Intangibles in a Venture Capital Setting

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This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

Signed:

Date:

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Abstract

In recent years intangibles have taken a more prominent role in the economy. Within the technology sector, young companies may have very little in terms of tangible assets. With no assets to serve as collateral, these companies often find it difficult to obtain funding. Venture capital firms attempt to fill this funding gap by providing finance in exchange for equity.

This research considers intangibles from the point of view of the venture capitalist. Specific emphasis is made on patenting, as a formal way of protecting intellectual property. In high technology firms patents not only prevent competitors from copying inventions, but may also preclude them from advancing in their technologies. The availability of patent statistics enables objective measurement of the level of IP protection. The role of the reporting of intangibles in the investment decision is considered. Then, the role of intangibles *per se* is examined. The link between patenting and the level of investment is explored further.

In a move away from the previous studies which focused only on existing datasets, unstructured interviews were conducted amongst early stage investor associations. Thereafter, a series of interviews was carried out amongst venture capitalists in the United Kingdom. Finally, a new dataset was constructed which includes information on venture capital investments, financial accounting information, and data relating to patenting. This data was then analysed statistically using regression techniques.

Policy making organisations have been promoting the need for increased reporting on intangibles. However, key findings suggest that venture capitalists consider the existing level of reporting of intangible assets by investee companies to be adequate. Increased complexity within the financial reports does not reduce the level of due diligence carried out. They are more concerned about the nature of the intangibles than the financial reporting aspect. Although this study identifies a link between patenting and the level of investment by venture capitalists, they consider the business proposition as a whole, and no specific value is ascribed to patents.

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List of Abbreviations

AIC	Akaike's Information Criterion
AIM	Alternative Investment Market
ARD	American Research and Development Corporation
ASC	Accounting Standards Codification
BIC	Schwarz's Bayesian Criterion
BIMBO	buy-in management buy-out
BVCA	British Venture Capital Association
CFO	chief financial officer
CIMA	Chartered Institute of Management Accountants
DOCDB	master documentation database (of the European Patent Office)
EBIT	earnings before interest and tax
EFAS	European Federation of Financial Analysts
EFRAG	European Financial Reporting Advisory Group
EPO	European Patent Office
EU	European Union
EVA	Economic Value Added
EVCA	European Venture Capital Association
FASB	Financial Accounting Standards Board
FRC	Financial Reporting Council
FRSSE	Financial Reporting Standard for Smaller Entities
GAAP	Generally Accepted Accounting Principles
GBP	Great Britain Pound
GPI	Global Patents Index
IAS	International Accounting Standard
IASB	International Accounting Standards Board
IBM	International Business Machines Corporation
IBO	institutional buy-out
ICAS	Institute of Chartered Accountants of Scotland
ICC	intraclass correlation coefficient
IFRS	International Financial Reporting Standard
IQR	interquartile range
INPADOC	International Patent Documentation
IP	Intellectual property
IPO	initial public offering
IT	information technology
MBI	management buy-in
MBO	management buy-out

NACE	Nomenclature générale des activités économiques dans les Communautés européennes
NCAIS	North American Industry Classification System
OECD	Organization for Economic Cooperation and Development
P/E	price earnings
P&L	Profit and Loss
PCs	personal computers
PCT	Patent Cooperation Treaty
RICARDIS	Reporting Intellectual Capital to Augment Research, Development and Innovation in SMEs
R&D	research and development
SIC	Standard Industry Classification
SSAP	Statement of Standard Accounting Practice
Std. Dev	standard deviation
UK	United Kingdom
US / USA	United States / United States of America
VC	venture capital / venture capitalist
VIF	variance inflation factor

1.0 Introduction

1.1 Introduction

The general objective of this thesis is to explore in more detail intangibles in a venture capital investment decision making setting. This research considers the subject of intangibles from two aspects. Firstly, we consider the reporting of intangibles by investee companies and the role of same in venture capital investment decisions. Thereafter, the role of intangibles *per se*, in the investment decision is considered. This research is considered from the perspective of the venture capital investor.

Intangible assets have taken a more important role in recent years (cf. Cañibano, Garcia-Ayuso, & Sánchez, 2000; García-Ayuso, 2003; Lev, 2001; OECD, 2013; Seetharaman, Sooria, & Saravanan, 2002; Zéghal & Maaloul, 2011). In the twenty first century knowledge assets have become increasingly important as production shifted from labour intensive to capital intensive particularly in the western world (Wilkins, Van Wegen, & De Hoog, 1997). It has been argued that over the last eighty years, the value of a company which is not explained by tangible assets has increased from fifty to over ninety per cent (Low, 2000). However, this figure is unverifiable given that according to the latest UK Intellectual Property Awareness Survey published by the UK Intellectual Property Office (2010), 93% of the respondents do not value intellectual property.

Outside an academic context, the discrepancy between book and market value is confirmed by a recent study conducted by Beattie & Thomson (2010) in which 57% of the finance directors interviewed indicated that more than 50% of their company's value was attributable to intellectual capital. With the increase in knowledge-intensive industries, innovation, globalisation, deregulation and technological change (Holland, 2004; Lev, 2001), we have seen competition intensify as firms try to establish their niche in the new marketplace. In order to achieve competitive advantage, a number of specific categories of intangible assets have emerged to play a greater role. These include intangibles related to human resources, organisational structure and innovation. The increased competition has led to the need for increased methods of protection for intellectual property. One of the most important methods of protection is the patent (Hall, 2007), which will be considered in further detail throughout this thesis.

We will discuss briefly some aspects relating to the context of this research in the next section.

1.2 Context of this thesis

1.2.1 Venture capital

In this thesis, intangibles are considered from the perspective of the venture capital investor who invests in technological companies. Pearce & Barnes (2006, p. 6) define venture capital investment as being investment in *"high risk start-ups, in return for equity (i.e. shares), with the aim of generating substantial capital gains by selling those shares at a later date through some form of exit event"*

In the USA, the term venture capital usually refers only to the investment in businesses which are in their early stages. However, in the UK, the term 'venture capital' is sometimes considered as being equivalent to private equity (British Venture Capital Associaton, 2010c). In this respect, the British Venture Capital Association (BVCA), the leading association of venture capitalists in the United Kingdom, clarifies that in the UK, the term private equity refers *"medium to long term finance provided in return for an equity stake in potentially high growth unquoted companies"* irrespective of the company's development stage (British Venture Capital Associaton, 2010c, p. 6). The difference between the UK and the USA does not only lie in the definition but also in the investment patterns. For example, the US tends to favour syndication (more than one venture capitalist would invest in the same deal) more than in the UK (Manigart et al., 2006). Furthermore venture capitalists in the UK tend to invest in later stages of the development capital cycle (Manigart et al., 2000; Reid, 1998). In Europe (including the United Kingdom), syndication tends to be used primarily to reduce financial risk, in the United States, the motive is also resource based i.e. to share information prior to venture capital selection and on the management of the investments after this is made (Manigart et al., 2006).

In terms of the definition of venture capital, Mason & Harrison (2004b) argue that there are two sources of venture capital in the UK. The first type is business angels, who are usually entrepreneurs who are willing to invest their own wealth in start-ups, either independently or with other high net worth entrepreneurs, (in which case these are referred to as angel syndicates). The second source is venture capital firms, which create venture capital funds consisting of a portfolio of different entrepreneurial investments. (De Clercq, Fried, Lehtonen, & Sapienza, 2006). Financial institutions (such as banks and pension funds) and other investors (such as wealthy individuals or non-financial companies) invest in such funds. In the UK, these venture capitalists tend to invest in later stages of the investment cycle (Mason & Harrison, 2004b), whilst business angels tend to invest in earlier stages. Usually, business angels do not compete with venture capitalists in terms of investment because the size of deals business angels undertake is too small to be of any interest to the venture capital firms. (De Clercq et al., 2006)

Venture capital investment consists of three major stages: the pre-investment stage, the post investment stage, and finally the exit (De Clercq et al., 2006; Fried & Hisrich, 1994), as shown in figure 1-1.

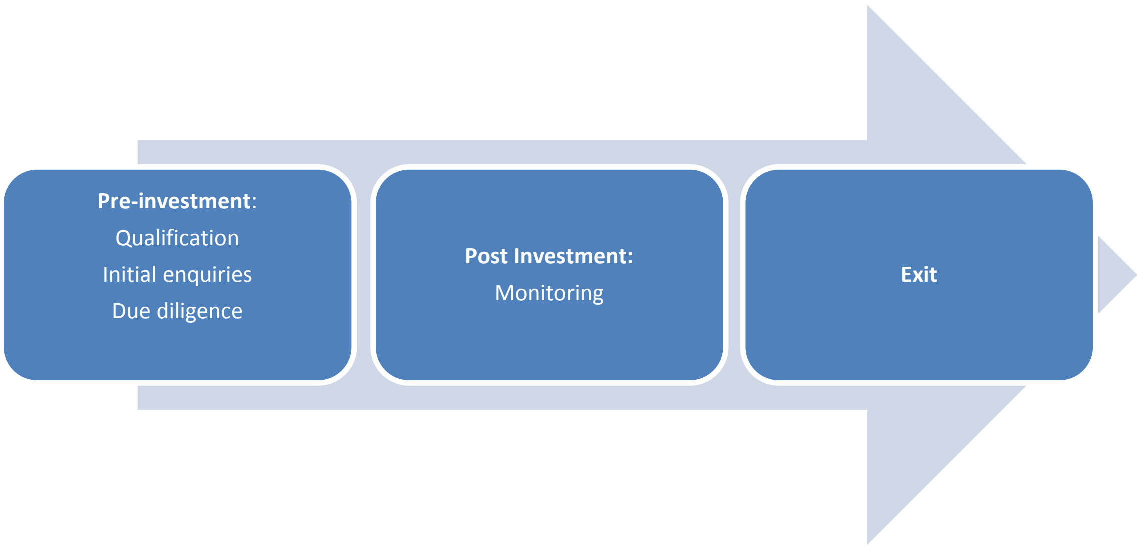


Figure 1-1: The venture capital investment process

Initially, an entrepreneur would pitch for funding to the venture capitalist. In the qualification stage the proposals are screened and those which do not meet the investment criteria established by the venture capital investor are rejected without further consideration. In the initial enquires and negotiation stage, additional information is provided, and the business plan is discussed. Outline terms are negotiated at this stage, and a valuation of the business is made by the venture capital firm. In the due diligence stage a detailed assessment of the financial and technical feasibility of the investment is made (De Clercq et al., 2006; Fried & Hisrich, 1994; Ribeiro & Tironi, 2006). More often than not, the venture capitalist is not the only investor in the company (Zider, 1998). Once an investment is made, the role of the venture capitalist is to monitor closely the investee company. Usually the venture capitalist is involved in the management of the company or acts as a consultant to the firm (Bertoni, Croce, & D'Adda, 2010; Kortum & Lerner, 2000).

One important characteristic of venture capital is that the funding is not long term although usually it is not for less than 3 years (although short term venture capital financing is sometimes provided to companies which are going to be listed within one year) (British Venture Capital Associaton, 2010c). The role of the venture capitalist ends when the company can be sold either to the public market or is taken over by a larger company.

The importance of the venture capitalist lies in the fact that banks are usually reluctant[1] to lend to new companies, given that in today's world they usually would not have significant tangible assets (Zider, 1998). Banks refuse to finance these new companies because of the nature of the intangible assets. Intangibles are subject to a rapid decline in value. For example, patents may be subject to frequent and costly litigation, which if not successful would lead to the patent being worthless. Moreover, key employees can easily obtain jobs at competitors (Lynskey, 2004). Furthermore these, assets are usually not liquid, although recently there has been an emergence of a number of firms which specialise in patent auctions (Odasso & Ughetto, 2010). In view of their expertise in the field, venture capitalists are usually skilled enough to mitigate the moral hazard and adverse selection problems associated with start-up firms (Amit, Brander, & Zott, 1998). They reduce these informational problems by pursuing active monitoring of their portfolios, and by imposing certain restrictions e.g. offering staged financing instead of a lump sum (Bertoni et al., 2010). Despite these restrictions, one advantage of venture capital is that the investors do not require collateral or any personal guarantees from directors. When it comes to liquidation, the venture capitalist is not given preferential treatment, unlike bank loans or debentures, but they are treated like normal shareholders depending on the class of shares they own (British Venture Capital Associaton, 2010c).

The British Government, recognises the role of venture capitalists in providing funding to early stage companies. With the ultimate aim of increasing funding for early stage companies, the government seeks to improve the availability of venture capital financing by introducing tax relief schemes such as the Enterprise Investment

[1] Lynskey (2004) mentions one exception, in which the Development Bank of Japan granted loans using intellectual property as collateral.

Scheme. Under the aforementioned scheme, individuals can deduct 30% of the cost of the shares purchased in unquoted companies (up to a maximum tax reduction of £300,000) from their tax liability (HM Revenue & Customs, 2013). Furthermore, in the Autumn 2013 Statement, the government indicated that funds will be committed for investment by the British Business Bank in later stage venture capital funds (HM Treasury, 2013).

1.2.2 Technology

Another aspect of this research is that it relates to venture capital investors which invest in technology-focused companies.

There is no accepted definition of technology in a venture capital context (BVCA, 2013). However, for the purposes of this research we adopt the definition used by the BVCA for statistical purposes which incorporates mobile and fixed line telephony, computer (computer hardware, internet, semiconductors, software), other electronics, biotechnology, and medical (medical equipment, pharmaceutical and healthcare) (BVCA, 2013). The choice of technology investments is based on the presumption that technology investments are more likely to have a substantial amount of research and development expenditure and intangibles. Indeed, as early as 1977, A. C. Cooper and Bruno (1977, p. 17) recognised that 'many [high-tech] such firms have been responsible for technological innovation and seem to have evolved unusually fertile climates for effective research and development'.

Technology based firms, have been described as being 'an engine of economic growth and job creation' (Siegel, Wessner, Binks, & Lockett, 2003, p. 121). The firms are important for economic growth because of the competitive advantages they create and also because of their role in increasing the technology and science base of a country (Ganotakis & Love, 2011; Pownall, 1998). In this respect, a study amongst new technology based companies in Sweden identified the use of a higher proportion of scientists and engineers when compared to more traditional sectors (Rickne &

Jacobsson, 1999). Furthermore, they are portrayed as providing a larger share of jobs (direct and indirect) than other kinds of start-up companies (Pownall, 1998). The levels of innovation are higher when compared to start-ups not in these technology sectors. Despite these desirable attributes associated with investment in such firms, studies in Europe have shown that the average direct employment of firms which survived for a period of ten years did not exceed twenty employees (Storey & Tether, 1998). Furthermore it has been argued that the firms in Europe did not achieve the same levels of growth as those in the United States (Storey & Tether, 1998).

Oakey (2003) provides a historic analysis of the policy interest in these firms. Upon realising the extent of the growth being achieved in the United States by new technology based firms in the 1970s, the governments in Europe started to pay particular attention to the needs of these new technology based firms. However, Oakey (2003) questions the provision of direct support by governments throughout the years arguing that hardly any support was provided, in line with the non-interventionist policies of the Conservative government in power in the 1980s, and early 1990s in the United Kingdom. The main support came from venture capital companies, i.e. from the private sector (Oakey, 2003). However, over the years, there was a decline in interest in these types of companies. Traditional venture capitalists were reluctant to invest in these early stage investments, and preferred to focus their efforts on later stage investments such as MBOs and MBIs (management buyouts/buy-ins) (Oakey, 2003; Reid, 1998). Indeed the recession of the early 1990s, and the government policy of the day did nothing to improve the situation. Despite that, in the last decade, venture capitalists have become more experienced when it comes to investing in technological companies, but investors are still somewhat reluctant to invest in the very early stages of the venture capital cycle of new technology firms (Lockett, Murray, & Wright, 2002). Even though there is this reluctance, a study carried out by Mason & Harrison (2004a) revealed that the performance of technology investments does not vary significantly from that of other types of investments. Although the study by Mason & Harrison (2004a) has significant limitations in terms of data collection, it implies that the perceived higher risk associated with technology investments is questionable.

Prior to the UK general election of 1997, there appears to have been resurgence in support for investment in new technology companies. The Bank of England commissioned a study on the problem of funding in technology based companies and identified the difficulties associated with the funding of new technology companies (Bank of England, 1996). Indeed, more recently, venture capital firms are investing more in high-tech companies (Lockett et al., 2002). The UK government is actively promoting venture capital investment in new technology start-ups. In a speech in 2012, David Cameron set his ambition to make 'Britain the best place in the world for early stage and venture capital investment', and promised £200 million in investment for new Technology and Innovation Centre (Cameron, 2010). Apart from policy initiatives relating to early stage investments, the UK government has launched schemes specifically targeting technology companies, such as the R&D tax credit scheme, which provides tax relief for companies investing in research and development (Department for Business Innovation and Skills, 2011).

1.2.3 Patents

Having considered the context of technology investments in a venture capital field, this section focuses on the role of patenting in this setting.

In the introduction of this chapter, the move towards an economy which is more knowledge focused and the increased focus on intangibles has been highlighted. This change has brought with it the increased need for protection of inventions or ideas (Hall, 2007). One key instrument in protecting inventions is the patent. A patent is simply a 'legal right of an inventor to exclude others from making or using a particular invention' (Hall, 2007, p. 168) for a limited period of time, which in most countries is twenty years. In obtaining a patent, the inventor is making information on the inventions publicly available. In Britain, a patent system had already been established formally in 1624 with the passing of 'Statute of Monopolies' (Sullivan, 1989), although the modern patent, which required a detailed description of the invention or a working model, came about later on in the 18^{th} century (Hall, 2007). Statistics published by the UK Patent Office in 2013, shows that 23,235 patents applications were filed in the UK, out of which 15,370 had a British applicant (the data considers only the first applicant included in the application) (Intellectual Property Office, 2013). On a policy making side, there has recently been an increased focus on patenting, with the ultimate aim of increasing investment in technology. In particular, in April 2013, the UK Government launched the 'patent box' which provides a tax incentive to companies which create intellectual property in the United Kingdom (KPMG, 2013b).

The traditional role of patenting has been that of protecting a product from being copied by another entity. A firm might decide to patent an invention strategically to block competitors. Strategic patenting could be done offensively, i.e. in order to prevent competitors from producing the product. The firm in this case might not actually be using this product itself, but the aim is to prevent competitors from advancing in their technologies. Alternatively, it could be a defensive patenting strategy whereby the ultimate aim is to be able to advance in the technology without being disrupted by litigation by other firms claiming ownership of the invention. Apart from these primary motives, there could be ulterior reasons for patenting which go beyond the traditional blocking motives. For example, having a patent could be seen as a way of increasing the company's reputation and enhancing its image (Blind, Edler, Frietsch, & Schmoch, 2006). In a similar way, it could also be providing an indication of company value. Other motives could be to obtain better access to external funding (Blind et al., 2006; Lynskey, 2004), or to obtain licensing income. Furthermore, patents could be seen as a measure for the performance of employees involved in research and development within an organisation (Blind et al., 2006).

With a young company, the role of patenting is somewhat limited given the costs which are involved (Hughes & Mina, 2010; Kitching & Blackburn, 1998). In particular, firms might not have the necessary funds to actively be involved in patent litigation (Kitching & Blackburn, 1998). In this respect, firms might be reluctant to obtain formal intellectual property rights and therefore often rely on informal methods of protection. These informal methods are not legal ways of protection and as a result these may avoid the costly litigation efforts. Examples include the maintaining of good relations with the relevant stakeholders of the organisation, and being on the forefront of new ideas, and thus having a lead time advantage over competitors (Hughes & Mina, 2010; Kitching & Blackburn, 1998). An alternative approach to protection could simply be ensuring that there are confidentiality clauses within contracts with customers and suppliers (Kitching & Blackburn, 1998). Nonetheless, in the technology sector, and in particular the high-tech sector, patenting serves an important role, and might be crucial in order to secure the competitive edge over competitors in the sector (Hughes & Mina, 2010).

Patents are particularly suitable for research because unlike other intangibles, there are datasets available through Patent Offices (Dou, 2004) from which one is able to extract information on patents. For example, one is able to assess the number of patent applications a particular firm has, the number of patents which were granted and also the number of patent families.

Throughout this work, reference is made to the patenting process and to various key terms relating to the filing of patents. A diagram showing the patenting process from application date until the actual granting of the patent is shown below:

Figure 1-2: Patent application process

Patents could be *applied for* i.e. an application is lodged with patent office, upon provision of the necessary documents and fees. If the documentation is in order, a filing date is given, referred to as *priority date*. Thereafter, after conducting the necessary searches for *prior art* (technology relevant to the invention, publicly available at the time of the invention, or technology which could possibly invalidate the patent or limit its scope). A *search report* is provided, usually detailing an initial opinion on the patentability of invention. Thereafter, a patent is *published*. This usually takes place 18 months after the priority date. Following publication, if the applicant decides to proceed further, *substantive examination* takes place. This examination is carried out by a patent examiner which determines whether the patent should be *granted* or otherwise. The grant decision takes place on the date of publication of a granted patent (European Patent Office, 2013a; OECD, 2006a). The invention can be subject to a number of applications worldwide. Therefore one invention can be subject to various documents describing the invention in different languages throughout the world. For the EPO, a patent document with equivalent priority dates forms part of the same *simple patent family*, technically referred to as the *ESPACENET patent family*.

Having considered three important aspects relating to the context of this research (venture capital, technology and patents), the next section focuses on the research questions on which this thesis is based.

1.3 Formulation of the research questions

The increased role of intangible assets has brought with it increased concerns on the reporting and valuation of intangibles. Even in the context of small young firms seeking additional funding, organisations such as the Organisation for the Economic Co-Operation and Development (OECD) are increasingly emphasising the need for reporting intangible assets (OECD, 2012, 2013). Furthermore, Cassar (2009) argued that the increased uncertainty associated with start-ups brings with it greater demand for accounting information.

Bearing in mind the venture capital and technological early stage investee company context, the following is one of the research questions on which this thesis is formulated:

- Does the existing reporting of research and development expenditure and intangible assets in financial statements reflect the needs of venture capital investors?

The Conceptual Framework for Financial Reporting states that the objective of financial statements is 'to provide financial information about the reporting entity that is useful to existing and potential investors, lenders and other creditors in making decisions about providing resources to the entity' IASB (2011a, OB2) . This research considers the information contained within the financial statements. In particular, the research considers the usefulness of the reporting of intangible assets and research and development for venture capital investor.

The focus of the research is on venture capital investments in early stage technological companies. In this area, intellectual property rights such as patents are perceived to play an important role, and in this research there is an emphasis on this type of intangible assets.

This study expands further on earlier studies made by Wright and Robbie (1996) and Reid and Smith (2005) which covered aspects relating to the financial reporting for the venture capitalists in the United Kingdom. This study focuses more on the relevance of research and development expenditure as well as aspects relating to intangible assets. In a recent literature review article on the accounting treatment of intangibles Zéghal and Maaloul (2011), make a case for further qualitative research with investors, and suggest that the focus of research should be on the need for disclosure of intangible assets for investors. Furthermore, in line with suggestions for further research by Cañibano et al. (2000) the study does not only focus on research and development expenditure but also considers other intangibles, with a particular emphasis on patenting.

Apart from the reporting aspect, the importance of intangibles *per se* in the context of venture capital investment decisions is considered. Stinchombe (1965) coined the term "liability of newness", referring to the concept that new firms are more likely to fail than more established firms. Under this concept, Stinchombe argues that firms may fail because new organisations may have not yet established a customer base. Employees have to be able to learn their new roles, and these roles might affect creativity and are constrained by costs. Social interactions between key players also need to be established from scratch. To date, this concept remains widely researched in the venture capital literature (e.g. Haeussler, Harhoff, & Muller, 2009; Rosenbusch, Brinckmann, & Bausch, 2011; Wiklund, Baker, & Shepherd, 2010).

To combat this problem of early failure, previous works carried out in North America have identified that venture capitalists are often resorting to signals (cf. J. A. C. Baum & Silverman, 2004) which help them in their investment decision. Under the concept of signalling which was first applied to the labour market (Spence, 1973, 2002), firms voluntarily disclose information to those less informed, in order to convince them that they have specific positive attributes. Studies in North America have previously argued that patenting could serve as a signal to convey information to investors (Levitas & McFadyen, 2009; Long, 2002). Indeed, intellectual property has often been portrayed 'as the main bargaining chip on the table between the investor and the entrepreneur' (Reid & Smith, 2008a, p. 158). Given the above context, a further research question is considered:

- To what extent does venture capital investment relate to patenting activity?

In this research we consider the relationship between the amount invested by UK based venture capitalists and patenting activity. The role of patenting as a signal in venture capital investment decisions is also discussed. The research question is considered both quantitatively, through the use of regression analysis, and also by means of qualitative interviews carried out amongst venture capitalists in the United Kingdom.

Indeed, even on this aspect of the research, traditionally the literature is based on quantitative analysis using existing secondary datasets in the United States. For example, Hindle (2004) calls for increased qualitative research in the field because, by focusing only on the quantitative aspects, there is increasingly a lack of methodological diversity in entrepreneurship research. In terms of the quantitative aspect, a new dataset is constructed, which brings together information from disparate data sources relating to venture capital investment, patenting, as well as financial information. As such, it appears that the newly constructed dataset is a first attempt at linking the three different types of information together in the United Kingdom.

1.4 Addressing the research question

Academic research is shaped by particular research philosophies i.e. the manner in which knowledge is developed, and the nature of the knowledge in relation to the research being carried out (Saunders, Lewis, & Thornhill, 2009). This section provides an overview of the approach which seems to best fit this research.

The epistemology (i.e. what constitutes acceptable knowledge) which best fits this research is the pragmatist approach. In fact, throughout this research there is an emphasis on concepts such as usefulness and relevance, which are not value free (Beams, 1969; Lefley, 2006). For example, the research is concerned with the usefulness and relevance of financial statements and of intangibles in venture capital decisions. Indeed, the subjectivity of these concepts implies that there is an element of value judgement, which contrasts with more empirical research approaches (Lefley, 2006). Moreover, proponents of pragmatism contend that 'no single point of view can ever give the entire picture and there can be multiple realities' (Saunders et al., 2009, p. 130). In terms of ontology i.e. the nature of reality (Saunders et al., 2009), the pragmatist approach agrees with the positivist approach on the existence of a reality but denies the existence of the absolute truth (Tashakkori & Teddlie, 1998).

One of the key elements of pragmatism is that facts are not studied just for the sake of analysing facts but to solve problems for the benefit of society (Feilzer, 2010). For example, one of the implications of this research should effectively be the reconsideration of accounting standards relating to intangibles and other forms of reporting in the light of the responses provided by the investors.

Apart from qualitative analysis we use some quantitative analysis, which is traditionally positivist, although the interpretation does not conflict with the principles of pragmatism (Howe, 1988; Tashakkori & Teddlie, 1998). Indeed, a mixed methodology is one approach which is undertaken most often by researchers embracing the pragmatist philosophy (Saunders et al., 2009).

Initially a series of interviews were carried out with early stage investor associations in the United Kingdom, and also European associations. These not only provided an overview of the subject under consideration from an industry perspective, but also provided insights for the research which followed. After these initial interviews, a series of 21 semi structured interviews were carried out by means of administered questionnaires. These questionnaires were designed on the basis of the feedback received from the unstructured interviews, and also from the literature on the subject. Finally, in the second part of the research, a database was constructed using disparate data sources to analyse further by means of statistical analysis the link between patenting and investing.

The research questions mentioned above are considered in the context of venture capital firms which are based in the United Kingdom. Although the main focus of the research is the United Kingdom, the investee companies of these venture capitalists could be located worldwide. Whilst this research focus does not affect the epistemology and ontology of this research, it does restrict the applicability of the research conclusions to the context of venture capital investments carried out in the United Kingdom.

An alternative way to tackle this research would be to look at the study in purely financial terms, by looking at data from various financial statements and patent databases, and analysing regressions and correlations between the investment and some patent measures using a traditional positivist approach. However, the results would be based purely on financial terms ignoring completely the viewpoints of the investors which are curicial for this research. In fact, this is the approach taken in most of the American literature on the subject, whereby the data analysed is extracted from existing databases.

Perhaps the reasons for this is the approach taken by American journals. Searcy and Mentzer (2003) considered the top 4 American Accounting journals, and pointed out that only one of these journals was willing to accept non positivistic articles. The author's shows how 88.5% of articles published in these top four American journals adopt a positivistic view. American business schools have traditionally showed commitment to neo-classical accounting theories, favouring positivist research (Gaffikin, 2007). Unfortunately, it has been claimed that academics also experience difficulties when it comes to tenure and promotion within universities if published research is not positivist (Baker & Bettner, 1997). There is furthermore also a bias towards positivism in the prerequisites required by doctoral students, and doctoral training provided to PhD students in the United States (Baker & Bettner, 1997).

After considering the key research questions and the research approach, the next section outlines the structure of the thesis, by detailing the contents of each of the chapters and the appendices included within this thesis.

1.5 Structure of thesis

This thesis comprises of six chapters, along with a number of supporting appendices. The layout is subdivided using the normal sequential modules of research presentation:

Chapter 1: Introduction

After a brief introduction on the topic, the research questions are formulated highlighting the need and importance of the research. The chapter introduces also the context of the thesis, by explaining the relevance of venture capital, the focus on technology, and the role of patenting. The research approach and methodology used in this research are also explained in more detail.

Chapter 2: Literature review

An analysis of the existing literature on financial reporting, intangible assets and patenting in a venture capital context is considered in this chapter. The limitations of existing research are highlighted throughout the discussion.

Chapter 3: Methodology and research design

This chapter describes in detail the three parts of the research – namely the unstructured interviews with early stage investor associations, the semi structured interviews carried out with venture capitalists (including a section on questionnaire design) and finally the database construction. The chapter provides a detailed account of how data related to venture capital investment, intangible assets within the financial statements, and patent counts were collected from disparate data sources and inserted into a new database for further analysis. Detailed descriptive analysis of the data included within the database can be found in this chapter.

Chapter 4: Fieldwork with venture capitalists and venture capital associations

The first part of this chapter provides an analysis of the interviews carried out with early stage investor associations. Key differences or similarities with the existing literature are explained. These initial unstructured interviews set the tone for the interviews which were carried out with the venture capital investors across the United Kingdom. The chapter includes the overall results and an analysis of these interviews. These were analysed both qualitatively and also with the use of some non-parametric statistical tests. The final section of this chapter focuses on five of these interviews with the venture capitalists in more depth. With the aid of some secondary data, these are developed into case studies which provide further insights on the topic under consideration. The results are discussed in the context of the literature and theory included in Chapter 2.

Chapter 5: Analysis of the dataset on patenting and venture capital investment

After considering the descriptive analysis of data included within the new dataset, this chapter moves on to the actual analysis of the data. The first section explains how cluster analysis was used in order to identify patterns of similarities within the data. In the second part of this chapter, through the use of statistical analysis, in particular regression analysis, the dataset is analysed in order to show the relationship between patenting and venture capital investment. Various measures relating to patenting are considered, including whether or not a firm had a patent applied for or granted at investment date, whether a firm had multiple patents, the actual number of patent applications and patents granted as well as the number of patent families. The assumptions of the regression models are also discussed in this chapter.

Chapter 6: Conclusion

In this chapter, the research questions are addressed in the light of the research carried out amongst the early stage investor associations, the venture capitalists and using the dataset. The chapter highlights the contribution of the research to the academic field, as well as to practice. The limitations arising from the research carried out amongst venture capitalists by way of interviews, as well as those limitations arising from the construction and analysis of the new dataset are outlined. Finally, suggestions for future work in this research area are made in the final section.

Appendices

The thesis is supplemented by a number of appendices which are relevant to this research. The first six appendices relate to the interviews carried out on the field, with early stage investor associations and venture capital firms. Appendix A includes the letter and interview agenda sent to venture capital associations, requesting them to participate in an interview. Appendix B, includes the letter submitted to the venture capital firms, requesting their participation in the second set of interviews, which were carried out by means of interviewer administered questionnaires. A list of interviewee participants has been included in Appendix D. The results of these questionnaires were then coded, in SPSS as shown in Appendix E. Appendix F shows the content of an intellectual capital report which was shown to the interviewee participants during the course of the interview. The next set of appendices relates to the dataset collection and the analysis. Appendix G provides the names of the venture capital firms for which investment data was collected, and the coding of the industry sectors within the dataset. An extract from the actual dataset is included in Appendix H. Finally Appendix I considers further assumptions related to the regression analysis which were not included as part of Chapter 5.

1.6 Conclusion

Having considered the policy background as well as the context of this research, in this introductory chapter the two key research questions were identified, and the research approach was discussed. The next chapter provides a review of the literature on the subject available to date. The literature review, considers both the reporting of intangibles with specific reference to the venture capital context, and also the role of the intangibles in the investment decision, with a specific emphasis on patenting.

2.0 Literature Review

2.1 Introduction

The aim of this chapter is to provide an analytical review of the previous research carried out on the two aspects of intangible assets covered by this research. Initially, the reporting aspect of intangibles is considered from a broad perspective. After outlining the key reporting requirements in terms of legislation and accounting standards, previous academic literature on the need for increased recognition and the disclosure of intangibles in the financial statements is discussed. Specific reference is made to the reporting requirements on patenting. In the second part of this literature review the venture capital setting is introduced. The role of financial reporting and the reporting of intangibles within the venture capital field is considered. Thereafter, a discussion follows on the role of patenting in the investment decision. The literature relating to the signalling aspect, and the link between patenting and venture capital investment is also considered.

2.2 The existing accounting standard requirements (with specific reference to patenting)

Despite attempts by the International Accounting Standards Board (IASB) to improve and standardise the international reporting of intangible assets (IAS38 Intangible Assets) there remain concerns that such assets are not being clearly valued in published financial statements (Cañibano et al., 2000; OECD, 2006b; Seetharaman et al., 2002). It has long been argued that, given the rapid changes in the technological environment, a frequent review of accounting standards which are affected by technological innovation is necessary to ensure that these are consistent with today's realities (Odgers & Nimmervoll, 1988). At a European Union level, policymakers have also been arguing that entrepreneurs are not giving the necessary importance to the valuation of intellectual property, and found difficulty in applying the correct accounting treatment (European Commission, 2006a).

When considering investments in high-technology companies, venture capital investors may often have no published accounts by which to judge their potential investee companies. They are very often prior to the initial public offering (IPO) stage and may only be private limited companies with minimal financial accounts (Reid & Smith, 2008b) possibly based on the *Financial Reporting Statement for Smaller Entities (FRSSE)*¸ and which are often unaudited (Cassar, 2009).

Within an international financial reporting framework, intangible assets are considered in IAS 38. The standard specifies the identifiability criteria for an intangible asset namely that is should (i) be capable of being treated separately and capable of transfer to another party; and (ii) arise from contractual or other legal rights.

As discussed in the Introduction (see Section 1.2.3), a key focus of the research is patenting. Grube (2009) explains how IAS38 – Intangible Assets, can be applied for recognising and disclosing patents. Given that patents arise from legal rights and therefore are identifiable, they fall within the definition of intangible assets under IAS38. However, the standard states that for patents to be recognised the enterprise must expect future economic benefits, and the cost can be measured reliably. Grube (2009), explains how the future economic benefit requirement is to be based on 'reasonable and supportable' assumptions. Initially, the standard permits only measurement at cost – i.e. the cost of making the patent ready is the one which can be recognised. Under IAS 38, to be able to recognise development costs as an asset, one needs to be certain of the ability to complete the asset in terms of both the resources required and technical feasibility. Furthermore, there needs to be the intention to use or sell the patent, and the ability to show whether future economic benefits will arise as a result of the patent. Finally one needs to be able to measure reliably the various costs associated with the assets (IAS 38, para. 57). One must not assume that by showing patents at cost we are providing useless information. Wyatt (2008) argues that the cost price of the patent may serve as an indication that the company owns patents and therefore one would be able to look at patent databases and derive further information from there.

However, if the patent is obtained as a result of a company acquisition this may be recognised at fair value. Although the standard permits subsequent revaluation of intangible assets, this would require an active market for patents which is virtually not existent to date. Finally, given that a patent has a finite life, the standard requires the amortisation of the cost over its lifetime.

Although this study primarily deals with the United Kingdom, given the wide range of US literature it is worth considering the treatment under US GAAP. Under ASC 730 05-03 published by the Financial Accounting Standards Board (FASB) (2011), all research and development cost has to be expensed, and contrary to IFRS (which allows capitalisation of patents at cost, if the stringent criteria set out in IAS 38 is met) they can never be capitalised if internally generated. However, if the patent application costs are incurred after the research and development phase is completed, they can be capitalised if they fall within the normal definition of an asset i.e. probable future economic benefits are expected to arise as a result of the patent (Pricewaterhousecoopers, 2009). Nakamura (2003) explains how the reasons for the immediate expensing of R&D in the USA are intended to prevent earnings management. For example, firms are unable to capitalise certain development costs in order to prevent losses. Secondly, the expensing approach reduces risk because it is less certain that intangible assets would provide future economic benefits. Nakamura (2003) explains that the expensing of R&D could also reduce the tax liability, and therefore this approach could be seen as encouraging R&D. However, the author argues that there are other approaches which can be used, such as tax subsidies specifically on R&D, if the capitalisation approach would be adopted.

Moreover, since 2001, similar to IFRS, patents obtained as a result of company acquisition have to be recognised at fair value. These may be reported in aggregate with other intangibles (Annis & Pursel, 2010). Annis & Pursel (2010) argue that in this case the most common method to value patents in this case is the 'relief from royalty' approach, which entails looking at cash flows which would have had to be paid if the firm did not own the patent. Other methods mentioned by the same authors include discounted cash flow, and a 'profit split method'. When one of these two alternative methods is used, the relief from royalty approach is sometimes still calculated as a verification check (Annis & Pursel, 2010).

Interestingly, under US GAAP legal fees incurred in defending patent rights can be capitalised if future benefits arising from the patents are likely to increase and if the outcome of the case is successful. However, IAS 38 is more stringent in this respect, and indicates that only rarely subsequent additions are made to capitalised intangible assets (IAS 38, para 38). If the expenditure related to the patent was originally recognised as an expense, subsequent expenditure has to be recognised in the same way (IAS 38, para 42). However if the additional expenditure satisfies the criteria of development expenditure then this can be capitalised.

It is worth noting that even though an intangible may meet the recognition and disclosure criteria set in the standards, line item information on research and development is limited (Rennie, 1999; Wyatt, 2008). Separate recognition of each specific type of research and development expenditure is not a requirement, making it difficult to carry out analysis from the information available in the financial statements (Rennie, 1999). Furthermore this has resulted in some companies producing more information on research and development than others, creating differences which may lead to unfair advantages amongst firms (Wyatt, 2008). Critics of this subdivision argue that by showing the separate components of the intangible assets, one would be introducing an element of subjectivity (Wrigley, 2008).

2.3 Requirements as per Companies Act

Apart from the requirements in terms of international accounting standards, there are a number of additional requirements in the Companies Act, which are applicable only to specific companies. In accordance with the Companies Act (2006) small companies[2], are only obliged to file a balance sheet with Companies House. The companies which file abbreviated accounts can either prepare financial statements using full UK GAAP or using the Financial Reporting Standard for Smaller Entities (FRSSE). Under UK GAAP, development costs may still be expensed and 'in practice, most companies write off research and development costs rather than attempt to justify capitalising and development expenditure' (Pricewaterhousecoopers, 2011, p. 15026). Furthermore under the FRSSE, companies are not required to disclose the amount of research and development charged to the income statement (Pricewaterhousecoopers, 2011).

In relation to this requirement, Kitching, Kašperová, Blackburn, & Collis (2011), have attempted to identify the users' perspective on the filing of abbreviated accounts. In a series of interviews made by the authors, the users have argued that removing this exemption and requiring companies to file the full accounts would be more beneficial. On the other hand, the preparers of financial statements had concerns about the confidentiality issues related to the filing of full accounts. Some users not only questioned the usefulness of abbreviated accounts, but expressed concerns that not even the full accounts would be useful in today's world. One key issue relating to this study is that venture capitalists were not interviewed, despite the fact that a wide range of users, including banks, were contacted.

It is also important to note that venture capitalist in the United Kingdom do not only invest in companies which file abridged financial statements at Companies House.

[2] The qualifying conditions for small companies specified in article 236(2) of the Companies Act (2006) require companies to meet two of the following criteria: (1) a turnover of not more than £5.6 million, (2) a balance sheet total of not more than £2.8 million (3) not more than fifty employees

Some of the later stage investments in which venture capitalists invest may involve high-tech companies which are quoted on the Alternative Investment Market (AIM). Rule 19 of the London Stock Exchange AIM Rules for Companies published by the London Stock Exchange requires compliance with all the International Accounting Standards if the company is a parent company registered in an EU member state.

If the company does not qualify as a small company, section 417(5) of the Companies Act (2006) requires the company to prepare a business review as part of the directors' report. Factors which affect the future performance and development of the business should be included. In this respect, section 417(6) of Companies Act (2006) requires the use of financial and non-financial key performance indicators. However, discretion is left up to the preparers of the financial statements as to which indicators will be most useful. In view of this requirement, although the relevant standard – 'Operating and Financial Review' has been repealed, the Accounting Council (formerly Accounting Standards Board) recommends the use of the 'Reporting Statement on the Operating Financial Review' (Accounting Standards Board, 2006). This statement suggests that resources owned by the company should be described even though they are not mentioned in the balance sheet (examples cited include licences, patents and trademarks). This may not necessarily include quantifiable data.

2.4 Recognition of intangible assets in financial statements

Having considered the background related to the existing reporting requirements, it is worth considering the case for additional disclosure and recognition requirements in the financial statements. Over the years, academics and policymakers have been advancing the idea that intangible assets have taken a more important role (Cañibano et al., 2000; García-Ayuso, 2003; Low, 2000; OECD, 2006b; Seetharaman et al., 2002; Wilkins et al., 1997). It has been argued that the amount of intangible assets in an organisation has increased substantially. The idea that many intangibles (which would potentially lead to future cash flows) were not being recognised or disclosed within financial statements, has led to increased criticism on the relevance of financial statements (Francis & Schipper, 1999). The key argument is that, as a consequence of the so called ‘New Economy’, the relevance of financial statements has declined (Cañibano et al., 2000; Eccles, Herz, Keegan, & Phillips, 2001; Edvinsson & Malone, 1997; García-Ayuso, 2003; Maines et al., 2003; Rennie, 1999).

One of the problems is that intangible assets lead to rapid changes in business performance. As Leadbeater (1999) explains, these rapid changes which occur make it increasingly difficult to match revenues with expenses, suggesting a decline in the relevance of traditional accounting based on specific accounting periods. According to the author, continuous accounting, based on a series of announcements which would not only include financial information, would be more relevant. Evidence of same is a study which was carried out in 1999 by Pricewaterhousecoopers amongst investors in fourteen countries. The results, were surprising – only 19% of investors believed that financial statements were useful (Eccles et al., 2001). Edvinsson & Malone (1997) compared the financial statements and other published documents of a company to a tree with branches and leaves. Metaphorically the authors argue that the intellectual capital of a firm is its roots as, although not visible, they are more useful in assessing a company’s future than by looking at the tree itself. Therefore, having stated this, it is difficult to ignore the issues relating to the valuation of intangibles if the future of a company is dependent upon them. In fact, the tree metaphor mentioned above was later on adapted by the European Union in the RICARDIS Report (European Commission, 2006b).

From a practitioner’s standpoint, The European Federation of Financial Analysts Societies (EFAS) (2008) and Leadbeater (1999) also argued that accounting has not evolved to reflect the changes in today’s world. The association argues that the ever increasing importance of intangibles has been ignored. Although the association makes a case for more disclosure, analysts tend to gain from the lack of adequate disclosure. Financial analysts have a greater role in the analysis of high technological companies. This is due to the judgement required in making predictions, taking into consideration the intangibles owned by technological firms (Barron, Byard, Kile, & Riedl, 2002). Holland (2004) showed how sometimes analysts base their forecasts on the credibility of management, and do not take into consideration the links between the intangible assets and the financial effects of same. Undervalued shares as result of uncertain information relating to intangibles give analysts the opportunity to obtain greater commissions (Barth, Kasznik, & McNichols, 2001). However, Barth et al. (2001) show how a greater effort is needed to analyse firms which own intangibles. Although the regressions used in Barth et al.'s (2001) study show a significant explanatory power, the study is based on a series of assumptions and proxies for intangibles and analysts' effort. The paper does not indicate that any direct contact was made with analysts to provide further insights on their views on the financial reporting, and analysis of intangibles owned by the firms. It is also worth considering that concerns have been raised about analysts filling the gap of information not contained in financial statements. Furthermore, critics argue that overvaluation of shares has arisen as a result of unethical optimistic earnings forecasts by analysts and auditors, which are unverifiable given that information on intangibles is not publicly available (García-Ayuso, 2003; Leadbeater, 1999).

At a European institutional level, the RICARDIS Report by the European Commission (2006b) outlined that the financial statements are useful in assessing historic information. However, the performance of a business cannot only be judged on historic information which provides minimal information on intangibles. In fact, the lack of information on intangibles leads to greater analyst forecast errors (Barron et al., 2002; Gu & Wang, 2005), especially when analysing companies in the technological sectors (Gu & Wang, 2005). In view of the asymmetric information which arises as a result of the non-disclosure of research and development, it is argued that insider dealing is more significant in companies which are considered to be research and development intensive (Aboody & Lev, 2000; Leadbeater, 1999). For example, it has been argued that due to the lack of information on intangibles in the financial statements, researchers within the organisation are more likely to benefit from unpublished information on intangibles than potential outside investors (Leadbeater, 1999).

From an accounting standard setter perspective, the case for recognition of intangibles in the financial statements was even subject to a discussion both at the American standard setter – the Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB). In a study commissioned by the FASB, it was argued that, although some authors have claimed that the relevance of financial statements has declined, academics have provided mixed conclusions on the matter (Maines et al., 2003). It has been stated that the differences in studies which seek to determine whether financial statements are value relevant to investors are possibly a result of the different methodologies used (Skinner, 2008a). Indeed, although the need to review the accounting standards on intangibles has been recognised, the joint discussions relating to a project on intangible assets by the FASB and IASB have now been put on hold. In May 2007, the IASB cited lack of resources as the key constraint in carrying out such a project. In the latest update on the topic (May 2012), the IASB indicated its intention to undertake a research programme which amongst other aspects considered research and development as well as intangible assets (International Accounting Standards Board, 2012b).

Although a significant amount of literature promoted the idea that intangibles have become increasingly important in today's world, Basu & Waymire (2008) and Upton (2003) criticise this argument and indicate that intangibles were always present and are not a new concept. Basu & Waymire (2008) are critical of any changes which are made to accounting standards as a result of the presumption of increased importance of intangibles, citing the notion that intangibles are reflected in the income statement, and hence there is no need to reflect these in the balance sheet, and also that the present standards have stood the test of time. Having stated this, in their thought provoking paper, the authors recognise that there has been an increase in the number of accounting intangibles (which they define as being the intangibles arising from legal rights – such as patents and trademarks). Basu & Waymire (2008) argue that whilst the number has increased, it is questionable whether the actual value of these accounting intangibles has increased. The authors explain that, in their opinion, the difference between market and book values are not due to the increase in accounting intangibles, but are attributable to changes in the economic environment such as a deregulation. Similarly, Skinner (2008b) has been critical of the fact that the so-called traditional industries have declined in importance, and argues that these are still of great significance in countries like China. Moreover, although Francis and Schipper (1999) argue that financial statements are less relevant for high technological companies than for other types of companies, the rate of relevance of financial statements for this type of firms declined only marginally. Therefore, according to Francis and Schipper (1999), one could not attribute any loss of relevance in financial statements to the increased role of high technological firms in the global economy.

As one can see, there has been significant disagreement amongst academics on the increasing role of intangible and the loss of relevance of financial statements. As Upton (2003) argues, although this issue of increased importance is questioned, what matters most is how financial statements can be made more relevant to the users. In order to achieve this there is the need for more research directly involving the users of financial statements. Young (2006) explains how concerns on the loss of relevance of financial reporting are often not connected to evidence provided by the users of financial statements.

2.5 Showing intangibles not presently recognised on the balance sheet

It has been argued that the income statement is used for valuations of companies and not the statement of financial position (balance sheet) (Basu & Waymire, 2008; Elwin, 2008; Skinner, 2008a; Wrigley, 2008). This is confirmed also in the study of Roberts & Barley, (2004) – whereby none of the venture capitalists interviewed mentioned that they make use of the balance sheet. The venture capitalists appeared to be more concerned about profit margins, and the accuracy of the financial statements. Therefore, according to these academics, by modifying the accounting standards to recognise more intangible assets in the balance sheet one would not achieve any benefits. As Basu & Waymire (2008), explain this idea is not something new – B. Graham and Meredith (1937) had argued that balance sheet valuations of intangible assets were not to be taken into consideration. Their argument was that what matters are the earnings that are generated as a result of the intangibles but not the value of the intangibles themselves. Some analysts argue that, by incorporating figures related to the intangibles in the balance sheet, one would be increasing the amount of useless information for investors. This is based on the notion that if forecasts are done solely on the basis of the balance sheet, the analysts would be making use of outdated information given that balance sheet shows the position of the company as at year end (Elwin, 2008).

On the other hand, Lev (2008) states that given the nature of the income statement, by expensing research and development, the asset values and profits of R & D intensive firms were being understated. By omitting values from the balance sheet, we are understating the amounts shown in the income statement. Interestingly, in a reply by Skinner (2008b) to Lev (2008)'s rejoinder, Skinner (2008b) seems to completely ignore this argument, and replies to other issues outlined by Lev (2008) instead. In his criticism, Lev (2008) appears to be ignoring the fact that adjustments are also done by analysts to the earnings figure shown in the income statement. Financial analysts concentrate on 'core earnings', which are earnings related to recurring activities. In view of the uncertain nature of expenses related to intangibles, more often than not analysts do not classify these expenses as being part of the core earnings (Barron et al., 2002). However, as Barron et al (2002) state, one of the problems which the analysts have is that the calculation of the core earnings figure involves subjectivity. Concern however remains on how, according to Barron, et al (2002), analysts prefer to eliminate intangible related expenses from their calculations when these are likely to lead to future growth and profitable opportunities.

In an earlier article, Lev (2003) had suggested that rather than adjusting the existing balance sheet, a comprehensive balance sheet should be provided. This would provide additional information to the balance sheet, similar to the comprehensive income statement. From this new statement investors would be able to infer the value of the company with and without capitalised intangibles. Previously, Rennie (1999) had suggested the use of a new financial statement showing potential knowledge assets. Similar to Lev's (2003) suggestion, these additions to the existing financial statements have never been implemented.

2.6 Introducing new reports: Intellectual capital reports

Apart from the above suggestions by Lev (2003) and Rennie (1999), there is a wide range of literature on intellectual capital reports, particularly in Germany and Scandinavia. One of the earliest intellectual reports was published by Skandia AFS, in 1995 (Edvinsson & Malone, 1997). Subsequently, in 2000, the Danish Ministry of Trade and Industry published the first guidelines for the preparation of Intellectual Capital Statements. A revised version was published in 2003, together with another guide detailing how to analyse intellectual capital statements. Despite this, intellectual capital reports were never part of the Danish legislation and in fact, the Danish Financial Statements Act simply requires a description of intellectual capital resources in the managements review (Denmark Parliament, 2001). In 2006, the European Union, having recognised the increasing importance of intellectual capital, produced the RICARDIS Report, which outlines the ever increasing importance of intellectual capital and the need for the SMEs to report such capital to the users of the financial statements. Finally it also makes a case for the need to standardise such reports (European Commission, 2006b). The reports are complementary and do not substitute existing financial statements. Besides being complementary to external financial reporting, they are also complementary to management accounting – particularly when it comes to organisational strategy and resource allocation. The intellectual capital statements usually do not provide only a narrative description of intellectual capital within the organisation, but also include visualisations and can include quantitative data (European Commission, 2006b). Alwert, Bornemann, & Will (2009) argue that for intellectual capital reports to be useful to practitioners, they have to include quantitative data.

