1) Full Sample	(2) ES	(3) LS
Intercept	3.446***	3.787***	2.152**
	(0.75)	(0.97)	(0.85)
Div by Country	0.354*	0.200	0.428*
	(0.24)	(0.31)	(0.44)
Div by Industry	- 0.620**	- 0.227	- 1.433***
	(0.28)	(0.34)	(0.546)
Ln(Fundsize)	0.125**	0.100*	0.143
	(0.04)	(0,04)	(0.09)
Dummy(Followon)	- 0.354*	- 0.398*	- 0.462
	(0.19)	(0.22)	(0.37)
Ln(Capitalinflows)	- 0.434***	- 0.483***	- 0.231*
	(0.10)	(0.13)	(0.14)
Firmexp	0.006*	0.007**	0.008
	(0.00)	(0.003)	(0.01)
Synd	- 0.084	-0.23	- 0.025
	(0.25)	(0.29)	(0.53)
Year Dummies	YES	YES	YES
Log pseudolikelihood	-176.19	-120.49	-40.90
McFadden's Adj R2	0.06	0.32	0.77
N. obs.	314	228	86

[a] Robust Standard errors in parentheses.
[b] *** = p < 0.001; ** = p < 0.05; * = p < 0.1

Overall the robustness check on sample bias confirms previous findings on our main theoretical variable regarding the effect of portfolio strategies on VCs performance. Now I will turn to the second robustness check, which deals with the measurement of performance.

5.4.2. The percentage of IPOs as an alternative measure of VCs performance.

I measured the dependent variable (VC performance) as the proportion of companies exited via IPO and M&A. In paragraph 3.4. it has been shown why this measure should be considered a reliable proxy for VCs return. Indeed by including only the portion of M&As or only the portion of IPOs one is putting aside the other portion of exits which generate returns (Hochberg et al. 2004). Furthermore, previous research on UK and analysis on sample trend reveals that exit via third sale is a fundamental driver for VC returns (Wright and Lockett 1999).

However some authors pointed out that IPO should be the most important exit route, since it is by bringing ventures to public markets that VCs receive the highest capital gains (Black and Gilson 1998). Hence IPO might be considered by VCs as the strongest driver to invest (Jeng and Wells 2000), especially for early stage investors, for which a successful IPO can cover the costs and risks of several failures (Gompers and Lerner 1999).

As a robustness check I proxy VCs performance aa the proportion of IPOs, i.e. the number of portfolio companies brought to public market scaled for the total number of portfolio ventures, and repeat the regressions on the full sample and split samples.

Table 5.2. shows the results of this check. Looking at the first column for the regression on the full sample, results of the analysis confirm the findings displayed in Table 5.4. Higher levels of Diversification by Country seem to enhance the probability for a VC to bring backed ventures to public markets. On the contrary, and still

consistent with previous results, higher levels of Diversification by Industry have a negative impact on the ability of VCs to perform IPOs.

Table 5.6. Regression for funds raised between 1981 and 2000 (Dependent Variable: % of IPOs) [a, b]

	Dependent Variable: % of IPOs		
Variable	(1) Full Sample	(2) ES	(3) LS
Intercept	-2.060*	0.387	-2.135*
	(0.60)	(0.74)	(0.85)
Div by Country	0.689**	0.462*	1.641**
	(0.24)	(0.26)	(0.44)
Div by Industry	- 0.183**	- 0.031	- 1.308**
	(0.29)	(0.34)	(0.546)
Ln(Fundsize)	0.30	0.049	0.078
	(0.04)	(0,04)	(0.10)
Dummy(Followon)	- 0.48*	- 0.301*	- 0.912**
	(0.16)	(0.18)	(0.42)
Ln(Capitalinflows)	- 0.053	- 0.318**	- 0.037
	(0.07)	(0.17)	(0.126)
Firmexp	0.003	0.003	0.001
	(0.00)	(0.28)	(0.00)
Synd	- 0.294	-0.204	- 0.093
	(0.24)	(0.32)	(0.51)
Year Dummies	YES	YES	YES
Log pseudolikelihood	-178.83	-137.666	-37.284
McFadden's Adj R2	0.09	0.30	0.81
N. obs.	649	487	162

[a] Robust Standard errors in parentheses.
[b] *** = p < 0.001; ** = p < 0.05; * = p < 0.1