In Germany, Von Colbe et al. (2005) provided a proposal for the contents of an intellectual capital statement, consisting of seven categories of intellectual capital (innovation capital, human capital, customer capital, supplier capital, process capital and location capital). These categories were subsequently included as part of the German domestic accounting standards, which suggest that information on intellectual capital (under the various subdivisions discussed above), should be included in the financial statements within a management commentary. It is worth noting that this standard applies to all companies in Germany, irrespective as to whether they are listed or not. However the disclosure of intellectual capital is not mandatory by the standard (Von Colbe et al., 2005).

Initially the interest in the intellectual capital report of Skandia AFS (mentioned above) was significant - with over five hundred companies contacting Skandia and requesting more information on the report (Edvinsson & Malone, 1997). Nonetheless, the publication of such statements is very limited (Bukh, 2003; Mouritsen, Johansen, Larsen, & Bukh, 2001), particularly in countries outside Scandinavia. Furthermore, even though Alwert et al. (2009) in a study carried out with German practitioners, explained the ever increasing relevance of intellectual capital reporting, particularly when it comes to the assessment of creditworthiness (indicated by the practitioners themselves), the practical impact of the inclusion of voluntary intellectual capital reporting requirements in German legislation does not appear to have had a practical impact on increased disclosure. Mouritsen (2003) attributes this ambivalence towards intellectual capital reports to difficulties associated with education. He argues that traditionally analysts would be trained and know how to read balance sheets, but when it comes to looking at reports dealing with intangibles, they may encounter difficulties in interpreting same. For example, Johanson (2003) argues that investors are uncertain on whether the key indicators within the reports are reliable.

One must point out that if the publication of such reports is not popular with large firms, small firms which are targeted by venture capitalists are less likely to be willing to produce intellectual capital reports themselves. Furthermore, it is also questionable whether investors would find the information contained in the reports useful for their analysis. In fact, in a study conducted amongst US investors, it has been argued that the information contained within the reports is already made available to investors during the due diligence stage, and therefore there is little scope for producing such reports (OECD, 2006b).

2.7 The case for additional disclosure

Instead of showing intangibles on the face of the balance sheet or introducing new reports as outlined in the discussion in the previous section, several academics and practitioners have made the case for additional disclosure (Aboody & Lev, 2000; Leadbeater, 1999; Skinner, 2008a). Beattie & Thomson (2010), have pointed out that 76% of the finance managers interviewed believed that if additional disclosure led to an improvement to the perception of users on the financial statements, then additional notes to the financial statements should be provided.

Despite being sceptical about the need to modify the accounting standards relating to intangibles, Skinner (2008a) argues that if there was a case for increased disclosure, such disclosure should be voluntary, especially when considering that the importance and types of intangibles is not uniform across industries. In view of the differences and the costs of additional disclosure, Stark (2008) argues that rather than indicating specific disclosures, a framework for disclosures should be made. However, Stark (2008) himself is sceptical about such a framework, given that a number of guidelines on disclosure of information are already made available by the

Financial Services Authority (FSA) and various industry bodies. Any further guidance provided should be of an incremental nature (Stark, 2008).

Several arguments are also made against the case for additional disclosure on intangibles. Maines et al. (2003) argue that the benefit of additional disclosure of intangible assets is uncertain and therefore further studies have to be carried out. For example, a study on patent non-financial data by Hirschey, Richardson, & Scholz (2001) has demonstrated that, although this data is relevant for users, it is already reflected in the market values, implying that investors might be making use of information from other sources and not simply the financial statements. However, in this respect Deng, Lev, & Narin (1999) argue that although the information is available it is not being immediately reflected in the stock prices. The authors stated information on patent attributes are rarely considered in the initial investment decision. This view also reflects the opinion of the OECD, which found that information is obtained from other sources and already included in valuations (OECD, 2006b). Hirschey et al. (2001) argue that, until the alternative sources of information patent data remain publicly available, there is no need for further disclosure. Similarly, Gu & Li (2003), provide evidence that when a company is heavily involved in research and development, more media disclosure is already being provided (through news reports) and therefore this acts as a substitute for additional disclosure in the financial statements. It is questionable however whether this should be acceptable, given the subjectivity of news reports. Unlike financial statements these are not subject to any form of auditing. Moreover, in contrast to the study by Gu & Li (2003), Striukova, Unerman, & Guthrie (2008), in their analysis of publicly available disclosures have shown how traditional intellectual capital intensive industries were not producing more disclosure on intellectual capital than other industries. This could be possibly explained by the results of a study by Williams (2001), who found evidence that the more valuable the intellectual capital, the less the amount of information disclosed at a particular threshold point. This is possibly due to fear of competition from new firms entering the market and reducing the competitive advantage that particular firms have.

Both the papers of Gu & Li (2003) and of Hirschey (2001) could imply that, although investors do have information about the firm's value, the fact that they are resorting to other information rather than the financial statements themselves is a signal that the financial statements are simply not disclosing enough information for investors. Perhaps, it is as a result of this that information is being sought in alternative sources. However, one should be careful when suggesting that additional disclosure should be provided, in the light of incidents where additional disclosure was misleading and fraudulent in the UK biotech industry (Stark, 2008).

2.8 Venture capital and financial accounting information

After considering various aspects related to the presentation, disclosure and recognition of intangible assets in financial statements in a general perspective, the next section focuses more on the relevance of financial statements and intangible asset reporting for venture capitalists. However, the literature related specifically to accounting in a venture capital setting is somewhat limited. More specifically, the literature does not deal with the reporting of intangible assets by venture capital investee companies. After considering the reporting aspect within the venture capital setting, intangibles *per se* are considered. The study focuses on one type of intangibles, which is relevant to high technology investments, namely patenting. Specific reference is made to patenting and the investment decision. Reference is also made to patenting as a signal to the venture capitalist and to problems associated with such signalling.

Academics have stated that, given the uncertainty associated with new venture technological start-ups, there would be greater demand for accounting information (Cassar, 2009). Cassar (2009) shows how there is a positive relationship between the frequency of preparation of financial statements and external funding. However, when looking at separate financial statements, the author does not find any relationship between the frequency of preparation of the balance sheet and external funding. The frequency of preparation of cash flow statement appears to be the only historical financial statement which is positively related to the amount of intangible assets held. On the other hand, Cassar (2009) shows a significant relationship between intangible investments and forecasts, suggesting that prospective financial information is more relevant for the tech start-up companies given the significant amount of intangible assets which they would typically have.

Hand (2005a) explains that although technological companies have different characteristics, financial statements are still expected to be value relevant to technological investors. Under US GAAP, similar to IFRS, financial statements should be useful (FASB 2010, para OB2, IASB 2011a, para OB2) for all investors regardless of the environment in which the firm operates. The IASB Conceptual Framework for Financial Reporting, states that financial information affects the decisions of investors if it has a predictive value, confirmatory value or both (IASB 2011a QC7). The present recognition requirements of intangible assets are aimed at ensuring the reliability of the financial statement. However, Barron et al. (2002) outline that reliability is being obtained at a loss of the predictive value attributable to financial statements. It is important to note that both the conceptual framework of the IASB and FASB indicate that the financial statements may not be sufficient for investors and other sources of information might need to be used. (FASB 2010, para OB6, IASB 2011a OB6). Rather than showing the actual value of the company, the financial statements are only meant to assist in the estimation of such (FASB 2010, para OB7, IASB 2011a OB7).

In this respect, in a publication on the reporting of information on intellectual capital, the CIMA (2003, p. 26) stated that 'financial statements should only be seen as a part of a jigsaw of how companies assess and communicate value'. For example, the European Commission (2006b), in the RICARDIS Report, argued that intellectual capital statements (see Section 2.6) could also be useful for venture capitalists in assessing and understanding further profitable opportunities. However, the problem is that these new companies often do not publish full financial accounts, so it remains questionable as to how willing they will be in publishing additional information.

Hand's (2005a) evidence shows that the financial statements of start-up firms are not as relevant as those of public companies. Non-financial information such as the patent scope, and the age of the firm, appear to be more value relevant in the case of the firms in which venture capital was invested. Hand's (2005a) research outlines how in the case of listed firms, the non-financial information is highly irrelevant. Another conclusion which can be drawn from the same study is that the relevance of financial information increases as the firm matures. On the other hand, the non-financial information becomes less relevant as the firm progresses. Hence, according to Hand (2005a), the non-financial information acts merely as substitute for the financial information when the latter is not available. The results of Hand's (2005a) study highlight how, during the first round of financing, the financial statements are value irrelevant. This is in line with classical finance theory which states that the value of the company would be equivalent to the present value of growth opportunities given that firms would not have any assets in place except for human capital (Miloud, Aspelund, & Cabrol, 2012).

Armstrong, Davila, & Foster (2006) have followed up the study by Hand (2005a) in analysing the usefulness of financial statements for venture capitalists. In contrast to Hand's (2005a) study, Armstrong et al. (2006) carried out the study across diverse industries (not just the biotech industry). The authors show how financial statements are important when it comes to the pricing of equities of early stage companies. The authors argue that the cost items in the income statement are an important aspect to the venture capitalist because the cost of sales, selling general and administrative expenses, and research and development costs of start-ups are viewed as investments which lead to increases in future revenues. A relationship between the market value of the firm, and two balance sheet figures (cash, and non-cash variables), as well as between the market value and the non-financial variables – (firm age, number of financing rounds, and number of patents) was identified. Of concern however, is that the studies by Hand (2005a), Armstrong et al.(2006) and Cassar (2009) are based on US law, US accounting standards and the US venture capital market, which are significantly different from the UK equivalents.

According to the literature discussed above, it appears that financial statements might not be entirely useful for the venture capital investor. The next section outlines other aspects that venture capitalists consider prior to investing. Wilkins et al. (1997) indicate that initially what matters is the founders' knowledge and experience. However, as the firm matures, financial information becomes more important. Rather than asserting that there is an emphasis on financial statements, the author argues that there is an emphasis on the human capital aspect. Besides this human capital aspect, venture capitalists also consider the type of industry, the amount of investment needed, the technology that the company possesses, business plans and also direct/indirect social ties (Shane & Cable, 2002). It is important to point out that as Knockaert, Clarysse, & Wright (2010) outlined European venture capitalists are not heterogeneous in their investments. Whilst some venture capitalists are concerned about strong financial prospect, others would tend to focus on a strong proprietary regime prior to investing, or on the human capital aspect. It is not uncommon that only one of the three aspects outlined is taken into consideration.

Interestingly, Shane & Cable (2002) argue that any estimates made in the business plans provided by the entrepreneurs do not affect the the investor's decisions. Similarly, Reid & Smith (2005) argue that investors are sceptical about the usefulness of financial statements (as published by the firm) and prefer making their own assessments. In practice, an example of this can be seen in the case of intangible assets. A guide published for business angel investors (i.e. aimed at the informal venture capitalists, see Section 1.2.1) which details relevant questions to be asked at the due diligence stage with respect to intellectual property, does not advise the angel investor to enquire directly on the value of the intellectual assets. Instead, the guide outlines a series of questions which will potentially lead the investor to assess how valuable the intellectual property is indirectly e.g. the geographical scope, and any pending litigation (British Business Angels Association, 2009).

The results of the study by Reid & Smith (2005) were in line with earlier studies carried out in the United States and Canada by Pricewaterhousecoopers in the late

1990s. Surprisingly, these studies had found that only seven per cent of investors in high tech companies perceived financial statements to be useful (Eccles et al., 2001). It is also in line with an earlier study by Sweeting (1991), who had found that the financial statements provided with the business plans were considered to be of secondary importance to venture capitalists.

Reid & Smith (2005) argue that, for the investors, their own due diligence appears to be sufficient. Nonetheless, some of the respondents of an earlier survey by Wright and Robbie (1996) had indicated that although they carry out their own market evaluation, they still have their own independent accountant's report. Usually early stage investors are less likely to seek advice from accountants than those investing in later stages, reflecting the relative importance of the financial statements to the investor (Fried & Hisrich, 1994). This view is also confirmed by Wright and Robbie (1996), who argued that accounting reports tend to be used by later stage investors who are usually involved in buyouts. However, Wright and Robbie (1996), argue that in the detailed due diligence stage, after the screen process, detailed accounting information is analysed although this is at times unpublished. In their study amongst UK venture capitalists, the authors find out that unaudited financial statements of the previous year prior to the investment are given considerable importance by the venture capitalist when it comes to evaluating potential investments. The venture capitalists also appeared to make some use of the audit report where financial statements were audited, although its influence appeared to be much less than that of the prior year unaudited financial statements (Wright & Robbie, 1996). However, one must state that a limited amount of performance history is available, which means that the venture capitalist cannot rely on past performance data, unlike in the case of companies which are listed on the Stock Exchange (Tyebjee & Bruno, 1984).

Reid & Smith (2005) also point out that UK investors are also not enthusiastic about increasing the legal disclosure requirements in order to include more information in the financial statements. The investors believe that the decision on whether to invest in a particular company should be made on the basis of the due diligence process and not on the published accounting information. In a subsequent study, Reid & Smith (2008b) identified mixed views on the relevance of the financial statements. Whereas some investors argued that the financial statements were useless for their purposes, some entrepreneurs pointed out that the financial statements were very useful not only for themselves but also for the investors. Some pointed out that the useful figures include the earnings before interest and tax (EBIT) shown in the income statement and those related to projected income growth. Once again, they questioned the R&D figures included in the income statement. This is also in line with the earlier study by Sweeting (1991), which had pointed out that the financial figures are not completely ignored, but it was more a matter of verifying whether the figures provided were credible. Given the legal requirements (see Section 2.3) it could be the case that the income statement is not published – and therefore there appears to be no publicly available source where this financial information can be obtained. This would force investors to rely on information provided by the entrepreneur himself in the due diligence stage.

After considering the reporting aspect, the next section will discuss the role and importance of patenting for the venture capitalist in more depth.

2.9 Patenting as a signal for venture capitalists

Start-ups firms face the problem of the 'liability of newness', i.e. start-up firms are more likely to fail than established companies (Stinchombe, 1965). When investing, venture capitalists are attempting to overcome this problem, because ultimately their aim is to select investments which are likely to lead to financial gain (Pearce & Barnes, 2006).

In the case of start-up firms, it has been claimed that venture capitalist investors make use of signals that give an indication of the companies' future (Armstrong et al., 2006; J. A. C. Baum & Silverman, 2004). The concept of signalling stems from the work of Spence (1973) on job market signalling, which can also be applied in the case of start-ups. As Fontana, Geuna, and Matt (2006, p. 312) explain, signalling is 'the activity carried out by firms aimed at voluntarily disclosing knowledge to less informed economic agents, to convince them of their firms' specific attributes'.

As discussed in the previous section, financial statements may not always be useful for venture capitalists. This can be attributed to the problems identified in previous sections, namely the difficulties associated with start-ups not having tangible assets and significant income. Furthermore, there are problems associated with the measurement of intangible assets (Ribeiro & Tironi, 2006).

One of the possible signals of a future profitable opportunity can be patent ownership (Conti, Thursby, & Rothaermel, 2011; Haeussler et al., 2009; Hsu & Ziedonis, 2007; Lemley, 2000b; Long, 2002; Nadeau, 2010). Some contend that venture capitalists also use patents as evidence of entrepreneurial ability (Lemley, 2000a; Sichelman & Graham, 2010), because by patenting they have 'defined and carved out a market niche' (Lemley, 2000a, p. 1506). Moreover, Sichelman and Graham (2010) argue that patents may also serve as a proxy for resources within the start-up firm which may not be easily quantified.

The importance of patents in the venture capital setting is not a new concept. General Georges Doriot, who is considered by many as the father of venture capital, had strict criteria for investments by his venture capital firm, ARD, which was founded in 1946. He argued that investment should only be made if 'projects are protected though patents or specialised knowledge and techniques' (Ante, 2008, p. 112).

The notion that patents can serve as a signal for the investor was substantiated by Hand (2005b), who showed a relationship between increases in revenues and increases in the number of patents in the healthcare and IT industries (i.e. where patents are traditionally predominant). More recently, Helmers and Rogers (2011) showed that start-ups with patents registered higher asset growth figures in subsequent years than those without. Furthermore, Cao and Hsu (2011) through the use of the capital asset pricing model and the model developed by Fama and French (1993), show how patenting is an important patent signal which reduces information asymmetry for venture capitalists. In fact, the authors show how when there is an increase in the standard deviation of residual volatility, the number of patents held by start-ups increases.

Moreover, the ability to patent is seen by the venture capitalist as a potential signal of future survival (Helmers & Rogers, 2011). This can be seen particularly in the biotechnology industry where the chances of survival are much smaller if one does not own new innovative products (J. A. C. Baum & Silverman, 2004). Despite the criticisms associated with patenting, investors are often unwilling to invest in the biotech sector unless there is IP protection (Jackson, 2003). One of the reasons for this is that patents provide significant information, which is not available in alternative sources, cheaply to outsiders (Long, 2002). Given the number of start-up failures, and the adverse selection associated with early stage investments, the legal protection afforded by patents is seen as a quality signal for potential investors (Nadeau, 2010).

In this respect, Long (2002) explains that the fact that patents are costly is a signal within itself, because a firm is not expected to undertake costly procedures for no reason. In fact, as discussed later on in more detail in Section 2.10, S. Graham, Merges, Samuelson, and Sichelman (2010) cite costs as the major reason for which certain technological firms do not patent. Furthermore, if there are inaccuracies related to the patent, the firm will have to bear significant litigation costs. Firms may not only lose the patent, but it is also a criminal offence to provide grossly misleading information in patent documents (Long, 2002).

It is also argued that by having patents, firms are demonstrating credibility to investors who may have limited time at their disposal to analyse the firm at the due diligence stage (Sichelman & Graham, 2010). A patent is a legal document, whereas a simple press release indicating an invention has no legal enforcement (Long, 2002). One further reason why patenting is seen as important for the firm is that knowledge which could have been lost when key employees leave the company is being safeguarded (S. Graham & Sichelman, 2008). Given the various reasons outlined above, patents act as quality signals for even the most experienced investors. In this respect, Hsu and Ziedonis (2007) have shown that by having more patents, the chances of obtaining funding from reputable investors increase.

Several studies have been carried out to verify whether the number of patents is a measure which attracts financing. Most of the studies, with the exception of a number of studies carried out amongst European firms (particularly Germany), are based on US firms. Haeussler et al. (2009) in a study carried out amongst German and UK biotechnological companies, found that firms which have one patent application are able to obtain venture capital funding significantly faster than companies which do not have any patent applications. Furthermore, according to the authors, the chance of obtaining funding if a firm holds patent applications is considerably higher.

In another study carried out amongst German firms, Engel and Keilbach (2007) revealed that when founded, venture capital backed firms are more likely to have a patent application than those which are not venture capital backed. Initially, the authors do not argue in depth as to the merits of why the difference arises in the venture capital backed firms, but merely argue that the reason why the company was founded was because it actually owned a patent. In the concluding remarks, however, the authors hint at a possible reason for the differences – namely that the venture capitalists are able to screen better profitable opportunities, although no supporting evidence is provided. This is also stated in the light of the fact that the venture capital funded firms in the sample were proven to be more successful. Similar findings related to the performance of the venture-capital backed companies were also identified by Hsu and Ziedonis (2007) and Cao and Hsu (2011) who indicated that companies which have a larger number of patents also appear to have a greater rate of successful exit by means of an IPO. The relationship identified by Engel and Keilbach (2007) was also confirmed by Schertler (2007) who identified a significantly positive relationship between the number of early stage venture capital investments and patenting amongst the members of the EVCA i.e. across European countries.

An important distinction must be made between patents applied for, and patents granted. Haeussler et al. (2009) and Cockburn & MacGarvie (2009), do not report an increasing in venture capital financing for companies with patents granted (as opposed to patent applications). This might be due to the fact that an investor would have thoroughly reviewed the patent application prior to investing in the firm (Haeussler et al., 2009), and, due to the fact that they might be concentrating more on the future of the firm (Cockburn & MacGarvie, 2009). These studies contrast with the study of J. A. C. Baum and Silverman (2004) on biotech start-ups, which illustrated evidence of an increase in venture capital funding as both a result of the number of patents granted and also the number of patents applied for. Moreover, a study by S. Graham et al. (2010) carried out across technological industries in the United States, identified a two way relationship between the holding of patents and the provision of venture capital. On one side, the venture capitalist is seen as unwilling to provide funding if the firm has no patents. On the investee company's side, the entrepreneur is seen as engaging in patenting activity prior to obtaining funding.

Whereas some studies highlighted the positive emphasis venture capitalists give to patents when it comes choosing which company to invest in (S. Graham et al., 2010), others argued that there was a significant number of venture capitalists who claimed a negative relationship between patenting and their investment decisions (Knockaert, Huyghe, & Clarysse, 2014). Interviews carried out amongst entrepreneurs provided mixed views as to the importance they gave to obtaining patents in securing financing, possibly implying that without patents, firms can still obtain financing on the basis of other selection criteria (S. Graham et al., 2010). S. Graham et al. (2010) also explain that the entrepreneurs stated that patenting is not only seen as important by the venture capital investor, but also by other types of investors – namely commercial banks, family and friends.

Whilst acknowledging that patents may increase the likelihood of obtaining funding, Mann & Sager (2007) find no evidence of this in the software industry, which shows that patenting prior to financing is related to performance and argues that only a small portion of the firms under study had patents prior to financing. However, one must not assume that these studies are entirely contradictory to the study by Hsu & Ziedonis (2007). Similarly, in another study amongst German investee companies, Hoenig and Henkel (2012) also contend that patents are not a signal of start-up firms' technological quality for venture capitalists. However, their study does not conclude whether patents can be signals of other aspects, such as entrepreneurial ability (cf. Lemley, 2000a). Whilst Mann & Sager's (2007) study is based on the software industry in the United States, the study of Hsu & Ziedonis (2007) is based on the semiconductor industry in the United States. This difference between industries was confirmed, by S. Graham et al. (2010) and Sichelman and Graham (2010) which outline that software start-ups are less likely to hold patents but on the other hand, start-ups biotech and hardware companies hold more patents. Sichelman and Graham (2010) argue that in the case of software and internet companies, the competitive advantage arising from patents is much lower. In fact, most respondents to their survey in these industries rated the role of patents in preventing other firms to copy their product much lower than firms in other industry subsectors.

Furthermore, a study by Munari & Toschi (2014) based on venture capital in the nanotech industry sheds more light on the possible reasons for the differences between the studies outlined above. The authors confirmed that the simple number of patents does not make a difference for initial financing, however, the number of patents classified by the patent office as being related to the nanotech industry does affect the investment decision of the venture capitalist.

One problem associated with the studies outlined above is that the majority of the studies did not involve any interviews or contact with the actual investors, and made use only of figures identified from venture capital and patent databases. In one of the few interview based studies carried out, Roberts & Barley (2004) conducted four interviews with Silicon Valley venture capitalists, which have pointed out different views on patents. There was consensus amongst the respondents that, although if patents are in place the firm would benefit, especially in terms of blocking competition they are not critical to the investment decision. Although the results of such a study cannot be generalised, it casts doubt as to the relative importance of patenting as a signal for the investor and as to whether it is applicable to other markets such as the United Kingdom.

2.10 Problems associated with the use of patents as a signal for venture capitalists

As discussed in the preceding section, the literature seems to indicate that investors use patents as a signal of profitable information when financial information is lacking. However, using simple number counts as a measure of innovation is not without its problems. Verifying the validity of patents is a different matter from simply verifying the number of patent applications (Long, 2002). In particularly large companies, investors may incur the costs of having to hire specialists or provide training to its employees in order to be able verify whether the patents are legally valid. Third party experts benefit from economies of scale, and therefore might provide a better and more cost effective service than providing training to staff (Long, 2002).

To assist in eliminating these costs, government / EU assisted funding may be available, and investors would be refunded for legal and expert opinions they obtain on the intellectual property (Mason & Harrison, 2004b). Given the valuation risk associated with intangibles (Mason & Harrison, 2004a), patents are seen as possibly increasing rather than diminishing asymmetric information (Knockaert et al., 2014).

It could however be the case that companies are making use of patents as a signal of profitability, because they do not have sufficient resources and time to perform full valuations of companies at the due diligence stage (S. Graham & Sichelman, 2008). Furthermore, the signalling effect, may not be entirely applicable to all industries (Ribeiro & Tironi, 2006). It is argued that patents may have a negative effect in specific industries, for example Cockburn & MacGarvie (2009) found that software firms operating in an environment where patents were restricting entry are not likely to obtain start-up venture capital financing. The authors attribute this to the additional costs of licensing which would be required, and to the fact that uncertainty related to patents may be higher in environments where patenting appears to be restricting innovation.

Moreover, although patenting might be an important signal, some authors contend that the importance of this intangible asset has been overstated in literature and that the importance of prototypes as a signal for investors has been overlooked (Audretsch, Bönte, & Mahagaonkar, 2012). According to Audretsch et al. (2012) a company which has both patents and prototypes is more likely to obtain financing from business angels and entrepreneurs. Audretsch et al. (2012) show how firms with prototypes but no patents are more likely to obtain funding then firms with patents but no prototypes, implying that perhaps the case for prototypes has been understated. Despite this, the authors themselves question the fact that this may not be applicable to all industries. Prototypes may be more a more important signal than patents in one industry, however they may be less relevant in other industries.

In this context, another issue worth considering is that the venture capitalist is often evaluating patents applied for rather than patents granted. This implies that the appropriate verifications by the experts at the relevant patent offices would have not been carried out as yet. There is also the issue that the number of patents is only a crude measure. Whilst recognising the fact that the value of the firms cannot be derived from simple patent counts, the effect of patent counts as a positive signal cannot be denied. As Clarisa Long (Professor of Intellectual Property Law at Columbia Law School) has argued - 'Nobody associates patents with sloth and shiftlessness' (Long, 2002, p. 654).

It is worth mentioning some of the reasons why the entrepreneurs themselves are sometimes unwilling to patent despite that they might have the necessary capabilities and technology. S. Graham et al.'s (2010) results showed that the main reason for this was the cost associated with the patent application itself, and also with subsequent litigations, especially if the firm was small. Other respondents argued that they were reluctant to patent in order to avoid divulging information, or believed that trade secret protection was sufficient for their needs. Industry wide differences were also identified in this respect. For example, in the case of the biotechnology industry, they are most likely not to patent because of secrecy. However, in the case of the software industry, the most likely reason is the costs. The authors attribute the reason for this to the fact that in the biotechnology industry patents are more useful in securing protection than in the case of software firms.

2.11 The link between patenting and market value

One of the reasons for which patenting is seen as a signal for investors is possibly the link with the market value of the firm. Hall, Jaffe, & Trajtenberg, (2005) studied this relationship using forward patent citations i.e. the number of times patents have been referred to in subsequent patent documents. Patent citations were used in order to avoid the problem of skewness associated with patent counts and issues, such as the fact that patents may be worthless. The forward patent citations are seen as an indicator of importance, given that it means that invention has led to further technological advances (Deng et al., 1999). However, some argue that patent citations are not without problems because they may not necessarily be directly related to the patent which is owned but merely serve as background information (Mogee, 2007). This problem was highlighted by Jaffe, Fogarty, & Banks (1998), who argued that one fifth of the patent citations which were attributable to patents owned by the Electro-Physics Branch (EPB) of NASA were not directly related to the technology or the processes described in the cited patents. Besides this, most patent citations tend to be from Anglophone countries given the language barriers (Mogee, 2007). Mogee (2007) argues that no evidence was found that US patent citations are good predictors of patent value. However, if these are supplemented with the European and international (PCT) patent citation information this would provide more accurate information.

Deng et al. (1999) and Hall et al. (2005) show that the higher the number of citations, the higher the market value. Furthermore, the study by Hall et al. (2005) also shows that if the citations were self-citations (citations of other patents owned by the same company), the market value would even be higher, although the effect of self-citations is more pronounced in companies which own less patents (Hall et al., 2005). However Deng et al. (1999)'s study showed that the relationship between market and book value (implying larger growth expectations for investors) is not only associated with the number of patent citations, but was also strongly visible in the simple patent count of patents granted. This analysis might put into question the need to use patent citations, in view that the simple count of patents granted has shown similar associations with market values. Nonetheless, one must say that Deng et al. (1999)'s study was based on a dataset from four technology or science related industries.

Apart from patent citations, another relevant patent measure is *patent scope*. The broader the patent scope, the greater the significance of the patent. Using the number of IPC (international patent classification) patent classes identified available on the patent document as a measure of patent scope, Lerner (1994) identifies a robust link between the value of the firm and patent scope. In fact, Lerner (1994) shows how an increase by one standard deviation in patent scope, leads to an increase of nearly a quarter of the firms value. It is worth noting however, that the study was carried out in the biotechnological industry, and might not be relevant for other industries as well.

Having stated this, even though the link between patent citations and patent scope may be linked to the market value of the firm, the investors might not have the required amount of time to take these into consideration. Whilst the patents may be generating value to the firm, the investors may overlook and underestimate their importance in view of their time constraints (S. Graham & Sichelman, 2008).

2.12 Patents and the size of the investment

Several authors have argued that patenting not only increases the chances of obtaining venture capital financing but there is also a positive relationship between the number of patents and the amount invested (J. A. C. Baum & Silverman, 2004; Cao & Hsu, 2011; Conti et al., 2011; Mann & Sager, 2007; Schertler, 2007). Although, as explained earlier Mann & Sager's (2007) questions the relevance of patents for the purposes of the initial investment by the venture capitalist, the authors identify a significant increase in the size of the investment made by the venture capital if the number of patents held increased. Once again, it is important to qualify that Mann & Sager's (2007) study is restricted to the software industry in the United States, and that the authors themselves claim that the results have low explanatory power. Although for comparative purposes, throughout the study the authors consider also the biotechnological sector, no reference to the total amount of venture capital financing has been made. Nonetheless, these results have been confirmed in a study by Cao and Hsu (2011) which controlled for the effect of different industries. The authors show how US start-ups which held patents received over seven million dollars more in venture capital than those without.

Interestingly, J. A. C. Baum and Silverman (2004) not only argue that firms receive more funding if they have more patents, but also argue that if the firms are not granted any patents for a significant amount of time, they are likely to receive less funding than those who have more recently obtained patents. Whilst Mann & Sager (2007) and J. A. C. Baum and Silverman (2004) consider the number of patents granted, Schertler (2007), using a European dataset and Conti et al. (2011) using a US based dataset of technological companies, study the link between venture capital financing and patent applications. Despite this difference, similar results were obtained in the four studies. In their study, Conti et al. (2011) contend that this relationship is only statistically significant in the case of formal venture capital investment, and not in the informal venture capital market (business angels).

However, not all of the studies have shown this clear relationsip between patenting and the amount of venture capital financing. Munari & Toschi (2014), using a global dataset, find no evidence that there is a significant relationship between the amount of funding and simple patent application counts. Similarly, no significant relationship was obtained between patent scope and the amount of venture capital financing. However, as stated in Section 2.9, a relationship was identified between the amount of financing and the number of patents specifically relating to nanotechnology, implying that venture capitalists could be increasingly specialised when it comes to considering the patents for venture capital funding (Munari & Toschi, 2014). Related to this aspect of industry specialisation, one cannot automatically argue that the role of patents in the investment decision is the result of more venture capitalists who are experts in scientific/technological matters. Knockaert et al. (2014) state that venture capitalists who have education in scientific or engineering subjects do not appear to make a difference when it comes to the analysis of patents.

Although the above studies provide contradicting views, one has to take into consideration that this could be due to the different methodologies, and or the different countries and industries considered in the studies. It is also worth mentioning that none of the studies has considered specifically the UK venture capital situation.

2.13 Does venture capital foster patenting?

There is also a strand of literature which indicates that patenting increases *after* the venture capital funding is provided. The main study in the area is Kortum & Lerner's (2000) industry wide study. The authors make use of a dataset which incorporates data from companies in twenty industries, for the time period 1965-1992. The study found a strong relationship between patenting and the provision of venture capital. The authors cite two possible reasons for which venture capital backed companies may be patenting more. One of the arguments is that either the entrepreneur might be afraid that the venture capitalists would make use of his ideas themselves, or else they could be using this as a signal to attract more funding as outlined in the previous section. Other possible reasons for the increase in venture capital funding include the fact that venture capitalists target firms which are highly innovative and have important discoveries. If the inventions are developed, the venture capitalist may be the one who is funding the actual patenting process (Arqué-Castells, 2012). Ueda & Hirukawa (2008) extend the study carried out by Kortum & Lerner (2000) up to 2001, and confirmed that even during the later period, venture capital investment appeared to be leading to an increase in patenting activity as measured by patent counts, but also argued that this was not necessarily synonymous with an improvement in productivity in US manufacturing firms.

In an attempt to replicate the studies by Kortum and Lerner (2000) and Ueda and Hirukawa (2008) in the US, Popov and Roosenboom (2012) carried out a similar study in Europe. The authors take into consideration that different countries in Europe have different regulatory regimes with regards to employment, taxation and intellectual property rights. Popov and Roosenboom (2012) find weaker (although still positive relationships) results than those identified in the previous studies. Unlike the US studies however, it is worth noting that this study only included investments carried out between 1991 and 2005. The author shows that the differences between the studies in the USA and in the United Kingdom are probably as a result of stronger links between R&D, venture capital and patenting in the 1960s and 1970s. Arguably, the authors agree that the link between patenting and venture capital is more strong in European countries where there are more favourable taxation regimes for VCs. However, in the paper the authors do not specify clearly the countries included in the subsample which was used to verify this.

The weak relationship between venture capital and innovation in Europe was previously outlined at a firm level in the study conducted by Engel & Keilbach (2007) amongst German firms. Although at first sight, their study seemed to have indicated that venture capital increases the number of patent applications, a high variance in the number of patent applications led to the results not being statistically significant, implying that there is only weak evidence that venture capital leads to an increase in patenting. Given that this study by Engel and Keilbach (2007) is not a cross country study which tests for cross country heterogeneity (cf. Popov & Roosenboom, 2012), the results of the study could arguably be different from the rest of the studies due to differences in the Germany regulatory regime.

Contrasting these studies, is research carried outside the USA which shows that venture capital funding led to an increase in the number of patents. These were not mentioned in the study by Popov and Roosenboom (2012). In particular, Bertoni et al. (2010) found that even in Italy there was an increase in the number of patents granted, and in the chances of obtaining patents, after venture capital funding. Bertoni et al. (2010) show that the relationship between venture capital and the number of patents is not simply attributable to the increase in financing. In their study they took into consideration the cash flow and debt financing of the firms under consideration, and therefore this could be one of the reasons for the differences between the studies under consideration. A similar relationship was also identified amongst Japanese firms by Lynskey (2004) who argued that venture capital in Japan appears to be contributing to innovation. He shows that there is a link between both the number of new products and the number of patents applied for by firms in which venture capital was invested.

Whilst most of the studies outlined above consider the number of patents applied for or granted, Dushnitsky & Lenox (2005) consider the number of patent citations, which the authors use as a measure of innovation. The authors identify a positive relationship between the amount of venture capital invested and the number of future patent citations, although this relationship is not identified in industries where there is a strong intellectual property regime (i.e. where there are less disputes related to the intellectual property – e.g. chemicals, pharmaceuticals).

Since these studies did not involve interviews with the actual investors, they provide no supporting evidence for the reasons why patenting increases (or otherwise) after the first venture capital financing round. In fact, the majority of the studies outlined in this section are time series studies based on data extracted from American venture capital databases. It has also been argued that the data used by Kortum and Lerner (2000) and Ueda and Hirukawa (2008) excluded small firms, because the National Science R&D database used by the authors did not include these type of firms (Popov & Roosenboom, 2012). However, the authors of the various articles cited above attempted to provide suggestions for the increase. Ueda & Hirukawa (2008) argue that venture capital augments the competiveness of the firms in which funding is invested, which in turn leads to an increase in patenting. The authors extend their analysis to verify whether the reason for holding the patent is simply to block other firms from making use of the inventions without commercialising them (and hence leading to an increase in future profitability). Ueda & Hirukawa (2008) find no evidence attributing the increase in number of patents to the blocking motive. Furthermore, they believe that given the nature of start-up firms, venture capital backed investors are more likely to patent than established firms. Patents also appear to be crucial to secure further financing (Ueda & Hirukawa, 2008). Another possible reason outlined by Bertoni et al. (2010) is that, given that more financial resources are available in venture capital backed firms, these tend to invest more in research and development, leading to more patent applications.

2.14 Conclusion

In this chapter, the existing literature on the reporting of intangible assets, with a focus on the venture capital context, was considered. The literature relating to patenting and investing in a venture capital context was considered. Throughout the chapter, the lack of methodological diversity (focusing mainly on the analysis of existing datasets), and the primary focus on the United States was highlighted. Having considered the existing literature on the subject, the next chapter outlines the methodology adopted in this thesis.

3.0 Methodology and research design

The purpose of this chapter is to discuss how this research was actually carried out. The first section outlines how the first set of interviews with early stage investor associations were carried out. These were then used to develop a further set of interviews conducted directly with key personnel of venture capital firms, as discussed in Section 3.2. Finally, Section 3.3 provides an explanation of how a dataset was constructed using disparate data sources on venture capital investment and patenting, as well as information from financial statements.

3.1 Unstructured Interviews with investor associations

Initially a series of unstructured interviews amongst early stage investor associations, representing investors in the UK and at European level, were conducted. The purpose of these interviews was to obtain an overview of the situation from an industry point of view. Due to the small number of investor associations, interviews were considered to be the most appropriate method of undertaking this research. Furthermore, an unstructured format was also considered to be appropriate because of the exploratory nature of this research (D. R. Cooper & Schindler, 2008). The research is considered to be exploratory in view of the limited amount of literature (Hair, Money, Page, & Samouel, 2007) on accounting aspects in the venture capital field. Unstructured interviews were also deemed appropriate because, at this stage of the research, a framework for the following research stages was still being developed. Moreover, in view of the role and background of the interviewees, it is more likely that they will be willing to participate in an interview rather than answering an online or postal questionnaire (Saunders et al., 2009). Unstructured interviews allow for more detailed discussion of new ideas which arise during the interview itself (Scapens, 2004). The unstructured approach was also beneficial because it did not restrict the respondents by the questions posed but instead they were only meant to stimulate further discussion. In fact, in line with Berg (2007), the questions generated during the course of the interview led to further probing questions. The interviews provided insight into questions which were further explored in later stages of the research, particularly in the semi-structured administered questionnaire which was carried out amongst venture capitalist (cf. Greene, Caracelli, & Graham, 1989 on the use of different methods for the development of further research).

Target participants included leading early stage investor associations in the United Kingdom and at a European level. At this stage, two types of investor organisations were interviewed – namely formal venture capital associations and informal venture capital associations – i.e. those representing angel investors. Following suggestions from the associations, two patent lawyers were also interviewed, one of which was employed by a venture capital organisation. Only one of the associations contacted refused to participate after indicating that they were not concerned about the issues related to the accounting of intangibles of companies within underlying investment portfolios. Table 3-1 shows the type of organisations interviewed and the number of interviewees in each case.

Table 3-1: Initial interview participants

Type of Organisation	Number of Interviews held
Venture capital associations	3
Angel investor associations	3
Patent lawyers **(referred to by investor associations)**	2

In this case, an introduction letter was sent by post, and also by e-mail with subsequent reminders being sent by e-mail. With the introduction letter, an interview agenda was also forwarded to the interviewees (Appendix A). This was not meant to constrain the content of the interviews, but to act as a reminder of the topics which had to be covered (Burgess, 1984). The agenda was developed by making reference to the literature available on venture capital investment and intangible assets. In developing the agenda, the literature considered was not only from an academic perspective, but publications by practitioners were also reviewed. The agenda consisted of three parts. The first part was intended to provide an overview of the venture capital market, particularly relating to investment in hi-tech companies. The second set of points on the agenda was aimed at briefly identifying the views of the associations on the use of financial statements by the venture capitalists. Particular reference was made to the use and relevance of intangible asset disclosure. In the final part, the relevance of patents and other intangibles for the venture capitalists was considered.

Interviews were held at the offices of the investment associations or other places suggested by the participants, such as offices of venture capital investment firms, in London and Glasgow, and in various cities in Belgium (Brussels, Antwerp and Leuven). A seed corn grant was provided by the Institute of Chartered Accountants of Scotland (ICAS) in order to cover the necessary expenses of these interviews in May 2011. The interviews were subsequently carried out between July and December 2011. After obtaining the relative consent, the interviews were digitally recorded. Some researchers have criticised this approach on the basis that the transcription of recorded data leads to massive amounts of redundant information which needs to be transcribed (Reid, 1998). Although, redundant information was an issue when transcribing the interviews, audio recording allowed the researcher to concentrate more on the interview itself. Despite this, note taking was considered to be useful particularly in order to maintain focus during the interview (Ghauri & Grønhaug, 2005).

3.2 Interviewer administered questionnaires

In line with suggestions made by the investor associations interviewed in the unstructured interviews conducted, a series of interviewer administered questionnaires were carried out amongst venture capitalists. This is not a new approach to conducting venture capital research – it has previously been successfully used by Dixon (1991), Reid (1998) and Reid and Smith (2008b).

This approach helps the researcher to obtain a certain degree of consistency in terms of the questions and response approach (Dixon, 1991). Similar to the previous unstructured interviews, due to the nature of interviewees, (i.e. key personnel within venture capital investment firms), a face to face approach is preferred since this is more likely to lead to a higher participation rate (Healey & Rawlinson, 1993; Saunders et al., 2009). This is further highlighted by the number of different questions being asked within the questionnaires. Respondents in a mail questionnaire are less likely to respond to a questionnaire of such length (Healey & Rawlinson, 1993). One further advantage is that responses are likely to be more accurate than in a postal survey because an explanation could be provided relating to the questions in which a clarification was required. Furthermore, in the case where answers are deemed to be too brief, further questions can be asked to ensure that an adequate response is provided (Healey & Rawlinson, 1993).

3.2.1 Interviewee selection

The target interviewees of this study were key personnel from all the member firms of the British Venture Capital Association (BVCA), whose investment preference was technology and who invest in the venture capital stage, as listed in the BVCA Member Directory. The British Venture Capital Association, which is the national association for venture capitalists, had more than 230 full members listed in the 2012 Venture Capital Directory. An online version of the directory was used directly from the BVCA website. The online data was supplemented by information from a printed version of the directory of the BVCA 2010/2011 Directory (British Venture Capital Associaton, 2010a).

In line with past studies, it has to be pointed out that this directory is not a complete listing of venture capitalists in the United Kingdom. In order to tackle the above problem the population of potential interviewees was augmented by a number of firms who are known to provide venture capital investment to technology firms and others which were referred by the initial interview participants, in line with a previous study by Reid and Smith (2008b). Key individuals within the organisations were targeted. These were identified either from the BVCA Member Directory itself, or else when no person was specified in the directory, an online search on the firm's website was done. Due to the fact that intangible assets – particularly patents, tend to be technologically related, the target interviewees are only those firms which invest in technological companies (cf. Wright & Robbie, 1996). It has been argued that the term 'high tech' has not yet been universally defined by venture capitalists. For the purposes of this study, we assume the industry sectors identified in statistics of investment activity published by the BVCA (reproduced in Table 3-2 below) as being technology.

Table 3-2: Technology sectors identified in BVCA Private Equity and Venture Capital Report Investment (2011)

Sector
Mobile Telecommunications
Fixed Line Telecommunications
Computer Hardware
Internet
Semiconductors
Software
Other Electronics
Biotechnology
Medical Equipment
Pharmaceuticals
Health Care
Other (Technology)

A significantly large proportion of the potential interviewees were located in London and South East (around 65%), followed by Scotland (around 16%). This is consistent with a study on the geographical distribution of venture capitalists, carried out bysee Mason and Harrison (2002). The authors state that the reason for such concentration is the availability of firms investing in technology and the number of high growth firms in such regions.

From the study, we have excluded a number of venture capital firms investing in high technology on the basis of possible biases in the investment. Non-profit venture capital firms and venture capital firms specifically setup to invest in start-ups of specific universities were excluded from the study due to the investment bias which could have an effect on the overall responses. Based on the above, the final list of potential participants which were contacted for potential interviews included 59 venture capital firms.

3.2.2 Introduction Letter & Agenda

Similar to the previous case of the unstructured interviews with the investor association an introduction letter was sent to the interviewees together with an agenda showing the four main topics under discussion (see Appendix B). In the letter, the purpose of the research and an assurance that confidentiality relating to the responses provided will be retained. An emphasis was made that the interviewee was willing to travel to the participants' offices, thus making it easier for the respondent to participate in the interview. Although the initial letter was sent formally by conventional mail, subsequently contact was made with the interviewees by telephone and e-mail to ensure greater participation. If the person contacted was unable to participate due to other commitments, an attempt was made to interview an alternative person within the same organisation.

3.2.3 Questionnaire content

The questionnaire (see Appendix C) has four parts. Each part has a series of questions which were developed based on past literature on the topic and the various interviews carried out with the associations representing the venture capitalists. In the next section the various components of the questionnaire will be analysed briefly.

The first part is aimed at getting some background information on the firm being interviewed. Questions included information on the type of investments made by the venture capital firm. The type of questions found in this section is similar to those found in the initial sections of most questionnaires which are carried out amongst venture capitalists.

The second part, deals with the use of financial statements by the venture capitalist. Amongst other questions, the use of financial statements used by the venture capitalist, and which figures are most important for venture capitalists are considered. Reid and Smith (2005) have previously questioned the importance of financial statements for the venture capitalists. However, this section looks in more depth into which components and key figures are important for the venture capitalists when looking at the financial statements. Questions were also posed regarding the use of intellectual capital reports as suggested by the European Union in the RICARDIS Report (see European Commission, 2006b). In this case, in order to explain better what these reports included a printed copy of a sample intellectual capital report (see Infineon Technologies Austria AG, 2006) first presented at OECD Conference held in Tokyo on 7-8th December 2006 was shown to the interviewees. Participants were given a few minutes to browse through the report in the course of the interview and then were asked a number of questions on their viewpoints relating to such a report. The first section of this sample report is a narrative description of the intellectual capital within the organisation, split into various sections by type of intangible assets: Human capital, Structural Capital, Relational Capital and Location Capital. The final section called 'The Balance' provides a list of indicators, the subdivisions of which are included in Appendix F. These indicators are split into those relating to Input (intellectual capital), the processes relating to these inputs, and those relating to Output and Impact. The participants were informed that not all of these indicators were relevant to smaller business, and that each intellectual capital report was tailored to the requirements of the firm under consideration.

The third part seeks to obtain information on how the venture capitalists value the investments under consideration. Questions are asked on the types of documents requested during valuation and their relative importance, the valuation methods used, and their suitability given that the firms in which investment is being made usually have a considerable number of intangible assets.

The final section is specifically on intangibles. Questions include at which stage various kinds of intangible assets by venture capitalists in the United Kingdom (cf. Ribeiro and Tironi (2006) – in a study carried out amongst Brazilian venture capitalists). The role of patents as a signal for the venture capitalists (Audretsch et al., 2012; J. A. C. Baum & Silverman, 2004; Conti et al., 2011) is investigated further in this section. Furthermore the link identified in literature between patenting and venture capital investment is also considered (Conti et al., 2011; Haeussler et al., 2009; Kortum & Lerner, 2000). Questions also related to the importance of various patent measures identified in the literature (Deng et al., 1999; Lerner, 1994; Odasso & Ughetto, 2010). Where there was the need to resort to the use of certain terms, these were defined with the questionnaire themselves in order to eliminate any misunderstandings which could have occurred in the course of the interview.

3.2.3 Interviewee participation

Out of the 59 venture capitalists contacted, 21 agreed to participate in the study (see Appendix D). Two of the venture capitalists initially contacted indicated that they do not invest in companies with intangible assets, and therefore the research was not relevant to their work. As expected (see Section 3.2.1), the majority of the participants were based in venture capital firms in London (13 participants). Figure

3-1 highlights the location of the participants. The interviews were carried out between June and December 2012.

Figure 3-1: Location of interview participants

As in the previous set of interviews carried out amongst early stage investor associations, the interviews were digitally recorded, and later transcribed, although the questionnaire was still filled in during the course of the interview.

3.2.4 Questionnaire coding

The numerical responses, as well as those which required a yes or no answer within the questionnaire, were subsequently coded and inputted into SPSS, as shown in Appendix E. In the case of non-numerical values, '1' was coded as being a 'Yes' answer, whereas '0' was coded as being a 'No' answer. In the case of the respondent sheets, which included the rating scales questions, where the interviewee stated that the item was not relevant or important at all this was coded as ‘0’. This coding not only allowed descriptive and statistical analysis to be carried out on the data, but also facilitated the identification of specific responses for the qualitative analysis carried out. For example, in respect of Question 19a within the questionnaire (Appendix C), one could identify which respondents stated that patents could be a sign of a profitable investment opportunity (since this would be code as 1) and those which stated otherwise. Thereafter, by looking at the ID field (within SPSS, this was the number of the interview, which can be linked to the paper of the questionnaire) of the respondents which stated that patenting is a signal of profitable investment opportunity, this could be cross-referenced to the actual questionnaires in order to consider the content of Question 19.1 (Questionnaire - Appendix C) which required the reason for the response in a qualitative manner.

Having considered how the interview data collection was carried out, the next section provides details as to how additional secondary data was gathered in order to construct a new dataset which included information on venture capital investment and intangibles in the United Kingdom.

3.3 Secondary data analysis

3.3.1 Data collection

Following the unstructured and semi structured interviews, it was decided that the construction of a database using secondary data on patents and venture capital would provide further insights on the topics considered. The advantage of hand collected datasets is that the data can be linked with the research design more easily (Bender, 2011). Sekaran and Bougie (2010) explain how existing datasets may not always meet the exact requirements of the researcher. However, this approach is time consuming and would not be suitable for larger scale datasets (Bender, 2011). Although statistical analysis of existing data sources is widely used in venture capital related literature; most of the existing databases do not have the necessary information required for the purposes of this research, given that the study relates to the United Kingdom. In view of this, it was decided that data should be hand collected and collated from disparate data sources (cf. Hellman & Puri, 2000). For United Kingdom data we also collected information on intangible assets from the companies' balance sheets; which is not usually done in venture capital research. Although large scale studies on venture capital and patenting have been carried out using North American data, not much analysis has been done previously on data relating to UK venture capital deals.

The disparate data sources used to collect the data can be categorised into three groups, as illustrated in the diagram below (Figure 3-2):

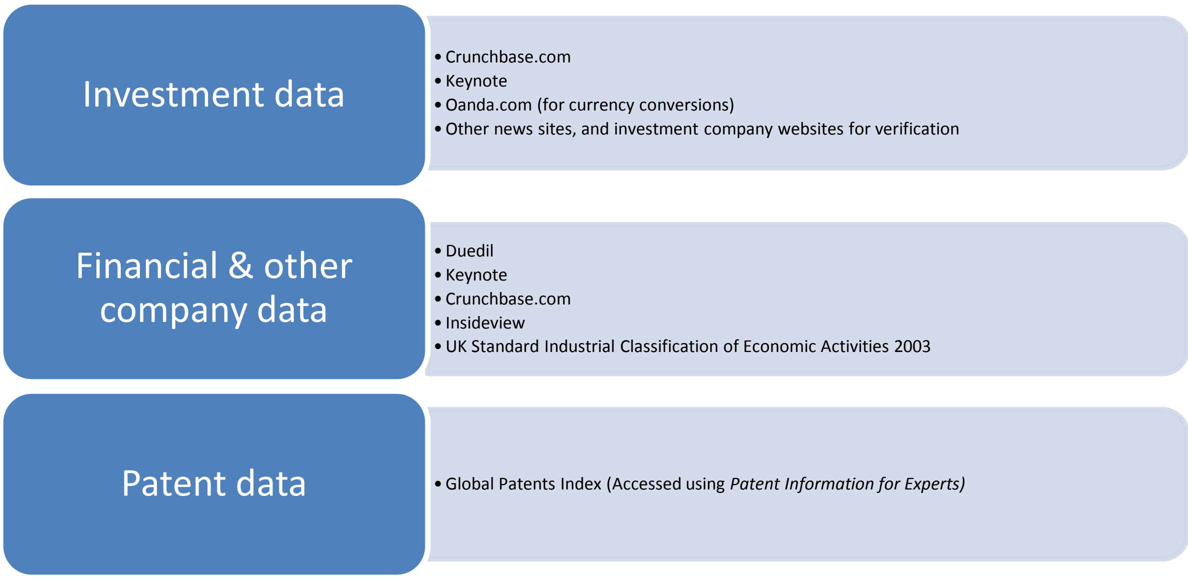


Figure 3-2: Data sources

Investment data

In order to identify specific investments made by venture capitalists the news website *Crunchbase.com* ("Crunchbase") was used (cf. Alexy, Block, Sandner, & Ter Wal, 2012; Block & Sandner, 2009; Werth & Boeert, 2011). Crunchbase is maintained by Tech Crunch; a well-respected blog related to technological innovations. It summarises the activities of venture capitalists in start-up companies (Block & Sandner, 2009). Whilst it is recognised that the dataset is not complete, and not entirely free from errors, other databases rarely include information on start-ups (Werth & Boeert, 2011) in the United Kingdom, especially if they did not expand into successful companies. Data on investments in the United Kingdom is usually published in aggregate, classified by investment stage, industry and geographical region, in the BVCA Report on Investment Activity which is published annually (British Venture Capital Associaton, 2012). As of June 2013, the Crunchbase dataset includes data on 9,348 financial organisations, 38,325 funding rounds and 148,431 companies worldwide.

Crunchbase uses data from various news articles; so details about the investments is uploaded by professionals in the technology community (Werth & Boeert, 2011). These are obtained from either the media or investment company websites, and they usually reference the original source. Random checks were made on the data under consideration for data validation purposes (cf. Block & Sandner, 2009; Werth & Boeert, 2011) and the figures were found to be in agreement to those of news releases relating to venture capital deals.

Some of the investments listed on Crunchbase do not disclose the amount of the deal. In this case, we attempted to look up manually the shareholder documents within Companies House, where this was possible. To facilitate this, Key Note Companies was used. *Key Note Companies* ("Key Note") (http://www.keynote.co.uk) is an online database, which provides access to information on more than 7 million UK companies, directors and shareholder information (Key Note Ltd., 2013), including data from Companies House. From Key Note, we retrieved Form 88(2) of the company in question, which shows the amount paid on shares and how they were allotted. For example, we note that the Investment Deal carried out by Octopus Ventures in May 2009 in Phase Vision was registered at Companies House on 5th June 2009. From Form 88(2) we were able to derive that this was an investment deal of £1.09 million in exchange for 1,534,629 ordinary shares.

Venture capital companies in the United Kingdom identified through previous fieldwork (see section 3.2.1 Interviewee selection) as investing in technology were examined manually. Each investment listed on Crunchbase as being carried out by the company was entered into the database. To ensure that we included only investments carried out by UK venture capitalists, companies which had Head Offices outside the United Kingdom (e.g. Mitsui) were excluded. Table G-1 (Appendix G) lists the investment firms considered for the analysis. The data was collected between January and April 2013, and covers investments listed on Crunchbase, the earliest of which dates back to the year 2000. Data was initially collected in a spreadsheet in Microsoft Excel 2010 (see Appendix H for an extract of the data collected) , and was subsequently uploaded for analysis onto the two statistical packages used, namely Stata Statistical Software Release 13 ("Stata") and IBM SPSS Statistics for Windows Version 21.0 ("SPSS").

The amount invested was converted into British Pounds, using the exchange rate as at the first date of the month in which the investment was made. This approach was adopted because the exact date on which the investment was made was not known, but data was available for the month under consideration. The process of converting the investment amounts into British Pounds was carried out manually using online facilities available online by *Oanda Corporation* (http://www.oanda.com).

Crunchbase lists venture capital deals, not individual venture capital investments (i.e. there could have been an investment carried out jointly with a number of VCs). This, therefore, required manual elimination of any duplicate entries from the database. This was facilitated by sorting the investments by company name and investment names and eliminating any duplicate entries.

Financial statement data & other company information

For investments within the UK and Ireland, we can identify whether the investee companies showed any intangible assets on their balance sheets, and the amounts of same. This depends on whether financial statements were filed prior to investment date. Manual searches were conducted on the balance sheet of each company, using *Duedil* and Key Note as primary tools for accessing Companies House data. *Duedil* is an online facility, available since April 2011, which allows free basic searches on companies, using various data sources. This free service provides access to financial statement information, which is usually available at a charge from Companies House (Deudil Ltd., 2013a). The website content is assumed to be accurate, with the firm guaranteeing a £5 payment if inaccuracies in the financial information are spotted (Deudil Ltd., 2013b). In one of the semi-structured interviews carried out earlier in this study, the venture capitalist cited Duedil as one of the data sources used by venture capitalists at due diligence stage.

The industry classification of each investee company was also considered. For each company under analysis, the 'SIC Code' (Standard Industry Classification) was identified. This classification attempts to classify the economic activities of firms (Office for National Statistics, 2002).

SIC-2003 codes were obtained for UK and Irish Companies, from Duedil or Keynote, depending on which system the data was available. In the United Kingdom, SIC-Codes are a modified versions of the *Nomenclature générale des activités économiques dans les Communautés européennes (NACE)* used by the European Union (Office for National Statistics, 2002). Although the latest version of these codes is the SIC-2007, SIC-2003 was used for practicality in view that we have investments dating prior to this date. Furthermore, Duedil and Key Note, still showed 2003 SIC-Codes.

For non UK companies, where the North American Industry Classification System code (NCAIS) was available, the closest identifiable UK equivalent SIC Code was used. This process was done manually, one by one for every company in the dataset. For example, Prexa Pharmaceuticals had an NCAIS code of 541711, Research and Development in Biotechnology. In the database, the field was inserted as 7310 Research & Development On Natural Sciences & Engineering, the closest UK classification. The NCAIS were identified using online sources namely InsideView (http://www.insideview.com), an online information service for companies which on registration provides a company profile and industry description free of charge.

Although InsideView does provide the closest UK SIC Code to the NCAIS code, at times this did not accurately reflect the economic activities of the company, and the closest relevant SIC Code was used instead of the one suggested by Insideview. For companies located outside the USA, UK & Ireland (less than 15% of the data), where NCAIS or SIC Codes were not available, the closest SIC Codes based on the company activity descriptions was used.

Patent data

Data on patents was collected by conducting manual queries in the Global Patents Index (GPI), by using the *Patents Information for Experts* tool available online. This is a facility offered by the European Patent Office. The content of the GPI is based on two databases – INPADOC and DOCDB. DOCDB contains bibliographic information on worldwide patent publications, whereas INPADOC contains information regarding the legal status of the patents during its lifetime (European Patent Office, 2013b).

Patent terminology has already been discussed briefly in Chapter 1. However, when considering the data collection, it is important to distinguish between the various key terms relating to the filing process which are briefly explained below. Upon verification that all the required documentation is in order, a patent application is accepted. The date on which the application is accepted, is referred to as the *priority date*. Thereafter, the Patent Office at which the patent is filed conducts initial searches and a report is drawn giving an initial opinion on the patent. The patent application is then made public and publication (the date of which is referred to at the *publication date)* normally around 18 months after the priority date. After this, an applicant has six months to decide whether he wants to confirm the application and proceed with the more rigorous *substantive examination* which will eventually lead to patent being *granted* if it fulfils the requirements of the patent examination.

The grant date is deemed to be the date at which the publication of the granted patent is made. Multiple patents, may be filed to protect an invention in different jurisdictions. There are various classifications of patent families, such as the Extended INPADOC patent family, the Thomson scientific WPI patent family, and the ESPACENET patent family. For the purposes of this thesis, any reference to patent families unless otherwise specified refers to the ESPACENET patent family. Under this approach, documents having the same priority date are treated as being part of the same patent family. (European Patent Office, 2013a; OECD, 2006a)

Searches were made, company by company, using the first day of the month of the investment, and investment month as a filtering restriction. Data collected included the number of patents applied for and patent families with a publication date / priority date prior to this investment date restriction. Similar searches were carried out for patents granted with a publication date prior to the investment date.

The online interface of the GPI (Global Patents Index) allows searching patent data using boolean queries[3] (European Patent Office, 2012) . For example, if the search entry is:

APPD = “Oxford Nanopore” AND PRD <= “20100301”

This would show all patent publications in the database with Oxford Nanopore as applicant, with priority date prior to 1st March 2010.

Similarly, a query: APPD = “Oxford Nanopore” AND PUB <= “20100301” and ISG = “Y”, would show all *granted* patent publications in the database with Oxford Nanopore as applicant, with publication date prior to 1st March 2010.

The results of these searches, which were conducted manually for each investment under consideration, was then “filtered” to show the number of unique patent

[3] Boolean queries consist of “logical expressions composed of keywords connected by boolean operators, AND, or NOT” (Chen, Koudas, Korn, & Muthukrishnan, 2000)

applications and the number of patent families. Publication level filtering was necessary to ensure that the oldest publication matching the search was included in the result list. The number of patent families was obtained using the simple patent family filter, which is available in the *Patent Information for Experts* web service (European Patent Office, 2012). This filtering is done using the ESPACENET Simple Patent family (European Patent Office, 2011). It is important to note that in the user manual for the GPI, the EPO qualifies that a significant number of documents do not have the indicator of whether the patent was granted or not (European Patent Office, 2012).

3.3.2 A closer look at the data collected

After considering the data sources, and the manner by which data was collected, in this section, a detailed descriptive analysis of each type of data collected is provided. The analysis was carried out using SPSS and Stata.

Investment in British Pounds

This represents the total investment done in an investment round. The mean investment was 5.73 million British Pounds per round.

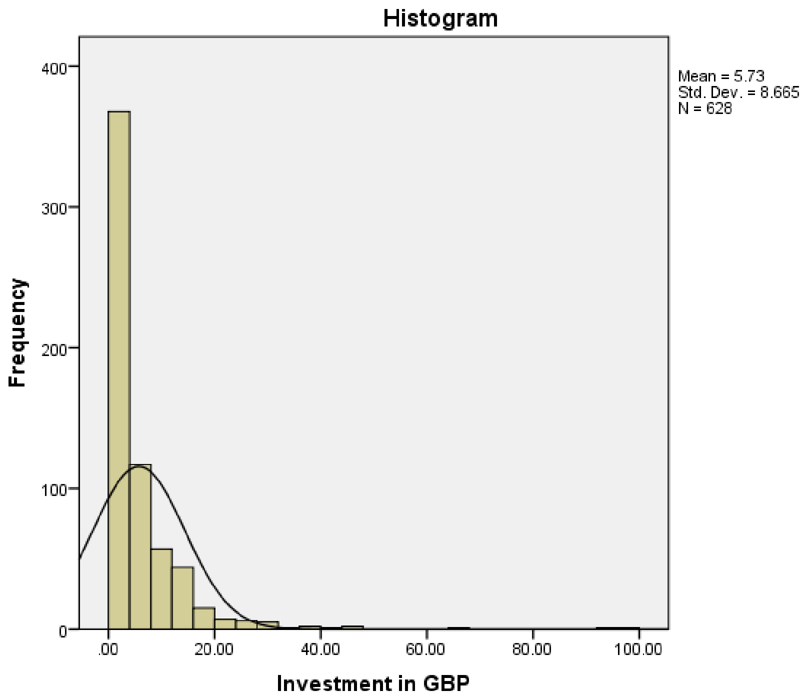


Figure 3-3: Histogram showing the Investment in GBP

From the histogram (Figure 3-3) one can note that the data is skewed towards lower investments, with few high values. This is in view of the nature of venture capital investments in the United Kingdom (Mason & Pierrakis, 2011). Furthermore the Stata *iqr command* identified some extreme outliers. The *iqr* command, developed by Hamilton (1992) is based on the interquartile range, i.e. the 75th percentile – the 25th percentile range (Hamilton, 2005). A severe outlier lies more than 3 times the interquartile range away from the nearer quartile (in symbolic terms: $x < Q(25) - 3IQR$ or $x > Q(75)+3IQR$). A mild outlier lies more than 1.5 times away from the near quartile, but is less than 3 times the interquartile range (as originally defined by (Tukey, 1977)). Hamilton (1992) argues that the presence of severe outliers is likely to cause problems in the application of traditional statistical techniques.

Outliers were verified as not being due to procedural errors i.e. they are considered to be genuine data and there were no errors in the inputting (Hair, Black, Babin, & Anderson, 2010). To overcome the problem, we transformed the data in a way which minimises the skew of the distribution (Field, 2009; Hamilton, 2005) Since we have a positive skew, we consider the use of a logarithmic transformation because this would squash the right tail of the distribution. (Field, 2009). Natural logs (ln) were preferred because for small values this enables direct interpretation as a proportion of approximate differences (Gelman & Hill, 2007). Having carried out the necessary transformation in Stata, a histogram was plotted once again (Figure 3-4) and we verified once again for the presence of extreme outliers.

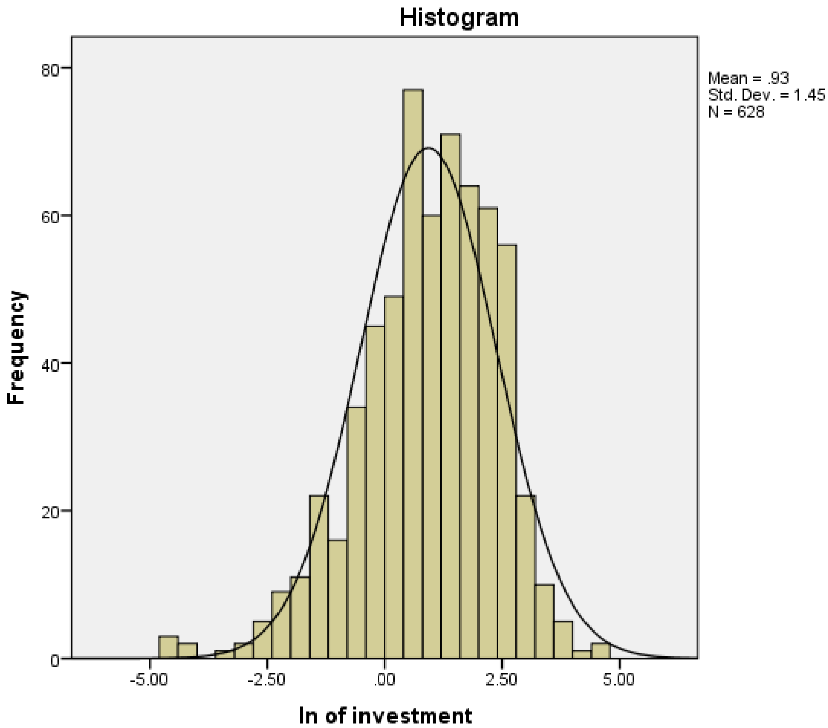


Figure 3-4: Histogram showing the natural log of the investment in GBP

Skewness was reduced from 5.10 to -0.66; implying that the distribution is approximately symmetrical; as also shown in the boxplot (Figure 3-5).

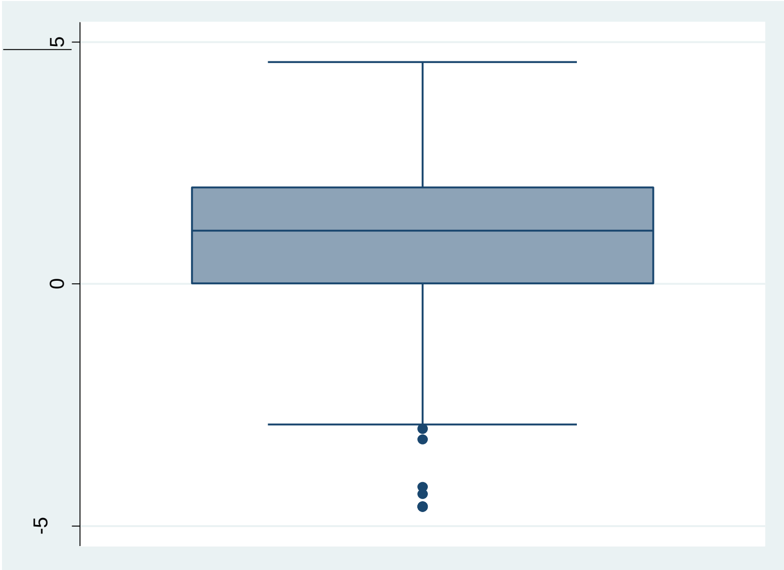


Figure 3-5: Box plot showing the ln of investment

Using IQR command described previously, we identify that there only mild outliers on the lower investments. This rules out any severe outliers, and the distribution seems fairly symmetric. These are investments below £0.5m; which tend to relate to start-ups in the seed stage. Mild outliers appear common in samples of any size and there is no need for elimination of same (Hamilton, 1992).

Table 3-3: IQR output from Stata

```
. iqr lninv

   mean=   .9268           std.dev.=    1.45          (n=  628)
 median=     1.1    pseudo std.dev.=   1.477        (IQR=   1.993)
10 trim=    1.02
                                                   low         high
                                                   -------------------
                                      inner fences   -2.989       4.982
                                 # mild outliers   7            0
                                 % mild outliers   1.11%        0.00%

                                      outer fences   -5.978        7.97
                               # severe outliers   0            0
                               % severe outliers   0.00%        0.00%
```

Age of Firm

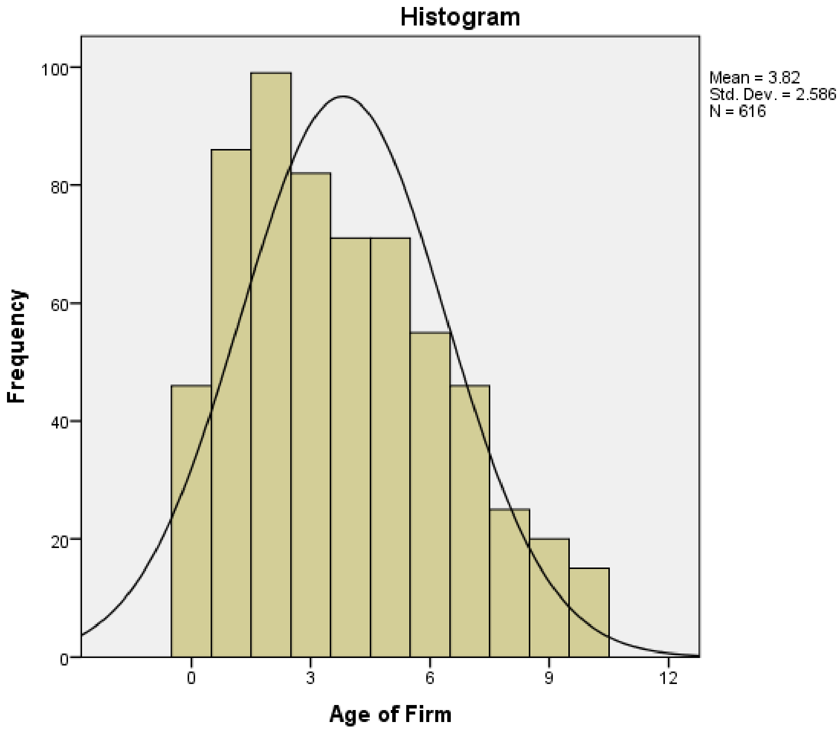


Figure 3-6: Histogram showing the age of the firm at the time of investment

The age of the firm was computed by deducting the investment year from year of incorporation as derived from Duedil, Keynote or Crunchbase depending on the availability of data. Months are ignored due to a lack availability of data within the original data sources. A histogram showing the age of the firms at the time of investment has been included in Figure 3-6.

The focus of this research is on start-up / early stage companies and therefore similar to previous studies dealing with start-ups (cf. Davila & Foster, 2005) we have excluded investments in firms over ten years old. Investments in firms older than 10 years were deemed to be extraordinary observations (outliers) (cf. Hair et al., 2010) and do not fit within the objectives of this research. Data on age was available for 648 observations; out of which 616 investments were made to firms under 10 years of age, which means that less than 5% of the data was dropped.

The mean age in the sample is 3.82 years. Data was collected in aggregate and at this point no distinction is made between first round and second round financing. We also note that firm age has a figure of 0.49 as skewness. This is expected, since venture capitalists by definition invest mainly in early stage companies.

Furthermore we used the *iqr* command in Stata described earlier in this section (see Investment in GBP), and determined that there are no mild or severe outliers in the data.

Country of Incorporation / Country code

Although the data relates to investments made by venture capital firms in the United Kingdom, these could relate to investment related to start-ups located outside the United Kingdom. As expected a priori, in line with Bottazzi, Da Rin, and Hellmann (2004) and the British Venture Capital Associaton (2012), the most popular investment country outside the United Kingdom, was the United States, although the most popular region was the European Union.

The country of incorporation of start-ups was as follows:

Table 3-4: Country of incorporation of data under consideration

Country of Incorporation	Freq.	Percent
Argentina	2	0.3
Austria	2	0.3
Belgium	1	0.15
Denmark	1	0.15
Finland	2	0.3
France	15	2.24
Germany	36	5.38
India	1	0.15
Ireland	34	5.08
Israel	3	0.45
Italy	1	0.15
Japan	1	0.15
Netherlands	3	0.45
Norway	1	0.15
Russia	2	0.3
Spain	6	0.9
Sweden	4	0.6
Switzerland	14	2.09
USA	107	15.99
United Kingdom	433	64.72
Total	**669**	**100**

These were later subdivided into 4 major categories as shown in Figure 3-7:

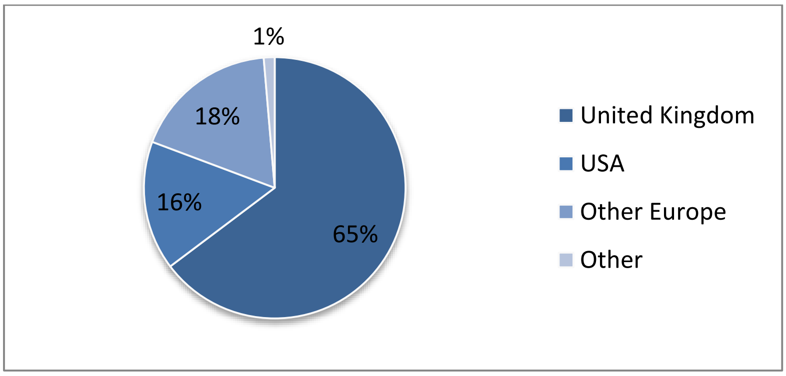


Figure 3-7: Country category of the investments

Industry classification

This variable includes the standard industrial classification (SIC) for the companies in which the investment was made. Having considered the data, the industry codes were grouped in Stata, and a new variable was created for the industry groupings. Details of the coding of these grouping are available in Table G-2 (Appendix G). The groupings follow the main headings of the UK Standard Industrial Classification of Economic Activities 2003 (Office for National Statistics, 2002). However in the case of Group K within this classification – 'Real Estate, Renting, and Business Activities', further industry subdivisions were made. This is because this category includes both Computer and Computer Related Activities and also Research and Development, and in both cases there is substantial investment within the technology subsectors. Since we are dealing with investments done by venture capitalists, which invest in technology a priori we expect the majority of the investments to be carried out in technology related industries.

The frequencies of the industry groups in the data collected are as follows:

Table 3-5: Table showing the industry classification for the data under consideration

Industry group	Freq.	Percent
Mining and Quarrying Energy Materials	1	0.15
Manufacture of Wood and Wood Products	1	0.15
Manufacture of Pulp, Paper and Paper Products	4	0.60
Manufacture of Coke, Refined Petroleum	1	0.15
Manufacture of Chemicals, Chemical Products	20	2.99
Manufacture of Rubber and Plastic Products	1	0.15
Manufacture of Machinery and Equipment	7	1.05
Manufacture of Electrical and Optical Equipment	85	12.71
Manufacturing Not Elsewhere Classified	7	1.05
Electricity, Gas and Water Supply	2	0.3
Wholesale and Retail Trade	33	4.93
Hotels and Restaurants	2	0.30
Transport, Storage and Communication	25	3.74
Financial Intermediation	8	1.2
Real Estate	3	0.45
Computer and Related Activities	281	42.00
Research and Development	78	11.66
Other business activities not elsewhere classified	94	14.05
Education	2	0.30
Health and social work	2	0.30

One can note a high proportion of ‘computer and related activities’ investments as well as R&D which is mainly in research and development in the natural sciences and engineering (SIC-2003 code 7310). This reflects the current trends in investment by European venture capitalists (Bottazzi et al., 2004), although there is some diversification across other sectors as well. The industry sector “Manufacture of Chemicals, Chemical Products” includes mainly manufacture of basic pharmaceutical products, and pharmaceutical preparations, whereas the other major group “Manufacture of Electrical and Optical Equipment” includes the manufacture of semiconductors and microchips. The popularity of the SIC Code, “Other business activities not elsewhere classified”, highlights a deficiency in the SIC Code classification system. The data source, Duedil, argues that ‘Other business activities’, is the most widely used industry classification by UK companies (Deudil Ltd., 2012)

Patent variables

Data was collected on various patent variables. We collected data relating to the number of patent applications and patent families which have priority date prior to the investment date (month & year), and the number of patents granted which have a date of publication prior to investment date (month & year). Definitions and details on how these were collected, were described in Section 3.3.1.

Table 3-6: Table showing the number of patents/patent families applied for/granted for the data under consideration

	Patent applied for				Patents granted			
No of patents or patent families	**Patent applications**		**Patent families**		**Patent applications**		**Patent families**	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
0	371	55.46	371	55.46	542	81.02	542	81.02
1	29	4.33	72	10.76	34	5.08	48	7.17
2-10	101	15.1	143	21.38	62	9.27	70	10.46
11-21	48	7.17	42	6.28	21	3.14	4	0.6
21-30	36	5.38	18	2.69	2	0.3	3	0.45
31-40	15	2.24	7	1.05	3	0.45	1	0.15
41-50	16	2.39	6	0.9	1	0.15	0	0
51-100	28	4.19	10	1.49	4	0.6	1	0.15
101-150	10	1.49						
151-200	5	0.75						
200-251	4	0.6						
251-300	1	0.15						
301-350	1	0.15						
351-400	4	0.6						
	669		**669**		**669**		**669**	

In line with Mann and Sager (2007), we also created the following binary related variables relating to:

(a) Whether the firm had a patent applied for or not
(b) Whether the firm had a patent granted or not
(c) Whether the firm had multiple patents

The relevant percentages are shown below:

Table 3-7: Binary variables - frequencies

	YES	NO
Patents applied for	44.54% (n=298)	55.46% (n=371)
Multiple patents applied for	40.21% (n=269)	59.79% (n=400)
Patents granted	18.92% (n=127)	81.02% (n=542)

From the above table, we can note that 55.46% of the investments made were made in companies without patents applied for and 81.02% had no patents granted. Although we acknowledge that the patents granted statistics may not be entirely complete in the original patent data source, this is in line with initial expectations, given that the dataset deals with early stage companies who may still be in the patenting process.

3.4 Conclusion

After considering briefly the three types of data collected for the purposes of this research, the next two chapters provide the actual results and analysis of this study. The results and analysis of the unstructured interviews (the data collection of which has been explained in Section 3.1) are provided in Chapter 4. Within the same chapter, the results and more detailed analysis of the semi structured interviews (referred to in section 3.2) with venture capitalists is provided. Finally Chapter 5 provides the results of regression analysis carried out on the new dataset described in Section 3.3.

4.0 Fieldwork with venture capitalists and venture capital associations

In this chapter, an analysis of the results of the interviews carried out in the venture capital field is carried out. Section 4.1 provides an overview and discussion on the set of unstructured interviews carried out with early stage investor associations. Section 4.2 provides an overview, overall results and discussion of the semi-structured interviews carried out with the venture capital firms. Finally, section 4.3 focuses on five of the semi structured interviews carried out amongst venture capitalists. These are analysed using a case study approach.

4.1 Unstructured interviews with early stage investor associations

Initially, a series of unstructured interviews were carried out amongst early stage investor associations in the United Kingdom. Thereafter, a second set of interviews was carried out with European associations representing the early stage investors, including those of the United Kingdom. The primary purpose of these interviews was to obtain an overview of the situation from an industry point of view. A secondary goal was to generate ideas for the future development of a more detailed, semi-structured questionnaire, for application to venture capitalists themselves. In this chapter, we present an overview of the outcome of the interviews. In discussing these, we have outlined differences or links to literature on the topic under consideration. These unstructured interviews were funded by ICAS (The Institute of Chartered Accountants of Scotland), and a summary of the research results was published in their Spring 2012 research newsletter (ICAS, 2012)

4.1.1 General overview

Each interview opened with a general discussion about the current state of the venture capital market in the UK and Europe, and with regard to technological companies specifically. There was some recognition that the market had become more cautious of late, with early stage companies needing to seek business angel funding, while the venture capital investments were being directed towards latter stage, more established companies. Some of the comments from the respondents illustrated the way the market had changed, as shown below:

"In early stage companies … it's all business angels. The venture capitalists have withdrawn from early stage … you do not see them very much until the companies have become much more mature, so they are not interested in investing the smaller amounts that angels invest (under £2 million), but … that market is very active – it is a good market … the amount of investment and the number of companies have increased. Quite a lot of it is on existing portfolio companies because the banks are not willing to lend and the venture capitalist does not want to come in at the low end so angels have to continue finance companies, but it's a strong market and it remains strong all through."

"It is declining because around the year 2000 we had a bubble, at a time when venture capital in Europe was too young to have had spectacular success, so around the year 2000 huge amounts of money were put into venture capital and a lot of that money was wasted. The money backed inexperienced teams, and therefore the investment returns were very poor, and European venture has never really had a golden era. It's also true that European returns in the last decade are the same as US returns. Europe is not worse. Probably neither is any good."

"The amount of money that goes into the seed and early stage of the start of the business by the VC community in the United Kingdom is about £200 million, whereas the amount given by business angels is about four times as much."

"If you are a start-up entrepreneur in technology, the first port of call is probably going to be the angel community, possibly also some grant money. You have to raise that seed round then you might have an angel round or move to a series of VC rounds. The VC tends to be more comfortable investing when there's a little bit more of tangible growth in what this company is trying to achieve."

Respondents were asked to comment on sectoral differences and, in particular, on whether they thought there was now any bias against investments in the high-technology sector (cf. Lockett et al., 2002). The general conclusion was that high-technology was still popular amongst investors, and that the UK government, in particular, was taking steps to make this a more attractive proposition for investors:

“VCs still like high tech. It still has a lot of advantages, particularly in terms of low start-up costs, but it’s very difficult.”

“Venture capitalists are moving a bit away from seed and start-up and moving towards later stage ventures. It has been a little bit less pronounced in the high-tech space because high-tech space has the advantages of low start-up costs. There are a number of businesses that do very well, and a number that shut.”

“There is no bias against the high-tech sector – the lack of start-up costs is one of the appealing things, particularly in an uncertain economic environment, where the option value of waiting in large expensive investments is very high. Is it better for me to back a factory being built, or better for me to back a firm with a couple of PCs in a room somewhere?”

“With regards to investment in high-tech firms, venture capitalists in Europe, and in the US to a degree, are moving away from capital-intensive investment towards easy investment and capital-efficient investment – software, social networking etc. and away from deep technology built on fundamental research.”

“There is a strong movement from the high net worth and sophisticated investment community to find good technology business that … can grow in scale, and have very strong intellectual property that can be patented or protected in some other way, or exploited. Technology businesses are very, very popular.”

“We are still undersupplied in the United Kingdom with seed and start-up capital, but this is an area that policymakers are looking at, particularly in the angel market with enhanced tax breaks. There is a consultation process … between the Treasury and players in the market, on having additional tax breaks. They want to see the money targeted to technology start-up businesses.”

The feedback related to this part of the interview suggests that, while the investment market is still active, there is perhaps a need for more at the early-stage, where seed funding and development capital are needed to push for growth and expansion. In this regard, the UK Government has started to take steps to encourage such investment through new policy initiatives (Cameron, 2010; HM Treasury, 2013). It is encouraging to note that respondents found the high-technology sector to be buoyant and still attractive to investors, even though such investments were ‘difficult’ to undertake, with the main attraction appearing to be that the start-up costs in the sector are low.

4.1.2 Existing financial statements

The second part of the interview was intended to explore the use and usefulness (or otherwise) of existing financial statements when the investor came to making an investment decision. Particular reference was made to intangibles. In particular this research seeks to identify the relevance of financial statements to the venture capital investor, and how important these documents were to them.

“It matters, but it’s not a very important piece of paper. All you are doing is establishing that the company has got all its liabilities and assets correctly stated but these companies are not yet making profit, probably don’t have sales. We look at the balance sheet, but it does not really have much bearing on the value of the investment.”

“Financial statements are useful and are an important part of any investment decision, particularly when talking about intangibles. There is always an issue about the degree of uncertainty around some of the assumptions and some of the valuations within those financial statements but at the very least they are always a jumping-off point, or a springboard, with which you can move to a different assumption about valuation or returns or prospective growth, which will then lead to an investment decision. They are an important influence. In some instances the investment decision may be based much more on the individual assessment investors make which may be different from the financial statements, but they are important, and useful. What really helps about the financial statements is the clarity of those assumptions.”

“Financial statements would not be very useful. Certainly you look at the income statement, and look at the earnings figure if there is any, but less so the balance sheet. You look at the gearing and equity structure in the balance sheet … The information needed is given by the entrepreneur himself in the due diligence stages. Certainly it does not appear they might be more relevant to private equity investors – (for venture capitalists, the weight given to them is less than 10%)”

“Angel investors, when investing, will obviously ask for the balance sheet before they invest - if the company has undertaken any trading or any loans or possibly committed some liabilities with creditors … in technological companies, this would include the protection or the development of the forward cash flow of the business, the forward forecast of the P&L, is the critical instrument on the financial side, coupled with a statement of affairs of the company at the time they invest. Historic financial statements are not a very major component of due diligence.”

“Certainly, if you realise there are intangibles in the balance sheet the investor would ask questions about them but the specific figure is not very useful because everything is provided by the investor. Any information is provided during the due diligence stage by the entrepreneur and one can look at the actual patent documents.”

The impression gained from the above responses is that, if financial statements exist, then they would be considered; it is better to be fully informed than not, although projected future statements would be more useful than past historic statements. But often they were considered to be simply a ‘starting-point’ from which the investor could then explore further the underlying assumptions behind the figures included in the statements. However, if it were up to the particular investor to seek such information independently, for example from Companies House then the costs of doing so might outweigh the benefit that might be gained from the additional information, which may, in any case, be redundant:

“Usually, if we receive the statements, and they seem to be adherent, we might not confirm them from Companies House. Quite often the information at Companies House will not be meaningful because they file seven months after the year end, so if they come to see us at a certain time the information at Companies House may be out of date.”

“In general, whatever information we want we get. Capital is very scarce and this has been true in venture investment for the last decade. There are occasional deals where the company seeking investment could say ‘we won’t tell you’, but these are very rare cases; but in most situations the companies are very keen to have the investment, and need to be completely open, and deal with every question. So if we’re provided with accounts which leave questions then we ask questions. So the fact they don’t file the full accounts with Companies House is irrelevant.”

Probing on the particular interest in intangible assets, or more specifically, patents, and the reporting or disclosure of these on the face of the balance sheet, we tried to elicit whether or not accounting standards were sufficiently explicit to allow valuations to be made.

“It’s important, where possible, that patents arrive, and that the product has been patented. At that stage [prior to investment] the patent has not always been granted. You still [take a] risk, even though it is applied for, because they might not get it, or it will be modified in some way.”

“Different investors will look for different things, in terms of how they form, and ultimately make, their decision, particularly in high-tech companies, and a lot of the time some of the intangible benefits are not actually represented in the financial statements, such as drive and passion or experience of the entrepreneur. The disclosures around some of the valuations and some of the assumptions are important because they tell you where to question … the disclosures on intangibles in the balance sheet are important, particularly in terms of questioning. Patenting in particular, ‘what stage are you in?’, and ‘when do you expect patents to be granted?’ is important.”

“In some companies we invest in, [they] have nothing yet – just a founder with some clever ideas … there is more than just a financial statement to understanding the value of intellectual property. With earlier stage investments, it’s impossible to make a financial statement analysis of intellectual property. The only thing you can probably do sensibly is value the IP at the cost of creating it and almost certainly that’s too high. The only prudent value to put on IP in an early stage company is zero. There are so many risks associated with early stage investing that all of these things have to be right before the IP has any value … market risk, product risk, competition risk, economic environment … even when you think it’s a fantastic patent, for an early stage company, it’s very difficult to value them sensibly above zero, until you find somebody who will pay and you can sell them something.”

“The last place I would look to find out about the intellectual property would be the historic financial statements. I would ask if there are patents or other intellectual protection in the company - copyright, trademarks. I would ask for evidence of them. If there is a patent applied for you would ask for the relevant paperwork to discover exactly what the patent is. I wouldn’t rely on a statement in the financial statements of the company. I would therefore be to some extent surrogating the responsibility the accuracy of what’s written up to the directors and the auditors, and they might not have any auditors, so it wouldn’t be a very high level of satisfaction and protection. You do your own due diligence on the company’s IP.”

“We do not believe these [disclosures on intangible assets] are very relevant. The entrepreneur provides all the information, whether it’s financial information, business strategy information”

So it appears that the reference to a patent in the financial statements is only the beginning of the story, as it is difficult for investors to accept that you can make a sensible measure of intellectual property. What seems to matter more is that, where relevant, the potential investee discloses the nature of the patent (or other intellectual property), the stage it is at, the underlying assumptions made in arriving at a valuation, the potential sales (e.g. firm orders made), and so on. Given the impression, from the above, that financial accounts have little to offer investors when they try to evaluate a prospective investment in a high-technology firm, one might expect them to suggest improvements or amendments to financial accounts, to make their lives easier. Their thoughts are outlined below.

"I think they are OK, you can overcomplicate things. Early stage companies have rarely spent an awful lot of money, they are probably developing a product, patents are quite important. The historical financial figures are not terribly important. We are much more interested in the forecast, the future financial figures."

"Accounting standards are getting more complicated, and on a personal basis you would argue on simplification rather than increasing the complexity. My opinion [is that] we wouldn't lobby [to change accounting standards]. It means more professional fees. If young firms have to value as part of their accounts, they ask a professional to value, they would incur fees to do that."

"When you're investing, you're investing in future value, not past value. If the patent is worth anything it will generate sales in the future. The value of the past is almost irrelevant, it's about the future."

"At the venture capital level, there is an awful lot of due diligence, far above and beyond financial statements. Financial statements are a useful backdrop and useful starting point but a typical venture investment will involve several meetings between the VC and the entrepreneur or the company management, and that will be partly around individual style and individual preferences, what people think of him, and getting to grips with some of these issues particularly around the patents side. It's not the intangible space which only matters; anything which involves innovation is very important – be it in manufacturing or agriculture. I don't think having more explicit disclosures will stop that process of further investigations."

"I don't think there is a belief in the group of people I know that financial statements are defective in any agreed way. There is no consensus that there is a defect. Clearly financial statements are always not the whole truth and sometimes they're not even very close to the truth but I don't think anyone believes that the problem is always the same problem. In some situations, the problem is the way the rules work about declaring licence fees, depreciation, R&D. There can be all kind of ways in which the financial statements can be misleading, but I don't think anyone believes there is an easy fix to this."

“The investor is making the decision to spend time on due diligence based on the proposed investment in the company which is not likely to be based on the financial statements. It would be based on the business plan – the executive summary. At some stage going down the process you might come across the financial statements but it’s so down the chain. It is so less important at the early stage. It’s probably more relevant five years down the line when the company is profitable and turning over large sums of money based on what is in their balance sheet – patents etc. In the first instance it’s almost irrelevant.”

The feedback on possible changes to financial accounts is interesting. It shows that, although they are not perfect, investors believe that there is nothing intrinsically wrong with financial accounts; and to require more detailed disclosure would only add to the burden (in terms of complexity and/or cost) already placed on a young high-tech firm. So financial statements are regarded as a starting point that a venture capitalist might use to then pursue his or her own line of due diligence. The narrative surrounding various financial reports, including the business plan, executive summary and any disclosures about future expectations were all considered to be more worthy of attention at the early stage and prior to investment.

4.1.3 Other forms of reporting and other documents used

Related to this, the respondents were next asked to comment on the proposal that new reports be introduced, specifically to look at intellectual property, in line with suggestions from the European Union and the OECD (European Commission, 2006b; OECD, 2012).

“I think that will be useful. It’s another ingredient in the investment decision. Even with that kind of detailed information, I don’t think it’s a panacea. Even with a stand-alone source of information there still needs to be meetings between the VC and the management, and they will still take place over a number of months in the process of eventually making an investment.”

“It’s up to the individual investor to obtain as much background information as possible on the state of intellectual property. That’s a very complex area and it might require third party experts to validate. If it’s a large syndicate, backing a start-up who claims to have strong intellectual property – it might be in medical technology, which is very complex, for example – it would need an expert to give feedback to the investor. It's a long way away from looking at financial statements."

"I think it [an intellectual property report] would just be a waste of money by the entrepreneur."

"I think that would be quite useful. Very often it's useful for more mature companies. It is difficult for them to express the real value of intangibles they have. If you actually had a report which states, we've got three patents granted, two applied for, I think that would be of great interest, but later up the chain. Bear in mind, here, we are talking about early-stage companies."

The results from this section are fairly equivocal; some thought it might be a good idea, while others were unconvinced, and thought it would only be a waste of money. Therefore, we wondered, what else would investors like when trying to value a possible investment? For example, would they prefer to have provided more information on a patent, in addition to the financial information already available?

"As investors, we would demand to see all the patent documentation."

"You look … for: first mover advantage; first to market a piece of software; potentially, that the software has taken so long to develop, and so many man-hours; that anybody coming in behind would find it too heavy to invest in if there's a product already in the market. So, you're looking to get in quickly and corner a bit in the market before other people can catch up with you."

"It will be combination of different things. Clearly you have the financial statements of the company as whole, particularly at the VC level, the profile and experience of the entrepreneur is incredibly important. VCs may want or get someone else to cross check those. When you come to pitch there would be an assumption of the overall size of the market and the share of the market. Sometimes, a bit of inspection work on competitors is done. If this is a genuine start-up, a new area, new product or new service, you see who else is in the space, and you would look at how much of a threat do they pose."

"Sometimes the reason you invest in a company is that you can see that they have contracts in place, and some revenue stream, clear, capable products already developed which people love. This is a situation where the IP has value. The value relates to the capable staff. You can ascribe some value to the IP in that case. In a situation where the product is not available, and there are no contracts, we would always evaluate the IP ourselves."

“Each investment is a different situation. In one investment we may be very comfortable about the nature of the product, supply channels, the market, price points, the margins, the opportunity, and the one question we have is whether the team are capable of delivering, so we might want to do due diligence on the team. In another situation you may have a first class team, the product is good but we might thing that fundamentally the market may disappear in two years time due to developments in a related field. One kind of technology might be about to die and the other kind of technology is better. In this situation the due diligence that’s needed is why the entrepreneurial team believes that the technology is not obsolete – market due diligence, and we would need to commission that probably. We could ask the company/team for a lot of material – management reports, board packs, marketing strategy documents, budgets, all of this, but we might still go out to get third party reports, to help us understand the technology.”

As we can see from the above, there is a huge amount of due diligence undertaken by investors to supplement the information that they have been given by investee companies. What is important tends to vary according to the nature of the investment or the sector in which they are investing. Very often, the personal qualities of the team or management are important, as is their experience in bringing a project to market. The existence of contracts for sales, or identifiable future revenue streams, might be a deciding factor too. At the end of the day, it seemed that each potential investment was appraised on its own merits, with financial statements only providing part of the picture.

To summarise the findings on existing financial statements, the respondents seem to indicate that they are a necessary, but not the only, source of information about a new high-technology investment. They are used as an indicator, but the existence of intangible assets, such as intellectual property, or patents, in the statements serves merely as a foundation for further investigation to determine the underlying assumptions behind any valuations. Therefore, while financial reports cannot in themselves, provide the whole story to investors, there did not seem to be any call for changes to required reporting standards or for additional reports on intellectual property specifically. Doing so would only complicate what were seen to be already complex requirements, as regards to financial reporting.

4.1.4 The significance of patenting to the investor

The investor associations argued that patent documents were more important than looking at the financial statements because "the most important decision is where the business is going with the money they're injecting into the company", and "many times this would include looking at the production or development of intellectual property". However, there are other intangible assets which might also be relevant but which, in a similar way to patents, are difficult to value. If the company does not yet have patents, or has alternative intangible assets, how, we wondered, would that affect the decision of the investor about an investment?

"The value you put on the company [without a patent] would be lower, because you acknowledge that there is no protection at that stage that you're investing; and, equally, if a patent was going to be applied for, there would be a future cost in relation to that, and risk. It is not hugely scientific; there is no kind of set formula. If a patent has been applied for, and certainly if it has been granted, you would expect a higher valuation of the company."

"Clearly, having a patent is better than not having a patent. If you have two identical investments, one with and one without a patent, I would read the patent, and I would evaluate the value of the patent and then I would decide what this patent told me. If the patent is well written, thoughtful, strategic and very valuable, within the package with the entrepreneurs in that company, it would be a valuable part of the mix. On the other hand, I could read the patent, and I could find that it is poorly drafted, full of defects, very easy to work around, and might be commercially too expensive to use, or it's in a very crowded packet space, and you could probably do nothing with it – in which case it would be actually a negative, because you think that these people have wasted time and money producing a patent that is worthless – so they're fools and they've already spent money doing this."

"Patents are only one part of the company's intellectual property – if we're looking at drug development, medical technology … then, yes, they are very important. If the scaling of that business model in getting high gross margins, driven by the fact that competition cannot enter into the market because the patent will protect the company in this particular project, then you put a lot of reliance on patents."

The investor associations were asked whether patenting was conveying a signal to investors (cf. Long, 2002). Most of the associations agreed that patenting does convey a message to the investors:

"They [patents] can be a signal in two ways: if you already have the intellectual property in place, clearly the potential to make a return on that is greater than if you haven't. Once you have the intellectual property in place, you reduce the uncertainty associated with someone else coming in. Patents are also a signal about the entrepreneur. You may have a brilliant engineer, with great ideas, and has no idea how to provide that ring fence around the intellectual property. That probably raises a few of questions marks in some people's minds or, at the very least, is a signal that the kind of support that the entrepreneur will need to turn the idea into a successful business may be a bit different from that of someone who has already been through that process before, and successfully built a business around it. So, it's a signal – not only about the investment but about how developed the idea is, how experienced the entrepreneur is, the likely amount of work that the VC might have to put in. It's a signal in a lot of different ways."

"They can be a signal but no more. It is good to have a patent, but on the other hand the patent could be worthless."

It seems that the existence of patents is helpful to the investor, but that they would want to know more about who the inventor is and what stage the patent is at before placing any value on it. So again, it is only a part of the picture, and requires a judgement call on the part of the investor about whether it confers any value.

"The perfect situation is that the patent has been granted and it's effective – then you're in a stronger position. Often, you're left guessing whether it will be granted because, in the time you are having to make the investment decision, the patent hasn't been through the whole process, so you make an evaluation of its progress since the application was launched, and make a commercial judgement."

4.1.5 Patent valuation

In the fieldwork, an interview was carried out with a patent attorney who is renowned in the venture capital field. He argued that firms are not willing to attribute a value to intangibles because of possible tax implications. He explained that "tax law is extremely complex, and there are always uncertainties relating to the advice given when it comes to tax advice. The outcome of tax decisions cannot be easily predicted". Furthermore, he mentioned the subjectivity involved in valuing intangibles, which might possibly lead to reliability issues. He mentioned that although Germany has a standard for valuing patents – "this is simply a list of factors which are taken into consideration when calculating patent value. However the cost to value the patent using this approach is likely to exceed the cost of the patent itself and would cost around 500,000 euro". The attorney explained how the investors, particularly universities often request a form of valuation. However the main concern is maintaining costs to the minimum. He explained how usually patent analysis or valuations are requested by the investors, rather than the entrepreneurs, with the exception of universities. He admits that despite all efforts, the valuation is still inaccurate but "it is better than having nothing".

Because of the existence of information asymmetry between the investor and investee (cf. Aboody & Lev, 2000; Reid & Smith, 2008a), each party to the contract of investment may place a different value on a patent within an organisation. The respondents were asked whether they actually tried to ascribe a value to patents, and how they might deal with valuation difficulties. One gave the following response:

"The investor will try to say that it's not worth it a lot, but the founder will be trying to say that's worth a lot. There's a bit of cross chat on negotiation about how much that's worth, but to be honest a founder that doesn't have some kind of patent protection is not that attractive as a founder who does have. To put those aspects on the balance sheet is very difficult. Actually it might cause more argument, because how do you value a patent? It's judgemental value."

Furthermore, they were also asked whether they might take into consideration specific items in the patent document, such as patent citations and/or patent family size:

"We dig deeply … it's a very important part of diligence, because anybody can apply for a patent; it depends on how strong it is. If there are challenges cited and they appear to make sense, they devalue the patent. Some [of the information] is readily provided by the investor."

"The most important aspect is having applied for a patent. Assuming they have, the next important aspect what's the coverage of the patent (geographical coverage). Past experience is relevant, if someone has been in the patenting process before. That can be useful. But to be honest, what might be more important aspect is the commercialisation ratio. Or in other words, if someone has been through the patent process before how successful have they been in generating a sustainable business on the back of their intellectual property. Some may have brilliant ideas, but really struggle to turn those ideas into commercial entities and that's a really important signal – how successful has been the entrepreneur in turning a protected idea into a revenue stream."

"The family size begins to indicate something because somebody who owns a single patent in one country is a fool, but maybe a small fool. A company that has 30 patent families being rolled out in multiple countries has somewhere found millions of pounds to invest in patents – patents are very expensive … The indication is that if they have 30 patent families they have some valuable IP. In terms of the number of citations, it is probably a good sign, but I doubt that very much attention is giving to investors to that, because there are so many other factors to consider – people, markets, products competition, regulation … But even then it could be that it's very fundamental technology which is what is cited a lot, but its an old patent … it could be a way of doing something that is superseded, e.g. the wrong type of solar cell, if you have the wrong kind of battery technology … age matters as well. We would probably be interested also in who drafted it – are they solid with the company."

"You try and identify the strength of the blocking of the competitor, and what the competitor advantage your target investee company has. The product has still to be something that people want to buy, you cannot get too carried away with the patent itself. It might something great as an idea but is sold only to 5 people. You have to do all the other tests of market penetration, size of market, capability of entrepreneur to exploit the IP, and all the usual problems that go with investing in start-up businesses. It's part of an important suite of decision making situations you have to evaluate."

"How would you value it if they haven't sold any products? It's protecting something that hasn't gone into the market. It's very difficult. All it's doing is adding more intelligence to the angel investor. They still have to assess the ability of the management team before going into the market. It might be one of the products which sits on the shelves for ten years and doesn't really sell."