Also, Diversification by Country is significant for both ES and LS. Geographic scope increases the range of investment opportunities providing more chances for VCs to identify and select higher-return investments. Agency and business risks could be reduced by decreasing industry-specific risk through the spreading of investments

across different countries. Although data show this should be true for both the sub-samples, the positive effect of geographic diversification is bigger for LS than ES, as the magnitude of relative coefficients says. A possible explanation for this might lay on the fact that, by dealing with more mature companies, LS may find easier to bring a venture to public market. These ventures concern businesses better defined so that it may be easier for VCs to evaluate the profit potential of companies and to select the most promising ones. On the other hands, also for public markets it is easier to float more established companies because it may offer more guaranties of returns to shareholders. In other words, the higher stability and solidity of companies in later stages might induce LS to look for the advantages of portfolio diversification on the geographic dimension

Conclusions and limitations of the research

Contribution of the research

This research analysed the impacts of VCs' portfolio strategies on their performance. In particular it addressed the question whether a diversified approach to investment portfolio leads to better performance than a specialized strategy. Hence the main contributions of this research are that it adds on the literature that studies the strategic behaviour of VCs, analysing for the first time the VCs strategic decisions relatively to portfolio composition, and their impacts on performances.

VCs invest in highly risky ventures with the hope of obtaining a profit in return. While, on the one hand, the traditional financial approach suggests that diversification eliminates non-systematic risks (Scharpe 1964, Brealey and Myers 1996), on the other, the competence-based approach seems to support greater specialization of VCs portfolio as a means of reducing uncertainty (Bygrave 1987, Lubatkin and Rogers 1989, Manigart et al. 2002). The very nature of VCs is the investment in highly risk and (potentially) highly reward, privately held companies with the goal of providing expected returns to investors, by supporting and developing backed ventures and then by realizing capital gains through the exit of portfolio companies via third sale or public offer. Hence analyses of portfolio strategies is a relevant question since it represents a powerful means VCs have to manage their risk/return profile. It is important to examine factors influencing these decisions and the consequences on VCs performance.

This research suggests that VCs' performances are contingent on their choices as to the composition of their investment portfolios. Also, the decision determining the composition of a VC's portfolio of investments and thus the level of diversification, plays a crucial role in the creation of a fund. First these are long term strategic decisions that are difficult to change. Second the maximum amount a VC fund is allowed to invest in a single company as well as in certain financing stages, industries, or countries is fixed in the partnership agreement with the limited partners, i.e., the investors. A deviation from this agreement is only possible if all limited partners approve.

Previous research on this topic showed that VCs can choose between two alternative approaches to portfolio management: diversification or specialization of investment portfolio. These approaches apply to different theoretical perspective: the literature that takes a financial intermediation perspective on the VCs insists on the financial advantages resulting from the reduction of risk exposure through the combination of ventures whose financial flows are not correlated. The resource-based perspective applied to venture capital, instead, advances the superiority of a specialization strategy. The specialization of VCs' portfolio in those particular industries, stage of development and geographic markets, make them more capable of dealing adequately with the risks, uncertainties, and information asymmetries associated with investment opportunities.

Both these approaches some limitation in explaining the behaviour of venture capital and they do not address the question of the relationship between portfolio strategies and VCs performance. Hence this thesis is an attempt to go directly at the core issue of this relationship, by modelling two conflicting hypotheses, one supporting the view that diversification should lead to better performance than specialization (as

predicted by Financial intermediation theory), the other one stating that specialization should lead to better performance than diversification (as predicted by the Resource based approach to venture capital investment). I modelled portfolio strategy considering different dimensions along which a VC can diversify or specialize, namely the industry and geographic scope of portfolio investments. In this sense indexes of diversification have been calculated so that higher values in the indexes indicate diversification, while lower values mean specialization. Then I analyse the impact of these factors on the performance of VCs in the UK, taking in consideration also the particular involvement of each VC in early stage deals or in later stage deals.

The analyses evidenced, first, that in VCs in the UK are heterogeneous in their characteristics and apply to portfolio strategy in different ways. Overall VCs have higher level of Diversification by Industry than Diversification by Country. This research suggests that the geographical distance imposes some boundaries on the possibility to oversee and control funded companies, implying that it might be easier or more convenient for VCs to follow a diversification strategy by industry than a diversification strategy by country. The latter may be more time- and resource-consuming since it requires the deployment of various type of resources in different locations (Gompers 1995). This in particular is supported by the fact that later-stages VCs (LS) have higher levels of Diversification by Country than early-stages peers (ES). The former indeed have portfolio of companies which are by definition more easy to evaluate because they represent more developed business, while the latter have to deal with businesses often entailing only the potential of a future profit at the date of investment. Since these investments are those requiring the greatest involvement and support of the VC in their management, thus imposing constraints on the possibility to

invest abroad or in a large number of different countries. This is not true relatively to Diversification by Industry, where ES have the same average rate of diversification, if not higher, than LS. This lead to the conclusion which contradict previous literature (Gupta and Sapienza 1992, Norton and Tenenbaum 1993, Carter and Van Auken 1994, Elango et al. 1995) which found for ES a preference for less industry scope than LS. As a possible explanation it is argued that the existence (or absence) of investment opportunities available to VCs affects the composition of their portfolio of investments.