In assessing patents, therefore, the investors looked at a number of different items. For example, citations were considered, and family size (representing scope of protection) was also important. Furthermore, the age of the patent and the actual inventor were additional considerations that were mentioned by the respondents.

4.1.6 Patenting and the investment deal

The associations were also questioned on whether they believed patents would make a difference, not only to whether an investment was made or not, but also to the actual size of the investment:

"It might do – a difference in the value of the investment, not the size of the investment. The size of the investment will be how much does the company needs to take it to breakeven or profitability. The value of investment, the percentage of equity you're buying will differ. If there is a strong patent in place, you're likely to get a higher value of the company, so that means you get less equity."

"No. Certainly not a significant one. If the business needs £100,000 then the business needs £100,000. Whether it has a patent will have a second order impact on the size of that – whether you get a £100,000 or a £90,000. In terms of equity, you do have the difference. If you've been through the patent process already, you have gone one further step down the road and so in the investment size there may be some impact but I don't expect it to be big. In terms of equity you can see the difference. If I'm coming to do an investment where there hasn't been a patent process, there is implicitly more risk, you can see the difference in the equity."

"No – not even in terms of equity. No cause or correlation between the two. Its probably statistically true, that large investments tend to be made in companies with more patents, but it is also true that they will have more fire exits too because large companies have more of everything."

“Probably yes – making an assumption that the management team was adequate. Remember jockey on a horse. Do you look at the horse or bet on the jockey who is riding it, or would you would say, I know who’s riding this horse, but I’d like to look at this horse. If the company has a patent but the management is rubbish - no strong management team, the chances of making a profitable return for the angel investor in that business are not that great. You might choose one with a stronger management team but less IP. The decision to invest is not always based on what’s on their balance sheet at the time. The actual exploiting of the intellectual property, creating a business that create ten times or more exit value for the angel is very difficult to achieve. You need very good people at the helm of the company as well. You might pay a little bit more for a company which has patents but that is not always the case.”

The feedback above suggests that investors do not have a ‘rule of thumb’ or explicit formula that can determine the value of an investment, whether in nominal terms, or as a percentage of the equity stake that the investor wants to take. Instead, the existence of patents seem to suggest that there is something of value in an organisation, and that it is worthy of having money spent on it through patenting; and how that investment is then valued is down to additional research by the venture capitalist. Given the expense of patenting, and the nature of high-technology organisations, after the initial investment, we wondered, would the respondents expect to see an increase in patenting? The respondents had varying thoughts on this as a proposal, with no firm conclusion either way.

“Yes. You are always looking for patent protection, if you can get it. It helps a lot, to the extent that if you’ve got a family of patents that are coming through, even if only applied for that potential will add value. But again, this cannot be expressed in a balance sheet.”

“It depends on the deal. Sometimes the entrepreneur will have an idea on a completely different unrelated field whereby there may be a potential for another patent but it’s not related to the previous business. But I’m not sure, the investment decision has a first order effect on the number of patents you go for. When you pitch to a VC, part of the pitch will be how I’m going to build a business and run it. Something as important as a patent in an intangible business would be there. I’m not sure that the number of instances you have a new idea within the same business, is particularly high.”

“Sometimes we invest in a company and we’re aware that the intellectual property protection has been poor and that we would need to get the company’s IP better organised. It could be that you go in a company but the technology is good but the sales department is not very good – it could be IT, sales department, product strategy etc. It's very hard to say there is a tangible value to that argument."

"If the company needed to raise the money to complete the process of the patenting, then a fair amount of the weighting of money going into the company will be allocated in the direction. That's pretty normal. If it has patenting in one territory, and wants to expand the patent suite into other parts of the world, the new money is going to fund that."

The patent attorney mentioned earlier in this discussion explained how the investor is very cautious, in particular due to the subjectivity involved.

"[The investor] He is likely to be inclined to say there is no relationship – despite that studies show that a relationship exists. They often state that their decision was based on the basis of management or the business strategy. Although valuation may be useful for the investors often they are unwilling to obtain such information in view of the costs involved."

With regards to patenting and other intangible assets from the investor's standpoint, it seems that the financial accounts again have little to offer in terms of valuation information. The existence of intangible assets on the balance sheet is something that the investor would want to explore further through their own due diligence and, while patents can be seen as a signal of value, judgement is required to estimate what that value might be. Patents were not the only intangible discussed during the meetings. Respondents also raised the issue of backing 'the idea' or 'the individual', and their knowledge, know-how, strategy, product quality and track record, amongst other things. Where patents were used as a measure of value, patent citations, geographical coverage by patent families and the individual inventor were all also considered to be important considerations. But even when all of these were taken into account, there was no deterministic way of valuing an investment according to patents or intangibles.

4.1.7 Other intangibles

If patents are not important for a particular investment opportunity, there may be other intangible assets which are. The respondents were asked to talk about the types of intangible assets that they would look for, and how (if at all) they would place a value on such an asset.

"The fundamental one which is hard to put a price on is the idea. Even if you managed to apply for a patent for a production process or a new form of technology, the very art of venture capital is backing somebody who brings about something new and often that new thing, in a broad economic context can be considered as intangible asset. It's an idea. Sometimes you might be able to patent it sometimes not. As a VC, particularly in the start-up and seed stage, you are starting from scratch; you are backing an individual over the idea. The individual and the idea are two ingredients you have before you put the money in. In a broader economic perspective, in the seed and start-up stage basically everything is intangible apart from the person – and even that is intangible in terms of the human capital that's located there and the degree of expertise and specialisation that person has. Essentially it's everything. It's not always recognised in terms of the financial reports."

"Definitely, know-how, and team track record. Generally the things like the strategy and quality of the team are considered."

One recurring theme considered above is the backing of the individual, or the team surrounding an entrepreneur and his 'idea'. These are clearly intangible assets, which are very hard to value at an early stage, but which an investor needs to evaluate in order to determine whether he or she can expect the business to succeed.

4.1.8 Conclusion

The feedback from interviews with key personnel from early stage investor associations, summarised in Table 4-1, shows that there remains a relatively healthy market for investment in the UK. Venture capitalists are still extremely active but arebecoming more cautious, as exhibited by their shift away from the very early-stage investments towards later-stage 'safer' investments, where the technology and people have been 'proved'. For companies looking for early-stage financing, the consensus seems to be that business angels, either individually or in syndicate form, are the way to go. Investments in high-technology are still popular, primarily because of their low start-up costs, but again, caution is being shown by venture capitalists, who favour tried-and-tested technology investments over unproven not-yet-to-market products.

Table 4-1: Summary of findings - Unstructured interviews

A. General overview

- UK venture capital buoyant but prefers later stage investment
- Very early stage may require business angel funding
- High technology investments still popular

B. Existing financial statements

- Existing financial statements helpful but not crucial
- Income statement more relevant than balance sheet
- Disclosure of intangible assets more useful than balance sheet figures
- Additional reporting not required
- New financial reports superfluous
- Venture capitalists use many measures to determine investment

C. Patenting and early stage investments

- Patenting seen as a signal of value
- The ‘idea’ and the ‘individual’ important key measures
- Patents measured by citations, family size, scope, age, inventor
- Patenting not related to size of investment in monetary terms
- The percentage of equity required might be linked to patenting
- Patenting may or may not increase post investment

With regards to the use of financial statements by the early stage investors, some differences were observed in the responses given. Some argued that, because they were dealing with early stage investment, historical accounting statements were not relevant, and one went so far as to say that financial statements are “almost irrelevant”. Although it was claimed that the historic balance sheet was of limited use, they might still demand a balance sheet, but only to check whether an investee company had any loans or other liabilities. Furthermore, it was argued that the purpose of the balance sheet is simply to establish that the company in which the investment is being made has correctly stated its assets or liabilities. Having stated this, the balance sheet itself had no particular bearing on the actual investment made by the investor. It was also argued that these firms might not have any auditors, in which case the reliability of the financial statements could be questioned. The critical instruments in an investment decision were more likely to be the forward forecasts of the profit & loss and balance sheet. Nonetheless, it was argued that at some later stage of the investment, financial statements might become relevant. It was also clear that decisions are not solely based on the financial statements and that there are instances where the financial statements are not used in the decision process.

The respondents all agreed that they see no need to improve existing financial statements, partly because they were unimportant to the investment decision, but also because they were already thought to be complex enough. One even argued that, if anything, a simplification of the financial statements is desirable, although they were not willing to raise concerns with standard setting bodies on the matter. A typical response was that “as a trade body, we rarely consider the accounting issues that relate to underlying portfolio investments”. Although it has been claimed that the financial statements can be a useful backdrop in the case of venture capital investors, it appears that such an investor is unlikely to be concerned about increasing the disclosure of the financial statements because “having more explicit disclosures will not stop that process of further investigations”.

The views of respondents are in line with the analysis by Hand (2005a) and Wilkins et al. (1997) that financial statements are not relevant. However as the firm matures financial statements are more likely to become relevant. The reason for this can be explained partially by referring to a recent publication by the British Business Angels Association, which shows that more than half of the companies in which business angels invested still did not have any revenues (Wiltbank, 2009). As one of the respondents explained, the investor is “investing in future value and not past value”. This is a reflection of the fact that the balance sheet shows a representation of the company’s affairs at a fixed point in time (Elwin, 2008). For the very early stage investor, what matters most initially is the entrepreneurial ability (Wilkins et al., 1997) and possibly any proprietary rights. Early-stage investors are in agreement with Sweeting (1991) in claiming that the early stage the financial statements are used primarily only to ensure the credibility of the entrepreneur.

The discussion on financial statements in general was followed by debate on the use of intangible assets figures, as shown in the financial statements. One respondent argued that whether the figure of the intangible asset is used depends on the investor preferences. However, it was pointed out that the intangibles which are more useful to the early stage investor are those relating to human capital, such as the experience of the entrepreneur, and the drive and passion he has. In view of the difficulties in measuring these, in line with accounting standards, human capital related intangibles are not found in the balance sheet. It was argued that the disclosures on intangible assets that are not found in the balance sheet "are particularly important in terms of questioning". Even though a figure may not appear to be useful, given the estimates involved in calculating it, it may be an indication that further questions need to be asked on it in the due diligence stage. On the other hand, some were more sceptical about such figures, arguing that "the last place one would look at to find out about intellectual property would be the financial statements". It was suggested that such information would probably be much more relevant to later stage investments but not at early initial investment stage; valuations are very difficult in the early stage particularly because no products might have been sold.

Although the respondents argued that financial statements are useful for the investor they still appear to be mainly concerned about monetary items in the financial statements such as loans rather than, for example, intangible assets. Despite that fact that the IASB Framework states that the financial statements are meant to be useful for investors (International Accounting Standards Board, 2011a), the early stage investor representatives argued that their use is somewhat limited and that there is no substitute for additional documents obtained at the due diligence stage, and meetings held with entrepreneurs. It is unlikely that the investor becomes aware of the intangible assets whilst analysing the financial statements. In view of their importance, the investor would be made aware of the intangibles during the various meetings with the entrepreneur.

This analysis is contrary to Wyatt's (2008) argument that the figure representing intangibles in the balance sheet would serve as a signal for investor to obtain more information on the intangibles from other sources of data. Conversely however, one respondent did explain that if there is disclosure in narrative terms relating to the intangible assets this could be important in terms of questioning, implying that additional narrative information would be of limited use as opposed to estimated figures in the balance sheet, especially at the venture capital stage. Perhaps this is the main reason why the early stage investor representatives did not discard the idea of having intellectual capital reports.

The respondents were not concerned with modifying the financial statements to make them more useful because they were still managing to obtain the information from other sources. Similar views were found in previous research carried out by Reid and Smith (2005) which perhaps is an indication that the lack of enthusiasm by investors to increase the relevance of the financial statement is not a new issue. Furthermore, the perception that financial statements do not need to be made more useful appears to be in line with a previous study by Hirschey et al. (2001) who concluded that, as long as information is obtainable from other sources, there is no need to modify the financial statements. For example, patent information can be found online in patent databases such as the one maintained by the European Patent Office. All this leads to questions as to whether there is any need to incorporate information of a qualitative nature on patents in the financial statements. Having stated this, the fact that investors resort to other sources of information rather than financial statements could be a result of financial statements historically not containing enough information particularly on aspects such as intangible assets.

Another interesting point worth mentioning is that the IASB is actively seeking investors' feedback on which topics to place on its agenda. For example, Georgiou (2010, p. 103) discusses what he calls 'the dearth of research into users' participation in, and influence on, the process of setting accounting standards'. Amongst other aspects this includes the recognition of some internally developed intangible assets.

Whilst questioning the relevance of historic financial statements, investor associations appeared to be disinterested in providing similar feedback to the standard setters. This raises some concerns, given the potential benefits that investors might gain from participation in such discussions.

There has been a movement in favour of companies producing intellectual capital reports. Reference was specifically made to venture capitalists in an EU publication on the production of such reports. The respondents agreed that the production of such information could be useful because “it’s up to the individual investor to obtain as much background information as possible on the state of the intellectual property”, although there was agreement that they would be of more relevance to the later stage investors. However, as one interviewee argued, such reports “are not panaceas”; the reports would never substitute for lengthy meetings held with the entrepreneurs during the due diligence process. The intangible assets area, it was argued, is very elaborate, and often experts must be engaged to advise on complex matters related to intangible assets. Therefore it is not simply a matter of referring to an intellectual property report published by the entrepreneur in order to attract the investor.

It does appear, however, that some investors would welcome any information provided by means of intellectual capital reports, especially by those who invest in the later stage. Whilst the use of other documents by investors is line with the IASB Framework’s concept that the financial statements are not the only document that should be used by the investor in evaluating investment decisions, it remains questionable whether intellectual property reports would actually be used. Although on paper practitioners appear to be in favour of such reports, the use of such statements is not widespread (Mouritsen et al., 2001). One must point out that if the publication of such report is not popular with large firms, small firms which are targeted by venture capitalists are likely to be less willing to produce intellectual capital reports themselves. However, it is clear that if these reports are produced, no matter how much information they contain, they will only be additional to the due diligence discussions.

Probing more specifically on the existence of patents and/or patenting activity, one can observe that it can be seen as a 'signal' to the investor that there is value in the organisation (cf. J. A. C. Baum & Silverman, 2004; Engel & Keilbach, 2007; Hsu & Ziedonis, 2007) although some argued that this can be dependent on the industry. However, this is not without its own problems, and still requires further investigation, in order to determine the nature of the activity undertaken. This investigation would examine additional measures of intangible assets, that do not necessarily appear in a company's financial statements, such as 'the idea' or 'the individual', for example (cf. Basu & Waymire, 2008; Oliveira, Rodrigues, & Craig, 2010).

Patents, when used, were measured in a number of different ways. Some thought that citations would be important (cf. Dushnitsky & Lenox, 2005); others mentioned geographic scope, patent families, age of the patent and the individual who invented the innovation in the first place (cf. Conti et al., 2011; Hand, 2005a; Munari & Toschi, 2014; Schertler, 2007). Prior research had found it questionable that patenting or other intangible assets could be related to the size of the investment, but without supporting explanatory detail (cf. Mann & Sager, 2007). Respondents gave suggestions as to why it might be difficult, if not impossible, to determine the size of investment according to patenting activity. Finally, they were equivocal about whether or not patenting might increase post investment, in contrast with North American studies by Kortum and Lerner (2000) and by Ueda and Hirukawa (2008). One respondent argued that the reason for such differences between studies in the United States and the United Kingdom could be the lower prevalence of serial entrepreneurs in the venture capital market (cf. Wright, Robbie, & Ennew, 1997).

The findings of these unstructured interviews suggest that the financial statements are of limited value to venture capital or business angel investors, particularly at the initial stages of the investment. Investor associations appeared to be sceptical on the recognition and disclosure of intangibles within the financial statements, although some argued that they may be useful for further questioning. What seems to matter more than reporting is the nature of the patent (or other intellectual property) and whether it is beneficial to the business model of the investee companies. However, the respondents questioned the direct link between the investment amount and the number of patents, arguing that if there is a link, this would be more related to the percentage of equity requested and the number of patents. Following these initial interviews, as recommended by the associations themselves, a series of interviews were conducted with UK venture capitalists. In the next chapter more detailed aspects relating to the reporting of intangible assets, and the link between the investment and the intangible asset with a particular focus on patenting, are considered.

4.2 Overall discussion and results of the semi-structured interviews with venture capitalists

In this section, we present the overall results of the administered questionnaire (see Appendix C for a copy of the questionnaire) carried out amongst 21 venture capitalists across the United Kingdom. We have analysed the coded answers of the interviewer administered questionnaire in a narrative manner (cf. Reid & Smith, 2008a), using graphs and some statistical analysis where this is considered as needed. Under each graph or table we have indicated the number of respondents which have actually answered to the particular question relating to the topic under consideration.

4.2.1 Financial Statements

The first section of the questionnaire dealt with financial statements. Initially the respondents were asked to indicate the importance ascribed to certain figures available in the financial statements (which could be both prepared for management use or published).

We first asked the importance of the key figures within the income statement. Respondents used a rating scale from 1-5, and were asked not to mark if they considered the figure to be irrelevant. This was then coded as being a '0'. The results of this analysis are shown below in Figure 4-1.

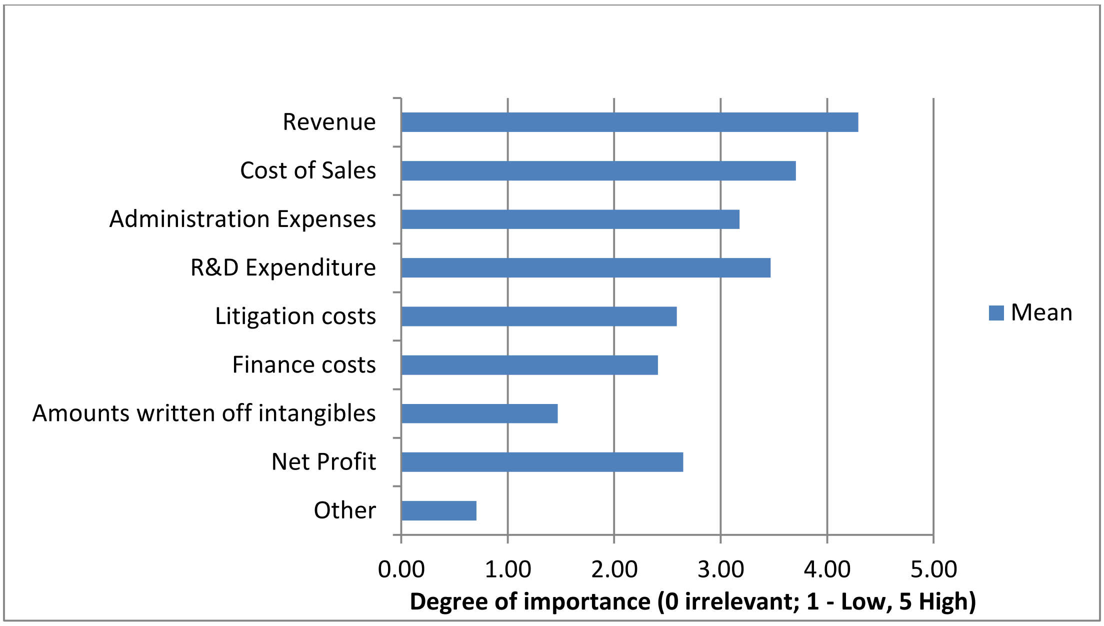


Figure 4-1: Importance of figures within the income statement (when it comes to assessing a potential investee) (n=17)

The respondents argued that if the firms are making revenue this figure is crucial, followed by the cost of sales and the level of research and development. Some of the venture capitalists argued that they invest mainly in pre-revenue stages, and therefore the figure would not be relevant to them at the start of the investment but would become important as the firm grows.

The figure for research and development expenditure within the income statement was seen as important by most venture capitalists interviewed, with only one respondent claiming that it is irrelevant. The majority of respondents (58.8%) ascribed it a value of 4 or 5. Those respondents, who ascribed very low importance to the research and development expenditure figure in the income statement, were often sceptical about the use of the income statement in general (with some stating that a cash flow statement would be more appropriate). Other firms indicated that research and development is not their particular area of focus when evaluating proposals. One particular respondent argued that "if a company has a piece of IP, it may have not been paid for, what matters is how much it has. The fact it has IP is vital but what it spends on it, who cares". It was also argued that:

"the amount spent on R&D, if you're in a really good company shouldn't really relate to the value of the business. The value of the business is more does the product work, is there a significant market, is their do you have a strategic position of the market, are there high levels of IP which may not be patents around the product. You can have two identical businesses one might have spent twice as much money and there might be one which spent half the money, and the on which spent half the money has done it properly, has some secret source that is difficult to copy, but the one which has spent twice fails and you lose everything."

The intraclass correlation coefficient (ICC) was used to assess consistency of agreement of individual responses relating to the importance of specific figures within the financial statements. Under this model, if all the ratings differ by the same constant value amongst respondents they are deemed to be consistent. The intraclass correlation coefficient is equivalent to one if there is perfect agreement amongst respondents. Conversely, if the value is low, it means there is a large degree of variability in the responses (Sheskin, 2007). Theoretically it is possible to obtain a negative value for the ICC, but Sheskin (2007) argues that when this occurs, the ICC is usually treated as being zero. We have used Stata to compute the ICC, and we obtained a value of 0.39, which shows a "fair agreement" amongst respondents who rated the importance of specific figures within the income statement. We assessed consistency of agreement of individual respondents. This relatively low ICC value can be explained by differences between venture capitalists who invest in different technology subsectors. In fact, research and development appears to be more important for investors which invest in the pharmaceutical sector (Mdn=4.5), than for those VCs which do not invest in the pharmaceutical sector (Mdn=3) [$U = 8.00$, $z = -2.129$, $p < 0.05$, $r = -.52$]. The Mann Whitney U-test is a non-parametric test used throughout this chapter to test for differences amongst different groups of respondents (e.g. different industries and different investment stages) (cf. Manigart et al., 2006). We made use of this bivariate non-parametric test since the underlying assumptions of the t-test are not met (Nanna & Sawilowsky, 1998). In line with Field (2009), we present the median instead of the mean because this is considered to be more relevant when conducting non-parametric tests. There are no other significant differences relating to the industry investment preference and the importance of research and development expenditure in the income statement when evaluating investment proposals.

However, this level of importance ascribed to research and development expenditure is contrasted with the importance attributed to amounts written off intangibles in the income statement. Despite IAS 38 being clear on when intangibles should be capitalised, investors appeared to be generally reluctant to show any form of intangibles on the statement of financial position (balance sheet). One reason for this is that most start-ups file abbreviated accounts to Companies House, which typically would consist only of a balance sheet, in line with the requirements of the Companies Act, 2006 (see Literature review, Section 2.3). The companies which file abbreviated accounts can either prepare financial statements using full UK GAAP or using the Financial Reporting Standard for Smaller Entities (FRSSE). Under UK GAAP, development costs may still be expensed and 'in practice, most companies write off research and development costs rather than attempt to justify capitalising and development expenditure' (Pricewaterhousecoopers, 2011, p. 15026). Furthermore, under the FRSSE, companies are not required to disclose the amount of research and development charged to the income statement (Pricewaterhousecoopers, 2011).

One particular respondent claimed that "research and development may have no value and so therefore our view is you should write it off. Furthermore, if you're acquired by a US acquirer they may have different depreciation policies and you don't want immediate write off of any intangible assets on acquisition. If you write it off earlier on you make earlier losses but more profits later on which are more representative of cash flows and so typically you can get a better valuation". Others argued that at the point of investment they do not usually get capitalised intangibles on their balance sheet.

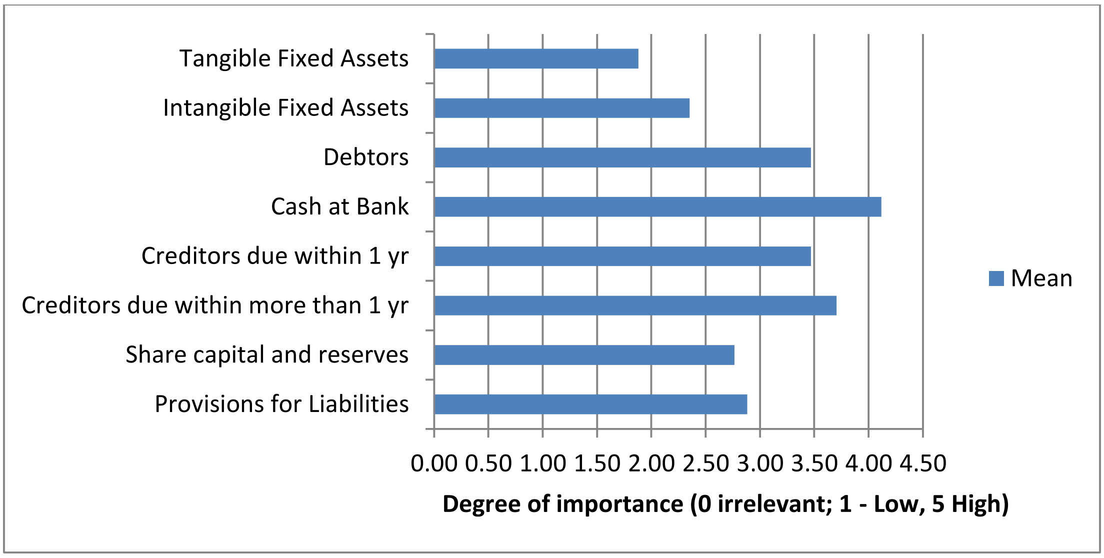


Figure 4-2: Importance of figures within the statement of financial position (when it comes to assessing a potential investee) (n=17)

Similarly, venture capitalists appear to ascribe very low importance to intangible assets shown on the statement of financial position (balance sheet) (see Figure 4-2). Some investors said it does not matter whether the intangible is shown in the balance sheet or not. The importance lies in whether the firms actually have the intangible or not. Those few firms which rated its importance as being high were also sceptical about the figure; in fact they claimed that it was only important because it raises concerns about why they capitalised the intangibles, and they would then need to question it. As one investor argued, a figure on the balance sheet could be seen as "just a way of over glamorising EBIT [earnings before interest and tax]". Tangible fixed assets are considered to be the least important because they would not be substantial in the case of start-up firms.

On the other hand, figures such as creditors were considered to be important because the investors want to make sure that the money they are investing would be used in profitable projects and not to pay out creditors. Cash is seen by the majority of investors as being crucial and a determinant of how much more cash they need to put in to make the business viable. In this case, we also checked statistically as to whether there was agreement amongst respondents for the whole set of responses relating to the balance sheet. We report an ICC of .44 (the intraclass correlation coefficient, details of which were discussed previously in this section), suggesting a slightly higher agreement than in the case of the income statement. No statistically significant differences relating to the investment stage, or the investment industry preferences were identified relating to the relevance of the intangible fixed assets figure in the balance sheet.

4.2.2 Increased detail and additional disclosure

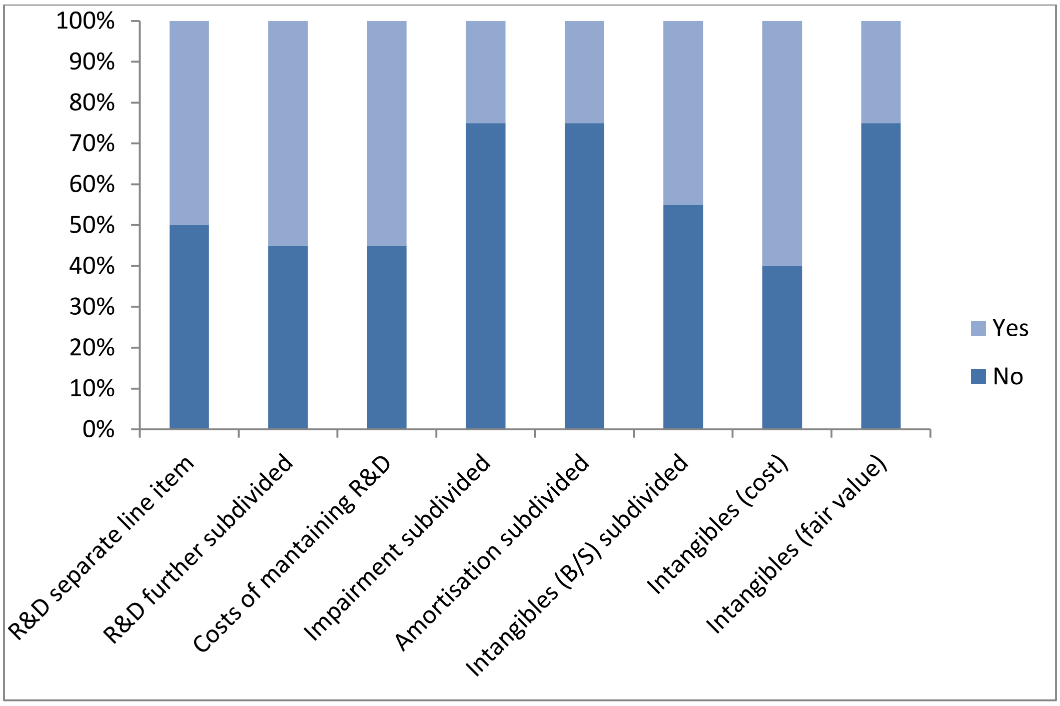


Figure 4-3: Views on presentation/recognition of intangibles on financial statements (n=20)

After identifying the importance of certain figures within the financial statements, we asked venture capitalists whether they were interested in having more detailed line items on the face of the financial statements (Figure 4-3). There was general disagreement amongst respondents as to whether research costs should be shown separately from administration expenses, with exactly 50% of the respondents in favour of showing such figures separately. One of the respondents argued that one of his "biggest frustrations is that under the Companies Act, costs get all dumped into administration expenses". Yet another respondent argued that if this was shown separately, it would be an added burden, since it would already have been shown as a result of the tax credits associated with research and development. Others argued that financial statements "can't be granular" and that such subdivision would not be useful because they would ask for it anyway at the due diligence stage. Some even cast doubt on how realistic these figures would be, arguing that they never believe figures provided in financial statements. They argued that information could be commercially sensitive, and though they would like to see it at board level, they would not want to have the subdivisions publicly available.

Similar mixed views were also obtained with regards to further subdivision of research and development expenditure, and the disclosure of costs relating to the maintenance of IP. With regards to the costs of maintaining IP, some investors were more willing than others to have this shown because they argued "all investors have a rough idea of these costs", and it is therefore not considered to be sensitive information. However, respondents were clear with regards to having separate line items for impaired intangibles and amortisation of intangibles, with 75% of respondents preferring to recognise these as a global figure rather than showing these as a separate line item. Respondents argued that if impairment/amortisation costs are subdivided, there would be too much unnecessary detail. Furthermore, some investors stated that their investees do not capitalise development costs hence such recognition is irrelevant for them. Although 60% of respondents would be willing to show any intangible assets at cost given that "cost is verifiable", 75% of respondents expressed concerns about having to show intangible assets figures at fair value, in view of its subjectivity and that "it can be subject to abuse". Interestingly, all of the respondents who argued that they would like to see an estimate of the actual value on the balance sheet would also want to see the value of the intangibles at cost. One particular respondent argued that he does not find any difficulty with showing them at fair value, "as long as there is a clear rationale for the figures including third party verification of that rationale". No significant differences were identified for respondents investing in different industries and across different stages. Having stated this, it is clear that if more detailed recognition were done in the financial statements, it would not eliminate any need to ask for information about these subdivisions at the due diligence stage, with 85% of respondents stating that such information would still be required because “you still wouldn’t get the full picture”.

Venture capitalists were also asked to indicate whether they would like to see more disclosure within the financial statements, concerning qualitative aspects, such as the number of workers involved in research, the number of patents and the geographical scope of patents. As can be seen in Figure 4-4 once again, mixed views were obtained from the participants, although most participants were against additional disclosure (with the exception of disclosure on the number of patents held).

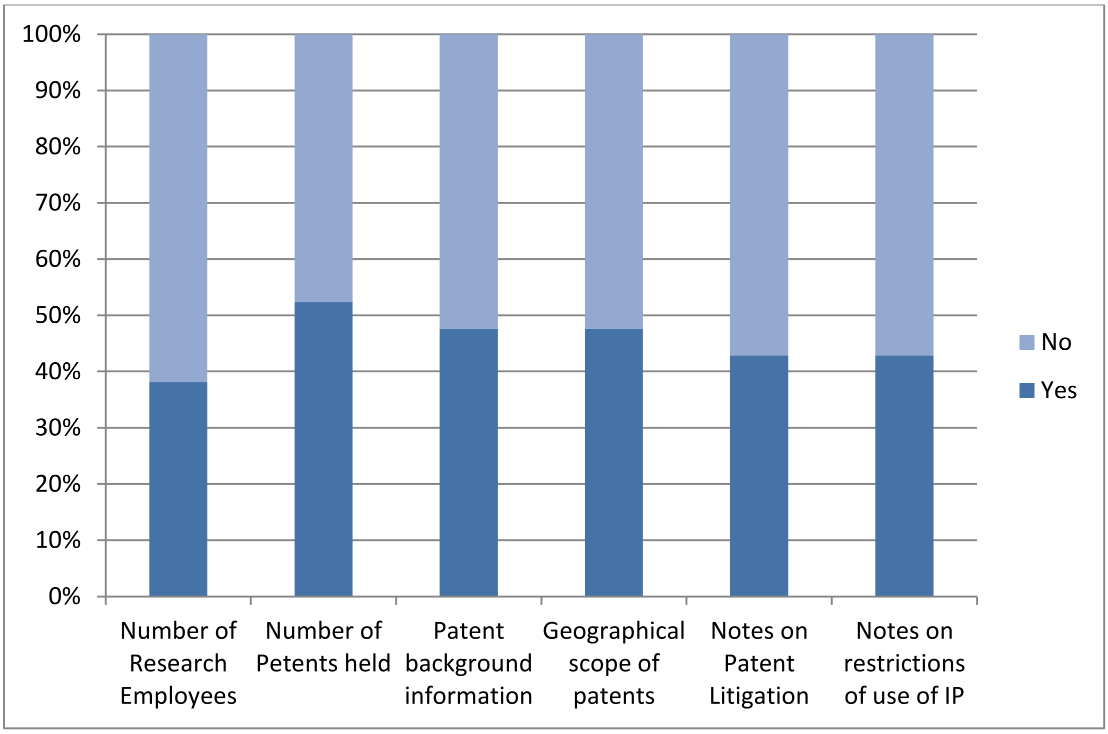


Figure 4-4: Responses to question relating to increase qualitative disclosure on various aspects relating to the intangibles (n=21)

Those in favour of such disclosure, argued that the more information they have, the better. On the other hand, whilst investors appeared to be interested in the contents of such disclosure, they questioned the scope of same within the financial statements, arguing that they “will find out the answers to all those questions by other means … which are more meaningful". Investors argued that information on patents is already publicly available – "If you look hard enough, you can find it, you look at the Patent Office … you can find that information". Some questioned the link between the qualitative aspects and financial statements – arguing that "they are not financial numbers". It was also mentioned that the inclusion of same in financial accounts would not be as useful, because more detailed questions on the aspects mentioned would still need to be asked at due diligence stage. A common argument was that although they would like to see the information, it is commercially sensitive and hence should not form part of the financial statements. These results appear to be consistent throughout all of the interviews carried out, immaterial of investment industry preference and investment stage. Similar to the detailed recognition discussed previously, 86% of investors argued that such disclosure would not eliminate any work at due diligence stage, and further questioning needs to be done just the same, although "this would depend on the level of detail". The respondents who argued in favour of showing a figure for intangible assets at fair value also made the case for additional disclosure (for example the number of patents; *$P < 0.05$, Fisher exact test*). Due to the size of the sample, in line with Cochran (1954) the Fisher exact test was used as an alternative to the χ^2 test (cf. Uhlaner, van Goor-Balk, & Masurel, 2004). This test was carried out using SPSS. It allows us to identify significant differences in the responses of two different groups of respondents when there are only two possible responses (in this case a yes or a no) (Corder & Foreman, 2009). Unlike the χ^2 test, the Fisher exact test does not provide a test statistic apart from the level of significance.

4.2.3 Other forms of reporting

The final issue which was considered was other forms of reporting. A sample Intellectual Capital Report was shown to the participants (see Infineon Technologies Austria AG, 2006), and they were asked to comment and indicate on how useful it would be from 1-5. Those who stated “not useful at all” were coded as having responded ‘0’ (see responses for each rating in Figure 4-5).

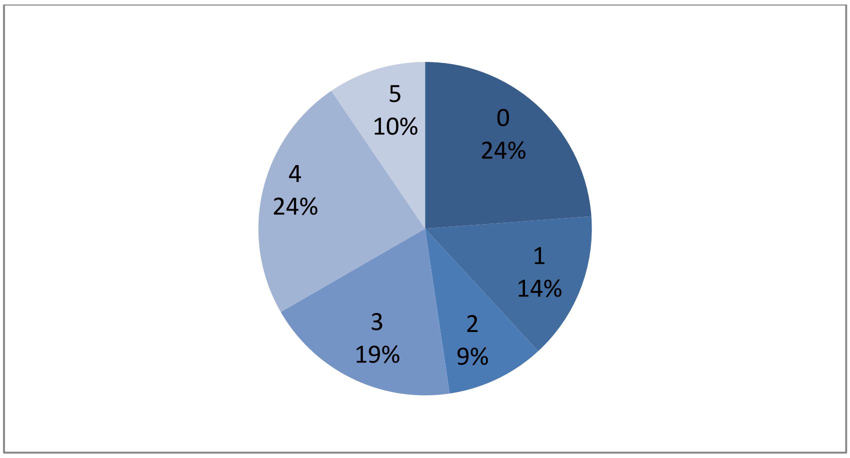


Figure 4-5: Responses to question on how useful would an intellectual capital report be (0= Not useful, 1 = Low 5 = High) (n=21)

A mean response of 2.3 was obtained, however 52% of the respondents have actually given a rating of 3 or more, suggesting that the reports could be of some use to investors.

The report shown to venture capitalists included key qualitative indicators, which related to various types of intangibles including human capital. Hence it is worth noting that interest in such reports was surprisingly higher for the software sector (Mdn=3), than for those VCs which do not invest in this sector (Mdn=0.5) [$U = 22.00$, $z = -2.213$, $p < 0.05$, $r = -.48$].

Similarly, those who invest in the Internet sector (Mdn=3) stated that such reports could be useful more than for those VCs which do not invest in this sector (Mdn=0) [$U = 10.5$, $z = -2.431$, $p < 0.05$, $r = -.54$]. Some respondents argued that the reports contained “some interesting benchmarking information” and that “it provides a view on company culture that is quite hard to get”. Critics questioned whether the intellectual capital reports/statements would say anything other than information which is already known. Respondents argued that the reports could be overcomplicating what could be obtained simply by questioning at due diligence stage. However interestingly, only 18% of respondents who suggested that intellectual capital reports/statements might be useful (they rate its usefulness as being 3 or greater) indicated that they would recommend entrepreneurs to prepare them. Respondents argued that such reports would be a difficult task for the start-ups, given the limited number of staff.

Apart from issues related to reporting we considered the importance of the intangibles *per se* for the venture capitalist. In line with an earlier study by Ribeiro and Tironi (2006) carried out amongst Brazilian venture capitalists, we asked the British investors at what stage in the investment screening process they would assess intangibles. The majority of the investors interviewed considered intellectual property at the qualification stage of the screening process prior to making the investment (68.4%). In this stage, proposals which do not meet the criteria established by the venture capitalist are rejected without further consideration. This highlights the importance given to intellectual property by venture capitalists investing in technological companies. More investors consider it in the initial enquiries and negotiation stage (73.7%). In this stage, more information is provided by the venture capitalist and the business plan is discussed. Nearly all investors interviewed consider it in the due diligence stage (94.7%), during which a detailed assessment of the financial and technical feasibility of the investment is carried out. Given that the venture capitalists interviewed invested in technology, we considered further the specific case of patenting.

4.2.4 Patenting

In one of the questions we asked the interviewees the importance of various documents and data when preparing a valuation for a potential investee company. The provided a value from 1-5 (we coded 0 as being not relevant). The mean response for the patent documents was 3.33. The importance of other documents is shown in the graph below:

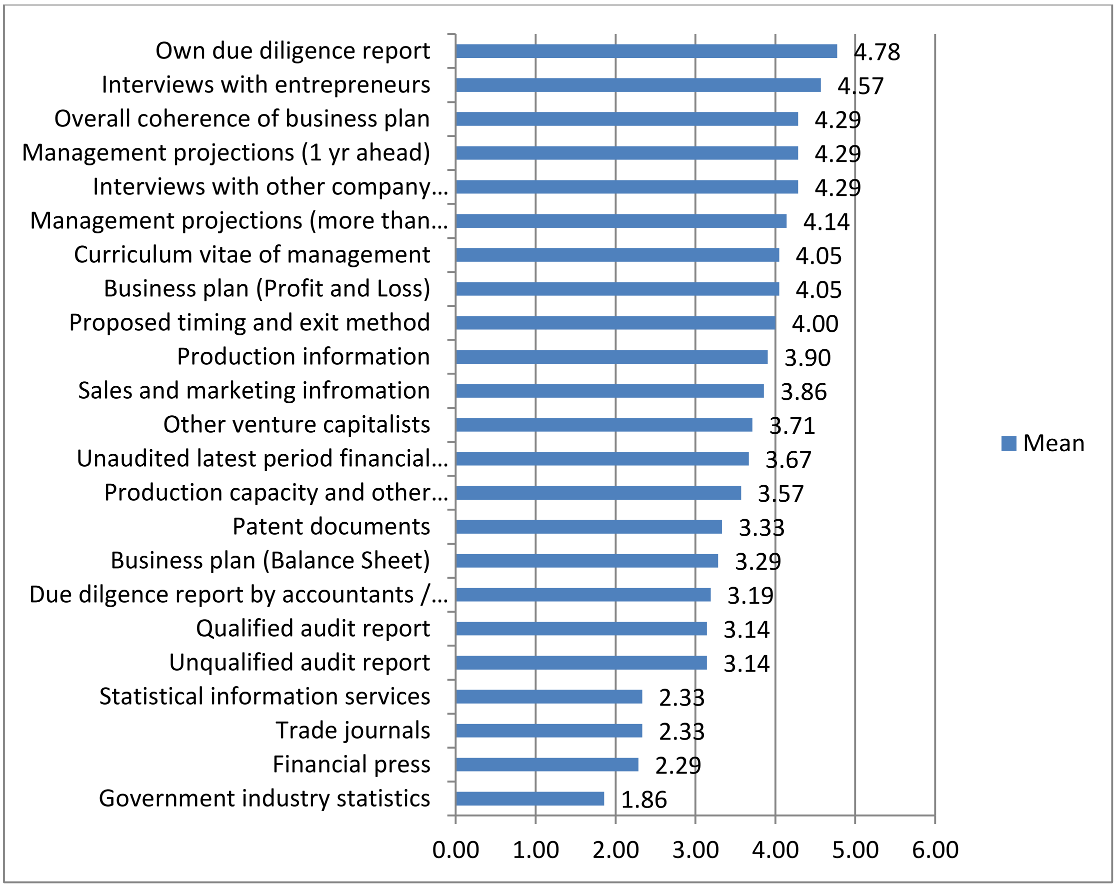


Figure 4-6: Importance of documents/information in investment decision (n=21)

As the graph shows, the most important information would lie in the venture capitalists' own due diligence reports, followed by interviews with the entrepreneurs and management projections for the next year. In terms of industry differences, we note that those VCs which invested in the biotechnology industry subsector rated the importance of patent documents as being higher (Mdn=5) than those which do not invest in this sector (Mdn=2.5) [$U = 23$, $z = -2.298$, $p < 0.05$, $r = -.5$]. This reflects the importance of patents in this subsector (cf. J. A. C. Baum & Silverman, 2004).

We asked specifically what patent attributes they would be interested in analysing further (an issue not considered in earlier venture capital literature on the UK). Again investors rated the importance from 1-5, and 0 was coded as being "not considered". The table below shows the mean and standard deviation of each patent attribute, in descending order of importance:

Table 4-2: Patent attributes (n=21)

	Mean	Std. Deviation
Importance of patents to specific industry	4.24	1.18
Residual life of patent	4.19	1.25
Existence of substitutes	4.10	1.55
Patent litigation issues	4.05	1.53
Patent scope	3.71	1.35
Inventor involvement	3.62	1.40
Patent status	3.52	1.29
Family size	3.43	1.47
Number of forward citations	2.72	1.64
Simple patent count	2.62	1.65
Number of backward citations	2.52	1.50

We note that when considering patents, the investors argued that the most important aspect to be considered is whether the patent is important within the industry considered, followed by the residual life of the patent and any litigation issues. The interviewees stated that litigation issues are important because if they become aware of patent litigation issues this could have a significant impact on the investment decision.

As one investor explains in more detail:

"As far as patents go, they're very difficult to value and very difficult to know how useful they are to the company. There was litigation between us and [another company]. They had to pay [us] $1.2bn. A series of patents to them would have been worth $1.2bn. A patent is a sword, not a shield; it's to defend yourself with, to stab a company with it if you need to. It is a very offensive tool or weapon. It is a defence mechanism, but you're not shielding yourself behind it because in its inert state it does nothing for you; it's only there if someone tries to do what you have a right to do because you've developed it."

Investors also commented on the importance of patent scope (i.e. how broad a patent is). For example, a pharmaceutical VC argued that "if you have a chemical that you file on that structure but not on any related structures they'll find ways around it, modify it slightly so you need to have quite a wide scope". However, the investor argued on the difficulties associated with obtaining broad patents: "It's really hard to get a broad claim, as broad enough to be valuable in the market and prevent other people entering and not getting picked up by the patent office".

On the other hand, they were less concerned about patent citations (backward and forward) as well as the simple number of patents held. We found that those VCs which invest in the seed stage (Mdn=2) are less likely to be concerned about the simple number of patents than investors which invest in later stages (Mdn=4) [U = 13, z = -2.538, $p < 0.05$, r = -.55], in view of the early nature of the investment. Investors also argued that quality is more important than quantity. For example, a company may have seven patents and uses only one, in which case the number of patents would not be so relevant.

Further analysis shows that those venture capitalists which invest in the pharmaceutical subsector are more concerned about backward citations (Mdn=4) than those which do not (Mdn=2.5) [U = 11.5, z = -2.438, $p < 0.05$, r = -.53]. The same applies for forward citations (investment in pharmaceutical subsector – Mdn=4; no investment in pharmaceutical subsector Mdn=3) [U = 14.5, z = -2.164, $p < 0.05$, r = -.47].

Patents as a signal

Long (2002, p. 653) stated that 'patents appear to play a valuable signalling role in the start-up phase of a firm's life'. Based on the initial unstructured interviews and the literature we asked investors about four different signals patenting may convey. We did not identify any particular industry differences in the responses, although responses varied between investors who were more patent oriented in their investment decisions and those who tend to focus less on the IP aspect of the business.

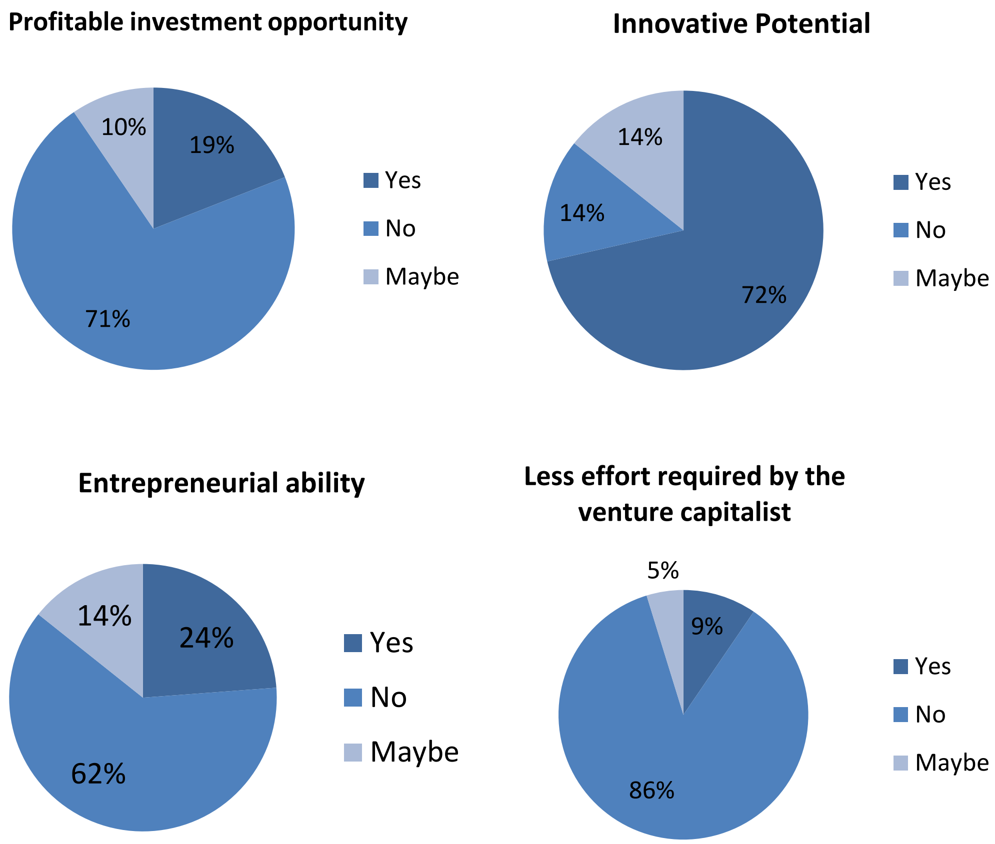


Figure 4-7: Patenting as a signal (n=21)

As shown in Figure 4-7, the majority of respondents (71%) had strong views that this is not the case. Investors argued that in the rapidly changing technology environment patents often go out of date, and simply having a patent is no indication of profitability. As one investor, argued patents are seen as being “only a means to create sustainable competitive advantage. We look at patents when it comes to testing how sustainable are the profits, rather than how profitable it can be”. Others argued that although patents created competitive advantage, “if you have no money to be able to defend it, patents are not very useful”. Investors argued that “it’s no indication that it’s going to be successful”. Some investors argued that “people can patent all sorts of things it doesn’t say anything whether the IP is executable and creates value for the venture investment”, and in the end “it’s more about the team and the opportunity rather than a piece of paper”. Arguably, patents might even lose importance during the lifetime of the investment: “We have come across businesses which had patents in place and the business model moved on in a new direction and those patents are now less important to us".

A number of investors however conceded that when combined with the "other ingredients as well: the people, the way they are going to attack the market, the market opportunity itself" then it might be a signal of a profitable opportunity. However, if considered in isolation, it is not necessarily a signal. This led to a number of respondents answering the question as "It depends", because as some argued although patents can be a sign of a profitable opportunity "they don't prove the commercial value of the technology". Furthermore, a company may opt not to patent deliberately, with one investor arguing that by patenting a firm "could open up itself to greater competition". On the other hand, the interviewees which argued that patents can be a sign of a profitable investment opportunities were investors whose business model depended entirely on patents. For example investors argued that: "We won't invest without patents. For a small business without resources if they don't have some method of protecting their business model from larger competitors then they will not survive. They must have intellectual property"; "I can think of 3 companies since I've been here that I've invested in without patents and that's not worried us but generally speaking, 9 out of ten times I expect to have some patent filings"; "[We are] an IP based business, so we put a lot of value on patents even though they're difficult to value".

Similarly, 62% of the venture capitalists (see Figure 4-7) argued that patenting is not a sign of entrepreneurial ability (cf. Lemley, 2000a) and experience. Most respondents contested this, and argued that patenting and entrepreneurship are not necessarily complementary. Firstly, they argued that patenting, occurs after the business is set up: "first, we do the product, it's fantastic, yeah, and then we patent". Investors argued that although the inventors were able to file patents, it does not mean necessarily that they are entrepreneurial. In fact, the investors argued that it is often the case that the inventor is not actually the entrepreneur: "There is the entrepreneur who is outward facing, has a vision, and the partner who is the more technical person, who can drive the patents; and therefore I don't think that the entrepreneur is the person who can drive the patents". In contrast, a small number of respondents argued that "the ability to formalise that [the invention] in the form of patents shows a degree of organisational structure", because "the entrepreneur went through the whole patenting process which is not an easy process" (cf. Long, 2002).

Contrary to the viewpoints of their investor associations (as expressed in the initial unstructured interviews), investors did not see patent filings as an indication that less effort would be required by them post investment. As Long (2002) stated patents have verification costs, for which experts may need to be employed. Investors argued that "we still have to assess patents, how useful they may or may not be. We have to do a freedom to operate search – are there blocking patents around which may stop them from commercialising them?" Some venture capitalists argued that they carry out specific due diligence on patents and hence would incur higher costs. Those who believed that patents would lead to reduced workload for the venture capitalist or for his organisation were investors in the earlier stages of the investment which invested lower amounts compared (Mdn=£475,000) to the other investors (Mdn=£4 million) [U = 2, z = -2.022, $p < 0.05$, r = -.44]. Investing in such an early stage might mean that patents are not already in place, and the venture capitalist would have to ensure that firms are actively seeking protection for their inventions.

The more patent intensive investors argued that they would not invest without a patent, therefore having patents does not have any bearing on the level of effort required by the venture capitalist. Some argued that if they have not patented, the entrepreneur is targeting the wrong type of investor because the venture capitalist does not want to get involved in the patenting process. However, one investor did argue that if the patent is already granted, it does save some time during the due diligence process, but to be relevant it needs to have considerable lifetime left. Having stated this, given that venture capital investments are usually concerned with young companies, not many firms are likely to have granted patents.

In contrast with the other signalling aspects, as shown in Figure 4-7, most venture capitalists (86%), considered patenting to be a signal of innovation within a firm. A number of investors argued that patents are a measure of innovation to a certain extent. “It is a sign of innovation, a sign of a business worth looking at because they’ve got some patents but it’s not necessarily valuable because you can patent so many things. You can have a great painting but it’s in the eyes of the viewer whether it’s worth anything”. Despite these comments, some respondents appeared to be more cautious on whether patenting was really a sign of innovation. As one investor put it they can be a sign of innovation: “if I’m comparing them to a sweet shop, yes … but I’m always dealing with tech companies. Most people could have patents and I only want them to have patents when it’s really going to give them sustainable competitive advantage. I don’t want them to waste £50,000 writing a patent for no reason”.

4.2.5 The link between patenting and investing

We then proceeded to ask them if they believed there was a link between the number of patents held/granted and the amount invested in monetary terms.

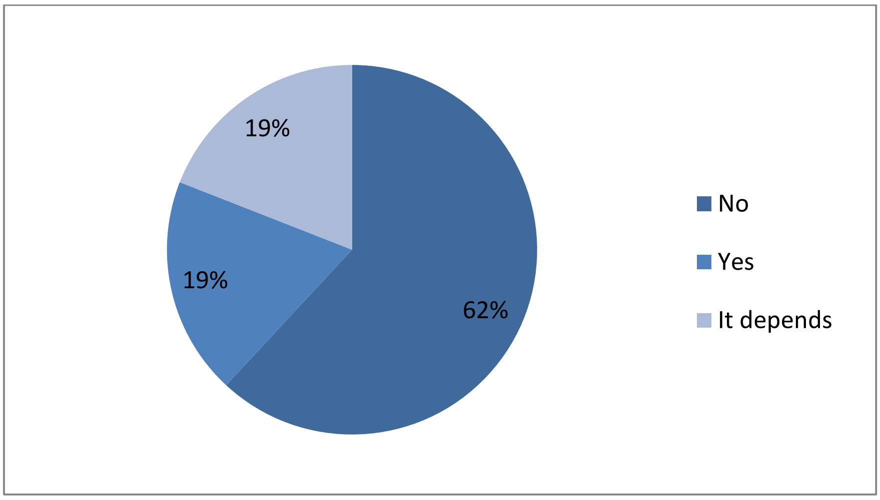


Figure 4-8: Response to question on whether there is a link between patents applied for and the amount invested (n=21)

As shown in Figure 4-8, most investors did not believe that there is a link between the number of patents and the amount invested in both the case of the simple number of patent applications (62%) and also in the case of patents granted (62%). There was no difference in responses when prompted if there was a link between patents granted and the investment made, rather than patent applications, although some venture capitalists argued that whilst granted patents would be an indication of a “worthwhile idea”, one needs to know for how long these patents have been in existence.

Venture capitalists argued that if the business model did not require any patents, they would still invest substantial amounts of money, and therefore they did not perceive there to be a link between the amount invested and patenting. For example some argued: “We invest in the business proposition. The business proposition may or may not be protected by patents”; “We’ve got some businesses that have lots and lots of patents and some business that have one and some that have none, and I don’t think the amount you invest has a huge amount to do with it”.

Investors argued that the amount invested depends on the returns rather than on whether or not they have patents. Having more patents might even imply more litigation costs (cf. Kitching & Blackburn, 1998) and "for little companies this can be difficult, because they are big guys and there were lawyer fees of ½ a million pounds". Enforcement of patents is also time consuming which is in itself a constraint for the investor because VCs are not investing in the long term of the company, but are looking for an exit.

Investors which specialise in different subsectors had different viewpoints on the matter - "you wouldn't do anything in medical and healthcare that you wouldn't seek patent coverage. But in software, good ideas can be solved through another way"; "They're an ecommerce shop, they supply goods for home and garden sector in the UK, and the business is not an intellectually property driven and yes it was quite sizeable – quite a large cheque for us to invest"; "Probably, I know [only] of one or two examples were we made a significant investment without patents"

We ran a Fisher exact test on the responses provided and this was able to confirm the industry differences between venture capital firms which specialise in different subsectors. For example, 88% of those who invest in the pharmaceutical sector said that there could be a link (yes or it depends) between the number of patents and the amount invested *($P < 0.05$, Fisher exact test)*.

However, some argued that there could be a link, depending on the quality of the patents:

"If we think it's a commercially valuable patent yes [there is a link]. If we don't believe its route to market is clear, it's all about Can we get the customers?" Some of the respondents stated clearly that there is a link between the investment amount and the number of patents - "We often expect a higher valuation for companies with patents, given the time and resources required to generate those patents". In the earlier unstructured interviews with venture capitalists, one interviewee representing investors argued that there could be a link between the investment amount and the percentage of equity requested by the venture capitalist.

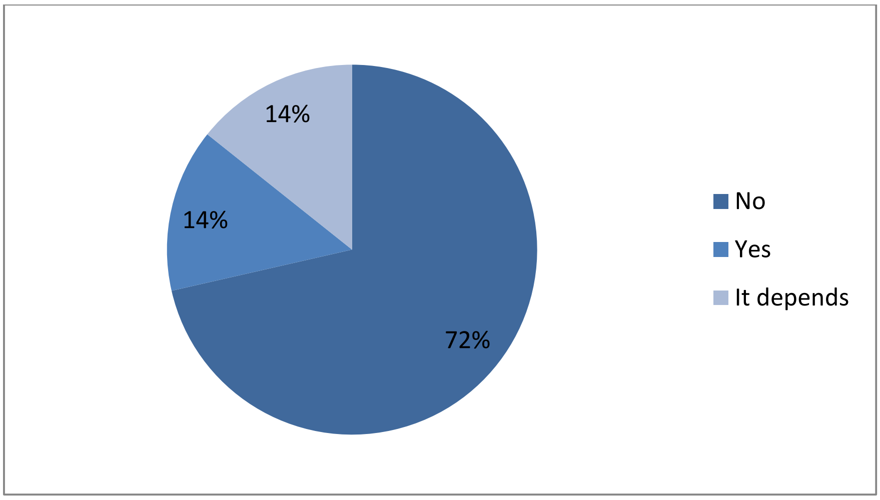


Figure 4-9: Response to question on whether there is a link between equity requested for and the amount invested (n=21)

This is because it was argued that patenting might be seen as a sign that there is less risk. However, 72% (Figure 4-9) of the respondents argued that this is not the case. In contrast with this statement made by the representative of the investor association, a number of investors argued that “it doesn’t correlate that much with the risk of the business” and that “a lot of the risk lies in the execution of the business plan and the monetisation of that technology”. A small number of venture capitalists, particularly those investing in biotechnology argued that there is some sort of link in this case because “if we’re getting to the point of the equity stake than we must believe the patent… if we qualified it as commercially viable we request a lower equity stake”. There is also the specific case of academics which hold patents, and in order for firms to transfer the intellectual capital to the company, they would have to give up a proportion of the equity to the inventor.

We also asked investors about the likelihood of a firm increasing the number of patents after the initial investment is made. Investors rated this from 1-5, with 1 being unlikely and 5 being very likely (Figure 4-10). No statistically significant differences in responses were noted across different venture capital investment subsectors, or across the life stages of investee companies.

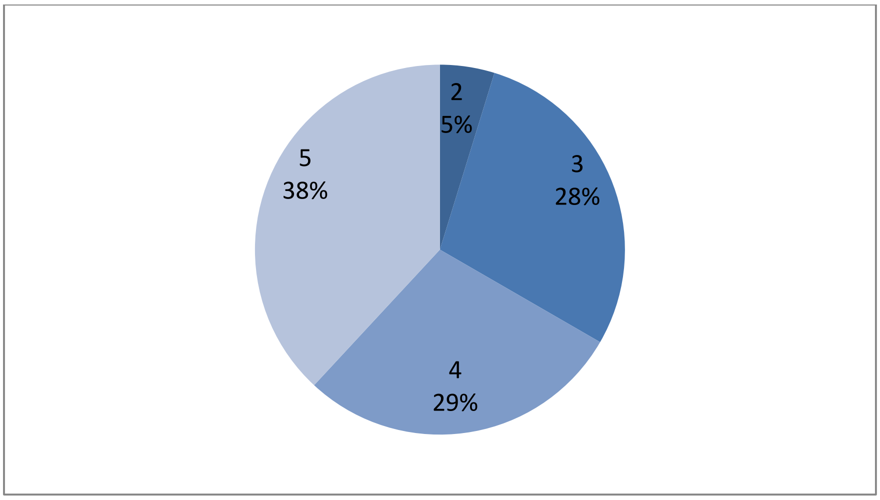


Figure 4-10: Likelihood of increase in number of patents post investment (n=21)

28% of the investors rated this as “3”, arguing that “it depends on the business. You might have a business that has a great portfolio of IP [and] they want to patent defensively and proactively. In other situations, the work would have already been done, and any investment is to grow the business or have a better management team. It is either 1 or 5 depending on the situation”.

The majority of the respondents (67% answered 4 or 5) agreed that after investing, patenting was likely to increase. Investors argued that patenting should not be a static activity, and that in order to survive firms have to constantly improve their technologies. Venture capitalists insisted that they actively encourage disruptive new product technology even post investment. For example, a venture capitalist which specialises in investments within the telecommunications sector argued that “some of our companies have patents, we invest and they keep growing the patents. You have to, it’s not a static value. You can’t have a patent and sit back and do nothing”; “They have money for additional engineering, it produces more products, and this means you need to patent aspects of it”.

Investors also made the case for patent families, and argued that if the initial patent was relevant then having a family of patents around the existing patent would be beneficial. By having new patents after investment, one would also have a patent with the full residual life. Since the venture capitalist is providing funding, the firm is more likely to be able to defend patents, although as one investor outlined "they're a good thing as long as there are not too many and become a financial burden on the company". There was one notable exception to the responses mentioned above. One of the investors interviewed argued that it was fairly unlikely to increase because if the patents required for value creation were not already there they would not invest in the first place.

On patent valuation and reporting

The investors were also asked a series of questions on patent valuation. Firstly, we asked them whether they would be interested in seeking a financial valuation of the patents held *prior* to investing. The majority of the respondents were not concerned at arriving at the value of the patent before the investment decision (76.2%). The investors argued that their investment decision is based on the business as a whole, and not specifically the patent – with one investor explaining that "it's not the patent which gives value, it's the business. Part of the business may be the patent, in other businesses it isn't the patent". Others were more concerned with the difficulties associated with arriving at a value for the patent. Investors were also concerned that the value at the investment date might not be particularly relevant because they could even become valuable in the future. Those in favour of considering some form of valuation for the patents argued that "it gives you downside protection, if all this doesn't work, what can I sell it for". Although only one respondent argued that he would seek external advice on patent valuation if this is required, external advice is often sought on more qualitative aspects relating to patents (66.7%). These would usually include external patent checks and an analysis of the scope of the patent in relation to the business plan.

Aspects related to litigation, such as the likelihood of patent infringement from competitors are also considered. More specialised venture capitalists might even have their own in-house patent experts, and some firms explained that some of the partners within the venture capital firm were formerly patent lawyers. Sometimes, even if the investee companies hold no patents, an intellectual property review is carried out to assess the situation of competitors. Although formal valuation of patents is not usually carried out, some investors mentioned the use of scales which give an indication of how valuable the patent is: “They look at discoverability and defensibility (on a 1-4 scale). We look for a level 3 or level 4 patent, which means very strong patents”. A key concern on the use of patent experts was the cost, and some argued that they only engage experts if it is a core patent or if they have suspicion there could be potential issues with the intellectual property of the investee companies. Investors explained that they often mitigate such external fees by seeking informal advice from their network within academia and also from the industry.

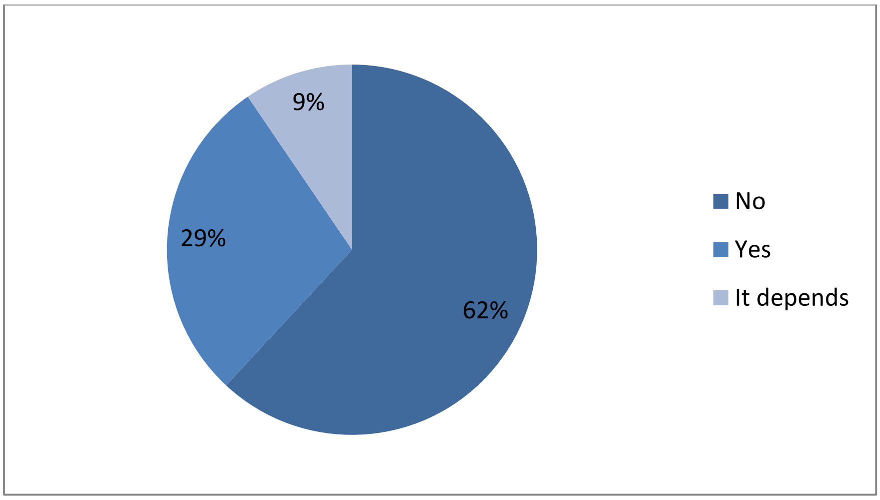


Figure 4-11: Responses to question on whether investors would be willing to show patents on the financial statements after investing (n=21)

We also asked whether a valuation of the patents held is provided by *entrepreneurs* prior to investment and if this was provided frequently. Nearly half of the respondents stated that this was never provided (47.6%). The remainder said that valuations are sometimes provided (33.3%) or are rarely provided (19%). Some investors argued that calculations for patent value could be very detailed: “they provide a spreadsheet with what the value is. Our patents are worth £X value is sometimes found in business plans etc.”, although it was argued that this was often a sign of inexperience in investing. As one investor explained “nine out of ten [times] we disagree” with any value provided even though “if there was one, we would ask for it”.

Investors stated that entrepreneurs “try to provide a value for the total proposition” rather than just for the patents themselves. In fact, the whole concept of attributing a value to the patent has been questioned by venture capitalists, who stated that the value of the firm needs to be seen in its entirety. “I don’t say there’s a valuation of £1 million for the people, £3 million for the patent, £1 million for the office because it’s lovely. No that’s not the way. But in big buyouts, they will attribute value to the patent because they attribute income, flow to the patent when it’s combined to the regulatory licence”. Linking to this concept of valuation for a whole business, we specifically asked which valuation methods they used and whether they believed that their existing valuation methods are capturing the value of patents within the financial statements. Respondents rated each method from 1-5 according to level of use, and 0 was coded for respondents who argued that they do not use the valuation method at all. In arriving at a valuation for prospective investee companies, investors rated the use of recent transaction prices in the sector (Mean = 3.90, SD = 1.45), industry rule of thumbs (such as turnover ratio) (Mean = 3.38, SD = 1.717), and responses given by other venture capitalists in attempts to solicit bids (Mean = 2.76, SD = 1.79) as the most popular methods from the list provided [See Respondent Sheet 4, Questionnaire, Appendix C]. Traditional methods, such as discounted cash flows, were deemed to be unpopular due to the uncertain nature and the early stage of the investments (Mean = 1.52, SD = 1.69).

When we asked whether the current valuation method was correctly capturing the value of intangibles held by the company, a mixed response was obtained. The majority of investors (57.9%) argued that they believed that their existing valuation approach correctly incorporated the value of intangibles within the business. Most of these argued that they “look at the company as a whole”: “95% of the value we invest is intangible. After you invest, you hope they start trading and they’ve got other assets but initially 95% of the value is intangible”; “Yes, in an odd way, although

I absolutely don't believe in being complicated and detailed about accounting for intangible assets, I think it's one of the most valuable things that the company has but oddly it's so valuable that I actually don't think you can put a number on it. I think it's so hard for accountants to put a number on intangible assets that I actually think they shouldn't bother". Some investors were confident that they were actually correctly incorporating the value of intangibles because "we've made our valuations which were most often right than wrong with the benefit of hindsight". As some investors argued, the use of transaction prices from similar industry sectors might be indicative that the market has already captured the value of the patent.

Other investors (42.9%) questioned the difficulties associated with knowing the correct value of intangible assets with some arguing that: "It's magic not science. The only things which help you is experience in judgement and good advice in the sector. Finding good external advisors can be difficult"; "The intangible side is something unproven. If someone came back to me 10 years ago telling me I've got a new way of speaking to a computer and two great patents for speaking to the computer. The valuation of that business was less than 3 million pounds. I didn't put any value to the patents because it was unproven in the marketplace"; "If the assets are essentially intellectual property, no compounds, no drugs, no building labs or whatever, that's very difficult to value".

Respondents were also asked to state whether they would be willing to show the specific value of patents on the financial statements *after* investing (Figure 4-11). Most investors were not interested in showing same on the financial statements of the investee company after the initial investment was made by the venture capitalist. As expected, the majority of respondents who invested in the software industry (92.3%) were against showing a figure for patents in the financial statements after investing (*$P < 0.1$, Fisher exact test)*. Some respondents argued that whether they would be willing to show this on the financial statements depends on how they are "trying to groom the company in terms of the investment strategy", and if they want to emphasise that it is valuable, depending on the industry.

When questioned further, those who argued they would not like to see the value of the patent on the financial statements argued that the figure was not accurate enough, and/or competition related arguments. The "other" answer shown in Figure 4-12 represents responses which, amongst others, included responses which suggest that such figure is not important at all for venture capitalists e.g. "it's not important", "it wouldn't be useful" and issues relating to the cost of engaging external experts.

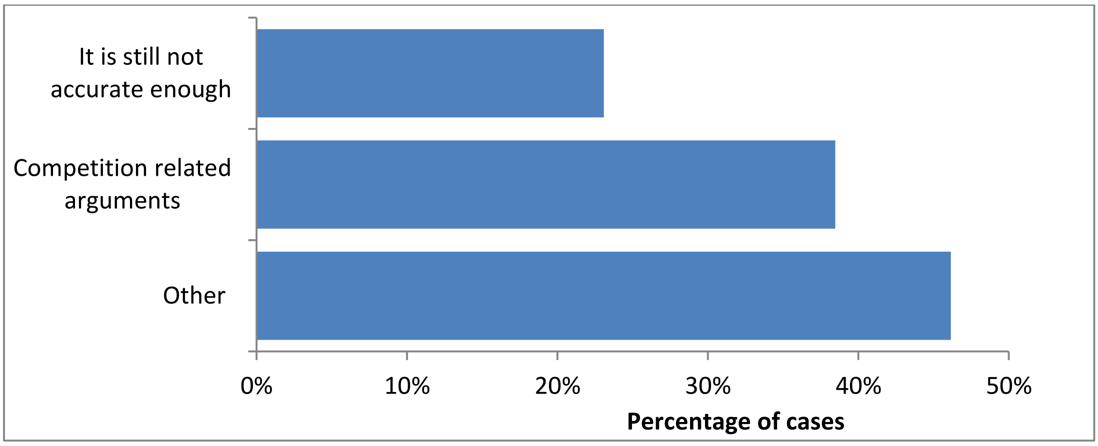


Figure 4-12: Analysis of responses of those unwilling to show patents on the face of the financial statements after investing (n=21)

4.2.6 Discussion and Conclusion

Having already considered the views of European and British early stage investor associations the viewpoints of actual venture capitalists were sought on the issue of reporting intangibles in the financial statements. After considering those aspects related to the financial statements, we then proceeded with asking a series of questions on the relevance of the intangibles, in particular patents for the venture capitalist. Specific reference was made to patent valuation and the importance of same for the investor.

The interviewees expressed a clear view in favour of the expensing of research and development costs immediately in the income statement, in line with common practice in the United Kingdom (cf. Pricewaterhousecoopers, 2011). This expensing approach, led to lack of interest towards showing intangibles on the balance sheet (even at cost), (and as a result of this to the amortisation and impairment of same through the income statement). Most investors were sceptical about showing intangibles on the financial statements, and do not see it as a signal for the need of further questioning on intangibles (cf. Wyatt, 2008). This is also in contrast with the viewpoints of the early stage investor associations which had indicated that information on intangibles may be useful for further questioning and to be able to understand the underlying assumptions behind the figures shown within the financial statements. Most investors considered the research and development expense figure as important for their due diligence. However, there was a degree of variability with investors specialising in the pharmaceutical sector considering the figure to be more important than those in other sectors.

Mixed views were obtained when it comes to whether the figure of research and development should be bundled with administration costs or disclosed separately, although the FRSSE does not require separate disclosure. This exemption also applies to most UK private companies, given that even under SSAP13 (Statement of Standard Accounting Practice 13), companies satisfy the criteria for medium sized companies[4] multiplied by ten, do not need to disclose separately research and development (Pricewaterhousecoopers, 2011). However, companies which adopt the new FRS102 (the Financial Reporting Standard which becomes mandatory from 2015 instead of the existing SSAPs) need to disclose the aggregate amount of research and development separately (Financial Reporting Council (FRC), 2013). Lev (2004, p. 112) stated that the fact that disclosure on research and development is not done within the financial statements 'keeps investors in the dark about … how companies allocate research and development budgets to basic research, product development and process improvements'. Yet only half of the venture capitalists interviewed were of the opinion that this figure should be shown separately within financial statements.

[4] Under the Companies Act section 465(3), any company which satisfies two of three conditions applicable is considered to be a medium-sized company. The conditions include: an annual turnover which does not exceed £25,900,000, a balance sheet total not exceeding £12,900,000 and 250 employees.

What is certain is that the figure is of interest to the venture capitalists given that most venture capitalists agreed on the fact that they would request details of research and development and its relative components from the entrepreneur at due diligence stage even if not disclosed separately in the accounts. In fact, it has been argued that most of the information required for investment purposes is obtained in the due diligence stage and not from financial statements (cf. Reid & Smith, 2008b)

In terms of qualitative disclosure (such as information on patents), mixed views were also expressed. The respondents argued that they obtain the information during the due diligence, and that information on patents is available from the Patent Office if required. Interestingly, the VCs who want more disclosure (in narrative form) are the ones who also want more recognition within the financial statements (cf. Reid & Smith, 2008b who stated that investors would be more interested in narrative explanations rather than quantiative information). The issue of writing off intangibles, does not seem to be a matter associated with start-ups (cf. Hand, 2005a who stated that financial statements are less relevant for startups). Even after initial financing, the venture capitalists would not like the entrepreneurs to disclose the value of intangibles on the face of the financial statements. Amongst the reasons for this were issues relating to competition, the subjectivity of the figure, and the irrelevance of the figure on the balance sheet for valuation purposes.

When it comes to the preparation of intellectual capital reports/statements, the interviewed venture capitalists showed some interest for such reports (cf. Alwert et al., 2009). Such interest in the intellectual capital report was also the case when the report was first launched in Denmark. Over five hundred companies contacted Skandia AFS (one of the first companies to use intellectual capital report) and requested more information on its report (Edvinsson & Malone, 1997). Yet there appears to be little support for requiring entrepreneurs to prepare such reports (cf. Mouritsen et al., 2001). This appears to be similar to the case of Germany, where the practical impact of voluntary disclosure on intangibles has not been as desired (Alwert et al., 2009).

Further questioning revealed that although the investors appeared reluctant to show intangible assets in the financial statements, patents are an important aspect of the investment decision. In fact, the majority of the venture capitalists argued that intellectual property is considered in the very first stage of the screening process of the investment decision. This appears to be in contrast with the study carried out by Ribeiro and Tironi (2006) amongst Brazilian venture capitalists, where it was found that intellectual property is considered primarily in the detailed analysis stage of the screening process, i.e. not in the initial qualification stage of the screening process. In this respect, in line with De Coster and Butler (2005)'s criteria of assessment for new technology spin-offs in the United Kingdom (initially proposed for use by banks), it can be argued that patents are an important aspect in the due diligence process (cf. Hoenig & Henkel, 2012). The interviews with venture capitalists suggest that intellectual property is important from the very early stages of the investment decision making process.

In a study carried out in 1994, investors had rated their own due diligence as being the most important source of information in preparing a valuation for an investment (Wright & Robbie, 1996). Nearly twenty years after this study similar views were obtained from the interviews conducted during the course of this thesis, with the venture capitalist's own due diligence report rated as being the most important. However, whilst in Wright and Robbie (1996)'s study investors had rated the profit and loss account as the second most important document for valuation purposes, in this study we find that there is an increased focus on interviews with investors and entrepreneurs within the field, suggesting the investor's scepticism on the use of financial statements. This study introduced patent documents as a possible source of information, and most investors agreed this would be useful although investors which specialise in different subsectors had varying opinions as to the importance of same. This was illustrated in a later question when investors rated the most important aspect of patenting as being the relevance of the patent to the industry under consideration. Respondents had differing viewpoints on the importance of certain patent attributes. The investors which invest specifically in the pharmaceutical sector for example, argued that patent citations were particularly important. Patent citations are often perceived as an indicator of quality (Hall et al., 2005). In an industry such as the pharmaceutical industry, patents are essential because of the traditional blocking motive. Therefore in line with Hall et al. (2005) discussion, we find that investors in this industry would consider patent citations as being more important, because the quality of each patent is essential due to the blocking motive. On the other hand, in the information technology sector, patents are essential for cross licensing and their individual quality is not as important as in the case of the pharmaceutical sector (cf. Hall et al., 2005).

This work also considers the signalling aspect of patenting (cf. Long, 2002). The respondents dismissed the idea that having patents filed would be an indication of reduced workload for the venture capitalist post investment. In contrast, it is posited that that the workload may actually increase due to increased verification of intellectual property at the due diligence stage (cf. Long, 2002). Mixed views were obtained on whether patenting is a signal of entrepreneurship in line with Lemley (2000b), with most respondents questioning the link between entrepreneurship and the ability to have inventions protected. Most investors also disagreed that patents can be a sign for a profitable investor opportunity. Investors clarified that they have had profitable investments without patents. This finding appears to be in line with Hoenig and Henkel (2012) and Audretsch et al. (2012), who contend that patents within themselves do not signal technological quality. In contrast with the signalling aspects discussed above, most venture capitalists did agree that having a patent within the firm is a sign of innovation culture within a firm (cf. Acs, Anselin, & Varga, 2002). Nonetheless, some investors expressed the scepticism mentioned by Pakes and Griliches (1980, p. 378), who stated that patents are not a reliable measure of innovation because 'not all new inventions are patented and .. patents differ greatly in economic impact.'

As outlined in the literature review (Chapter 2), a number of prior studies had already identified a positive relationship between the number of patents applications and the amount of funding received (J. A. C. Baum & Silverman, 2004; Conti et al., 2011). In contrast, Haeussler et al. (2009) and Cockburn and MacGarvie (2009) did not identify a relationship as the number of patents granted and the amount invested by the venture capitalist. However, J. A. C. Baum and Silverman (2004) also identified the relationship in respect of number of patents granted. Most of the prior research did not involve any contact with the interviewees themselves, and is mainly based on data from North America and related more to specific investment subsectors, which could be one of the reasons for the different outcomes. In this fieldwork study carried out amongst UK venture capitalists, most investors interviewed argued that there was no relationship between the number of patent applications or patents granted and the amount invested. This response appeared to be in line with the viewpoints of the unstructured interviews carried out with the early stage investor associations. Moreover, fewer investors argued that there was a link between the percentage of equity requested and patenting in contrast with comments provided by key personnel of the early stage investor associations in the earlier unstructured interviews. This disagreement between viewpoints of investor associations and the investors themselves suggests the need for further research on intangibles, in particular intellectual property.

A final aspect considered was the valuation of patents, irrespective of their disclosure within the financial statements. We find that some entrepreneurs attribute a value to patents prior to pitching for funding, although this was often deemed to be incorrect by investors and was even classified to be a signal of inexperience. External advice from patent lawyers and experts is often sought by venture capitalists, but this would relate to legal patenting aspects rather than valuations. Although more recently in the academic field (Amram, 2005; Dubiansky, 2005; Odasso & Ughetto, 2010) and also international bodies (including the European Union and the OECD), (see European Commission, 2006a; Kamiyama et al., 2006), there has been an increased emphasis on valuing patents, financial valuation remains particularly difficult, especially when considering that the start-ups in which venture capitalists in the United Kingdom are investing may not have revenue (cf. Amram, 2005). This fieldwork has shown how valuation of patents are generally not requested or used by UK based venture capitalists. They argued that their major concern is that of arriving at a value for the business as a whole rather than an individual patent. In arriving at a valuation for the whole business most investors made use of previous valuations in similar companies, industry rule of thumb (such as revenue multiples) or previous bids by venture capitalists. This contrasts sharply with the findings of Wright and Robbie (1996), who had indicated that venture capital investors in the United Kingdom would use more price earnings multiples and discount cash flow factors. Whilst Wright and Robbie (1996) targeted the members of the BVCA, we opted for early stage venture capitalists, and did not consider the private equity stage furthermore, most of the companies in which the investors interviewed invested do not have quoted investments and might indeed not have any revenues or profits as of yet. Whilst some investors were in agreement that in arriving at a value for the whole company you are capturing the value of the intangible assets within the business, other investors were sceptical primarily because of the difficulties in knowing how much the intangibles are worth.

The next section includes a more detailed analysis of five of the interviews mentioned in this section through a case study analysis. To complement the interview data some secondary data analysis on the investments made by the venture capitalists was also carried out.

4.3 Case Study Analysis

In this section we present illustrative case studies in order to highlight the issues associated with disclosure and patenting by venture capitalists. Case studies are sometimes viewed as limiting the generalisability of the analysis (Ryan, Scapens, & Theobald, 2002; Saunders et al., 2009). Nonetheless, one may make analytical generalisations comparing the results obtained with theory (Yin, 2009) although this is not a requirement because case studies are also appropriate where there is insufficient theory and could serve as an antecedent for future research (Ryan et al., 2002). Furthermore, as Scapens (1990, p. 279) states “Case studies may not locate general solutions to the problems faced by accountants and managers, but they can provide a better understanding of the issues involved”. Much of the way in which venture capitalists work is not published, especially in the United Kingdom, and is only accessible by fieldwork methods. In this case, the data of these case studies is derived from the semi structured administered questionnaires carried out amongst venture capitalists in the United Kingdom.

Five of the interviewer administered questionnaires were chosen as the basis of these case studies. Although all of the interviewees invested in technology companies, the venture capitalists have diverse investment specialisations. Having considered the interviewees under each subsector we selected the most illustrative cases in order to highlight the diversity of viewpoints across different subsectors and stages of investment. Seawright and Gerring (2008) refer to this case selection approach as being the “diverse case method”. We aim to provide invaluable insight into the mindset of the venture capital investor through new empirical evidence.

Initially we consider the relevance of financial statements of investee companies for venture capitalists, and in particular their viewpoints on the disclosure of intangible assets for investee companies. Thereafter, we proceeded at looking at the relevance of intangible assets for these investors, irrespective of their opinions on the presentation, recognition and disclosure of same in the financial statements.

The first case considered was a company which invests specifically in life sciences and pharmaceuticals; the second firm invests specifically in information technology related investments and the third firm deals primarily with university spinoffs. The other two cases deal with companies which are involved only in later stage investments namely in the expansion or growth stage. One of these venture capital firms invests in companies dealing with information technology, communications and media, and the other firm invests in companies dealing mainly with communications, media and technology.

We highlight the differences in viewpoints of each case, linking this to the relevant literature. Table 4-3 shown below provides a summary of some basic data relating to the investment firms under study.

Table 4-3: Comparative descriptive information on the cases considered

Comparison of cases	Case A	Case B	Case C	Case D	Case E
Specialist subsector	Life sciences & Healthcare	Information and communications technology (ICT)	General technology university spin-outs	Communications, media and technology	Information technology, healthcare and energy
Stages of investment	Seed, start-up, Other early stage, expansion	Seed, start-up, other early stage, expansion	Seed, start-up, other early stage	Expansion	Expansion
Portfolio	Healthcare	ICT	Technology except drug development	Technology, communications, and media sectors (except biotechnology and pharmaceuticals)	Software, digital media, e-commerce, healthcare and energy
Investment	£15m-£20m	£0.15 - £2.5m	£0.4m - £4m	£2-3m	£5-20m
UK funds under management	£800m	£68m	£136m	£50.75m	£270m
Number of investment professionals (global)	12	11	5	7	15

4.3.1 Case A: Venture Capital firm investing in the life sciences and healthcare subsector

Case A refers to a venture capital firm which invests in different stages of life sciences and healthcare firms. The geographic location of its investments is primarily the UK, US and Europe. They invest in various stages of the firm's growth and even in the public markets, though the investor interviewed specifically focused his discussion on the early stage and growth investments. In the case of growth investments, the firms are mostly like to be established and have revenues, but they would be seeking more funding in order to further expand their operations. The company's approach is usually to make investments which exceed the funding capacity of the more traditional venture capitalists, i.e. investments made by this venture capitalists tends to be larger than in the case of the other venture capitalists interviewed. Furthermore, the focus of the venture capitalist in this case, is to invest in companies which have first mover advantage. Lieberman and Montgomery (1988, p. 41) define first mover advantage in terms of 'the ability of pioneering firms to earn economic profits (i.e. profits higher than the cost of capital)'. Furthermore, Lieberman and Montgomery (1988) explain that in the case of companies engaging in research and development (such as the case of healthcare companies, in which this venture capitalist specialises), the first mover advantage is obtained through the use of patents or trade secrets. The venture capital has an investment holding period of 3-8 years, after which there is usually exit through either a trade sale or IPO. The venture capital firm goes beyond financial backing by providing technical assistance through its network of both scientific and also business related experts.

In this case, the venture capitalist indicated that financial statements are important in their due diligence (cf. Wright & Robbie, 1996). The venture capitalist explained that when considering the income statement, one of the most important line items would be research and development expenditure. The investor indicated that in the case of firms in the life sciences and healthcare sector, R&D is often outsourced (cf. Hsuan & Mahnke, 2011), and this needs to be taken into consideration and shown clearly on the income statement. When considering the balance sheet, the interviewee explained how the focus is always on cash (in line with most investors interviewed), but also they ascribe importance to the intangibles figure and the share structure.

The interviewee expressed concerns about differences in the quality of the preparation of financial statements of the investee companies, indicating that they often request firms to change their presentation "in order to make it easier for us to see what we want to see" (cf. Reid, Mitchell, & Terry, 1998). Investors ask for detailed expenditure, in this case by project (cf. Mitchell, Reid, & Terry, 1996), in order to decide whether the company should drop certain non-profitable projects and focus just on the successful projects. In contrast with the case made by Lev (2004) for increased subdivisions in the financial statements, he expressed concern about including more line items or more detailed published financial statements particularly because of competition issues in the field. Despite his scepticism, the venture capitalist argued that the cost of maintaining the intellectual property (such as official fees, and agent fees) can be substantial and should be disclosed on the financial statements. He argued that "this is less sensitive information because all of us [the] investors have a rough idea of what needs to be spent". Similarly, the investor is also sceptical about the need for further qualitative information (Aboody & Lev, 2000; Skinner, 2008a), particularly because they already have access to any information they need at board level (Reid & Smith, 2005) and they would not want to disclose such information to their competitors.

Having stated the above, we have considered the latest financial statements submitted at Companies House prior to investment date, even though UK investments made by the particular venture capitalist were outnumbered by the number of offshore investments. We noted that the UK companies in this investor's portfolio have a preference for expensing development costs, in line with current UK practice (Pricewaterhousecoopers, 2011). However, some disclosure regarding the nature of the intangibles and the expensing of R&D is clearly shown in the financial statements. For example, in the case of the manufacturer of bone implants, we note that financial statements indicated that "patents and associated legal costs are written off in the year in which they are incurred". Another investee firm (whose principal activities were the development and exploitation of medical devices) which had licensed patents indicated in the notes to the accounts that "licence fees are amortised on a straight line basis over ten years" but no further information as to the nature of these licenses was provided.

Although the information provided within intellectual capital reports is relevant for the investment decision, the firm does not see the need for the inclusion of such reports. The investors argue that the information within them can be produced on demand if required, and there is no need for the entrepreneur to prepare such reports beforehand.

Apart from considering the viewpoints of the venture capitalists on the accounting aspect relating to intangibles, we have also considered aspects relating to the intangibles *per se*. Stinchombe (1965) outlined how newly established firms have a 'liability of newness'. According to this concept, a higher proportion of new organisations fail when compared to older established organisations. In line with previous US studies (Hsu & Ziedonis, 2007; Long, 2002) we asked the investor his viewpoint on patenting as a signal (Spence, 1973, 2002) to overcome this "liability of newness" (Stinchombe, 1965). The investor argued that the fact that the firm has a patent could be a sign of a profitable investment opportunity, even if the patents were just applied for and not granted. He argued that most of the time his investee companies would have patents, although there were a few singular cases, in which funding was provided and the firm had no patents. According to the investor, this is because in healthcare companies "it's difficult to imagine a growing business if you can't provide barriers to others. This is an expensive business … discovering and developing drugs is very expensive so you have to have barriers" (cf. Lieberman & Montgomery, 1988 on first mover advantage in the case of the pharmaceutical industry).

In order to further assess the importance of patents in the investment decision, we considered the investments in the latest fund of this venture capitalist, which consisted of investment in 23 firms, 18 of which were investment in companies in the United States. Out of these investments, 9 did not appear to hold patent applications in their name at investment date[5]. One must point out that in the case of one of the firms, patents were filed later during the year that the investment was made, which suggests that the company was in the process of filing patents. Furthermore one of

[5] We considered the investment date to be the first day of the month in which the investment is made since the exact date of the investment could not be established.

the companies which did not hold patents at an investment date was actually an IT firm involved in the healthcare subsector (refer to Case B on a more detailed discussion on patenting in the IT sector). An online search on these companies showed that these firms which had no patent applications in their own name had a number of patents licensed to them. For example, in the case of pharmaceutical companies, the drug would not be discovered and entirely developed by the pharmaceutical company itself, but is instead licensed in. In this case royalty rates would be payable. These would depend on the stage at which the pharmaceutical company became involved in the development of the drug (Berndt, 2002).

The investor contends that patents are often an indicator of innovative potential within the firm, although the interviewee clarifies that it is just an indicator, because sometimes inventors file patents which are not of the desired quality. It could also be a sign of entrepreneurial ability and experience, especially when you talk to academics “who are savvy... and would have thought about patents”. However, the investor argues that patents are surely not a sign that less effort would be required by him as a venture capitalist, because the venture capital firm still has to conduct assessment of the idea, whether or not patents are filed. Furthermore, the quality of the patent has to be assessed in detail (see Long (2002) on the various costs associated with this verification).

The investor argued that there is probably a link between the amount invested and whether a firm has patent applications, although he outlined a few cases whereby if they have worked with the same entrepreneurs before, they would be willing to take the risk of investing without patents. For the venture capitalists, if the patents are already granted “you get the feeling that it’s a worthwhile idea”. However, when the patents are already granted, the concern is then their limited life. In fact the investor argues that “If you’re halfway through your 20 years of patent [life] already than that’s not attractive” (cf. Odasso and Ughetto (2010) who argued that if a patent has a longer residual life, it would mean that there is greater risk given that the technology would still be new). A link is also seen between the percentage of equity requested from the entrepreneur, because very often to transfer the intellectual property owned by some academic to the investee company, one would have to give up some equity.

The issue of patent valuation from an investor perspective was also considered. The investor argued that he would not be interested in a financial valuation of the patent prior to investing because “it’s based on gut feel as to how broad the scope is, how important the market is and how much competition is out there, but it is more of an art than a science”. The interviewee argues that if an investee company attributes a value to the patent then “you know he’s inexperienced” (cf. Reid & Smith, 2005) who stated that venture capitalists would ask for information on patent valuations to the investee companies). Detailed advice is sought on prior art, and the likelihood of patents being granted, but no specific advice is obtained on the financial value of the patents. The investor also expressed that he is not willing to show any value not even in the course of the investment, because “for a trade sale… we don’t want to be hampered by having a set value for such a difficult to value asset”. However, he would be more interested in the value in the course of the investment but once again this would be for internal use and based on a gut feel.

4.3.2 Case B: Venture capital firm investing in information technology

Case B deals with a venture capital firm which invests across different stages of the life of the firm from, start-ups to the growth phase. In fact, some of the firms in which the venture capitalist invests did not have published financial statements at the date of investment. The focus is on technology investments, or more specifically investments relating to information technology and digital communication. The venture capital firm’s key concern is the entrepreneurial team, rather than the stage or the size of the investment. In assessing the investment decision, the main consideration apart from the team is the organisational strategy and costs which will be incurred within twelve months from investment date. The company does not seek to invest in the US market, but opts only for British and European investments.

As in the previous case, we sought to uncover the investor's viewpoints on the financial statements. Similar to the previous case, the venture capitalist argued that financial statements are important. Yet, he argued that he would not be interested in having more detailed figures within the financial statements (cf. Wright & Robbie, 1996). However when probed with further questions, the interviewee expressed concern about having R&D bundled with administration expenses and argued that he would have preferred if this was shown separately. In fact, he said that he would prefer if the Companies Act was changed, and the cost base would be split out from administration expenses. The venture capitalist emphasised this by indicating that he "had a conversation with one of the CFOs of our portfolio companies last week where she had all the costs of a company in administration expenses including R&D and I was saying this isn't admin". The amount spent on R&D is crucial because firms have to maintain their competitive advantage over other competitors, and not just be the first ones to market the product.

With regards to detail in the financial statements, the investor stated that he "always recommend they take advantage of the exemptions like filing of abbreviated accounts" due to the competitive market environment. This is in line with a previous study by Dedman and Lennox (2009) who stated that companies file abbreviated accounts in order to conceal information regarding their financial situation from competitors. This was confirmed through verification of the financial statements available prior to the investment date for portfolio companies listed on the venture capitalist website. We note that all of the firms filed abbreviated accounts, with the exception of one firm which at the date of investment was well established with revenue of over £8 million pounds (and thus exceeding the maximum threshold allowing firms to file abridged accounts). The venture capitalist mentioned that the management of cash within the organisation is crucial in the current economic environment and contends that a cash flow statement would be particularly useful (cf. Yap (1997) who explains how changes in the environment in which a firm operates can lead to more demand for cash flow statements). However, one must note that the importance of cash flow statements for venture capitalists has been emphasised in prior studies carried out well before the current financial crisis (Reid et al., 1998).

Throughout the discussion, the investor stressed that financial accounts filed at Companies House are usually dated, and therefore more recent detailed management accounts would be required. The investor is not particularly concerned about the 'historical' aspect of the business, but what matters most is the output of the research. This is in line with earlier research by Reid et al. (1998) who showed that although published financial statements are requested by venture capitalists these are not sufficient. More detailed and frequent management accounts, together with detailed budgets and regular explanation would be necessary.

The investor argues that R&D is a cost to the business and should be expensed, because otherwise one would be leaving scope for abuse. If the company has capitalised development costs, the venture capitalist would have to understand the reasoning behind such treatment and the relative amortisation policy. However the venture capital investor insisted that most of his investee companies write off development costs immediately, in line with current UK practice (cf. Pricewaterhousecoopers, 2011). At due diligence stage, the investor would ask specifically for more information regarding research and development expense although he clarified that in the case of IT investments –

"It would be typically primarily people, so I [the investor] would want to see the breakdown of the R&D team by individual, what are their remuneration costs - salaries the bonuses etc, and an organisational chart of the R&D team. We would want to reconcile the numbers in the statutory accounts."

This is also dependent on materiality; it makes a difference if the intangible is £100 or £1 million. A closer look at the notes to the financial statements filed at Companies House showed that the majority of investee companies were expensing development expenditure. We traced one firm (a provider of website testing solutions) which indicated that "Intangible assets, which reflect rights acquired in respect of development expenditure are amortised over the period for which value is expected to be realised". However, we note that on the balance sheet at investment date no development expenditure was recognised during the financial year prior to investment date. In fact, development expenditure capitalised in previous years was actually written down to zero in the latest set of financial statements published prior to investment date.

However, when it comes to additional disclosure, similar to the previous case, we find that the interviewee argues that for competitive reasons, no more information on the intangible aspects should be divulged. The investor argues that from a due diligence perspective, the information could be useful, but if he was representing an investee company he would not want to disclose same. In the financial statements of investee companies considered, the level of disclosure on intangibles within the balance sheet was very limited. If there were intangibles in the balance sheet, the only information provided was usually relating to the cost and amortisation of same, but no detailed disclosure on the intangibles was provided. In some cases, a one line note indicated the type of intangibles. For example, in one of the filings of a portfolio company, a note indicated that “the remaining intangible asset relates to the website domain held by the company”.

The investor considered the information that might be included within an intellectual capital report as extremely relevant and useful (cf. Alwert et al., 2009). However, he argued that given we are dealing with early stage firms, such reports are secondary. For the investor “there are higher priority things, like the marketplace, competition, the product differentiation ahead of intellectual capital”

Similar to the previous case, apart from focusing on the reporting aspect of the intangibles, we also considered the case of the intangibles per se. The venture capitalist who invests in information technology argued that the investee companies do not usually invest in intellectual property rights (cf. Mann & Sager, 2007). Hence, he argues that a patent is not necessarily seen as a sign of a profitable investment.

As secondary evidence we considered the patents of portfolio companies listed on the venture capitalists website. From this analysis, we concluded that although some of the companies actually had some patent applications, none of the investee companies had patents which were granted at investment date. Furthermore, in the case of firms which had patent applications, the number of same was still low. For example, if we consider the case of the website testing and the storage and data processing investee companies, they only had two patent applications at the investment date. These patents all formed part of the same patent family, and therefore refer to the same invention. Out of the whole portfolio, one exception was noted – a company which developed embedded system design solutions had 25 patent applications, and had two granted patents.

The investor argued that some investee companies which had patents changed their production model and, as they grew, their patents were no longer relevant. Yet when questioned on whether patents act as a signal of entrepreneurial ability, the investor argued that if a firm has a relevant patent it does show "… a mindset of culture, not only they want to do ground-breaking things, but they want to make sure it's protected". The venture capitalist also argued that having a patent does not make any difference to the amount of effort required by him in the due diligence and post investment stages.

The venture capitalist sees no link between patenting and investing in his subsector (cf. J. A. C. Baum & Silverman, 2004; Conti et al., 2011), even if the patents are granted. On the contrary, he would get concerned if the company has a significant number of patent applications. The investor argued that "it's far better to have one critical patent than a dozen not very good patents". For the investor, the mere fact that the firm has a patent application or a patent which was granted has no meaning until the relevance of the patent to the marketplace in terms of product development is specified. In terms of the equity requested from the investee, intellectual property is not considered by the investor. The investor argued that he always considers the management team, the market opportunities, and the product as being far more important than intellectual property. For the venture capitalists, their efforts should be concentrated on scrutinising these aspects rather than seeking some form of patent valuation. They do not seek any external advice on patents (the cost of which can be substantial, see Long (2002) for discussion on patent verification costs), although when necessary internal expertise within the VC firm is available. The investee company would not even seek valuations after the investment is made because "it's so subjective that it's very difficult to be able to support your argument with the acquirer".

4.3.3 Case C: Venture capital firm which invests in general technology university spinouts

Case C represents the viewpoint of a venture capitalist who invests in various technology subsectors apart from drug development, but specifically focuses on early stage companies which have just spun out from universities (i.e. the investor does not invest in the expansion stage). Although the company is headquartered in the UK, it has an office in the United States, enabling the company to have a more global portfolio. Despite focusing on the early investment round (i.e. not seed financing) mainly Series A and Series B investments, the venture capital firms seeks to offer hands on assistance in order to maximise the value of their investments. Typically Series A investments are the first investment after the initial seed financing. In this stage firms seek to provide further validation of the product, and expand business development. On the other hand, in the case of Series B investments, these tend to be larger investments reflecting the fact that the technology has already been developed in earlier stages (Marks, 2009).

The interviewee confirmed that financial statements are verified at due diligence stage. Financial statements are requested to check if there are any financial related problems, but they also serve as the baseline of the projections. In general, however they are not concerned about the figures shown within the financial statements. There is general aversion towards the use of financial statements, and any historic financial information is not linked in any way to the investment decision. Any numeric figure or any content within the financial statements is not considered to be important. The investor questioned the meaning of figures relating to intangibles and R&D finance: “no matter which ... it’s meaningless” (cf. Wyatt (2008), who states that ‘even unreliable numbers could be useful signals that (unobservable) assets exist’).

We have also verified the financial statements of investee companies in the medical technology subsector which were published prior to investment date. Not all of the firms had published financial statements at the date and the level of detail in terms of disclosure in the financial statements varied between firms. In the case of the firms which had financial statements available, most of them were prepared in accordance with the Financial Reporting Standard for Smaller Entities (FRSSE) and provide only an abbreviated balance sheet. Most of the firms opted to expense development costs in line with current UK practice (cf. Pricewaterhousecoopers, 2011), although one particular firm specialising in wound imaging technologies indicated that “the directors will [would] continue to assess the requirements for capitalisation on an on-going basis”. Another example is that of a firm which develops peptide coatings for medical application. The firm shows purchased intellectual property rights on the face of the balance sheet but further detail relating to these rights is not available in the notes to the abbreviated accounts.

In the portfolio companies we identified only one exception - the case of a firm which produces diagnostic kits for invasive fungal infections. In this case, the directors have opted for voluntary adoption of the international financial reporting standards (IFRS), even though the company argues that it is still in the “development phase” and reported no revenues in the income statement. Significant detail on both intangibles and the criteria for expensing development costs is provided. For example, the management indicated that "only development expenditure incurred after regulatory approval has been obtained is recognised as an intangible assets", and further disclosure is provided on how the patents, licences and trademarks are stated at cost of acquisition, and the relative amortisation policy. Patents which were still not granted were not being amortised. A subdivision of how much of the figure of intangible assets shown on the balance sheet was patents, licences or trademarks is also shown in the disclosure notes.