In particular, the need to constantly find profitable companies to invest in, clashes with the actual existence (or absence) of suitable investment in the domain the VC is familiar with. This calls into question the maturity of venture capital markets (Black and Gilson 1998, Jeng and Wells 2000). Indeed European venture capital is considered to be still a young market, at least compared to the more mature USA, lacking (among other things) of the investment opportunities which arise overseas. This has been used as an argument to justify the poor return European VCs gain compared to US-based peers (Bottazzi et al. 2004). Assuming this is true also for UK venture capital, VCs might have to chase profitable investment opportunities by looking at other domains than those they are familiar with. This can be especially true for VCs which are involved with new markets and/or businesses, and is typical for "State-of-the-art" technologies, where the number of investment opportunity is lower than those in more consolidate environment, explaining why also ES have to face higher levels of Diversification by Industry.

On the relationship between diversification and performance, the analyses results show that different level of diversification have divergent impacts on VCs performance. In particular, while Diversification by Country have a positive impact on

performance, Diversification by Industry negatively affects performance of VCs. Hence on the geographic dimension, results confirm the prediction of the Financial Intermediation perspective, while on the industry dimension, results confirm the prediction of the Resource-based approach. As a possible explanation of this findings, it is advanced that there is a higher degree of geography homogeneity than industry homogeneity. In other words, the different country a VCs can chose to invest in are more similar each other in terms of venture capital investments, than on the industry domain. Indeed in Western economies processes of homologation are implemented in latest years relatively to market infrastructures and economic regulation. For instance in European countries small number of investment opportunities and poorer return during the 1990s have been associating to the differences between regional venture capital markets relatively to financial markets, business and sector regulation and policy interventions (La Porta et al. 1997, Jeng and Wells 2000). Furthermore Bottazzi et al. (2004) pointed out that a major issue explaining the gap between European VCs and US-based VCs has been the fragmentation of regional venture capital markets and the lack of critic mass in terms of investment opportunities to VC investment. Indeed several official documents of the European Commission and other European Organization policies urge for the integration of European Union's financial markets and the development of venture capital (European Commission 1998, EVCA 2000). Sample data show increasing trend in level of diversification for younger funds. Hence, is possible that in the context of integration of market infrastructures; converging business, sector regulation and policy interventions (Levin 2004); and aligning financial markets (Black and Gilson 1998), VCs may find easier to invest abroad and find profitable opportunities which were not available in countries where they were used to

invest in before. As a consequence, higher levels of Diversification by Country might be beneficial in terms of VCs performance.

Limitations of the thesis and future directions of research on Venture Capital strategy

In studying the patterns of VCs' portfolio strategies and its impacts on performance, this research shows several limitations.

A first limitation concerns the measure of performance implemented for VCs. The calculation of performance through internal rates of return (IRR) is tricky in terms of both data availability and measurement problems. First fund cash-flows are difficult to observe, but when a company exits the VC portfolio. Furthermore, a big fraction of deals is syndicated so that it is necessary to evaluate the syndication agreements on the sharing of returns for venture exits. Moreover, in IPO exits, venture capitalists typically keep a large stake for a certain period after the IPO and exit piece by piece (Cumming and Macintosh 2003). The difficult part for an outside observer would be to track all the actual cash flows the venture capitalist receives from selling portions of its ownership after the IPO. I used the fraction of portfolio companies exited via IPO and M&A as a proxy of fund returns. The question is: Can we then use exit rates as a proxy for investment success? We should certainly be careful in making inferences based on, say, the exit rate. Although IPOs and M&As are the highest profit

exit routes, exits differ widely in their terms and the price obtained. For instance, a success rate of 50% which gives a total capital gain of 20% on the total amount invested by the fund, is performing worse than a success rate which earns a capital gain of 50%. Future research should address the performance measurement issue, for instance by weighting each exits with the amount of capital invested in, or using the data of funds value when companies are exited. The problem of lack of available data it is not only due to the private nature of venture capital investments, but also to the difficulties in finding appropriate performance measures.

Another important limitation of this research concerns the modified Herfindahl-Hirschmann measures originally used to measure the Diversification by Stage of development (see paragraph 4.2.3.). In order to do so I assigned each portfolio company to a stage class, according to the 2-digit classification of Venture Expert. This classification counts four 1-digit classes relatively to the so-called early-stages (venture capital in strict sense) and two 1-digit classes for the so-called later-stages (private equity). Furthermore when looking at the two-digit subclasses, for early-stages each sub-class is defined in terms of development of the venture (see in Appendix 1 definition for e.g. *seed stage* and *expansion*), that is in terms of development of the business. On the contrary the sub-classed for later stage investments are assigned in terms of difference in the type of financing and/or acquisition than on the base of the venture development (see in Appendix 1 definition for e.g. *MBO* and *MBI*). As a consequence I doubt the reliability of said classification relatively to the measure an index of Diversification by Stage of development, since it is likely to induce distortion, which may affect analyses, as in my case.