Even though the venture capitalists would be interested in knowing whether the investee company has intangible assets, the investor questioned the relevance of intangibles in the balance sheet:

"If we have a number of intangible assets on the balance sheet, what does it mean? No matter which measures … you use, it's meaningless referring to additional detail in the presentation/recognition of intangibles in the balance. The only thing which means anything would be - does the company own the IP or is it licensed, what arrangements surround the IP and what is the ability of that IP to be commercialised town revenue, get into an interesting market position and prepare the company for exit, will we get return on our investment? Whether we write it off, amortise it, capitalise it is of no relevance as far as we are concerned"

When questioned specifically about the importance of the R&D figure, the respondent argued "if a company has a piece of IP, it may have not been paid for, what matter is how much it has". This implies that the venture capitalists do not care about the sunk costs, but what matters is whether the firm has the intellectual property or not. The same applies to the intangibles figure in the balance sheet. If they are not shown, it does not matter for the venture capitalist as long as they own the intangible asset. However, the investor would be interested in knowing whether the company can apply for R&D tax credits, but again "that's essentially not a matter of looking at financial statements".

In terms of qualitative disclosure, the investors do not see the scope for same within the financial statements. In fact the venture capitalist argued that:

"We will find the answers to all the questions by other means, and by means which are more meaningful than financial statements. If we're investing in a company, we've got an intimate and close relationship with that company. It's the company's obligations to disclose all relevant matters. We will have questionnaires and assessments on all those issues, which are completely independent and separate of the financial statements" (cf. Reid & Smith, 2005).

When presented with a sample intellectual capital report, the investor stated the material contained within the report was "ivory towers, and nothing to do with the venture capitalist's job", in sharp contrast to the reference to venture capitalists made in the RICARDIS Report by the European Commission (2006b). Similar to the previous cases, apart from considering the reporting aspects of intangibles for venture capitalists, we have also focused on the relevance and importance of the intangibles per se with a particular emphasis on patents.

The venture capitalist argued that patents are important, but the mere fact that a firm has a patent is not a sign of a profitable investment opportunity because "people can patent all sort of things... it doesn't say whether the IP is executable or creates value for venture investments" (cf. Long (2002), who states that since investors know that patent and patent applications are considered by investors, firms may opt to increase the number of patents at the cost of more profitable opportunities.). Nonetheless, the investor considers patents to be some sign of innovation. The venture capitalists, argued that protection could be in other methods such as know-how, barriers to entry and being first to market. According to the investors, these alternative protection methods all relate to how the company functions, compared to a patent which is based on what a filing attorney has done. However, the venture capitalist argued that if the business case is undermined by not having a patent in that area then patents can be crucial, and without a patent one would not even invest. Relating to this, we have had a closer look at the investments carried out by this firm in the medical technology industry subsector (e.g. firms dealing with advanced medical imaging, renal dialysis technology, and so on). After identifying the date the investment was made using data from Companies House, we considered the patent portfolio of these companies. Five out of the seven investee companies in this subsector had multiple patent applications spread across different jurisdictions.

Four out of these five firms already had some patents granted. These measures are indicative of the importance of patents within the medical technologies subsectors.

Nonetheless, the venture capitalist argued that there is no link between the amount invested (cf. J. A. C. Baum & Silverman, 2004; Conti et al., 2011) and the number of patent applications or patents granted. He contends that the investment decision is made on the business proposition, which may or may not include patents. However, the investor admits that although "patents are only part of the equation", ultimately "the decision may very well be informed by whether a company has a patent or not". The venture capitalist clarified further this statement by stating that "it becomes a yes/no [decision] rather than a question of value. There's no way to price the existence or otherwise of that". In other words, it can be a binary decision on whether the firm has a patent or not. No link is seen between the equity required and the number of patents. The investor emphasised that not only are patents within the potential investee company considered, but that also the experience of the entrepreneur in producing intellectual property is important: "if we [they] see that that the entrepreneur has done it all before, he gets a big tick".

In terms of patent valuation, in due diligence stage, the liquidation situation is considered (i.e. if the investment fails, what value will be given to the intellectual property). Experts are engaged to ensure that the patenting process has been correctly followed and not to value patents. In contrast however, later on in the course of the investment the investors would be interested in showing a figure for intangibles in the financial statements, and in fact "we'd [the investors] like to list as a big number [as possible] to bring it to the attention of potential acquirers" (cf. Wyatt, 2008).

4.3.4 Case D: Venture capital firm which invests in the media and telecommunications industry

Case D is the case of a venture capital firm which invests only in later stage investments in the growth or expansion phases. These companies may have some revenues, but might still be loss making. They usually have a product or service, and are already paying clients for same. The focus of the investments i mainly in the media and telecom sectors, although they do invest in internet and software companies. Although they invest only in companies incorporated in the United Kingdom, the venture capital realises its investments (exits) worldwide.

The investor stated that as a first step, they would consider the use of financial statements directly from Companies House, rather than the company. In contrast to other venture capitalists, the investment firm states clearly on their website that an analysis of Companies House filings is carried out as part of the analysis conducted prior to investing. If interested further in the company, they would then ask for the detailed financial statements later on in the due diligence stage, because the information at Companies House is usually dated given that the investment date may differ from the submission date. More detailed information is often requested. A closer look at the financial statements of investee companies available at the investment date in which the venture capitalist invested, revealed that although the firm invests in companies which are in the expansion stage, they were still eligible for abridged accounts, and the filings submitted consisted only of the balance sheet and the relevant disclosure notes relating to it. In assessing the company, the investor considers the statement of financial position and the income statement of a company as equally important. The venture capitalists stated that the revenue, cost of sales, R&D expenditure and the net profit are the key figures. From a balance sheet perspective, the crucial figures are cash and any liabilities which the company might have.

The venture capitalist stated that he did not recall ever seeing amounts written off intangibles in the income statements of companies in which the firm invests in.

Notwithstanding this statement, we did identify one investee company in the telecommunication sector that had a number of patents at investment date which were actually capitalised at cost, and were being written off in equal instalments over their estimated useful life. The financial statements do not give any further details as to the nature of these patents, and what their remaining useful life was. Although interested in the amount of R&D expenditure, he is not interested in having more recognition or detailed presentation within the financial statements because: "We recommend that small private companies expense their R&D as much as possible rather than capitalise it although we always ask for an estimate of cost and effectiveness of R&D (noting what has been spent and why it has been spent) and would never recommend formally accounting for it. You can spend a huge amount of time on spurious accuracy that doesn't really matter". An analysis of the financial statements of portfolio companies at investment date, revealed that most of the investee companies did not adopt the policy of capitalising developments costs at the investment date (cf. Pricewaterhousecoopers, 2011).

It has also been argued that in the case of the investments the firm carries out "80% [of R&D costs] is people", and therefore a detailed statement subdividing the various components of R&D expenditure would not be of a particular use. He argued that his key concern is not the numbers, but "what they've done, what they built, the competitive advantages; whether they have patents is far more interesting than numbers". It has been argued that for a small company, the number of employees involved in research might not be relevant measure because there might not be a specific R&D and implementation teams, and individual employees might be performing more than one task e.g. R&D and sales. As a consequence it was argued that some disclosure relating to the nature of patents, the geographical scope and patent litigation could be of benefit, although one must be careful not to include too many people. Despite the fact that his investments involved a great deal of intangibles, he did not believe that the use of the intellectual capital reports would be of any help to venture capitalists in the field, arguing that the contents of same are usually "not things we're interested in".

It therefore appeared that although considered initially, financial statements were not used by the venture capitalists to provide any insights on intangible assets. However, he did acknowledge that when considering the investment decision intellectual property was a crucial aspect considered at the qualification stage. In fact, most companies in which the investee company invested in not only had a significant number of patent applications, but also a number of granted patents. Yet, when questioned on the signalling aspect of patenting, the investor only believed that patenting could be a signal of some innovative potential, but that it is not a signal of anything beyond that. In fact the entrepreneur questioned patenting and profitability arguing that these are not linked. Furthermore, patenting is also not a signal of entrepreneurship: “Patents and profitability are not linked. Generally the skills that an entrepreneur has are not the technical skills for the patent. There is the entrepreneur who is outward facing and has a vision, the partner who is the more technical person, [and] is the person who can drive the patents, and therefore I don’t think the entrepreneur is the man who drives the patents”. Finally at this stage of investment, patenting does not appear to make any difference in terms of effort for the venture capital.

The investor was also clear that the link between patenting and investing does not exist in terms of the amount invested or the amount of equity requested. This is because the amount invested is determined independently, based on the amount of commercial return the investor wants to make: “Price is incredibly important and none is prepared to pay more than 25-30% gross margin because we have patents … Not only you need to have the patent but you need to be able to enforce it” (cf. Kitching & Blackburn, 1998). Post investment, the investor expects the firm to continue improving on its patent portfolio to keep in line with technology, and considered this to be a part of the normal routine and costs of the business.

On patent valuation, the investor also had clear views that there is no scope for attempting to provide a value for same, not even post investment. He contends that the value of the business as a whole is what mattered and not the value of the specific patent. Moreover, there could be businesses in which the investor invested which have no patents. He argued that in the small companies in which his venture capital firm invests one would not expect huge patent families, and as such it is the opportunities for growth within the business which generate the value and not the patents.

4.3.5 Case E: Venture capital firm which invests in the medical, IT and energy industries

Case E is the case of one of the largest venture capital firms in the United Kingdom, which invests in three key areas - medical, information technology and energy. Throughout its existence the firm has invested in different types of companies but nowadays, all of the investments are related to technology growth businesses, i.e. which are in the expansions stage. The companies usually have between £5 and £40 million of revenues. Most of the companies in which the firm invests tend to be already profitable. Most investee companies tend to be located in the United Kingdom, with a minority of investments in Europe. However, the company realises the investments through exits worldwide.

In this case, as part of the due diligence process the company would usually ask for financial statements dating two years back and 3-5 years forwards, apart from the latest management accounts. Prior to investment, although they do not access the financial statements directly from Companies House, they make use of information retrieval facilities which provide Companies House documents indirectly. In view of the investment criteria for companies which are already earning substantial amounts of revenues, the companies would have usually filed full accounts in accordance with UK GAAP as opposed to the case of potential investee companies in earlier stages which would have only filed abridged accounts.

The frequency of financial statements required depends on the nature of the business. For example, the investor indicated that if it's an internet business they would need to see the monthly trends and monthly numbers historically. Key figures include breakeven points, the minimum cash balances, and burn rates (a measure of negative cash flow). Within the financial statements, the key concern is risk, and given that they are investing in high growth companies, the venture capitalist would expect a certain amount of growth in revenue. In terms of intangibles, the venture capitalist argued against the capitalising of development costs: "We do not like companies capitalising intangibles. We argue that until a product is viable, R&D may have no value and therefore our view to write it off. If you're acquired by a US acquirer they may have different depreciation policy and you don't want immediate write off of any intangible assets on acquisition. If you write it off earlier on you may make earlier loss but more profits later on which are more representative of cash flows…. We may question the management culture, we may not be comfortable with overly optimistic not as prudent culture". In the analysis carried out, amongst investee companies, none of the investee companies with financial statements available at investment date had capitalised development costs, and these are written off as incurred". In some cases, the cost of intellectual property was capitalised at cost. However, often there is no further information as to the amortisation policy – for example in a case it was stated that '[the estimated useful life is] assessed by the directors on a case by case basis'.

The interviewee argued that the amount spent on research and development is important, and also insisted that if the figure is shown separately from other expenses within the financial statements this could be more useful. A closer look at some of the published financial statements of the investee companies' prior to investment date showed that some of the companies were already presenting such a line item separately. One purpose for requiring same is to be able to benchmark across different sectors. However, the investor was against showing the breakdown of R&D expenditure on the face of the income statement, although the information is asked for at the due diligence stages. Having stated this, the investor emphasised the importance of the management in these early stages arguing that "the amount you spent at these early stages is not necessarily related to success, it's more related to the management's ability to turn into a great company and the market being there". In terms of more narrative disclosure on intangibles within the financial statement, the investor appeared to be more cautious arguing that the information is commercially sensitive, and although asked for at due diligence these should not be included within the public accounts. In some cases of investee companies, we noted that they have provided more narrative disclosure (e.g. the number of employees involved in research development) than is required by law. In some cases, not only more detail was provided in terms of disclosure, but they also provided unaudited non-statutory income statements which showed a breakdown of costs, detailing the proportion of costs relating to patents and prototypes amongst other issues. When questioned on other forms of reporting, such as the intellectual capital report, the venture capitalist argued that the information contained therein could be of interest, as long as it is not made compulsory, because "you do not want to have more red tape". The investor stated that "the issue is that before you invest its very interesting but once you've invested you wouldn't want to start to impact the way you run the company", because there might be commercially sensitive information. For example, he stated: "we had one business where we decide to outsource the outbound call centre of six people to a UK agency… as a result turnover shot up because we made six people redundant. You wouldn't want to worry about the fact that you had to disclose that to then put off the right commercial decision".

But if the investor did not appear to be concerned about the reporting of the intangible assets, are intangibles actually important for the investor? The investor had clear viewpoints on the role of patents for the small investee companies in his sector:

"in small companies they are defensive rather than offensive… for us what's more critical is getting to profitability and that patents are there as a defensive measure in the early days. If you're looking to be acquired by a large company patents become more important but that's further off track. … Most important [in the investment decision] is what you think of management, what they've done in the past and if you think they are credible".

Furthermore, the interviewee explained that there are differences in the importance of patents across industries. For example the companies in the IT portfolios might not always patent. As part of the analysis carried out, we considered the number of patents held at investment date, and could clearly identify that there was substantial patenting activity in the healthcare investments (with some firms even having patents already granted), in contrast to the IT investments, where some investee firms had no patents at all at investment date.

On the signalling aspect, the venture capitalist argued that although not necessarily valuable, a patent shows a sign of innovation and implied that it could be a "business worth looking at". He argued that the fact that a firm patented, shows a degree of organisation from the management side, and could be possibly considered as a signal of entrepreneurial ability. However, the investor argued that given that in these early stages patents serve only as a defensive tool, there is no link between patenting and success, and they would not in any way reduce the effort required by the venture capitalist post investment.

On the link between patenting and investing, the investor stated that there was no link between the amount invested or equity required and the number of patents. From his experience one could invest large amounts in businesses with a small number of patents. He argued that there could be a positive correlation but only for a small number of patents. Once you go past a threshold, it becomes negatively linked to performance. Although he anticipates that post investment the number of patents would increase the investor argues that "if there are too many [they could] become a financial burden on the company". On patents granted, given the nature of venture capital investments, the investor argued there is no time to enforce patents, and as such these may pose problems rather than give additional benefits.

External advice is often sought on various aspects relating to patents, such as their relative strength and geographical scope but no advice is ever sought on the value of the patent because "it's not worth anything unless the business is worth anything. If you're more luck you may have patent trolls[6] approaching you but that's very rare". The investor is very much aware of the costs and difficulties involved with the valuation of intangibles. The investor complained about existing accounting costs, arguing that they are forced to value share options for staff using the Black Scholes model, which in itself is already a very costly exercise.

4.3.6 Conclusion

The cases provide insights on the reporting of intangible assets, and on the role of the intangible assets (particularly patents) in the investment decision made by the venture capitalist. Although the case studies highlight the fact that financial statements and figures relating to R&D and intangibles, are reviewed by the venture capitalists, the investors agreed that the figures contained therein are "historical", and that the focus is usually more on forecasts. There is agreement that any financial data required is usually provided by the entrepreneurs at the due diligence stage, and there is no need for further detail within the financial statements themselves. Venture capital firms in the UK which focus only on later stage investments (Case D and Case E) tend to attribute more importance to the financial statements, in line with the Hand's (2005a) study in the United States. However, even in these cases, the investors did not appear to be particularly concerned about intangibles shown within the financial statements. In line with the earlier unstructured interviews (see Section 4.1), the cases have shown how financial statements are used merely as a starting point when evaluating investment decisions by venture capitalists. In Cases B and E we highlighted the problem of having R&D bundled with administration expenses in line with the requirements of the Companies Act, although in the case of some of the later stage investments (Case D), investors were voluntarily disclosing

[6] These are companies which would purchase patents with the ultimate aim receiving compensation through licensing fees (see Jaffe & Lerner, 2004)

the total attributable to research and development. An analysis of the company accounts of the investee companies also confirmed that even technology focused early stage companies opt to expense development costs (even though they might meet the eligibility criteria for capitalisation) (cf.Pricewaterhousecoopers, 2011).

The investors in the cases highlighted, also question any figure attributed to patents shown in the financial statements (at cost) or which is provided elsewhere by the investee company. This is due to the ambiguity involved in the calculation of same and also due do issues related to competition. In fact, none of the cases highlight that patent valuations should be carried out by experts prior to the investment decisions (although Case A suggested that the investor would have some form of value in mind, which is usually based on "gut feel").

Yet, irrespective of the viewpoints of venture capitalists on intangible asset reporting and valuation, the case studies show that patents do have an important role for the venture capitalist. In the five cases provided there is agreement that patents serve as a sign of innovation within a firm. Depending on the quality of the patent filed they can be a signal to overcome the "liability of newness", originally outlined by Stinchombe (1965), although the investors agreed that patenting does not act as a signal of profitable investment opportunities.

The case studies also show that in the United Kingdom the relevance of patents is industry dependent. For example, in Case A we explain how the pharmaceutical investor would rarely invest unless there are patents in place due to "first mover advantage" (cf. Lieberman & Montgomery, 1988). Furthermore, given that for UK venture capitalists investments are considerably short term investments, and also early stage (with limited resources) (cf. Kitching & Blackburn, 1998), the role of patents tends is more defensive rather than offensive. On the other hand Case B and E highlight how, in the case of the information technology subsector, patents are less relevant. This is in line with the US study by Mann and Sager (2007) who stated that there is a lower amount of patenting in the software industry than in the scientific sectors. In other firms which do not invest in specialist technology subsectors, such as the one in Case C, the situation is more ambiguous. In this case the relevance of patenting depends specifically on whether the business case is undermined by not having patent. Rather than the number of patent numbers, in this case the difference is more likely to be whether the firm has a critical patent or not.

Having considered the various interviews in depth, the next chapter will present and analyse information relating to the new dataset on patenting and investment in more detail. Using statistical analysis, this chapter attempts to provide further insights on patenting and investments in the UK venture capital setting.

5.0 Analysis of the dataset on patenting and venture capital investment

Following the interviews on the field, as discussed in Section 3.3, secondary data analysis was carried out on a new dataset on venture capital investments in the United Kingdom. This included data related to investments made by venture capital in the United Kingdom, accounting information on intangibles, as well as patent counts. The dataset is a cross sectional dataset which includes details of investments made by UK based venture capitalists from the year 2000-2013. In analysing the data, we have carried out cluster analysis (Section 5.1). This analysis allowed us to identify some initial patterns and similarities within the data prior to conducting the regression analysis. Section 5.2 includes the results of the regression analysis carried out as part of the study.

5.1 Two-step cluster analysis

5.1.1 Introduction and descriptive analysis of clusters

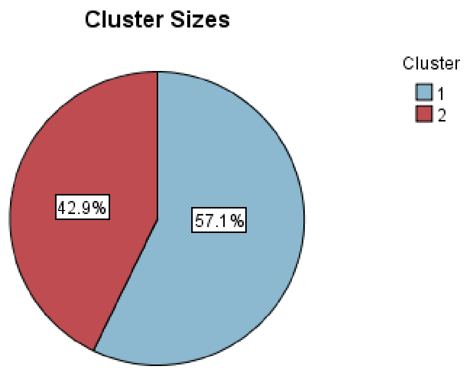
Cluster analysis involves the identification of homogenous groups within the data which share common characteristics. In this research for example, they might be investments in firms within the same industry subsectors, or investments in companies which own patents. Objects within the clusters, share many characteristics, but are dissimilar to others not belonging to the cluster (Mooi & Sarstedt, 2011). This analysis should enable us to organise the dataset in a way which is more readily understood, and by which information retrieval is facilitated. By clustering the investments, we would be able to clarify patterns of similarities and differences in the data (Everitt, 2011).

In order to carry this out, the two step cluster feature in SPSS is used. The two step clustering approach is as follows: First, it groups clusters into small subclusters known as 'preclusters'. In this stage, an algorithm considers possible pairs of data, and based on a distance measure, it decides whether data should form part of an existing precluster or if a new cluster should be formed (Norušis, 2012). In the second step, these are then grouped into a number of larger clusters (Wu et al., 2010). Under this two-step clustering approach in SPSS, the number of clusters can be determined automatically using measures of fit which consider different solutions using different number of segments, namely the Schwarz's Bayesian Criterion (BIC) or Akaike's Information Criterion (AIC) (Norušis, 2012). The number of segments is determined by considering the solution which gives the smallest number of segments under the chosen criterion (Mooi & Sarstedt, 2011). Since, Mooi and Sarstedt (2011) argued that sometimes this criterion overstates the number of clusters we have attempted to reclassify the data using the AIC, and this produced the same identical clusters.

This has several advantages over the other clustering approaches available in SPSS. Of particular relevance is that this is the only approach which is able to handle both continuous and categorical variables at the same time. One further advantage is that it identifies outliers and these are placed in an outliers clusters (Chiu, Fang, Chen, Wang, & Jeris, 2001) .

For the purposes of this cluster analysis, the industry (as identified by SIC Code groupings), the country group, and the dichotomous variables indicating whether they had a patent granted, whether they had a patent applied for, and whether they had multiple patents were treated as categorical variables. The natural log of the investment (ln) and age of the firm at the time of the venture deal are included as continuous variables. For validation purposes, the number of patents applied for and the number of patents granted were included in the model as evaluation fields.

The data was divided into two clusters as follows:



Size of Smallest Cluster	246 (42.9%)
Size of Largest Cluster	328 (57.1%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	1.33

Figure 5-1: Size of clusters

Table 5-1: Cluster frequency table

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Outlier	6	0.9	1	1
	Cluster 1	328	49	56.6	57.6
	Cluster 2	246	36.8	42.4	100
	Total	580	86.7	100	
Missing		89	13.3		
Total		669	100		

From Figure 5-1 and Table 5-1, one can note that the data was divided into two major clusters, with 6 values placed in the outlier cluster. A number of missing values were identified; these relate to firms for which the age is not known, and these were therefore excluded from the cluster analysis. Furthermore, we note that 1 % (n=6) of the cases were placed in the outlier cluster. This is minimal compared to the data under consideration. A closer look at the data suggests that these observations represent an insignificant segment within the data under consideration, relating to investments in companies which did not have any granted patents and which had no more than one patent applied for.

We also consider the cluster quality (the goodness of fit of the clusters identified). As shown in Figure 5-2 this is classified as being 'good' using with the silhouette measure of cohesion and separation. This measure, which is based on the work of Kaufman and Rousseeuw (2005), is an estimation of distances between which objects in the same cluster can vary. It can range between -1 and 1. Values between -1 and 0.2 imply a poor solution, whereas values between 0.20 and 0.5 suggest a 'fair' solution. On the other hand, if the measure is above 0.5 this implies a good solution (Mooi & Sarstedt, 2011). In this case, the silhouette measure of cohesion and separation is 0.6 (good). This result means that a significant amount of cases are located on the cluster centre.

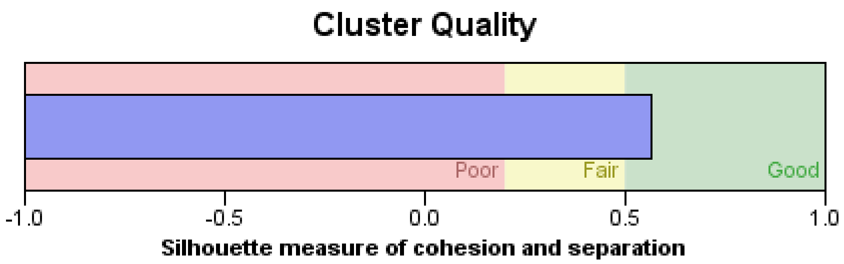


Figure 5-2: Cluster quality diagram

The predictor importance, which highlights the importance of each field in estimating the clustering model (IBM Corp., 2011), was considered. The dichotomous variables of whether the firm had multiple patents or patents applications were considered as being the most important whereas the country group was the least important as shown in the Figure 5-3.

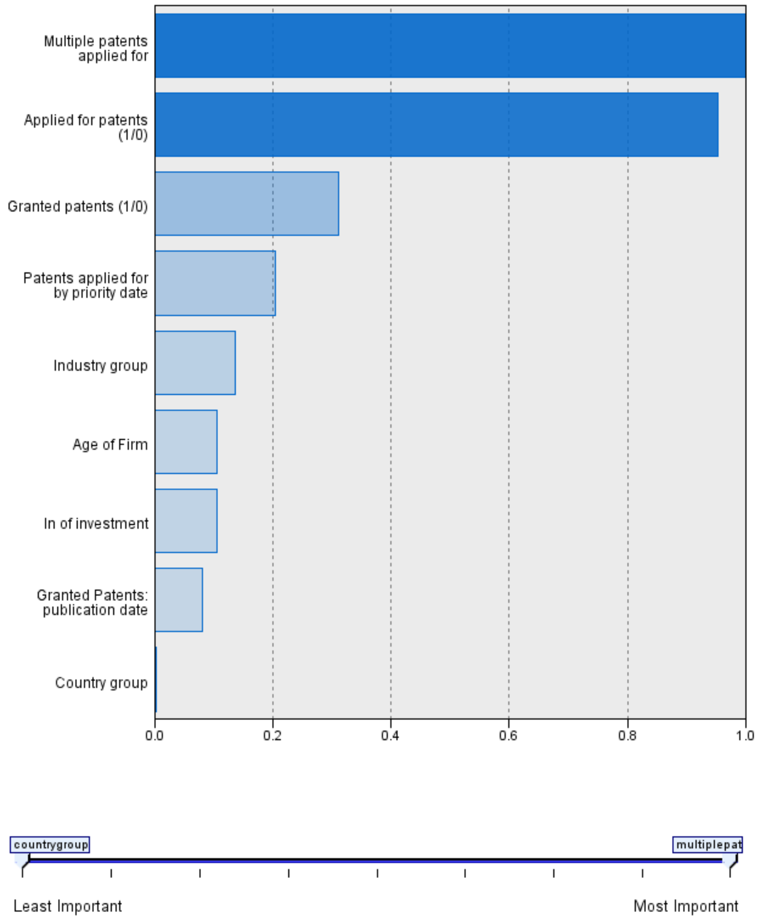


Figure 5-3: Cluster predictor importance

5.1.2 Profiling

After considering predictor importance, an attempt was made to profile the clustering variables. Profiling involves identifying characteristics of the clusters under consideration (Mooi & Sarstedt, 2011). The most frequent value of each categorical/dichotomous variable and the mean of each continuous value were considered.

Table 5-2: Cluster descriptive data

	Non Patenting Cluster	**Patenting cluster**
Cluster Number	1	2
Size	57.1% (328)	42.9% (246)
Multiple patents	No (100%)	Yes (96.7%)
Patents applied for	No (95.4%)	Yes (100%)
Granted patents	No (100%)	No (58.5%)
Industry group	Computer & related activities (modal) 53.0%	Computer & related activities (modal) 28.5%
Age of firm	3.2 (Mean)	4.76 (mean)
Ln of investment	0.5	1.35
Country group	United Kingdom (Modal) 69.2%	United Kingdom (Modal) 70.3%

From Table 5-2 we can infer that cluster one, which has been labelled as the non-patenting cluster, includes 95.4% of investments in firms without patents. On the other hand all of the investments in the patenting cluster (cluster 2) include patents. Almost all firms in the patenting cluster have multiple patents (96.7%), but only 41.5% had a granted patent. Whilst these are the most important predictors, one can also note that the mean age of the firm is slightly older in the patenting cluster. Furthermore the mean investment in the patenting cluster (cluster 2) is 3.86 million ($e^{0.5}$) as opposed to 1.64 million ($e^{1.35}$) in the non-patenting cluster, implying a higher investment on average in the patenting cluster. In both cases the highest proportion of investments represent those related to "Computer and related activities", although some noticeable differences emerge from the cluster classification.

The table below, (Table 5-3) is presenting a crosstab summary of the descriptive frequency statistics, showing the number of companies in each cluster within particular sectors.

Table 5-3: Industry classification within clusters

	Non Patenting Cluster		**Patenting Cluster**	
	Frequency	Percentage	Frequency	Percentage
Manufacture of Chemicals, Chemical Products and Man-made Fibres	2	0.61%	14	5.69%
Manufacture of Electrical and Optical Equipment	14	4.27%	52	21.14%
Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	23	7.01%	2	0.81%
Transport, Storage and Communication	10	3.05%	15	6.10%
Financial Intermediation	6	1.83%	2	0.81%
Computer and Related Activities	174	53.05%	70	28.46%
Research and Development	21	6.40%	49	19.92%
Other business activities	56	17.07%	31	12.60%
Other community, social and personal service activities	8	2.44%	1	0.41%
Other subsectors	14	4.27%	10	4.07%
TOTAL	328	100%	246	100%

As one can see from the above table, a higher proportion of computer & related activities firms fall in the non-patenting cluster (the cluster with firms with no patents); whereas investments in the patenting cluster relate more to the manufacture of electrical and optical equipment, manufacture of chemicals, chemical products and man-made fibres (which include the pharmaceuticals) and R&D subsectors. Traditional service subsectors such as wholesale and retail trade, financial intermediation, and other community social and personal service activities fall within the non-patenting cluster. It is important to note that in the initial sample we opted for firms which invest in technology investments; such investments in firms offering non-technology related services are only included as a result of the firm investing in some other sectors *apart from* technology.

From the profiling, we can conclude that we have two clusters; one with investments in firms that are involved in patenting, and one with investments in firms that are not involved in patenting. Those not involved in patenting tend to be younger firms, with the absolute majority of cases being investments in computer related firms. On the other hand; the other cluster has firms which are involved in patenting, usually having multiple patents, and possibly with some patents granted. Although the major industry remains computer related firms, here we note a higher proportion of investments in the research and development sector as well as in high-tech manufacturing.

5.1.3 Validation

The final step in cluster analysis is validation. In this stage, we ensure that the cluster solution is representative of the overall sample (Hair et al., 2010).

If we examine the two validation variables we included, the number of patents applied for, and the number of patents granted, we note that as expected, this is in line with the cluster subdivisions; granted patents (at investment date) were on average 3.42 in the patenting cluster and nil in the non-patenting cluster. Patents applied for were on average 36.07 in the patenting cluster and 0.05 in the non-patenting cluster.

Cross-validation was also used (Hair et al., 2010). In this case, the sample was split into two groups of identical size. This was done by numbering each record, and considering clustering half of the groups each time. The order of the numbers assigned was random; based on sorting in accordance with the order of a set of random numbers generated in Microsoft Excel 2010. Under normal circumstances, members of a specific cluster should be the same in different cluster solution. Therefore, using cross tabulations, cluster memberships were matched. Only 3.62% were assigned to a different cluster in the split groups, suggesting a very stable clustering solution (Hair et al., 2010).

As shown in Table 5-4 below, the two clusters generated from the two subsamples show identical features as the original clusters, highlighting the validity of the cluster solution.

Table 5-4: Cluster comparison - Cross validation with two subsamples

	ENTIRE SAMPLE		SUB-SAMPLE 1		SUB-SAMPLE 2	
	Non Patenting Cluster	**Patenting cluster**	**Non Patenting Cluster**	**Patenting cluster**	**Non Patenting Cluster**	**Patenting cluster**
Cluster Number	1	2	1	2	1	2
Size	57.1% (328)	42.9% (246)	56.5% (161)	43.5% (124)	52.5% (155)	47.5% (140)
Multiple patents	No (100%)	Yes (96.7%)	No (100%)	Yes (91.9%)	No (100%)	Yes (88.6%)
Patents applied for	No (95.4%)	Yes (100%)	No (100%)	Yes (100%)	No (100%)	Yes (100%)
Granted patents	No (100%)	No (58.5%)	No (100%)	No (58.1%)	No (100%)	Yes (64.3%)
Industry group	Computer & related activities (modal) 53.0%	Computer & related activities (modal) 28.5%	Computer & related activities (modal) 52.8%	Computer & related activities (modal) 32.3%	Computer & related activities (modal) 48.4%	Computer & related activities (modal) 31.4%
Age of firm	3.2 (Mean)	4.76 (mean)	3.37 (mean)	4.52 (mean)	3.14 (mean)	4.67 (mean)
Ln of investment	0.5	1.35	0.65	1.2	0.44	1.33
Country group	United Kingdom (Modal) 69.2%	United Kingdom (Modal) 70.3%	United Kingdom (model) 64.00%	United Kingdom (model) 70.2%	United Kingdom (model) 74.20%	United Kingdom (model) 69.3%

5.1.4 Conclusion

In this section some key characteristics relating to the data under consideration were identified through cluster analysis. In particular, the data showed that those firms which have patents were, on average, older and had higher investments amounts. Many of the investments in patenting firms were in the high-tech manufacturing sector or in the research and development sector. In the next section, the relationship between patenting and investment is examined using regression analysis.

5.2 Regression Analysis

In a regression framework, we have considered a number patent measures to analyse the relationship between patenting and investment, controlling for other factors such as age, the global recession of 2008/2009 and industry differences, as well as differences due to the country of incorporation.

5.2.1 Initial model

Mann and Sager (2007) had identified a positive relationship between the amount of financing received and the existence of patents, although this study related only to the case of software start-ups. In this case, the authors state that their data relates to patents held (i.e. patents which had already been granted) Similar relationships between financing and a binary value for patents applied for was also identified by Conti et al. (2011). However, the latter study is based on US data and restricted to a dataset of firms which spent some time at the incubator of the Georgia Institute of Technology. Through regression analysis, this relationship between the level of investment and the existence of a patent is reconsidered for investments carried out by venture capitalists in the United Kingdom. We argue that:

H_1: There is a positive relationship between the existence of a patent application and the level of investment

The first regression model considers the whole set of data, and does not take into consideration the stage of investment. The dependent variable is *lninv,* which the natural log of the investment received in a venture round. In terms of independent variables there is the variable indicating existence of a patent application (*binpatapp)*, and a number of control variables namely *age* which includes age as at investment date, *itind* which is an indicator of whether the firm is in the computer services industry, *USA* which is an indicator of whether the investment was in the USA, *Europe,* an indicator of whether the investment was in a company incorporated outside the UK but in other European countries and *fincrisis2008* and *fincrisis2009*, which are indicator variables for whether the investment was made in the financial crisis of 2008 and 2009. Apart from these, a number of interaction dummy variables relating to the above were considered and are discussed below. The model has an R^2 of 26.9%, a value which is similar to other studies in the area (cf. Mann & Sager, 2007; Munari & Toschi, 2014), and is overall significant at the 0.01 level. In this case, we note that the investment figure includes the total investment done in a venture round, irrelevant of the stage in which the investment is made. The results of the regression analysis are shown in Table 5-5 under the heading 'All Sample':

Table 5-5: Regression analysis - Investment and the existence of patent application

VARIABLES	All sample [1] lninv	<=1 year [2] lninv
age	0.1352***	
	(0.0350)	
1.binpatapp	0.5267**	0.7738*
	(0.2508)	(0.4635)
1.itind	-0.5627***	-0.5144
	(0.1498)	(0.3791)
1.USA	1.2423***	1.4115***
	(0.2020)	(0.4005)
1.Europe	1.1442***	1.1899***
	(0.1554)	(0.3923)
1.fincrisis2008	0.3470*	0.4008
	(0.2040)	(0.6485)
1.fincrisis2009	0.0806	0.6620
	(0.1741)	(0.4779)
1.binpatapp#c.age	-0.0128	
	(0.0439)	
1.binpatapp#1.itind	0.0921	-0.1904
	(0.2085)	(0.6244)
1.binpatapp#1.USA	0.0303	0.6961
	(0.2512)	(0.5615)
1.binpatapp#1.Europe	-0.5102**	-1.1897**
	(0.2284)	(0.5398)
Constant	0.0093	-0.2902
	(0.1879)	(0.3017)
Observations	580	120
R-squared	0.269	0.173
F ratio for regression	22.85***	11.36***

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

At first glance the regression confirms the hypothesis that that there is a link between the investment made and patenting, in line with previous studies carried out in the USA. The binary variable which shows whether a patent held with a priority date which is earlier than the investment made (*binpatapp*), is significant at the 0.05 level. Ceteris paribus, a firm having a patent would increase the amount of funding by

69.3%[7]. The result is also consistent with the response of a number of interviewees identified in the previous feedback, who mentioned that the relationship between patenting and financing is “binary” that is without patents they would not invest. For example, one investor stated that “the decision to invest may very well be informed by whether the company has a patent or not”. Furthermore, it is also confirmatory of the results of the profiling carried out in the earlier cluster analysis (Section 5.1), which had shown higher investment for the patenting cluster.

In terms of the control variables, we find a significant relationship between venture capital financing and age *(age)*. This appears to be in line with Gompers (1995) and Sahlman (1990) who show that venture capital investment is higher in firms which are older. Gompers (1995) argues that in the case of start-up firms the information asymmetry is higher. With more experienced firms, there is more information available for scrutiny prior to investment. More information can be scrutinised prior to investing in later stage deals. This is also confirmed in the BVCA Private Equity and Venture Capital Report on Investment Activity 2012, which shows higher average investment amounts in the United Kingdom, for later stage investments (BVCA, 2013). In a bid to reduce the problems associated with early stage investment, venture capitalists often resort to staged financing. In this case, the funds are not all made available upfront to entrepreneurs, but are spread out during the lifetime of the investment, allowing the venture capital firm to withdraw from the investment at different stages (Wang & Zhou, 2004). Having stated this, we do not find evidence that there is any increase in investment if we consider the joint effect (interaction effect - *binpatapp#age)* of patents and the age of incorporation of the firm.

Another control variable included in this regression is the investment country. From earlier descriptive analysis we noted that United Kingdom venture capitalists tend to invest outside of the country, primarily in the USA and Continental Europe.

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[7] This is calculated by considering the exponential of the coefficient (*binpatapp),* $e^{0.5267}$, which is equal to 1.693, and therefore an increase of 69.3%

Historically, between 1990 and 2005, 53 per cent of the funds raised by UK venture capitalists were invested in companies outside of the UK (Lerner, Pierrakis, Collins, & Bravo-Biosca, 2011). Munari and Toschi (2014) argue that due to the fact that the US venture capital market is the most developed, they would expect higher investments in the USA. Furthermore, we note that the average investment in the USA and Continental Europe and also in other countries, reported by venture capitalists in the BVCA Private Equity and Venture Capital Report on Investment Activity 2012, was significantly higher than the average investment done in the UK (BVCA, 2013). The regression confirms that investment in US (*USA)*, and Europe (*Europe)* tend to be higher.

We have also included a control variable for investments which fall under the Industry category "Computer and other related activities" (*itind)*, or more specifically for investments made in companies which provide hardware consultancy, software design and consultancy, data processing and other computer related activities. The reason for including this variable arises from Mann & Sager's (2007) study on patenting in the computer services industry. The authors outline that before the first round of financing patents are irrelevant for software start-ups. On the other hand, they argue that biotech start-ups are more likely to rely on patenting prior to financing. Gompers (1995) also show how firms in the software industry in the United States receive lower investment amounts. A closer look at the UK data for 2012 reveals that, for example, the average investment for pharmaceuticals and biotechnology was over three times higher than that of software and computer services (BVCA, 2012). In this study, a lower amount of investment, significant at the 0.01 level is identified for investments in companies with the industry code of "computer and related services". This further confirms what one of the interviewees in this sector stated when he argued that they "can't do [investments in] environmental, drug discovery, clinical trials just because the capital requirements immediately go beyond four, five or six million and we [they] don't have pockets that deep".

In the model we include an interaction dummy to show the joint effect of having a patent and an investee company in the computer industry sector. We find no significant difference in this respect amongst UK firms, which confirms the viewpoint of investors in this industry interviewed in the earlier fieldwork. According to the regression results, having a patent in the computer related services industry does not make a significant difference in the amount received in venture capital funding.

Apart from this, we have controlled for the effects of the financial crisis of 2008/2009. The dummy variables represent the periods in which the UK was officially in recession (Campos, Dent, Fry, & Reid, 2011) i.e. the dummy variable for 2008 *(fincrisis2008)*, is set equal to 1 for investments made in the period of April 2008 (commencing in Quarter 2) to December 2008, and the second dummy variable for the 2009 period *(fincrisis2009)* is set equal to 1 for investment made in the period of January to September 2009 (ending in quarter 3). Whilst the difference in 2009 is not statistically significant, we find a weak positive relationship (significant only at the 10% level) for investment during the 2008 recession. We note that although there was a decline in the 'riskier' seed and first stage investments (Pierrakis, 2010), according to the BVCA statistics covering the same period there was an increase in 'safer', later stage and expansion stage investments (BVCA 2009, 2010b) . We argue that this could be one of the reasons why the data shows the increase in investment in 2008 as statistically significant.

We also controlled for the interaction between the country of investment and patenting. Hughes and Mina (2010) highlight how the relative importance of patenting is viewed differently across countries. The authors show that UK firms perceive patenting to be less important in comparison with US firms. However, we do not find significant differences in the investment amount when considering jointly (*binpatapp#USA)* whether the investment country is the United States, and whether a firm had a patent. On the other hand, the dummy variable which considers the joint effect of *(binpatapp#Europe)* is significant and negative suggesting that British venture capital investment tends to be lower in Europe than investment in the USA, and in the UK when the firms have patents, although the overall effect still remains positive. This is perhaps due to the different regulatory regimes. There are differences in the nature of industries across European countries when compared to the UK and the USA. For example, in Italy biotech firms are not involved in drug research but only commercialise products which were invented elsewhere (Orsenigo, 2001). University spin-offs tend also to be less frequent, and most start-ups are formed as a result of spinoffs of larger pharmaceutical firms (Orsenigo, 2001). The variation could also be attributable due to different rates of patenting in Europe (for example only 163 Italian originating patent applications were filed with the European Patent Office between 1978 and 1996) (Orsenigo, 2001), suggesting that perhaps a lower degree of importance is given to patents in the case of European investments. There are also different regulatory regimes, for instance whilst in the USA, there is a one year grace period to file a patent after publication of an invention this does not exist in Europe (Orsenigo, 2001).

5.2.2 Earlier stage investments

It has been argued that financing from venture capitalists increases patenting. In other words, there could be a causality problem, because not only patenting leads to increases in the amount of funding received but also the reverse. Bertoni et al. (2010) showed how after the first round of financing, patenting increased. Munari and Toschi (2014) outline this problem of causality, and overcome it by considering only investments in the first round of financing.

To try and mitigate this known problem relating to the causality link between patenting and venture capital investment, we have carried out the same regression as in section 5.2.1, but using a subsample of investments covering only investment in firms less than one year old. In view that we are only considering firms one year old or less, the age variable is not considered. The results of this regression analysis are shown in the second column of Table 5-5. Contrary to the evidence found by Mann and Sager (2007) on software firms, once again we find a positive relationship relating to the holding of a patent application and higher levels of investment, although this is only significant at the 0.1 level. The interpretation and significant variables remain the same under this model, with the exception of the 2008 financial crisis variable (*fincrisis2008)* which is now not significant, reflecting the discussion on earlier stage investments and the financial crisis in section 5.2.1.

What follows next is a discussion of other regressions carried out using different patent variables, which in themselves are confirmatory of the results identified in the previous discussion.

5.2.3 Patents granted

We have also considered the above models using an indicator for a patent which has already been granted (cf. Mann & Sager, 2007) rather than patents applied for (cf. Munari & Toschi, 2014). Whilst acknowledging that the data for patents granted in the European Patent database is not complete (this is the reason why we considered patent applications first in the analysis), the results are similar to those presented above for the case of patents applied for.

Table 5-6: Regression analysis - Investment and the existence of a patent (granted)

VARIABLES	All sample [1] lninv
age	0.1455***
	(0.0276)
1.binpatgrant	0.6190**
	(0.2836)
1.itind	-0.6013***
	(0.1210)
1.USA	1.2508***
	(0.1535)
1.Europe	0.9591***
	(0.1247)
1.fincrisis2008	0.3495*
	(0.1967)
1.fincrisis2009	0.0851
	(0.1765)
1.binpatgrant#c.age	-0.0622
	(0.0449)
1.binpatgrant#1.itind	0.2909
	(0.2253)
1.binpatgrant#1.USA	-0.0480
	(0.2665)
1.binpatgrant#1.Europe	-0.3059
	(0.3084)
Constant	0.1598
	(0.1476)
Observations	580
R-squared	0.252
F-ratio for regression	20.51***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The regression model (Table 5-6) shows a significant positive relationship between the holding of a granted patent *(binpatgrant)* and the level of investment *(lninv)*, similar to the case of the holding of a patent application. There is a positive relationship between having a patent which is already granted and the level of investment received when considering the whole sample (see Table 5-6).

When considering firms which are less than one year old, we are unable to ascertain whether there was higher investment when these firms had patents granted. There are only 6 companies in the sample which had a granted patent (perhaps applied for before incorporation) and were incorporated for less than 1 year prior to the investment. We note that the patent process is usually lengthy, as evidenced in a recent report whereby the UK patent office argued that most patents receive a grant decision within 4.56 years (Mitra-Kahn et al., 2013) from application date. This confirms what early stage venture capitalist had indicated during the earlier interview fieldwork, at the time of investment there is usually no granted patents.

5.2.4 Multiple patents

The initial data analysis (see Table 3-7) shows that the vast majority of firms which have patents applications would have more than one patent applied for. There are various reasons for filing a number of patents for the same invention. A patent for the same invention could have been filed in different jurisdictions (Hall, 2007). Moreover, patents could be filed for different layouts or formats of invention to protect the whole line of research, an approach known as patent fencing (Granstrand, 1999). One further example is the case of the pharmaceutical industry. Various patents can be filed during the lifetime of the invention. Substance patents can be filed to protect the substances and compounds used in the drugs. The manufacturing process, the drug formulation and dosing may also be patented. Later on in the lifecycle, the drugs may be combined with others, to reduce the number of drugs the patient would be required to take, and a fixed dose combination patent may be filed. Moreover, if it is discovered that the drug has new indications and uses, then once again more patents can be filed (Sternitzke, 2013).

In view that the data suggests that the majority of companies which hold a patent have multiple patents (see Table 3-7), and on the basis of the previous regressions carried out which suggested a significant positive relationship between the holding of a patent and the level of investment, we would expect a significant positive relationship between the holding of multiple patents and investment. Furthermore, the previous study by Mann and Sager (2007) in the software industry suggests a positive relationship between the holding of multiple patents and total investment.

Table 5-7: Regression analysis - Investment and the existence of a multiple patent applications

VARIABLES	All sample [1] lninv
age	0.1363***
	(0.0323)
1.multiplepat	0.5893**
	(0.2519)
1.itind	-0.5485***
	(0.1414)
1.USA	1.2594***
	(0.1871)
1.Europe	1.0639***
	(0.1467)
1.fincrisis2008	0.3362*
	(0.2040)
1.fincrisis2009	0.0630
	(0.1741)
1.multiplepat#c.age	-0.0269
	(0.0436)
1.multiplepat#1.itind	0.1509
	(0.2171)
1o.multiplepat#0b.USA	0.0000
	(0.0000)
1.multiplepat#1.USA	0.0057
	(0.2457)
1.multiplepat#1.Europe	-0.3464
	(0.2308)
Constant	0.0190
	(0.1762)
Observations	580
R-squared	0.270
F-ratio for regression	22.93***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The data suggests a positive relationship (see Table 5-7) between the holding of multiple patents *(multiplepat)* and the level of investment *(lninv)*. We also considered this regression with firms which are 1 year old or less. We are unable to ascertain whether this positive relationship is also applicable to start-ups which receive investment within 1 year of incorporation, due to limited number of firms which had multiple patents in this subsample.

5.2.5 Number of patents applied for and number of patent granted

In the above regression analysis (Section 5.2.1), we have included only binary values for whether the firm has patents or not. We have also carried out regressions using the actual number of patents applied for and patents granted. J. A. C. Baum and Silverman (2004) argue that start-ups with both more patents granted and also patents applied for, in the biotech sector in the US obtained more financing. A similar relationship was also identified by Mann and Sager (2007) with respect to the number of patents granted to start-up firms in the software industry although this was only relevant post initial financing. The relationship was mentioned by Conti et al. (2011) for patents granted to the firms which spent some time at the incubator of the Georgia Institute of Technology. Furthermore, Cao and Hsu (2011) showed that in the case of the semiconductor industry, the stock of patent applications and also of patents granted increases the valuation of start-ups by venture capitalists. Moreover, Munari and Toschi (2014) identified a positive relationship between the investment made and the stock of patent applications when considering only specific technological classes, namely nanotech patents. Finally, in one of the few non-US studies dealing with simple patent application counts pre-financing, Schertler (2007) identified a positive relationship on the total volume of investments at a country level. Based on the above studies, we would expect a positive relationship between the number of patents (granted or applied for) and the level of investment. This contrasts with the earlier interviews in which mixed viewpoints were provided, with most investors denying that there is a link between patenting and investment (see Chapter 4). The potential reasons for the differences in the results are discussed further in the concluding chapter (Chapter 6).

H_2: There is a positive relationship between the number of patent applications held / the number of patents granted and the level of investment

Table 5-8: Regression analysis - Investment and the number of patents applications

VARIABLES	All sample [1] lninv	<=1 year [2] lninv
age	0.1335***	
	(0.0304)	
lnpatappprdate1	0.3296***	0.4987***
	(0.0727)	(0.1125)
1.itind	-0.4943***	-0.4536
	(0.1379)	(0.3597)
1.USA	1.3260***	1.4593***
	(0.1759)	(0.3866)
1.Europe	1.1337***	1.1513***
	(0.1437)	(0.3399)
1.fincrisis2008	0.3277	0.5391
	(0.2016)	(0.6269)
1.fincrisis2009	0.0839	0.7771*
	(0.1690)	(0.4443)
c.lnpatappprdate1#c.age	-0.0202*	
	(0.0117)	
1.itind#c.lnpatappprdate1	0.0812	0.0225
	(0.0653)	(0.3852)
1.USA#c.lnpatappprdate1	-0.0833	0.6547
	(0.0660)	(0.4503)
1.Europe#c.lnpatappprdate1	-0.2054***	-0.6974***
	(0.0731)	(0.1544)
Constant	-0.0730	-0.4047
	(0.1689)	(0.2802)
Observations	580	120
R-squared	0.296	0.221

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5-9: Regression analysis - Investment and the number of patents granted

VARIABLES	All sample [1] lninv
age	0.1396***
	(0.0260)
lngrapatpubdate1	0.3726*
	(0.1976)
1.itind	-0.5839***
	(0.1178)
1.USA	1.2430***
	(0.1472)
1.Europe	0.9838***
	(0.1221)
1.fincrisis2008	0.3455*
	(0.1974)
1.fincrisis2009	0.0841
	(0.1747)
c.lngrapatpubdate1#c.age	-0.0310
	(0.0260)
1.itind#c.lngrapatpubdate1	0.1614
	(0.1246)
1.USA#c.lngrapatpubdate1	-0.0336
	(0.1273)
1.Europe#c.lngrapatpubdate1	-0.2888*
	(0.1551)
Constant	0.1726
	(0.1434)
Observations	580
R-squared	0.252

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A positive relationship has been identified between the natural log of the simple number of patents applications (Table 5-8) (*lnpatappprdate1)* as well as the simple number of patents granted (Table 5-9) (*lngrapatpubdate1)* and the level of investment (*lninv*). Age and the country of investment remain a crucial determinant on the amount of investment made. In line with previous studies (Branstetter, 2001) and statistical literature (Field, 2009), we added a constant of *one* to the number of patents (both granted, and patent applications) throughout the whole set of data. The logarithmic transformation can only be applied if there are no zero values within the variable, because the log of zero is undefined. Some of the firms in the database had no patents and, in order to be able to apply the transformation, the constant had to be added. In view of concerns in the literature that the addition of this constant is arbitrary and might introduce some bias (Stewart-Oaten, 1996), we repeated the regression analysis using different constants (0.5 and 0.1) as well (McDonald, Erickson, & McDonald, 2000). The number of patent applications/patents granted remained significant in each case. Another issue is that in the case of patents granted we identified some evidence of possible multicollinearity: the variance inflation factor (VIF) of the number of granted patents (see Appendix I) is 11.96 (which is slightly above the threshold of 10). We identified a bivariate correlation between the age and patents granted of 0.4. We are aware that such a VIF may have an impact on predictability. However when we considered omitting the 'age' variable, there was no impact on the significance of the variables in the regression.

When considering only investments in companies which are one year old or less as stated previously in section 5.2.3, there are only 6 companies which had a granted patent (perhaps applied for before incorporation). As such, we cannot ascertain whether there is a relationship between the number of granted patents and the level of investment in this case.

5.2.6 Patent families

Another measure we used to verify the relationship between patenting and investing was the number of patent families. Patent families are discussed in more detail in the data collection discussion in section 3.3.2**.** In the data collection, we utilised the ESPACENET patent family. A patent family consists of all those patents which have the same priority date, i.e. the same filing date (European Patent Office, 2011). This way, we can say that patents protecting the same invention are counted only once (Martínez, 2011). The regressions show a positive relationship between the number of patents families and the level of investment, when considering patent families relating to patents applied for (Table 5-10) *(lnpatfamappprdate1)* both in the case of investments in firms which have existed for than one year, and also in the case of firms which are one year old or younger.

Table 5-10: Regression analysis - Investment and the number of patent families (applied for)

VARIABLES	All sample [1] lninv	<=1 year [2] lninv
age	0.1335***	
	(0.0304)	
lnpatfamappprdate1	0.3296***	0.4987***
	(0.0727)	(0.1125)
1.itind	-0.4943***	-0.4536
	(0.1379)	(0.3597)
1.USA	1.3260***	1.4593***
	(0.1759)	(0.3866)
1.Europe	1.1337***	1.1513***
	(0.1437)	(0.3399)
1.fincrisis2008	0.3277	0.5391
	(0.2016)	(0.6269)
1.fincrisis2009	0.0839	0.7771*
	(0.1690)	(0.4443)
c.lnpatfamappprdate1#c.age	-0.0202*	
	(0.0117)	
1.itind#c.lnpatfamappprdate1	0.0812	0.0225
	(0.0653)	(0.3852)
1.USA#c.lnpatfamappprdate1	-0.0833	0.6547
	(0.0660)	(0.4503)
1.Europe#c.lnpatfamappprdate1	-0.2054***	-0.6974***
	(0.0731)	(0.1544)
Constant	-0.0730	-0.4047
	(0.1689)	(0.2802)
Observations	580	120
R-squared	0.296	0.221

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We have also considered the case of the number of families with respect to patents granted *(lngrafampubdate)* (Table 5-11).

Table 5-11: Regression analysis - Investment and the number of patent families (patents granted)

VARIABLES	All sample [1] lninv
Age	0.1418***
	(0.0260)
lngrafampubdate1	0.6642***
	(0.2468)
1.itind	-0.5709***
	(0.1178)
1.USA	1.2429***
	(0.1446)
1.Europe	0.9842***
	(0.1217)
1.fincrisis2008	0.3554*
	(0.1984)
1.fincrisis2009	0.0987
	(0.1747)
c.lngrafampubdate1#c.age	-0.0627*
	(0.0337)
1.itind#c.lngrafampubdate1	0.2251
	(0.1798)
1.USA#c.lngrafampubdate1	-0.0344
	(0.1641)
1.Europe#c.lngrafampubdate1	-0.3579*
	(0.2027)
Constant	0.1439
	(0.1441)
Observations	580
R-squared	0.258

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Similar to the case of the number of patents applied for, we identify a relationship between the level of investment made and the number of patent families with respect to patents granted. As in the case of previous regressions relating to patents granted, we are unable to ascertain whether the relationship holds for patents which are one year old or less. In both the case of patent families relating to patents applied for, and the case of patents granted, the logarithmic transformation for the number of patent families has been used as in the previous models of the number of patents granted / applied for (see section 5.2.5). Furthermore, the issue of multicollinearity identified for the number of patents granted is also applicable in the case of the number of patent families (with respect to patents granted) although the variance inflation factor of the patent family variable is slightly lower (VIF=11.37 – see Appendix I) .

5.2.7 Intangibles in the balance sheet – some statistical considerations

In the dataset we have included the figure of intangibles shown in the balance sheet published prior to the investment date. This is only available for investments in firms incorporated in the United Kingdom which had published accounts prior to investment date.

In terms of the figures relating to intangibles in the financial statements, Wyatt (2008, p. 247) argued that 'even unreliable numbers can be useful signals that [unobservable] assets exist … for example a patent measured and recorded at £1 in the balance sheet is informative if it signals the existence of a patent for which publicly available to anyone who dares search the public patent office online databases'. In contrast, various academics have questioned the usefulness of figures related to intangibles in the balance sheet (Basu & Waymire, 2008; Elwin, 2008; Skinner, 2008a; Wrigley, 2008).

In the unstructured interviews carried out amongst early stage investor associations, we had obtained mixed viewpoints with one of the representatives of the associations stating that "the last place I would look to find out about the intellectual property would be the historic financial statements. I would ask if there are patents or other intellectual protection in the company - copyright, trademarks. I would ask for evidence of them". In contrast, another interviewee had stated that "the disclosures on intangibles in the balance sheet are important particularly in terms of questioning".

The semi structured interviews with venture capital investors, showed that they appear to ascribe very low importance for intangible assets shown on the statement of financial position. Some investors said it does not matter whether the intangible is shown in the balance sheet or not, what is important is whether they have it or not. Those few firms which rated its importance as being high were also sceptical about the figure, in fact they claimed that it was only important because it raises concerns about why they capitalised the intangibles, and they therefore would need to question it. As one investor argued, a figure on the balance sheet could be seen as "just a way of over glamorising EBIT". Others have argued that at the stage they invest in they would not have any capitalised intangibles.

Bearing the above in mind, we have looked closer at the figures of intangibles in the balance sheet. Using the variance ratio test available in Stata, we identified that the variance of the investment figures differs between the companies which had intangibles and the companies which had no intangibles. Thereafter we ran a t-test of the natural logarithm of the investment for firms without intangibles and firms with intangibles, and could not reject the null hypothesis that the investment is equal in both cases (Table 5-12). When running the test, we took into consideration the unequal variance assumption.

Table 5-12: T-test for Equality of means - based on subsample of investments in companies incorporated in the UK

	No Intangibles in balance sheet		**Intangibles in balance sheet**		***t-test***
	M	SD	M	SD	
Ln(Inv)	0.68	0.09	0.7	0.13	NS

Note: M=Mean SD=Standard deviation ; NS=Not significant

Ln(Inv) is the logarithmic of the investment amount

When considering the whole sample of UK investments which had a published balance sheet before the investment was made, the mean funding for firms with intangibles is very similar to that of those without (exp[0.7047748] = £2.02m vs exp[0.6806475] = £1.97m). The similarity in figures brings into question the relevance of the intangibles in the balance sheet of these start-ups. The above data is for the entire sample.

We also considered companies in which the venture capitalist invested within one year from incorporation. In the dataset, we identified only 7 companies incorporated in the UK which were one year old or less. We analysed further the financial statements of same, and found that the published information relating to the intangibles does not reveal any further information as to what the intangible assets held were. For example The Key Revolution Limited held an amount of only £2,570 in intangibles, but no information is provided on the nature of same. Allinea Software Limited held £366,693 in the year prior to investment, but this information was only available when the accounts were restated in 2010. 2009 accounts, which were the published accounts at the date of investment did not originally show that the companies had any assets. Perhaps the most informative in this case were the accounts of Helveta Limited, which in 2004 shows intangible assets which related to the acquisition of goodwill and intellectual property in 2004, but no further detail is provided relating to their nature. We argue that the lack of information in the financial statements has led to the investors' reluctance to consider intangible assets in the financial statements: "no matter which measures are used … [to show intangible assets in the financial statements], it's meaningless". One investor even went to the extreme by saying "no we're not interested in the financial statements".

5.2.8 Assumption of regression analysis

When conducting the statistical analysis, one of the main issues is to ensure that the assumptions of regression analysis were met (Field, 2009; Hair et al., 2010). In this section, we present the main assumptions relating to the first regression carried out for the initial model, shown in previously in Table 5-5. The assumptions relating to the other regression models carried out are presented in Appendix I.

Normality

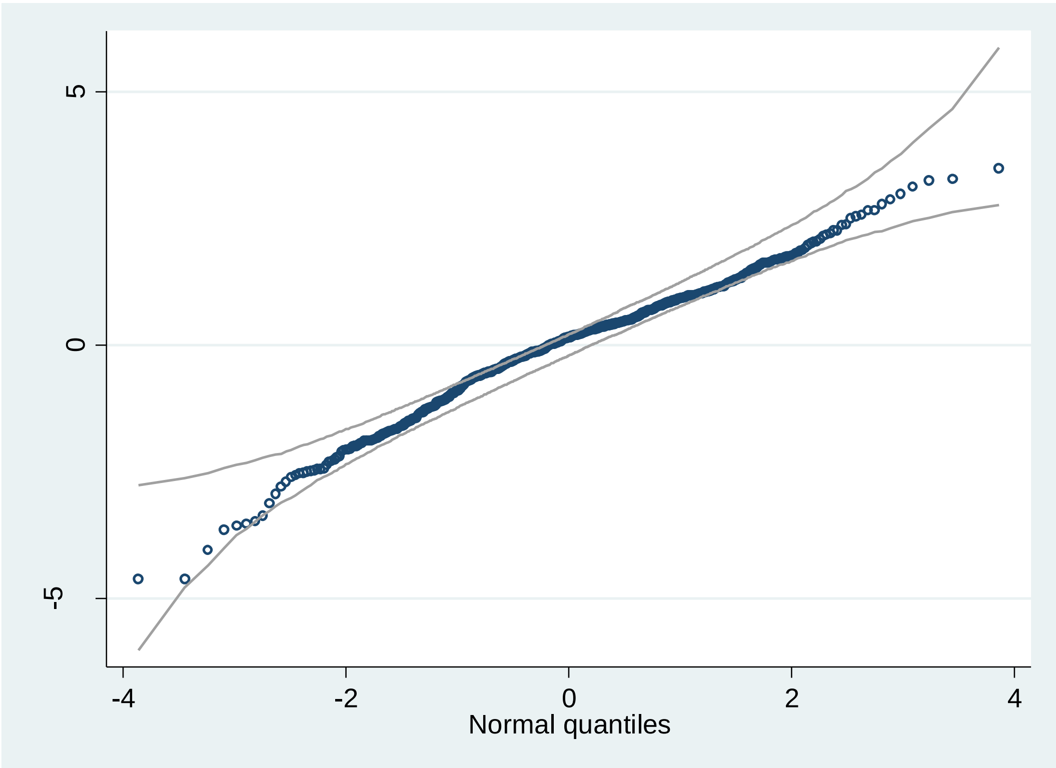

Figure 5-4: Q-Q plot of residuals

Normality of residuals is required for valid hypothesis testing, although the assumption itself is not required to obtain unbiased estimates of the regression coefficient. We used the Q-Q plots (Figure 5-4), which plot the quantiles of the residuals against the quantiles of the normal distribution (Miller, 1997). More specifically, to assess this assumption better, we used a package which comes as an add-on to Stata, *qenv*. This adds a “test like flavour” to the traditional Q-Q plots by showing boundaries generated from values of ‘low and high expectations for each quantile given repeated sampling from a normal distribution with the same number of values, mean and standard deviation as the data specified’ (Buis & Cox, 2012). On the basis of the graph generated (Figure 5-4), which shows only a very slight deviation from the boundaries we conclude that the residuals meet the requirements of this assumption. Q-Q Plots relating to the other regression models can be found in Appendix I.

Heteroscedasticity

Another important assumption is that of homoscedasticity i.e. the error terms have constant variance. In order to prevent the problem of heteroscedasticity (the absence of homoscedasticity), we applied the *robust* option in Stata to the regression. Under this approach the standard errors are estimated using the Huber-White sandwich estimator of the variance of the linear regression (C. F. Baum, 2006). C. F. Baum (2006) argues that this approach is increasingly used when performing regressions on large datasets. The only difference which arises is in the standard errors, and the confidence interval. The same values of the coefficients are retained. The adjusted R^2 is no longer shown because it is not a valid measure when computing regressions using the *robust* option. All the regressions computed in this chapter are computed using the *robust* option.

Linearity

We plotted component plus residual curve (Figure 5-5) for the independent (non-binary) variable (age). Although there is some curvature towards the age zero, we note that more central parts do not show this curved pattern and follow the regression model (Hamilton, 2005), and therefore there is not sufficient evidence of nonlinearity.

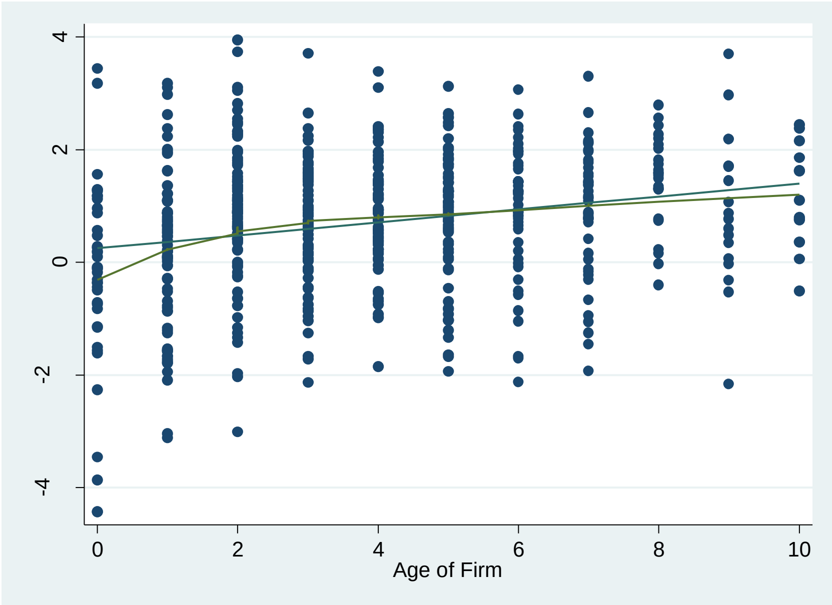

Figure 5-5: Augment component plus residual plot

In line with Hair et al. (2010) we also plotted partial regression plots (Figure 5-6) for each independent in the equation. We find no evidence of non-linearity.

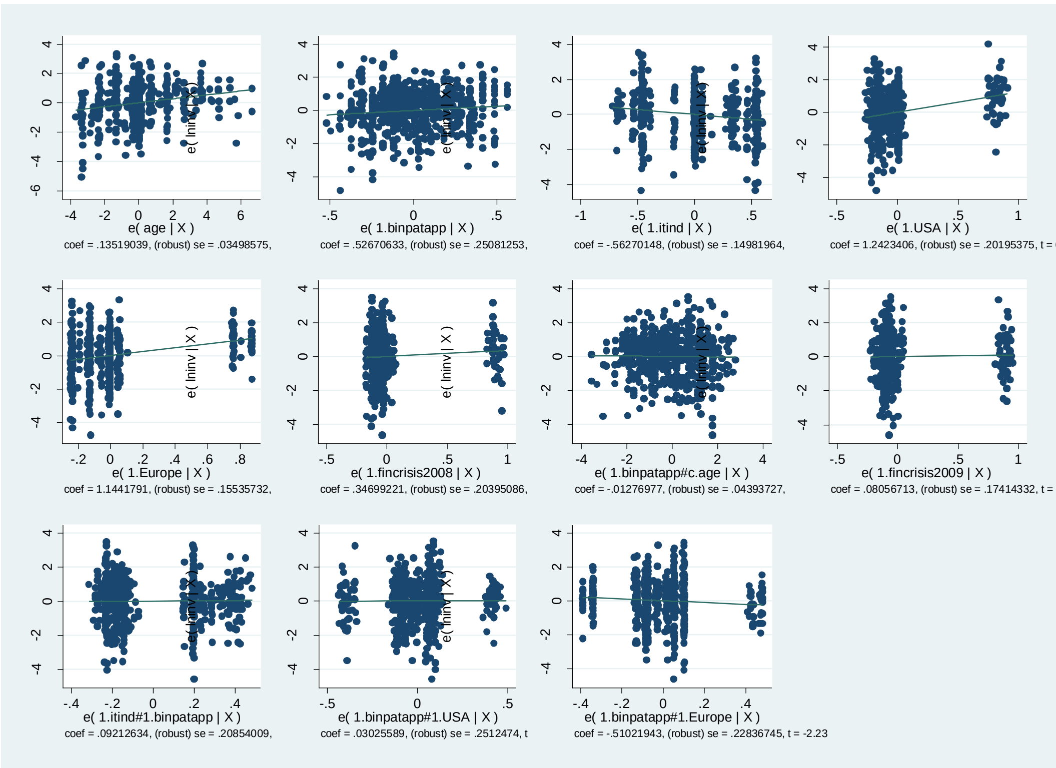

Figure 5-6: Partial regression plots

Multicollinearity

We tested also for multicollinearity using the variance inflation factor (VIF) approach. We find no evidence that the VIFs are greater than the suggested cut-off threshold of 10 (Hair et al., 2010). The table below shows the results of the variance inflation factors for the first regression model shown previously in Table Table 5-5 (with the entire sample and the a binary value for the existence of a patent application).

Table 5-13: Variance Inflation Factor

Variable	**VIF**
1.binpatapp	4.66
1.itind	1.87
1.USA	2.01
1.Europe	1.89
1.fincrisis2008	1.03
1.fincrisis2009	1.02
binpatapp#c.age	5.68
binpatapp#itind	2.23
binpatapp#USA	2.22
binpatapp#Europe	2.05
Mean VIF	**2.45**

Outliers

When considering the overall regressions, we have also checked for outliers using the *iqr* function mentioned earlier in Section 3.3.2. We identified less than 2% mild outliers, and no severe outliers, implying that we have no major issues with outliers in the case of this regression. We considered this for all of the regressions, and no severe outliers were identified.

5.2.9 Conclusion

The newly constructed database on venture capital investment suggests a positive relationship between investment and patenting. In particular, in this chapter we have shown how the existence of a patent application increases the amount of funding received from UK based venture capitalists to young companies in the United Kingdom. The study also showed how the amount invested is usually higher for older and more established firms, and also that it is also dependent on the sector. For example, IT firms were receiving lower amounts of investment than other sectors. Differences in the relationship between patenting and investing in different countries were identified. For example, when firms have patents investment tends to be lower in Europe. Although this merits further study, potential reasons for this were identified. In particular, one must mention the differences in industry across Europe (for example biotech firms in Italy are not involved in the research but only in the commercialisation). In order to try and mitigate problems relating to causation, a subsample of investments made within one year from incorporation was considered, and the results discussed above were found to be the same. Therefore taking into consideration the limitations of this study, we accept Hypothesis 1: there is a positive relationship between the existence of a patent application and the level on the investment.

A similar relationship was also identified for patents granted. However for reasons relating to the nature of venture capital (venture capital considers early stage investments), the causation problem cannot be mitigated because there is not enough investments made within one year from incorporation and therefore such results should be treated with caution. Another limitation which was also identified is issues relating to the data on the patent status within the original patent database which was not complete. In fact, the patent office also suggests to treat results relating to an analysis based on the number of patents granted with caution.

With regards to Hypothesis 2, the results are also confirmatory of a positive relationship between the number of patent applications held and the level of investment made. The difference in this hypothesis is that we are dealing with patent numbers rather than the existence of a patent (a binary variable representing whether a firm held one or more patent applications). The positive relationship was identified also for patents granted but such results are to be treated with caution.

As an alternative measure, the number of patent families was also considered, and similar results were obtained. We also noted that the vast majority of investee companies which held a patent actually held multiple patents (for various reasons, such as patent fencing), and therefore it comes as no surprise that similar relationships were also identified between the holding of multiple patents and the level of investment.

Finally, we considered the aspect of financial statements in the United Kingdom, and found no difference in the mean investment in companies which had intangibles in the balance sheet and those which did not have any. We also identified that for very young companies which had financial statements filed at Companies House and intangibles in the balance sheet, there was still very limited disclosure by way of notes. This highlights the lack of relevance of financial statements for venture capitalists, which was also identified in the previous fieldwork research carried out amongst investors.

The next chapter is the conclusion of this thesis. In it the results discussed in this chapter are reconsidered in the light of the previous sets of interviews carried out amongst investors and investor associations. On top of this, we consider the limitations of the research, including those relating to the regression analysis carried out in this chapter and suggestions for future research, some of which arise from the results of the regression analysis carried out.

6.0 Conclusion

6.1 Introduction

This research provides new insights on the role and reporting of intangibles in a venture capital setting. Initially, an extensive literature review was carried out to identify and explore further the previous work carried out in this research area. The literature review highlighted the need for more research on the subject, in particular within the United Kingdom. It also served as a basis for developing the agenda and the questionnaire for the interviews which were carried out in the field. Initially a series of interviews were carried out amongst early stage investor associations. These provided a broad overview of the industry viewpoints on the topic of intangibles and the role of financial statements. After due consideration and analysis of these initial viewpoints, a questionnaire was constructed and semi structured interviews were carried out directly with key individuals within venture capital firms across the United Kingdom. The overall results were then analysed both qualitatively and quantitatively. Five of the interviews were developed into case studies, which show in more depth the viewpoints of venture capitalists on reporting and the role of patenting by investee companies. Through this potential differences were identified amongst firms from different technology subsectors. After considering the viewpoints from an industry perspective, a database was constructed using disparate data sources on three types of data: venture capital investment data, data arising from financial statements and also patent data. In order to provide more insights on the patterns within the data, cluster analysis was carried out. Finally, in order to explore the topic further, regression analysis was used to establish by means of statistical methods, whether there was a relationship between patenting and investing in the United Kingdom.

The purpose of this chapter is to conclude this research by reconsidering the analysis carried out throughout this thesis, answering the research questions, and discussing the conclusions. Thereafter, the contribution of this research, both in an academic research context, and also in a policy making context is considered. The limitations of both the interviews and the database analysis are subsequently discussed. The final section provides suggestions for further research which can be carried on out on the area of intangibles in a venture capital setting. These are drawn directly from the findings, contributions and limitations of this thesis as discussed in the preceding sections.

6.2 Addressing the research questions

The increased focus on intangibles in recent years has led to several calls for research in the subject area (Cañibano et al., 2000; Zéghal & Maaloul, 2011). A careful analysis of the literature in the field has shown the increased focus in research on venture capital investment in the United States, and the need for more literature covering aspects relating to the United Kingdom.

This research tackles the relevance of intangibles for the venture capitalist in two aspects. The first aspect dealt with the reporting of intangibles by investee companies from the perspective of the venture capitalist. Thereafter the importance of intangibles *per se* and the link with investment decision is discussed.

The first research question presented in this thesis was:

- Does the existing reporting of research and development expenditure and intangible assets in financial statements reflect the needs of venture capital investors?

The research first considers whether financial statements in general were found to be relevant for venture capital investors in the United Kingdom. The study highlights how early stage investor associations argued that financial statements were not particularly relevant for the investment decision. Venture capitalists argue that the balance sheet has no bearing on the investment decision, although financial statements are considered as a starting point and more for verification purposes. In early stages, where historical information is limited; the focus is more on forecasts.

However, as a firm matures, the financial statements become increasingly important as shown in the case studies of venture capitalists investing in the expansion stage of a firm. When questioned on the role of intangibles in the balance sheet, the early stage investor associations had initially indicated that the figure is not relevant. They expressed the view that the figure of intangibles on the face of the balance sheet might serve as an indicator of potential questions which would need to be addressed at due diligence stage (cf. Wyatt, 2008). In the interviews with venture capitalists, investors expressed clear views that they would prefer if investee companies did not opt to capitalise their development costs. Amongst the potential reasons outlined were the uncertainty related to the developments costs, and problems associated with different accounting practices in the United States which would require immediate expensing of the intangibles, if an exit is made in the United States. However, the amount spent on research and development is considered in detail at due diligence stage. With regards to the level of detail provided on intangibles within financial statements, investors have mixed viewpoints. For example, investors had contrasting views related to showing R&D expenditure separately (Lev, 2004) on the face of the income statement rather than being bundled with administration expenses. Past literature (cf. Hand, 2005a) had suggested that disclosure had an increased role in the case of such early stage investments. In this case, investors also had mixed viewpoints, with those against increased disclosure arguing that such information could be obtained from elsewhere and should not be made public due to competitive reasons.

From this research, it is clear that the inclusion of more information within the financial statements will not lead to a reduction in the amount of due diligence which needs to be carried out prior to investing. This applied to the presentation aspect (e.g. more detailed subdivisions) and also the disclosure aspects (e.g. more qualitative information by way of notes to the accounts). Venture capitalists do not feel the need for any change in the financial reporting of investee companies, even though the published accounts are often abridged accounts, and prefer to rely on their formal due diligence rather than any other document. The research also considered new forms of reporting, such as intellectual capital reports. Although initially investor associations expressed interest in the content contained within the reports, there appears to be little support in favour of entrepreneurs spending their time to prepare such reports, with the argument being that focus should be on other key areas of the business.

The newly constructed dataset which includes data on patenting, financial information and venture capital investments was also used to verify whether there were differences in investment by companies which had some intangibles in the balance sheet. The results also identify no differences in terms of the investment amount between the average investment in a firm which had intangibles in the balance sheet available publicly at investment date and the firms which did not have any intangibles at all.

It therefore appears that financial statements are not playing a key role in the venture capital decision making process in the United Kingdom. The investors are not concerned about having more detailed information on intangibles within the financial statements. Information relating to same is obtained in the due diligence process and through other documents (cf. Gu & Li, 2003; Hirschey et al., 2001). The role of accounting by investee companies is seen as complementary, rather than solely useful for affecting decisions. As such, most venture capitalists are satisfied with the *status quo* in terms of the recognition of intangibles within the financial statements. Nonetheless, a significant proportion of investors would favour changes in the presentation (e.g. showing separately R&D expenditure rather than bundled with other expenditure) or increased disclosure (e.g. showing the number of patents held on the face of the financial statements).

In summary, from the above one can conclude that:

- Historical financial statements are of limited use to venture capitalists.
- Overall, venture capitalists appear to be satisfied with the existing level of reporting in potential investee companies.

- Venture capitalists expressed mixed views on additional detail in terms of presentation and qualitative disclosure.
- However, even if financial statements were more detailed this would not reduce the need for detailed due diligence carried out by investee companies.
- The figure of intangibles on the balance sheet of investee companies is not linked to the investment made by venture capitalists in the United Kingdom.
- There is also limited scope for the reporting of intangibles through alternative reports (such as intellectual capital reports).

The second research question moves beyond the reporting aspect of intangibles. The focus is more on the role of intangibles in the investment decision, with a specific focus on patenting. The question posed was:

- To what extent does venture capital investment relate to patenting activity?

Young technological companies very often have little in terms of tangible assets, and the intangibles are usually the only possessions that the firms have (Reid & Smith, 2008a). It has been argued that new firms are more likely to fail than more established firms (Stinchombe, 1965), and to combat this problem venture capitalists are perhaps resorting to signals (Spence, 1973, 2002). In the interviews, the signalling role of patents for venture capital was questioned (cf. Long, 2002). First of all, the research highlights the fact that one cannot generalise and state that in all early stage technological investments, patenting is crucial. As highlighted in the case studies and overall results of the interviews, the role of patenting depends very much on the industry under consideration. However, it appears that it is not enough to consider the industry in general, but one has to be more specific about subsectors. For example, in the IT industry, the role of patenting is far lower than the biotech and pharmaceutical industry where patenting is considered to be a must. Ultimately, the interviews shows that patenting has an important role. However this depends on the importance of the patent in the business strategy being adopted by the investee company.

Therefore, when we considered whether patenting is conveying some signals to the investors we concluded that for investors, the mere fact that a patent is held does not signal a possibility of having a profitable investment opportunity. In fact, investors highlighted instances whereby they invested in firms which had no patents but proved to be very profitable, and vice versa. Furthermore, investors agreed that having patents already filed is not a sign that the venture capitalist would be required to carry out less work post investment. The majority of investors also agreed that patenting is not a sign of entrepreneurial effort, arguing that the ability to patent has no link with entrepreneurship. However, patenting does signal that there is an innovative culture within the firm and it is considered as important in the investment decision.

The majority of the investors and their representatives (the investor associations) dismissed the idea that there is any link between the amount invested and the number of patents applications or patents granted. Firstly, they mentioned the different level of importance of patents within industry subsectors. Thereafter they insisted that there were cases where the firms had no patents and received substantial investment.

The more quantitative analysis carried out in the newly constructed database for UK investment suggested otherwise, and identified a potential link between the amount invested and the number of patents applied for. Although this research does not seek to confront the investors and ask them for potential reasons for this key difference, there are various reasons which can be attributed for such differences in thought. For example, in the interviews some of the investors argued that the most important aspects considered by them were the skills of the entrepreneur, his reputation and the product (cf. Baron & Markman, 2003; Shane & Cable, 2002). One could also argue that a skilled entrepreneur or an experienced team would be more likely to patent, and a firm which has a distinct product would seek to patent it to defend itself. Therefore, whilst investors, might be correct in claiming that the decision of the investment amount is not determined by the patents, the other attributes could indirectly be affecting patenting. Indeed, such influences on the investment decision are more "soft" as opposed to aspects which can be measured quantitatively when it comes to considering the investments made by venture capitalists. Furthermore, patents could be strengthening the overall business proposition, and as suggested in the interviews, a strong business proposition is likely to lead to higher amounts of financing.

Another possible reason for the discrepancy was explained by a leading patent attorney who is involved in the venture capital field:

"[It is] because the investor is very cautious, and [because of] the subjectivity involved. He is likely to be inclined to say that there is no relationship – despite studies having shown that such a relationship exists. They often state that their decision was based on the basis of the management, or the business strategy. Although valuation may be useful for the investors, they are often unwilling to obtain such information in view of the costs involved. However, very often they do try and seek some form of advice from patent lawyers and other experts in the field".

Perhaps investors might be playing a strategic game (cf. Holgersson, 2013) by refusing to admit that patent information may be useful so that the information would not be available to rival investors. Indeed, with some effort patent information may be available from alternative sources and the investor might not be willing to make this information public (cf. Hirschey et al., 2001). Another reason for the discrepancy in findings, as was suggested by the patent attorney in the course of this research, is that the investors are always reluctant to admit the important role of patents, because they are always concerned about any tax implications which may arise from the valuation of patents. In particular, this may pose a problem when dealing with the transfer of intellectual property outside the country of investment (cf. Murphy, Orcutt, & Remus, 2012). One should also bear in mind that the quantitative analysis included data on companies which were not willing to participate in the research carried out by way of interviews. Indeed, it should be noted that Knockaert et al. (2010) have explained that the venture capitalists are not heterogeneous in investments, and some could give more importance to the financial aspects, other to the human capital or the proprietary regime held by the organisation. Although the responses provided by interviews in the same technology subsector were fairly similar, the sample of interviewees remains a limitation, and one cannot know whether the companies which were not interviewed gave more importance to intellectual property.

This ambiguity on the link between patenting and investing highlights the increased need for research in the area, using not only secondary data sources, but also by means of interviews with the providers of finance and investee companies. Indeed, although the research seems to be indicating that there is some form of link between patenting and investing, the contrasting viewpoints of the venture capitalists identified in the interviews carried out in the United Kingdom would suggest that if there is a link between patenting and venture capital investment, this is either not directly related, or else they are strategically refusing to admit that such a relationship exists.

In summary, from this research one can conclude the following on the role of patenting in the investment decision of venture capitalists in the United Kingdom:

- Patents can serve an important role in the venture capital investment decision, but this is dependent on the technological subsector.
- Patents can be an indicator or 'signal' of innovative activity within an investee company.
- Patents are not seen as a signal of profitable investment opportunities.
- They are certainly not an indicator that the venture capitalist would have less workload upon investment.
- Most investors questioned any direct link between the amount invested and patenting activity.
- Venture capitalists indicated that they invest on the entire business proposition, which may or may not include patents.
- Most venture capitalists, also do not seek to ascribe a value to a patent held by a potential investee company.

- The newly constructed dataset shows that firms which had patents applications received higher amounts of funding from venture capitalists in the United Kingdom.
- This result suggests that there is a link between the investment decision and patenting. However on the basis of the interviews, one can say that the link is possibly not direct.
- The investor is not specifically investing higher amounts because they have patents, but perhaps because the firm has a strong business proposition or a stronger entrepreneurial team.
- Patents could possibly lead to a stronger business proposition, which is in itself leads to increased amounts of funding.

After addressing the research questions under consideration, the next section provides an explanation of how this research provides new contributions to the academic field.

6.3 Contribution of the thesis

6.3.1 Contribution to Research

This thesis attempts to fill the research gap in the literature relating to intangibles in the context of venture capital in the United Kingdom. After considering the contextual background through a set of interviews carried out amongst early stage investor associations, a series of interviews were carried out amongst venture capitalists. In itself, this is an innovative approach, because much of the previous literature on the subject of intangible in a venture capital setting was carried out through analysing existing secondary datasets in North America. In this research Instead of just looking at figures and analysing them statistically, we have also considered the viewpoints of investors.

Given that much of the venture capital information in the United Kingdom is not publicly available, there is increased scope for more qualitative research in the field.

Hence, this research has provided new unique insights on the venture capital scene in the United Kingdom which one could not obtain through quantitative methods alone. Hindle (2004) appealed for an increase in the amount of qualitative research carried out in entrepreneurship, to avoid the field being compromised by a lack of methodological diversity.

Zéghal and Maaloul (2011, p. 272) argue that 'managers should provide more information about intangible investments in order to attenuate different negative consequences resulting from their inadequate accounting treatment'. However, the interviews carried out for this study suggest that not all investors appear to be demanding this additional information. This highlights the need to distinguish between the stages of investment. For example, later stage investors might really demand such information. The same authors - Zéghal and Maaloul (2011) suggest the need for further research by way of interviews of investors on the subject of intangibles. This is now partially fulfilled in this thesis by the interviews carried out amongst one category of investors (venture capitalists). The answers to the research questions, considered in the previous section are also suggestive of the increased role of qualitative research in the field, and the problems associated with considering only the quantitative aspect of the investment decisions. Furthermore, this research moves away from the traditional intangible literature which tended to focus only on issues such as R&D and advertising (cf. Cañibano et al., 2000) but also considers other intangibles. For example, it deals with issues relating to the disclosure of patenting.

Whilst recognising the need and benefit of qualitative research in the field, quantitative based research should not be dismissed, and it also has a role in undertaking research (Neergaard & Ulhøi, 2007). In fact, this research seeks to complement the data collected from the interviews with the construction of a database. It appears that this is a first attempt at linking venture capital investment, patenting, and financial information using different data sources relating to the venture capital scene in the United Kingdom. The database suggests a positive link between patenting and venture capital in the United Kingdom, although we highlight differences between technology subsectors. Nonetheless, the construction of the database brought with it a number of limitations which are discussed in the next section of this final chapter. The mixed methodology approach allowed us to compare the results identified using the different research methods and to reflect further on the role of intangibles from a practical point of view.

6.3.2 Contribution to Practice

Implications for accountants

It appears from this research that investors are not demanding additional accounting information on intangibles by way of reporting in financial statements or alternative reports. Indeed, the research brings questions whether, in the case of early stage investors, financial statements are serving the decision making role as specified in the Conceptual Framework for Financial Reporting (IASB, 2011a). Furthermore, in a recent joint publication by ICAS and EFRAG stated that “professional equity investors rely heavily on financial statement information, particularly the income statement, in their decision making” (Cascino et al., 2013, p. 31). This is in contrast with the majority of the interviews carried out for this study, and suggests the need to distinguish between different types of investors – those which are investing in the early stage, and those investing in the public markets.

Implications for investors

Investors should make sure that investee companies are made aware of the importance they ascribe to the protection of intellectual property, and any form of intellectual property reporting is required. Associations representing early stage investors should provide further guidance on the role of intellectual property and the issues related to the valuation of same. In this respect, one of the organisations, the European Business Angels Network (EBAN), has already organised training for early stage investors on this topic (EBAN, 2011), however it appears that the British early stage investor organisations did not follow this approach.

Implications for investee companies

This research concluded that the role of reporting of intangibles in a venture capital is somewhat limited. Rather than focusing on the reporting of intangible assets, the investee companies should focus more on ensuring that they have a well-designed business plan in place. If intellectual property protection is relevant to the business proposition, then they should ensure that this is already in place before pitching for funding.

Implications for policy makers

The need for standard setters and policy making organisations to take more into consideration the viewpoints of venture capitalists is recognised. For example, in 2011 the IASB carried out a survey amongst investors on its agenda (IASB, 2012b) , which amongst other aspects asked respondents a series of questions on what they would change within the financial statements, and also made specific reference to intangible assets and whether these should be included in the future IASB agenda. Although the survey results (see IASB, 2012b) do not indicate whether any venture capitalist or venture capital investor organisation responded to the survey, during the interviews carried out respondents were asked whether they would be willing to participate in such surveys or discussions with standard setters. The majority of the interviewees (71.4%) stated that they are not interested and do not have time to participate in such consultations, although many expected investor associations to participate. This appears to be in line with a previous study by Georgiou (2010), who calls on standard setters to put more weight on the responses of member associations because many users of financial statements were relying on these responses. However, in the unstructured interviews carried out with venture capital organisations they did not express willingness and were not aware of surveys/projects of standard setting bodies. It appears that they are under the impression that such consultations are not relevant to them. In particular one must mention the response of one association who did not participate in the research but instead indicated that the accounting issues of interest to them are the accounting issues of their members (the investors), rather than the investee companies.

Policy making organisations, such as the OECD and the European Union had initially made specific reference to venture capitalists and small firms in their reports on the need for the reporting of the intangibles (European Commission, 2006b; OECD, 2012, 2013). They seem to be emphasising the need for the reporting of intangibles in a venture capital setting, although it appears that in these studies the viewpoints of investors were not sought. The results identified in these policy documents suggest the need for increased consultation with venture capitalists to understand their views on issues of reporting.

6.4 Limitations of this research

Like every other research project, a number of limitations were identified. In this section, an explanation of the limitations of this study is provided. Where appropriate, a brief explanation on how the issues which arose throughout the project were mitigated is provided.

6.4.1 Limitations arising from interviews

Selection of interviews

As indicated in the methodology, the population of venture capitalists investing in technology related investments was initially restricted to the members of the BVCA as listed in the BVCA Member Directory. Although this directory lists the majority of venture capital firms in the United Kingdom, it is not a complete list of venture capitalists operating in the United Kingdom (Harrison, Don, Glancey Johnston, & Greig, 2010; Reid & Smith, 2008b). To mitigate this problem, in line with past studies in the venture capital field (e.g. Pruthi, Wright, & Lockett, 2003), we used a "snowball" approach, in which other interviewees suggested further potential respondents to complement those of the list of BVCA members. This is considered to be a limitation of the study because, although the majority of venture capitalists which invest in the technology were treated as potential participants one cannot be absolutely certain whether some venture capital firms which invest in technology were omitted from the research.

Reliability of responses

The nature of the venture capital organisations, and the fact that the interviewees were carried out with key individuals with the organisations (usually partners), meant that only one interviewee per organisation could be interviewed. Throughout the interviews an emphasis was made to ensure that the responses provided should reflect the viewpoints of the organisation and not personal viewpoints. In some specific instances some interviewees distinguished between their own viewpoints and the viewpoints of the organisation. Furthermore, throughout the interviews the responses provided were often summarised and paraphrased to ensure proper interpretation (cf. Ang, Sum, & Yeo, 2002).

6.4.2 Limitations arising from the database construction

In terms of the database, this was manually collected using disparate data sources. This implies that there is a degree of reliance on the accuracy of data within these data sources. The section below discusses the issues surrounding the data relating to patenting, the venture capital investments and financial statements.

Data relating to patents

The patent database of the European Patent office provides a number of qualifications. A closer look at the user manual of the Global Patents Index facility from which the data was extracted highlights some of these issues. For example, the manual indicates that there are a number of records which do not have the field which indicates whether the patents were granted or not. A number of documents also do not have the publication date (European Patent Office, 2012). Due to the nature of the patent data, and the fact we are dealing with data supplied by different countries to the European Patent Office, such inaccuracies are unavoidable. Qualifications were made in the relevant sections of this thesis related to such issues. Apart from these known issues with the dataset, there are a number of errors which arise due to the vast amounts of data included within the European patent database. For example, there may be typographical errors in the patent procedures which are then included in the patent database upon insertion (Simmons, 2009).

Furthermore, the data contained within the patent database is updated once per week (European Patent Office, 2012). Since the data was collected manually from the dataset, any changes carried out after the initial data collection are not reflected within the dataset. The extent of these changes cannot be indicated but, in view that we used dates when carrying out patent searches, such updates did not have a significant impact on the dataset.

Availability of data given the nature of the venture capital market

The nature of the venture capital market, particularly in the United Kingdom implies that there is no complete data source for venture capital deals. This is particularly prevalent at the very early stages of company formation. Crunchbase proved to be a useful source of data for investment deals. Although the dataset is well-respected in technology community, when analysing venture capital data one has to be aware that the dataset is not complete. As with any data source, it is not entirely free from errors. Moreover, other databases rarely include information on start-ups (Werth & Boeert, 2011). In this case, to try to mitigate some of these limitations, random checks were made on the data under consideration for data validation purposes (cf. Block & Sandner, 2009; Werth & Boeert, 2011) and the figures were found to be in agreement to those of news releases relating to venture capital deals. Furthermore, although within Crunchbase a number of venture capital deals did not have the amount of the investment disclosed an attempt was made to try to identify the value of investment rounds which was not available on the database through Companies House. However, such searches were only possible for investments made in companies incorporated in the United Kingdom (see Section 3.3.1). Furthermore, the data was also double checked for duplicates and potential inaccuracies through sorting in spreadsheets and manual 'eyeballing' of the data extracted in the spreadsheets.

Finally, the data collected on investments relates to the venture capital firms which were identified as suitable participants for the interviews. These participants included those that did not accept to take part in the interview process. The problem of not having an official complete list of venture capitalists in the United Kingdom, (other than that of members in a trade association) is also applicable in this case.

Financial data for investment outside of the United Kingdom

The database does not include figures for intangible assets of companies incorporated outside the United Kingdom. One of the reasons for this is the difficulty of obtaining financial statements for non-quoted companies outside the United Kingdom. However, even if the data was readily available, any analysis carried out would have been distorted by differences in accounting requirements in different countries. For example, there is no option to capitalise development expenditure which meets the required criteria for capitalisation in the United States (KPMG, 2013a).

What causes patenting?

One problem identified in the literature is whether venture capital increases patenting or patenting increases venture capital (cf. Bertoni et al., 2010; Munari & Toschi, 2014). It is difficult to disentangle this “chicken or the egg” problem. In order to mitigate this problem, as described in section 5.2.2 a further regression was carried out for investments for companies established less than one year from the investment date (cf. Munari & Toschi, 2014). This minimises the possibility that previous venture rounds led to an increase in patenting.

Other factors

Some of the regressions included in the analysis have low explanatory power (R^2). This is not surprising, given the complexities of venture capital investment decisions. There are other factors which influence the investment decision beyond patenting, such as the level of experience of the entrepreneur, which are not measured in this research (cf. Mann & Sager, 2007). However, if one takes into consideration this explanatory power, the analysis can still provide useful insights into venture capital investments (cf. Mann & Sager, 2007).

Cross correlation in residuals

Fama and French (2002) outline the need for taking into consideration the cross correlation of residuals when carrying our cross sectional regressions. Market wide factors, could be affecting the investments made in the young companies, and these would be leading to cross correlation in the residuals (cf. Harris, Lang, & Mőller, 1994). In particular, the authors explain how cross correlation usually inflates the standard errors of the residuals in the model by two to five times. One way to tackle this issue in future would be to carry out robustness checks using the Fama and MacBeth (1973) method. Regressions are run for each year under consideration.

Thereafter, time series averages of the coefficient estimates are obtained. The time series standard errors of the average slopes would be used in the analysis (cf. Teo, 2009). Similarly, Harris et al. (1994) estimate the regressions with year specific intercepts and compare these to the overall regression in order to make sure that the analysis was not being affected by the cross correlation in the residuals.

6.5 Further research

Drawing on the conclusions arising from this thesis, and the limitations arising in this section, suggestions are made for areas of potential future research. Apart from these specific suggestions, this research highlights the role of more qualitative research in the field.

Later stage, private equity organisations

The focus of the research is only on venture capital investors which invest in young technological companies. The same research could be carried out amongst later stage investors. In this case, the investee companies would already be well established and trading. A study carried out by Smolarski, Wilner, and Yang (2011) suggested that there is greater use of financial statements by later stage buyout funds in Europe when compared to venture capital funds, but the issue of intangibles on the face of financial statements has not yet been tackled. The relevance of patents in such organisations, which are already established, could also differ from the case of young companies and therefore merits further investigation.

Further analysis of patent data, in particular patent citations

The relevance of patent citations outside a venture capital context is well discussed in the literature (e.g. Hall et al., 2005; Jaffe et al., 1998; Mogee, 2007). Forward citations for example, are often portrayed as a measure of success. However, this research did not focus on analysing the number of patent citations each firm had. The investors interviewed in this research did not consider patent citations to be one of the most important aspects when analysing patents. However, in view that forward citations become more relevant in later investment stages (although they would decline again once they reach maturity) (see Haupt, Kloyer, & Lange, 2007), if further research is carried out on later stage investments, patent citation analysis might be an approach which is worth considering.

Interview investee companies

The focus of this thesis is on the venture capital investor and his viewpoints, but it is also interesting to consider the research from another angle – that of investee companies. Zéghal and Maaloul (2011) expressed the need for interviewing both investors and managers on their viewpoints on intangibles. Indeed, in future the study can be expanded further by considering the viewpoints of managers in investee companies, and comparing and contrasting them with those of venture capitalists.

Consider other forms of intangible assets

In terms of intangible assets, the focus of this research has been primarily on patents. The reason for this was not only due to the availability of patent databases but also because there are various measures which can be used (for example one can see the number of patent families and whether they were granted). There are other forms of intangible assets which young companies might have such as trademarks, copyright and trade secrets (Wilkins et al., 1997). A recent paper by Block, De Vries, Schumann, and Sandner (2013), highlights the importance of trademarks in a venture capital context, but the research was carried out on investments made in the United States. The relevance and value for both venture capitalists and investee companies are topics which might be considered in further studies on intangibles in the UK venture capital context.

Comparison to the venture capital scene in Continental Europe and the United States

Much of the study on venture capital tends to focus on either United States or the United Kingdom. Although less developed, the venture capital market in Continental Europe is growing. (Bottazzi & Da Rin, 2002). Some cross country studies on other aspects relating to venture capitalists have already been carried out (e.g. Manigart et al., 2000; Sapienza, Manigart, & Vermeir, 1996), but research in the area needs to be developed further. In particular, the viewpoint of UK venture capitalists on the reporting of intangibles can be compared to those of investors in Continental Europe. Furthermore, the viewpoints of US venture capitalists (by means of qualitative interviews) could be provide further insights on the venture capital market beyond the usual quantitative analysis found in literature relating to the United States.

The different characteristics of the investors

From the interviews carried out, one could notice some differences between types of investors. VCs with non-accounting background (e.g. with a psychology or chemistry qualification), for example, were more in favour of the increased reporting of intangibles than those which had previously worked as accountants. In this respect, a similar study has been carried out by Knockaert et al. (2014) on the investment attitude of VC managers towards patents. The authors show how VCs which do not have technical experience in high-tech industries and which had general degrees, tended to show less interest in patenting. A follow up study, could be conducted to the show the attitude of different types of venture capitalists towards the reporting of intangibles in more depth.

The link between equity and patenting

Qualitatively the issue of whether the investor would require a lower equity stake from the investee company has already been considered in Section 4.2.5. In this case, the investors did not see any link between the investment made and the equity stake requested. However, the issue of whether more reporting on intangibles is necessary if a venture capitalist owns a higher equity stake, can be considered in future research. Rather than considering the amount invested, one could include the equity stakes in the regression analysis. In order to carry out such analysis, one needs to obtain details on the equity stakes in individual investee companies. The provision of this data may not be easily available with non-quoted companies.

6.6 Final remarks

This research has provided new insights on the role of intangibles and intangible asset reporting in a venture capital setting in the United Kingdom. Whilst the role of reporting of intangibles is seen as limited in a venture capital setting, intellectual property protection, in particularly patenting, is seen as important. However the role and importance of patenting depends on the technology subsector and the business proposition of the business.

As discussed in this final chapter, much remains to be done in terms of research in the field. One hopes that more research involving directly the users of financial statements on the area of intangibles would follow this initial work.

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Appendix A: Pre-letter and agenda for unstructured interview

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[Date]

Dear [name of participant],

Investment in companies with intangibles: What are the key issues?

Despite attempts by the International Standards Board (IASB) to improve and standardise the international financial reporting of intangible assets there remains concerns that such assets are not clearly valued in the financial statements and that investors might therefore have difficulties in evaluating companies they hope to invest in.

Against this background, with the assistance of The Institute of Chartered Accountants of Scotland (ICAS), a series of interviews are being conducted with trade associations representing early stage investors in the United Kingdom in order to get an overview of the area from an industry point of view. Specific reference will be made to patenting by early stage entrepreneurs and its relevance to investors. Following these interviews, we will be conducting a series of interviews with investors on the same topic.

We are therefore seeking your cooperation and would be grateful if you would agree to being interviewed for this project, which would enable us to get an overview of this topic from an industry perspective. The interview is being requested in connection to your position as [role] of the [name of organisations]. A broad overview of the interview of the agenda is attached to this letter. At the end of our research, a summary report of the findings will be provided, which we believe would also be relevant to you as an association representing investors.

The interview itself should not take more than an hour and we hope that you will be willing to participate to this interview. In the coming weeks, we will contact you by telephone in order to arrange the interview. If you require any further information, please do not hesitate to get in touch.

Yours sincerely,

Renzo Cordina	Dr. Julia A. Smith
Strathcylde Business School	Strathclyde Business School

AGENDA OF DISCUSSION

Investment in companies with intangibles: What are the key issues?

A. General overview of UK venture capital / early stage investment market and the extent of the investment in high-tech firms in the UK

B. Existing financial statements

1. Usefulness and relevance of existing financial statements for investors
2. Usefulness and relevance of existing intangible asset disclosure (incl. patenting disclosure)
3. Suggestions for further possible improvements
4. Possible introduction of new financial reports (e.g. intellectual capital reports)
5. Use of other financial / non-financial data apart from financial statements

C. Patenting and early stage investments

1. Patenting as a signal for possible investments
2. Other intangible assets considered
3. Relevance of various patent measures (e.g. number of patents, number of citations, patent family size) prior to investment
4. Patenting and the size of the investment
5. Patents after the initial investment
6. Assistance given to investors with regards to analysing intangible assets

THE INSTITUTE OF CHARTERED ACCOUNTANTS OF SCOTLAND

A project supported by The Institute of Chartered Accountants of Scotland

Appendix B: Pre-letter and agenda for semi structured interview

[Address]
[Date]

Dear [name of key contact],
Investment in Companies with Intangible Assets

We are researchers who are investigating investment in high-technology companies with intangible assets. The project is being directed by Dr Julia A Smith, Reader in Accounting & Finance, with collaboration by Mr Renzo Cordina, PhD student in Accounting & Finance at Strathclyde Business School. We are approaching you as we hope that you might be willing to meet with us to provide some insight into the practitioner view of such issues.