More broadly, future research should deepen the understanding of these diversification dimensions. Indeed results showed that funds specialize or diversify along these dimensions (at least by Country and by Industry), but further investigation is needed to understand the motives underlying a particular choice relatively to these variables. For instance, which factors influence the decision of VCs to diversify/specialize along the industry dimension and/or the geographic dimension? Is the industry and/or geographic diversification/specialization strategy by the same factors affecting performance? are these patterns steady over time? What types of VC are more sensitive to the different dimension of diversification/specialization? Are there other variables along which a VC can diversify/specialise? Since this research showed that different dimension have divergent impact on performance, analysing these issues seems relevant for the understanding of VCs strategic behaviour and performance.

Finally, this research pointed the existence of different patterns of diversification. For instance it has been shown for Diversification by Country, which has a positive impact on performance, while for Diversification by Industry values are higher but the relationship with performance is negative. This results, seem to suggest that the question whether diversification or specialization lead to better VCs performance cannot be solved straightforward. Instead the question should be put in terms of different levels or type of diversification for different variables. In other words this research suggests that a certain degree of diversification may benefit funds performance, but a stronger level of diversification might be detrimental. Put in other terms there may exist threshold-levels of diversification positively related with VCs performance. Over a certain amount of diversification, the relationship may become negative. Yet the literature on strategic management dealing with diversification has

recently convened that multi-business firms benefit from a *correlated-diversification*, only as far as such benefits derive from the creation of synergies between correlated ventures through the sharing of resource and competence (Grant 1988, 1991, Kanter 1989, Trautwein 1990, Goold and Luchs 1993), by means of which the performance of a given portfolio is better than the sum of each single venture (Panzer and Willig 1981, Prahalad e Hamel 1989, 1990). Attention is thus paid not only to the portfolio of ventures that can be managed contemporaneously, but also to the portfolio of competences developed by the VC.

Therefore future research on venture capital should address the issue of correlated diversification. The more VCs skills and resources can be redeployed to portfolio companies, the more it is convenient to keep said ventures in the VC's portfolio and to invest in the development and sharing of competences crucial thereto (Campbell 1992, Stalk et al. 1992, Barney 1997). VCs might reach a maximum level of efficient diversification, which is determined by the strategic correlation between its ventures; beyond said level, further diversification implies reduced benefits and worse performances (Palich et al. 2000).

In other words, diversification might entail benefits so long as the integration of a new venture in the portfolio does not imply costs (due to increased difficulties related to coordinating and controlling different ventures or inefficiencies due to conflicts and agency problems, which counterbalance the positive effects of such an inclusion.

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APPENDIX 1:

Definition of Development Stages

To measure diversification across financing stages, each portfolio company was assigned to a financing stage. In order to do so, the following definitions were used

- *Venture capital*: The term VC is used to describe the provision of equity or equity linked capital to young, high growth companies which have a limited history of operation (Gompers & Lerner 2004). According to the status of operation, VC is divided into (AltAssets 2005, Thomson Venture Economics 2005):
  - *Seed / early stage venture capital*: Seed capital refers to the provision of very early stage finance to a company which has not yet been established. Seed capital is often provided before venture capitalists become involved. Early stage VC is provided to companies which have been recently established. It is used for product development, as well as initial marketing, manufacturing and sales activities.
  - *Expansion / second stage venture capital*: It is provided for the first expansion of a company, which is already in production and shipment. The company is experiencing growth in inventory and accounts receivable.
  - *Later / third stage venture capital*: The term denominates funding of a company, which has sTable operations and is breaking even or profiTable. The capital is used for further growth of the company.
- *Buyout capital*: A BO is the purchase of a company or a controlling interest of a corporation's shares or some part of business (AltAssets 2005). The focus of BO capital are mature companies with a proven track record. Various types of BOs can be divided emphasizing each one important element of the transaction. The most important are leveraged BO (LBO), management BO (MBO), management buyin (MBI), recapitalization, and turnaround. The majority of classifications also assign mezzanine financing to BO capital because it is mostly used in BO transactions.
- *Listed securities*: In some cases PE firms buy shares of companies which are listed on public stock exchanges. Often these companies have been funded by the same PE firm years ago in a private transaction.
- *Other financing stage*: The category other financing stage was used for companies, which did not fit in one of the other categories.