Briefly, our project stems from the International Accounting Standards Board (IASB) attempts to improve and standardise the international reporting of intangible assets (cf. *IAS38 Intangible Assets*). Despite their efforts, there remain concerns that such assets are not being clearly valued in published financial statements, and that investors might therefore have difficulty in evaluating companies in which they hope to invest. We aim to find out, amongst other things, whether financial accounts accurately reflect the values of intangible assets; and the extent to which outside investment is linked to the level of research and development activity in high-technology firms.

Our preliminary study involved interviews with key players in the venture capital field, including members of the BVCA, EVCA and Business Angel support organisations, and was sponsored by the Institute of Chartered Accountants in Scotland (ICAS). Your participation now, as representative of an organisation that deals in high-technology firms, would help us to broaden our knowledge of this important area. The meeting with one of the researchers would take about an hour of your time, normally at your place of work, or elsewhere by mutual agreement, and would follow the attached agenda, by means of a semi-structured questionnaire.

In thanks for your involvement, we will provide you with an accessible summary report of our findings, which we hope you might find useful. Our broader findings will be used primarily for academic purposes, though we hope that the practitioners might also see some benefit from our results. We should stress that, at all times, any information you divulge will be treated with confidentiality, as we seek to discover consensus of opinion, rather than to identify individual sentiment.

Our next contact will be by telephone, to arrange a meeting with you or a nominated colleague. We very much hope that you are able to help us in this regard, and look forward to being in touch in the near future.

With kind regards,

Yours sincerely

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Investment in Companies with Intangible Assets

Interview Agenda

I. Background

II. Financial statements

III. Valuing potential investments

IV. Intangible Assets

Appendix C: Administered questionnaire

Administered Questionnaire

Investment in Companies with Intangible Assets

Ref No:

A project by

Strathclyde Business School

Interviewer:	**Mr. Renzo Cordina**		
Respondent:			
Company Name:			
Address:			
Telephone:			
Date:			
Start Time:		**Finish Time:**	

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I. BACKGROUND

1. Identify up to five of the most common stages of investment for your organisation (from 1 to 5) with 1 being the most important

(a) Seed	
(b) Start-up	
(c) Other early stage	
(d) Expansion	
(e) Management buy-out (MBO)	
(f) Management buy-in (MBI)	
(g) Buy-in management buy-out (BIMBO)	
(h) Institutional buy-out (IBO)	
(i) Secondary purchase	
(j) Replacement equity	
(k) Rescue/turnaround	
(l) Refinancing bank debt	
(m) Bridge financing	

2. Indicate industry preference (tick all that apply)

(a) Mobile telecommunication	
(b) Fixed line telecommunication	
(c) Computer hardware	
(d) Internet	
(e) Semiconductors	
(f) Software	
(g) Other electronics	
(h) Biotechnology	
(i) Medical Equipment	
(j) Pharmaceuticals	
(k) Healthcare	
(l) Other (please specify)	

3. Indicate your geographical preference (tick one)

(i) Local	
(ii) Regional	
(iii) National (UK)	
(iv) International (Europe)	
(v) International (Worldwide)	

4. Average size of investment (in £) and average equity stake

(i)	Highest	**£**	**%**
(ii)	Lowest	**£**	**%**
(iii)	Average deal	**£**	**%**

II. FINANCIAL STATEMENTS

General question

5. When considering a new investment do you ask for financial statements?

(Tick one)

Yes, internally prepared financial statements for management use ❒

Yes, the published statutory financial statements ❒

Both the internal and published financial statements ❒

No, we have our own requirements and formats ❒

5.1 Please indicate which of the following financial statements are requested?

(a) Balance sheet (Statement of financial position) ❒

(b) Profit and Loss account (Income statement) ❒

(c) Notes to the accounts ❒

(d) Statement of changes in equity ❒

(e) Cash flow statement ❒

5.2 Please circle the importance of the following figures when assessing a potential investee. These relate to figures found in the income statement.

Refer to respondent sheet one

5.3 Please circle the importance of the following figures when assessing a potential investee. These relate to figures found in the balance sheet.

Refer to respondent sheet two

6. **Do you look for financial statements yourselves through Companies House?**
   Yes ❒ No ❒
   In either case, please specify why (or why not)

Improvements to the financial statements

7. **Overall are you satisfied with the existing requirements for the preparation of financial statements? [The Small Companies and Groups (Accounts & Directors Report) Regulations, (2008), requires small companies to produce only abridged accounts]**
   Yes ❒ No ❒

   Please specify reason:

8. **As venture capitalist, what if any, improvements to statutory financial statements make your job easier?**

9. **As a venture capital investor are you interested in having the following as part of the financial statements:**

(a) Separate recognition of research and development on the face of the income statement (at present there is no obligation to disclose this separately from administrative expenses) Yes ❒ No ❒

(b) Separate line items for the various components of the R & D expense Yes ❒ No ❒

(c) Separate recognition for the costs of maintaining Intellectual Property (including official fees and agent fees) Yes ❒ No ❒

(d) Detailed subdivisions indicating any impairment expense on *each* intangible asset Yes ❒ No ❒

(e) Detailed subdivisions of any amortisation of *each* intangible asset Yes ❒ No ❒

(f) Subdivision of the various types of intangible assets recognised in the balance sheet Yes ❒ No ❒

(g) Recognition of internally generated intangible assets at cost Yes ❒ No ❒

(h) Recognition of internally generated intangible assets at fair value Yes ❒ No ❒

9.1 If the answer to one of the above is no, please explain the reason for your answer

10. As a venture capital investor do you ask for the following information during the due diligence stage?

(a) Research and Development expense Yes ❒ No ❒

(b) Detailed statement subdividing the various components of the R & D expense Yes ❒ No ❒

11. If the information in Question 9 (items relating to intangible assets which could be included in the financial statements) were included in the financial statements, does it eliminate the need to specifically ask for this information during the due diligence stage?

Yes ❒ No ❒

11.1 If no, please explain why it would still be required

12. Are you interested in having more qualitative information within the financial statements as part of the notes to the accounts on:

(a) Number of employees involved in research	Yes ❒	No ❒
(b) Number of patents held/applied for	Yes ❒	No ❒
(c) Background information on the patent	Yes ❒	No ❒
(d) Geographical scope of patent	Yes ❒	No ❒
(e) Detailed notes on patent litigation	Yes ❒	No ❒
(f) Any restrictions on the use and licensing of owned intellectual property	Yes ❒	No ❒

12.1 If you answered no to any of the above, please explain why:

13. If the information in (question 12 – qualitative information) is included in the financial statements, would it eliminate the need to specifically ask for this information during the due diligence stage?

Yes ❐ No ❐

13.1 If no, explain briefly why it would still be required

14. Standard setters usually issue consultation papers prior to issuing a new accounting standard. As an investor do you ever take an active interest in providing your views?

Yes ❐ No ❐

14.1 If no, explain briefly why

The European Union has recognised the importance of intellectual capital, and initiated discussions on better reporting of intellectual capital in 2004. [An example of an intellectual capital report is shown to the participant]

15. **How beneficial would an intellectual capital statements/reports be to you at the due diligence stage?**

(circle below)

Low **High**

1———2———3———4———5

15.1 Briefly explain the reason for your answer to Q15

15.2 Do you recommend that entrepreneurs prepare such reports?

Yes ❒ No ❒

III. VALUING POTENTIAL INVESTMENTS

Sources of information

16. In preparing a valuation of a potential investee company what sources of information do you use?

Refer to respondent sheet three

16.1 Please specify the degree of importance of any other source not mentioned in respondent sheet 3.

	No influence			Vital influence
	1———2———3———4———5			
	1———2———3———4———5			
	1———2———3———4———5			

17. Which methods do you use for valuing potential investments?

Refer to respondent sheet four

17.1 Why does the company use these methods as opposed to other methods which are not used?

17.2 Do you believe the valuation methods you use take into consideration the correct value of intangible assets?

Yes ❒ No ❒

17.3 Explain the reason why that the existing valuation method does or does not take into consideration the correct value of intangible assets

IV. INTANGIBLE ASSETS

18. During the screening process, various aspects relating to intangibles will be considered. Indicate at which stage you would consider the following:
(Tick all that apply)

In the qualification stage proposals are screened and those which do not meet the investment criteria established by the venture capital investor are rejected without further consideration. In the initial enquires and negotiation stage, additional information is provided, and the business plan was discussed. Outline terms are negotiated at this stage, and valuation of the business is made by the venture capital firm. In the due diligence stage a detailed assessment of the financial and technical feasibility of the investment is made.

We define structural capital as the knowledge which remains within the firm at the end of the day (e.g. databases, organisational culture etc.) Human capital refers to the knowledge the employees retain even when they leave the firm. Relational capital relates to the resources which are externally linked to the company, its customers and its suppliers, and R&D partners.

	Qualification	**Initial enquiries & negotiation**	**Due Diligence**
Structural Capital: Innovation			
Structural Capital: Business model			
Structural Capital: Intellectual Property			
Relational Capital: Reputation amongst stakeholders			
Relational Capital: Customer base and market share			
Relational Capital: Investors			
Human Capital: Management team			
Human Capital: Remuneration scheme			

Patents

19. Do you consider patents to be a sign of:

(a) A profitable investment opportunity Yes ❒ No ❒

(b) Innovative potential Yes ❒ No ❒

(c) Entrepreneurial ability and experience Yes ❒ No ❒

(d) Less effort required by the venture capitalist Yes ❒ No ❒

19.1 Briefly explain the reasons for your answer

20. Do you perceive there to be a link between the amount invested and whether or not the company has applied for patents?

Yes ❒ No ❒

20.1 Briefly explain the reasons for your answer, explaining how this link (if any) is reflected in the investment decision?

21. Is there a link between the amount invested and whether or not the company owns patents?

Yes ❒ No ❒

21.1 Briefly explain the reasons for your answer, explaining how this link (if any) is reflected in the investment decision?

22. Do you perceive there to be a link between the % of equity requested from entrepreneur and whether or not the firm has applied for patents?

Yes ❒ No ❒

22.1 Briefly explain the reasons for your answer, explaining how this link (if any) is reflected in the investment decisions?

23. Is there a link between the % of equity requested from entrepreneur and whether or not the firm owns patents?

Yes ❐ No ❐

23.1 Briefly explain the reasons for your answer, explaining how this link (if any) is reflected in the investment decision?

24. In assessing patent ownership, prior to an investment, please rank the importance of the following patent related attributes

Refer to respondent sheet five

25. In your experience how likely is a firm to increase the number of patents after the initial investment?

(circle below)

Unlikely **Very Likely**

1———2———3———4———5

25.1 Please explain the reason for the answer given in question 25

26. Prior to investing are you interested in the financial valuation attributable to patents owned by the entrepreneur?

Yes ❐ (proceed to question 27) No ❐

26.1 Briefly explain the reasons for your answer

27. Do you engage experts/external consultants such as patent lawyers or science experts in order to provide advice on the patents?

Yes ❐ (proceed to question 27.1) No ❐ (proceed to question 27.3)

27.1 Indicate on what aspects of patenting advice sought

27.2 Do you request a valuation of the patent from the expert prior to investing?

Yes ❐ No ❐ (go to question 27.3)

27.3 Explain why experts are not engaged to value patents?

28. Are you willing to have this valuation shown on the face of financial statements after investing

Yes ❐ (go to question 29) No ❐ (go to question 28.1)

28.1 Please explain why? (tick all that apply)

(a) It is still not accurate enough ❒
(b) Competition related arguments ❒
(c) Tax implications ❒
(d) Other (please explain) ❒
____

29. Do you request a valuation of the patent during the course of the investment?

Yes ❒ No ❒

29.1 Please explain the reason for requesting/not requesting same

30. Do you engage other experts to provide assistance relating to other intangibles e.g. psychologists to assess human capital?

Yes ❒ No ❒

30.1 If yes please explain which experts, and for what

31. Do entrepreneurs supply valuation of patents from third parties (prepared prior to approaching the investor) – tick one only

Always ❒
Most of the time ❒
Sometimes ❒
Rarely ❒
Never ❒

Other measures concerning innovation

32. Apart from patents, when considering innovation/technology indicate the importance you ascribe to the following indicators

Refer to respondent sheet six

32.1 Is there any other indicator you consider when evaluating the innovation/technology aspect?

Respondent sheet 1

Q5.2 Please circle the importance of the following figures when assessing a potential investee. These relate to figures found in the income statement.

Item		Degree of Importance Low — High
(a)	Revenue	1——2——3——4——5
(b)	Cost of Sales	1——2——3——4——5
(c)	Administration Expenses	1——2——3——4——5
(d)	R & D Expenditure	1——2——3——4——5
(e)	Litigation costs	1——2——3——4——5
(f)	Finance costs	1——2——3——4——5
(g)	Amounts written off Intangible assets	1——2——3——4——5
(h)	Net Profit	1——2——3——4——5
(i)	Other **[Please specify]**	1——2——3——4——5

Thank you.
Now please hand this sheet back to the interviewer

Respondent sheet 2

Q5.3 Please circle the importance of the following figures when assessing a potential investee. These relate to figures found in the balance sheet

Item	Degree of Importance
	Low — **High**
(a) Tangible fixed assets	1——2——3——4——5
(b) Intangible assets	1——2——3——4——5
(c) Debtors	1——2——3——4——5
(d) Cash at bank	1——2——3——4——5
(e) Creditors (due within 1 year)	1——2——3——4——5
(f) Creditors (due after 1 year) (including any bank loans)	1——2——3——4——5
(g) Share capital & reserves	1——2——3——4——5
(h) Provisions for liabilities (includes liabilities arising from litigations as a result of intangible assets)	1——2——3——4——5
(i) Other **[Please specify]**	1——2——3——4——5

Thank you.

Now please hand this sheet back to the interviewer

Respondent sheet 3

Q16 Could you please circle how influential to you the following sources of information are when it comes to preparing a valuation of potential investee companies?

Item	**Degree of influence**
	No influence **Vital influence**
(a) Financial press	1———2———3———4———5
(b) Trade journals	1———2———3———4———5
(c) Interviews with entrepreneurs	1———2———3———4———5
(d) Interviews with other company personnel	1———2———3———4———5
(e) Government industry statistics	1———2———3———4———5
(f) Statistical and information services	1———2———3———4———5
(g) Other venture capitalists	1———2———3———4———5
(h) Own due diligence report	1———2———3———4———5
(i) Due diligence report by accountants/consultants	1———2———3———4———5
(j) Business plan: Balance sheet	1———2———3———4———5
(k) Business plan: Profit and Loss	1———2———3———4———5
(l) Business plan: Unqualified audit report	1———2———3———4———5
(m) Business plan: Qualified audit report	1———2———3———4———5
(n) Business plan: Unaudited management projections (1 year ahead)	1———2———3———4———5

(o) Business plan: Unaudited management projections (more than 1 year ahead) 1———2———3———4———5

(p) Business plan: Unaudited latest period financial statements 1———2———3———4———5

(q) Business plan: Overall coherence of business plan 1———2———3———4———5

(r) Proposed timing and exit method 1———2———3———4———5

(s) Sales and marketing information 1———2———3———4———5

(t) Product information 1———2———3———4———5

(u) Production capacity and other technical information 1———2———3———4———5

(v) Curriculum vitae of management 1———2———3———4———5

(w) Patent documents 1———2———3———4———5

Thank you.

Now please hand this sheet back to the interviewer

-

Respondent Sheet 4

Q17 Which methods do you use for valuing potential investments

		Level of use 1 – Almost never used 5 – Almost always used
(a)	Historical cost book value	1——2——3——4——5
(b)	Replacement cost asset value	1——2——3——4——5
(c)	Liquidation value of assets (orderly sale)	1——2——3——4——5
(d)	Liquidation value of assets (forced sale)	1——2——3——4——5
(e)	Discounted future cash flows	1——2——3——4——5
(f)	Dividend yield	1——2——3——4——5
(g)	P/E Multiple (historic)	1——2——3——4——5
(h)	P/E Multiple (prospective)	1——2——3——4——5
(i)	EBIT multiple	1——2——3——4——5
(j)	Recent PE ratio of parent company's shares	1——2——3——4——5
(k)	Recent transaction prices in the sector	1——2——3——4——5
(l)	Responses to attempt to solicit bids for investors for investors	1——2——3——4——5
(m)	Industry rule of thumb ratios (e.g. turnover ratios)	1——2——3——4——5
(n)	EVA techniques	1——2——3——4——5
(o)	Payback method	1——2——3——4——5
(p)	Other **[Please specify]**	1——2——3——4——5

Thank you.

Now please hand this sheet back to the interviewer

Respondent Sheet 5

Q24 In assessing patent ownership, prior to making an investment, how do you rate the importance of the following patent related attributes?

		(circle below) **Level of Importance** **Low — High**
(a)	Residual life of patent	1——2——3——4——5
(b)	Number of backward citations *(reference to other patents)*	1——2——3——4——5
(m)	Number of forward citations	1——2——3——4——5
(n)	Family size	1——2——3——4——5
(o)	Simple patent count	1——2——3——4——5
(p)	Patent status (applied for, granted etc.)	1——2——3——4——5
(q)	Patent litigation issues	1——2——3——4——5
(r)	Inventor involvement	1——2——3——4——5
(s)	Patent scope (*as measured by the number of different classifications*)	1——2——3——4——5
(t)	Existence of substitutes to the patented technology	1——2——3——4——5
(u)	Importance of patents within the specific industry	1——2——3——4——5

Thank you.

Now please hand this sheet back to the interviewer

Respondent Sheet 6

Q32 Apart from patents, when considering innovation/technology indicate the importance you ascribe to the following indicators

(circle below)

Low

High

(a) Presence of star researchers	1——2——3——4——5
(b) Existence of R&D department	1——2——3——4——5
(c) Number of R&D workers	1——2——3——4——5
(d) R&D annual budget	1——2——3——4——5
(e) Proportion of workers with advanced degrees	1——2——3——4——5
(f) Organisation of R&D activity	1——2——3——4——5
(g) Number of strategic alliances with research institutes and other companies	1——2——3——4——5
(h) Existence of substitutes	1——2——3——4——5
(i) Average time to bring idea to the market	1——2——3——4——5
(j) Breakeven time *(Time for a new product to cover development cost)*	1——2——3——4——5

Thank you.

Now please hand this sheet back to the interviewer

Appendix D: List of interview participants

The table below lists, in alphabetical order, the companies which have accepted to participate in the semi-structured interviews carried out amongst venture capital firms.

	Name of Firm
1	Abingworth
2	ACT Ventures
3	Advent Partners
4	Barwell plc
5	Braveheart Ventures
6	Catapult Venture Managers
7	Crescent Capital
8	Delta Partners
9	DFJ Esprit
10	EC1 Capital
11	Environmental Technologies Fund
12	Herald Ventures
13	Mercia Fund Management
14	Mitsui & Co (Europe)
15	MTI
16	Octopus Ventures
17	Oregon Capital Partners
18	Pentech Ventures
19	Qualcomm Europe Inc.
20	River Capital Partners
21	Scottish Equity Partners (SEP)

Appendix E: Coding of Questionnaire in SPSS

Variable name	Description	Question No.	Content
ID	Interview number	Front page	Numeric (1-21)
StageA	Seed	Q1a	Numeric (1 if yes, 0 if no)
StageB	Start-up	Q1b	Numeric (1 if yes, 0 if no)
StageC	Other early stage	Q1c	Numeric (1 if yes, 0 if no)
StageD	Expansion	Q1d	Numeric (1 if yes, 0 if no)
StageE	Management buy-out	Q1e	Numeric (1 if yes, 0 if no)
StageF	Management buy-in	Q1f	Numeric (1 if yes, 0 if no)
StageG	Buy in management buy out	Q1g	Numeric (1 if yes, 0 if no)
StageH	Institutional buy-out	Q1h	Numeric (1 if yes, 0 if no)
StageI	Secondary purchases	Q1i	Numeric (1 if yes, 0 if no)
StageJ	Replacement equity	Q1j	Numeric (1 if yes, 0 if no)
StageK	Rescue/Turnaround	Q1k	Numeric (1 if yes, 0 if no)
StageL	Refinancing bank debt	Q1l	Numeric (1 if yes, 0 if no)
StageM	Bridge financing	Q1m	Numeric (1 if yes, 0 if no)
IndustA	Mobile telecommunications	Q2a	Numeric (1 if yes, 0 if no)
IndustB	Fixed line telecommunications	Q2b	Numeric (1 if yes, 0 if no)
IndustC	Computer hardware	Q2c	Numeric (1 if yes, 0 if no)
IndustD	Internet	Q2d	Numeric (1 if yes, 0 if no)
IndustE	Semiconductors	Q2e	Numeric (1 if yes, 0 if no)
IndustF	Software	Q2f	Numeric (1 if yes, 0 if no)
IndustG	Other electronics	Q2g	Numeric (1 if yes, 0 if no)
IndustH	Biotechnology	Q2h	Numeric (1 if yes, 0 if no)
IndustI	Medical Equipment	Q2i	Numeric (1 if yes, 0 if no)
IndustJ	Pharmaceuticals	Q2j	Numeric (1 if yes, 0 if no)
IndustK	Healthcare	Q2k	Numeric (1 if yes, 0 if no)
IndustL	Other	Q2l	Numeric (1 if yes, 0 if no)
Medical	Medical	Dummy	Numeric (1 if yes, 0 if no)
Geo1	Local	Q3i	Numeric (1 if yes, 0 if no)
Geo2	Regional	Q3ii	Numeric (1 if yes, 0 if no)
Geo3	National	Q3iii	Numeric (1 if yes, 0 if no)
Geo4	Europe	Q3iv	Numeric (1 if yes, 0 if no)
Geo5	Worldwide	Q3v	Numeric (1 if yes, 0 if no)
HIGHGBP	Highest Investment	Q4i	Numeric (millions of pounds)
LOWGBP	Lowest Investment	Q4ii	Numeric (millions of pounds)
AVEGBP	Average Investment	Q4iii	Numeric (millions of pounds)
HIGHPERC	Highest Equity stake	Q4i	Numeric (percentage)
LOWPERC	Lowest Equity stake	Q4ii	Numeric (percentage)
AVEPERC	Average Equity stake	Q4iii	Numeric (percentage)
INTPREP	Management accounts	Q5	Numeric (1 if yes, 0 if no)
PUBLISHED	Published accounts	Q5	Numeric (1 if yes, 0 if no)

BS	Balance sheet	Q5	Numeric (1 if yes, 0 if no)
PL	Profit and loss	Q5	Numeric (1 if yes, 0 if no)
NOTES	Notes to the accounts	Q5	Numeric (1 if yes, 0 if no)
CHEQUIT	Statements of changes in equity	Q5	Numeric (1 if yes, 0 if no)
CF	Cash flow statements	Q5	Numeric (1 if yes, 0 if no)
FS	Do you look for financial statements through Companies House directly?	Q6	Numeric (1 if yes, 0 if no)
SATISFY	Are you satisfied with existing requirements	Q7	Numeric (1 if yes, 0 if no)
RESSEP	R&D separate line item	Q9a	Numeric (1 if yes, 0 if no)
RAAND	R&D further subdivided	Q9b	Numeric (1 if yes, 0 if no)
IPCOST	Costs of maintaining R&D disclosed	Q9c	Numeric (1 if yes, 0 if no)
IMPAIR	Subdividision of impairment of intangibles figure	Q9d	Numeric (1 if yes, 0 if no)
AMORT	Subdivision of amortisation figure	Q9e	Numeric (1 if yes, 0 if no)
INTASS	Subdivision of intangibles in balance sheet	Q9f	Numeric (1 if yes, 0 if no)
RECOST	Internally generated intangibles in balance sheet at cost	Q9g	Numeric (1 if yes, 0 if no)
RECOFAIR	Internally generated intangibles in balance sheet at fair value	Q9h	Numeric (1 if yes, 0 if no)
DILRND	Subdivision of R&D - due diligence	Q10a	Numeric (1 if yes, 0 if no)
DILSTAT	Subdivision of various components of R & D	Q10b	Numeric (1 if yes, 0 if no)
NOINFO	Eliminate need to ask at due diligence stage	Q11	Numeric (1 if yes, 0 if no)
MORQUALA	Number of employees involved in research	Q12a	Numeric (1 if yes, 0 if no)
MORQUALB	Number of patents	Q12b	Numeric (1 if yes, 0 if no)
MORQUALC	Background information on patents	Q12c	Numeric (1 if yes, 0 if no)
MORQUALD	Geographical scope	Q12d	Numeric (1 if yes, 0 if no)
MORQUALE	Patent litigation (notes)	Q12e	Numeric (1 if yes, 0 if no)
MOREQUALF	Restrictions on use and licensing of IP	Q12f	Numeric (1 if yes, 0 if no)
QUALESS	Eliminate need to ask at due diligence stage	Q13	Numeric (1 if yes, 0 if no)
CONSULT	Consultation with standard setters	Q14	Numeric (1 if yes, 0 if no)
INTREPORT	Intellectual capital report - benefit	Q15	Numeric (0-5, 0 if not relevant at all)
PREPREP	Do recommend that entrepreneurs prepare such reports	Q15.2	Numeric (1 if yes, 0 if no)
VALINT	Do you believe valuation methods take intangibles correctly into consideration	Q17.2	Numeric (1 if yes, 0 if no)
INNQUAL	Qualification: Innovation	Q18	Numeric (1 if yes, 0 if no)
INNINI	Initial Enquires: Innovation	Q18	Numeric (1 if yes, 0 if no)
INNDUE	Due Diligence: Innovation	Q18	Numeric (1 if yes, 0 if no)
MODQUAL	Qualification: Business model	Q18	Numeric (1 if yes, 0 if no)
MODINI	Initial Enquiries: Business model	Q18	Numeric (1 if yes, 0 if no)
MODDUE	Due Diligence: Business model	Q18	Numeric (1 if yes, 0 if no)
IPQUAL	Qualification: IP	Q18	Numeric (1 if yes, 0 if no)
IPPINI	Initial Enquiries: IP	Q18	Numeric (1 if yes, 0 if no)
IPDUE	Due Diligence: IP	Q18	Numeric (1 if yes, 0 if no)

STAQUAL	Qualification: Reputation (stakeholders)	Q18	Numeric (1 if yes, 0 if no)
STAINI	Initial Enquires: Reputation (stakeholders)	Q18	Numeric (1 if yes, 0 if no)
STADUE	Due Diligence: Reputation (stakeholders)	Q18	Numeric (1 if yes, 0 if no)
CUSQUAL	Qualification: Customer base / Market share	Q18	Numeric (1 if yes, 0 if no)
CUSINI	Initial Enquires: Customer base / Market share	Q18	Numeric (1 if yes, 0 if no)
CUSDUE	Due Diligence: Customer base / Market share	Q18	Numeric (1 if yes, 0 if no)
INVQUAL	Qualification: Investors	Q18	Numeric (1 if yes, 0 if no)
INVINI	Initial Enquires: Investors	Q18	Numeric (1 if yes, 0 if no)
INVDUE	Due Diligence: Investors	Q18	Numeric (1 if yes, 0 if no)
MGTQUAL	Qualification: Management team	Q18	Numeric (1 if yes, 0 if no)
MGTINI	Initial Enquires: Management team	Q18	Numeric (1 if yes, 0 if no)
MGTDUE	Due diligence: Management team	Q18	Numeric (1 if yes, 0 if no)
REMQUAL	Qualification: Remuneration scheme	Q18	Numeric (1 if yes, 0 if no)
REMINI	Initial Enquires: Remuneration scheme	Q18	Numeric (1 if yes, 0 if no)
REMDUE	Due diligence: Remuneration scheme	Q18	Numeric (1 if yes, 0 if no)
PROFIT	Sign of a profitable investment opportunity	Q19a	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
INNOV	Sign of innovative potential	Q19b	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
ENTREP	Sign of entrepreneurial ability	Q19c	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
EFFORT	Sign of less effort required by venture capitalist	Q19d	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
PATAPP	Link between amount invested and patents applied for	Q20	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
PATOWN	Link between amount invested and patents owned	Q21	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
EQUAPP	Link between equity required and patents appllied for	Q22	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
EQUGRA	Link between equity required and patents granted	Q23	Numeric (1 if yes, 0 if no, missing - if answer is "it depends")
INCRPAT	Increase in number of patents after initial investment	Q25	Numeric (0-5, 0 if not relevant at all)
VALPRI	Prior to investing, would you be interested in knowing the value of the patent	Q26	Numeric (1 if yes, 0 if no)
EXTCONS	Do you engage external consults for advice on patents	Q27	Numeric (1 if yes, 0 if no)
VALEXP	Do you request a valuation from these experts	Q27.2	Numeric (1 if yes, 0 if no)
AFTERFS	After investing, willing to show value on FS of investee?	Q28	Numeric (1 if yes, 0 if no)
AFFSA	It is still not accurate enough	Q28.1a	Numeric (1 if yes, 0 if no)
AFFSB	Competition related arguments	Q28.1b	Numeric (1 if yes, 0 if no)
AFFSC	Tax implications	Q28.2c	Numeric (1 if yes, 0 if no)
AFFSD	Other	Q28.3d	Numeric (1 if yes, 0 if no)
AFTERVAL	Valuation of patent during investment	Q29	Numeric (1 if yes, 0 if no)
OTHEXP	Other experts	Q30	Numeric (1 if yes, 0 if no)
ENTVAL	Do entrepreneurs supply valuation from third parties	Q31	Numeric (1 if yes, 0 if no)

Variables relating to Respondent Sheets (Questionnaire)			
INCSTAA	Revenue	Q5.2a	Numeric (0-5, 0 if not relevant at all)
INCSTAB	Cost of Sales	Q5.2b	Numeric (0-5, 0 if not relevant at all)
INCSTAC	Administration Expenses	Q5.2c	Numeric (0-5, 0 if not relevant at all)
INCSTAD	R&D Expenditure	Q5.2d	Numeric (0-5, 0 if not relevant at all)
INCSTAE	Litigation costs	Q5.2e	Numeric (0-5, 0 if not relevant at all)
INCSTAF	Finance costs	Q5.2f	Numeric (0-5, 0 if not relevant at all)
INCSTAG	Amounts written off intangibles	Q5.2g	Numeric (0-5, 0 if not relevant at all)
INCSTAH	Net Profit	Q5.2h	Numeric (0-5, 0 if not relevant at all)
INCSTAI	Other	Q5.2i	Numeric (0-5, 0 if not relevant at all)
BSA	Tangible Fixed Assets	Q5.3a	Numeric (0-5, 0 if not relevant at all)
BSB	Intangible Fixed Assets	Q5.3b	Numeric (0-5, 0 if not relevant at all)
BSC	Debtors	Q5.3c	Numeric (0-5, 0 if not relevant at all)
BSD	Cash at Bank	Q5.3d	Numeric (0-5, 0 if not relevant at all)
BSE	Creditors due within 1 yr	Q5.3e	Numeric (0-5, 0 if not relevant at all)
BSF	Creditors due within more than 1 yr	Q5.3f	Numeric (0-5, 0 if not relevant at all)
BSG	Share capital and reserves	Q5.3g	Numeric (0-5, 0 if not relevant at all)
BSH	Provisions for Liabilities	Q5.3h	Numeric (0-5, 0 if not relevant at all)
BSI	Others	Q5.3i	Numeric (0-5, 0 if not relevant at all)
DOCA	Financial press	Q16a	Numeric (0-5, 0 if not relevant at all)
DOCB	Trade journals	Q16b	Numeric (0-5, 0 if not relevant at all)
DOCC	Interviews with entrepreneurs	Q16c	Numeric (0-5, 0 if not relevant at all)
DOCD	Interviews with other company personnel	Q16d	Numeric (0-5, 0 if not relevant at all)
DOCE	Government industry statistics	Q16e	Numeric (0-5, 0 if not relevant at all)
DOCF	Statistical information services	Q16f	Numeric (0-5, 0 if not relevant at all)
DOCG	Other venture capitalists	Q16g	Numeric (0-5, 0 if not relevant at all)
DOCH	Own due diligence report	Q16h	Numeric (0-5, 0 if not relevant at all)
DOCI	Due diligence report by accountants / consultants	Q16i	Numeric (0-5, 0 if not relevant at all)
DOCJ	Business plan (Balance sheet)	Q16j	Numeric (0-5, 0 if not relevant at all)
DOCK	Business plan (Profit and Loss)	Q16k	Numeric (0-5, 0 if not relevant at all)
DOCL	Unqualified audit report	Q16l	Numeric (0-5, 0 if not relevant at all)
DOCM	Qualified audit report	Q16m	Numeric (0-5, 0 if not relevant at all)
DOCN	Unaudited management projections (1 yr ahead)	Q16n	Numeric (0-5, 0 if not relevant at all)
DOCO	Unaudited management projections (more than 1 yr ahead)	Q16o	Numeric (0-5, 0 if not relevant at all)
DOCP	Unaudited latest period financial statements	Q16p	Numeric (0-5, 0 if not relevant at all)
DOCQ	Overall coherence of business plan	Q16q	Numeric (0-5, 0 if not relevant at all)
DOCR	Proposed timing and exit method	Q16r	Numeric (0-5, 0 if not relevant at all)
DOCS	Sales and marketing information	Q16s	Numeric (0-5, 0 if not relevant at all)
DOCT	Production information	Q16t	Numeric (0-5, 0 if not relevant at all)
DOCU	Production capacity and other technical information	Q16u	Numeric (0-5, 0 if not relevant at all)

DOCV	Curriculum vitae of management	Q16v	Numeric (0-5, 0 if not relevant at all)
DOCW	Patent documents	Q16w	Numeric (0-5, 0 if not relevant at all)
VALA	Historical cost book value	Q17a	Numeric (0-5, 0 if not relevant at all)
VALB	Replacement cost asset value	Q17b	Numeric (0-5, 0 if not relevant at all)
VALC	Liquidation value of assets (orderly sale)	Q17c	Numeric (0-5, 0 if not relevant at all)
VALD	Liquidation value of assets (forced sale)	Q17d	Numeric (0-5, 0 if not relevant at all)
VALE	Discounted future cash flow	Q17e	Numeric (0-5, 0 if not relevant at all)
VALF	Dividend yield	Q17f	Numeric (0-5, 0 if not relevant at all)
VALG	Price/Earnings multiple (Historic)	Q17g	Numeric (0-5, 0 if not relevant at all)
VALH	Price/Earnings multiple (Prospective)	Q17h	Numeric (0-5, 0 if not relevant at all)
VALI	EBIT Multiple	Q17i	Numeric (0-5, 0 if not relevant at all)
VALJ	Recent PE ratio of parent company shares	Q17j	Numeric (0-5, 0 if not relevant at all)
VALK	Recent transaction prices in the sector	Q17k	Numeric (0-5, 0 if not relevant at all)
VALL	Responses to attempt to solicit bids for investors	Q17l	Numeric (0-5, 0 if not relevant at all)
VALM	Industry rule of thumb ratios (e.g. turnover ratios)	Q17m	Numeric (0-5, 0 if not relevant at all)
VALN	EVA techniques	Q17n	Numeric (0-5, 0 if not relevant at all)
VALO	Payback method	Q17o	Numeric (0-5, 0 if not relevant at all)
VALP	Other	Q17p	Numeric (0-5, 0 if not relevant at all)
PATCHA	Residual life of patent	Q24a	Numeric (0-5, 0 if not relevant at all)
PATCHB	Number of backward citations	Q24b	Numeric (0-5, 0 if not relevant at all)
PATCHC	Number of forward citations	Q24c	Numeric (0-5, 0 if not relevant at all)
PATCHD	Family size	Q24d	Numeric (0-5, 0 if not relevant at all)
PATCHE	Simple patent count	Q24e	Numeric (0-5, 0 if not relevant at all)
PATCHF	Patent status	Q24f	Numeric (0-5, 0 if not relevant at all)
PATCHG	Patent litigation issues	Q24g	Numeric (0-5, 0 if not relevant at all)
PATCHH	Inventor involvement	Q24h	Numeric (0-5, 0 if not relevant at all)
PACHI	Patent scope	Q24i	Numeric (0-5, 0 if not relevant at all)
PATCHJ	Existence of substitutes	Q24j	Numeric (0-5, 0 if not relevant at all)
PATCHK	Importance of patents to specific industry	Q24k	Numeric (0-5, 0 if not relevant at all)
INDA	Existence of star researchers	Q32a	Numeric (0-5, 0 if not relevant at all)
INDB	Existence of R&D departments	Q32b	Numeric (0-5, 0 if not relevant at all)
INDC	Number of R&D workers	Q32c	Numeric (0-5, 0 if not relevant at all)
INDD	R&D annual budget	Q33d	Numeric (0-5, 0 if not relevant at all)
INDE	Proportion of workers with advanced degrees	Q33e	Numeric (0-5, 0 if not relevant at all)
INDF	Organisation of R&D activities	Q33f	Numeric (0-5, 0 if not relevant at all)
INDG	Number of R&D alliances	Q33g	Numeric (0-5, 0 if not relevant at all)
INDH	Existence of substitutes	Q33h	Numeric (0-5, 0 if not relevant at all)
INDI	Average time to bring idea to the market	Q33i	Numeric (0-5, 0 if not relevant at all)
INDJ	Breakeven time	Q33j	Numeric (0-5, 0 if not relevant at all)

Appendix F: Intellectual Capital Report – Key Indicators

This appendix outlines the indicators which are part of the sample intellectual report shown to participants. Each section is further subdivided into more indicators.

Intellectual Capital: Inputs (indicators)

Human Capital

- Basic data (number of employees, split by type)
- Labour turnover (e.g. labour turnover rate)
- Employee qualification (e.g. employees in training)
- Education and training (e.g. internally organised training courses)
- Work life balance (e.g. employees on maternity leave)

Structural Capital

- Quality and efficiency (e.g. suggestions for improvement)
- Flexibility and security (e.g. number of employees with additional voluntary tasks)

Relational Capital

- Worldwide corporate network (e.g. attendance at worldwide conferences)
- Supplier network (e.g. number of suppliers)
- R&D cooperation (e.g. number of cooperation partners in R&D projects
- Education and Qualification networks (e.g. cooperation in teaching and education)

Locational Capital

- Legal framework (e.g. professing time for labour permits)
- Governmental R&D incentives (e.g. effective rate of corporation tax)
- Quality of Life (e.g. Safety certifications)
- Energy (e.g. energy based consumption downtime)
- Labour market (e.g. number of university graduates)

Process indicators

- Production (e.g. flexible use of employees in production in %)
- Research and Development (e.g. R&D expenditure in £)
- Business responsibility (e.g. ratio of new products)
- Advanced services (e.g. cost reduction compared to previous years)

Output and Impact (by stakeholders)

- Customers (e.g. quality indicator of customer audits)
- Employee specific (e.g. number of employees which graduated whilst on training)
- Supplier specific (e.g. number of regional suppliers)
- Population specific (e.g. public appearance in panel discussions)
- Results of education and research institutions (e.g. number of funded projects with universities)
- Media specific (e.g. ratio of R&D topic in media coverage)
- Results relevant to macroeconomics (number of additionally generated jobs)

Appendix G: Tables relating to the data included within the database

Table G-1: List of venture capital firms considered for data analysis (database construction)

1	Abingworth*
2	ACT Ventures*
3	Advent Partners*
4	Albion Ventures
5	Aquarius Equity
6	Aspiration Capital
7	Barwell*
8	Bestport
9	Braveheart Ventures*
10	Catapult Venture Managers*
11	Chord Capital
12	Crescent Capital*
13	CT Investment Partners
14	Dawn Capital
15	Delta Partners*
16	DFJ Esprit
17	DN Capital
18	Environmental Technologies Fund*
19	Herald Ventures*
20	IQ Capital
21	Midven Ltd
22	MMC Ventures
23	MTI*
24	Novusmodus
25	Octopus Ventures*
26	Oxford Capital Partners
27	Par Equity
28	Pentech Ventures*
29	Saffron Hill Ventures
30	SEP*
31	Spark Ventures
32	Tate and Lyle Ventures
33	Wellington Partners
34	WM Enterprise

***** These companies were interviewed in earlier fieldwork. All the other firms were contacted as being potential participants, but did not agree to be interviewed.

Table G-2: Coding for Industry in Stata based on SIC-2003

Code	Industry
1	Agriculture, Hunting and Forestry
2	Fishing
3	Mining Quarrying & Energy Materials
4	Mining and Quarrying, Non Energy Materials
5	Manufacturing of Food Products, Beverages and Tobacco
6	Manufacture of Textiles and Textile Products
7	Manufacture of Leather and Leather Products
8	Manufacture of Wood and Wood Products
9	Manufacture of Pulp, Paper and Paper Products Publishing and Printing
10	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
11	Manufacture of Chemicals, Chemical Products and Man-made Fibres
12	Manufacture of Rubber and Plastic Products" 13 "
13	Manufacture of Other Non-metallic Mineral Products
14	Manufacture of Basic Metals and Fabricated Metal Products
15	Manufacture of Machinery and Equipment
16	Manufacture of Electrical and Optical Equipment
17	Manufacture of Transport Equipment
18	Manufacture not elsewhere classified
19	Electricity Gas and Water
20	Construction
21	Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods
22	Hotels and Restaurants
23	Transport, Storage and Communication
24	Financial Intermediation
25	Real Estate
26	Renting Equipment without operator
27	Computer and Related Activities
28	Research and Development
29	Other Business Activities
30	Public administration and defence; compulsory social security
31	Education
32	Health and social work
33	Other community, social and personal service activities
34	Private Households
35	Other

Appendix H: Extract from database

In the next page one can find a screenshot from the dataset as initially created in Microsoft Excel. In the table below the contents of each column is defined.

Field name	Description
id	A sequential number provided to each record
coname	Company name
Invmonth	Month in which investment was made
invyr	Year of investment
Incyr	Year of incorporation
age	Age of firm
round	Venture capital round (not used for current data analysis – incomplete/inaccurate in data source)
size	Size of Investment in domestic currency
sterling	Size of investment in sterling
intbs	Intangibles in balance sheet prior to investment date (as shown)
intmill	Intangibles in balance sheet prior to investment date (converted into millions)
fsdate	Last date of financial statements prior to investment date
country	Country of incorporation
siccode	Standard industry classification code
Industrydesc	Industry description based on SIC Code
grapatpubdate	Number of granted patents with publication date smaller or equal to investment date
grafampubdate	Number of patent families in respect of patents granted (publication date of patents smaller or equal to investment date
patapprdate	Number of patent applications (priority date smaller or equal to investment date)
patfamapprdate	Number of patent families in respect of patents applications (priority date of patents smaller or equal to investment date)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	id	coname	invmonth	invyr	incyr	age	round	size	sterling	*intbs*	*intmill*	*fsdate*	country	siccode	industrydesc	grapatpubd ate	grafampubd ate	patapppr date	patfamap pprdate
2	1	Musicmetric / Semetric	January	2013	2008	5	Venture Round	£3M	0.30	72,000	0.0720	Apr-11	United Kingdom	7230	Data Processing	0	0	0	0
3	2	Lamellar Biomedical	January	2013	2006	7	Series A	£3.30	3.30	204,000	0.2040	Jun-11	United Kingdom	7310	Research & Development On Natural Sciences & Eng	12	4	15	4
4	3	Fertility Focus	January	2013	2005	8	Venture Round			165,396	0.1654	Dec-11	United Kingdom	8514	Other human health activities	3	1	7	1
5	4	Caperfly	January	2013	2011	2	Venture Round			-	0.0000	Jan-12	United Kingdom	7221	Software publishing	0	0	0	0
6	5	NewVoiceMedia	January	2013	1998	15	Series B	$20M	12.35	149,445	0.1494	Jan-12	United Kingdom	6420	Telecommunications	2	2	6	4
7	6	Recite Me	January	2013	2010	3	Venture Round	£225k	0.23	-	0.0000	May-12	United Kingdom	7260	Other Computer Related Activities	0	0	0	0
8	7	Ultromex	January	2013	2011	2	Seed	£550k	0.34	230,000	0.2300	Jun-12	United Kingdom	3720	Recycling Of Non-Metal Waste & Scrap	0	0	1	1
9	8	Rentify	January	2013	2011	2	Series A	£2M	2.00				United Kingdom	7222	Other software consultancy and supply	0	0	0	0
10	9	FanDuel	January	2013	2007	6	Series C	$11M	6.80				USA	7221	Software publishing	0	0	0	0
11	10	GetYourGuide	January	2013	2009	4	Series A	$14M	8.65				Switzerland	6330	Activities of tour and travel agents	0	0	0	0
12	11	Labcyte	January	2013	2003	10	Series D	$5.3M	3.27				USA	7310	Research & Development On Natural Sciences & Eng	13	9	31	15
13	12	Versartis	January	2013	2008	5	Series C	$25M	15.45				USA	5146	Wholesale of pharmaceutical goods	0	0	0	0
14	13	Avillion	January	2013			Venture Round						United Kingdom	7310	Research & Development On Natural Sciences & Eng	0	0	0	0
15	14	Luluvise	February	2013	2010	3	Seed	$2.5M	1.58	-	0.0000	Jan-12	United Kingdom	9272	Other recreational activiities	0	0	0	0
16	15	Tyres on the Drive	February	2013	2011	2	Venture Round	£640k	0.64	-	0.0000	Jan-12	United Kingdom	5030	Sale of motor vehicle parts etc.	0	0	0	0
17	16	Kallik	February	2013	2001	12	Venture Round		0.12	13,923	0.0139	Dec-12	United Kingdom	7222	Other software consultancy and supply	0	0	2	2
18	17	Adizio	February	2013	2012	1	Venture Round	£250k	0.25				United Kingdom	7440	Advertising	0	0	0	0
19	18	Vizolution	February	2013	2013	0	Venture Round	£750k	0.75				United Kingdom	6420	Telecommunications	0	0	0	0
20	19	Windeln.de	February	2013			Series B	$19.6M	12.39				Germany	5263	Other non store retail	0	0	0	0
21	20	StrikeAd	January	2012	2010	2	Series A	£2M	2.00	-	0.0000	Mar-11	United Kingdom	7487	Other business activies	0	0	0	0
22	21	Performance Horizon Group	January	2012	2010	2	Series B			-	0.0000	Mar-11	United Kingdom	7260	Other Computer Related Activities	0	0	1	1
23	22	MGB Biopharma	January	2012	2009	3		0.352	0.35	75,695	0.0757	Apr-11	United Kingdom	7310	Research & Development On Natural Sciences & Eng	0	0	0	0
24	23	Maxymiser	January	2012	2004	8	Series B	$12M	7.72	-	0.0000	Dec-11	United Kingdom	5261	Retail sales via mail order houses	0	0	6	2
25	24	made.com	January	2012	2009	3	Series B	£6M	6.00	76,493	0.0765	Dec-11	United Kingdom	5261	Retail sales via mail order houses	0	0	0	0
26	25	Horizon Discovery	January	2012	2005	7	Series C	$18.6M	11.97	688,940	0.6889	Dec-11	United Kingdom	7310	Research & Development On Natural Sciences & Eng	0	0	0	0
27	26	Love Home Swap	January	2012	2009	3	Venture Round	£850k	0.85				United Kingdom	7032	Manage real estate, fee or contract	0	0	0	0
28	27	betapond	January	2012	2009	3	Venture Round	€1.15M	0.92				Ireland	7222	Other Software Consultancy and Supply	0	0	0	0
29	28	Blink Booking	January	2012	2011	1	Seed	$2.5M	1.61				Spain	7487	Other business activities	0	0	0	0
30	29	Farfetch	January	2012	2007	5	Series B	$18M	11.59				USA	5261	Retail sales via mail order houses	0	0	0	0
31	30	Prosensa	January	2012	2002	10	Venture Round	€23M	19.18				Netherlands	2442	Manufacture of pharmaceutical preparations	17	9	123	22
32	31	Artesian Solutions	February	2012	2006	6	Series A	£2M	2.00	-	0.0000	Feb-01	United Kingdom	7221	Software Publishing	0	0	0	0
33	32	Oxitec	February	2012	2002	10	Venture Round	£8M	8.00	-	0.0000	Dec-10	United Kingdom	7310	Research & Development On Natural Sciences & Eng	10	4	78	33
34	33	Polatis	February	2012	2000	12	Venture Round	$2.7M	1.71	-	0.0000	Mar-11	United Kingdom	3340	Manufacture of Optical and Photographic Equipmen	45	12	147	58
35	34	Secret Sales	February	2012	2006	6	Venture Round	£6.3M	6.30	-	0.0000	Dec-11	United Kingdom	7487	Other business activities	0	0	0	0
36	35	Memrise	February	2012	2010	2	Seed	$1.1M	0.70	-	0.0000	Dec-11	United Kingdom	8042	Adult and other education	0	0	0	0
37	36	Factonomy	February	2012	2003	9		0.055	0.06		0.0000	Jan-12	United Kingdom	7210	Hardware consultancy	0	0	0	0
38	37	Xceleron (Chapter 11)	February	2012	1997	15	Venture Round	$2.4M	1.52				United Kingdom	8514	Other human health activities	3	3	19	6
39	38	eSellerPro	February	2012	2008	4	Venture Round	£1M	1.00				United Kingdom	7222	Other software consultancy and supply	0	0	0	0
40	39	Blooie	February	2012	2011	1	Seed	£90k	0.09				United Kingdom	7260	Other Computer Related Activities	0	0	0	0
41	40	Odimax	February	2012	2011	1	Seed	$135k	0.09				United Kingdom	7222	Other software consultancy and supply	0	0	0	0
42	41	Michelson Diagnostics	March	2012	2006	6	Venture Round	£607k	0.61	-	0.0000	Mar-11	United Kingdom	3310	Manufacture of Medical and Orthopeadic Appliance	4	2	15	4
43	42	Comply Serve	March	2012	2006	6	Venture Round			57,443	0.0574	Mar-11	United Kingdom	7221	Software publishing	0	0	0	0
44	43	PlayMob	March	2012	2007	5	Venture Round	£500k	0.50	24,854	0.0249	Jul-11	United Kingdom	7210	Hardware Consultancy	0	0	0	0
45	44	KnowledgeMill	March	2012	2008	4	Series A	£1.5M	1.50	-	0.0000	Aug-11	United Kingdom	7210	Hardware Consultancy	0	0	0	0
46	45	PeerIndex	March	2012	2008	4	Series A	$3M	1.88	-	0.0000	Nov-11	United Kingdom	7230	Data Processing	0	0	0	0
47	46	Hailo	March	2012	2010	2	Series A	$17M	10.67	-	0.0000	Dec-11	United Kingdom	6420	Telecommunications	0	0	0	0
48	47	CrowdIPR	March	2012	2011	1	Seed	$135k	0.08				United Kingdom	7222	Other software consultancy and supply	0	0	0	0

Appendix I: Further assumptions of regressions

In section 5.2.8 we have presented some of the tests carried out and graphs plotted to verify that the assumptions of the multiple regression analysis were met. However, the graphs and tests presented in this section related mainly to one of the regressions – the regression carried out on the full sample with the existence of patent application as an independent variable (section 5.2.1). In this section, we now present some of the graphs/tests carried out to test the assumptions of the other regressions considered which are not included in section 5.2.8.

Q-Q Plots: Normality Assumption

We considered the normality assumption using Q-Q plots, but added boundaries to them using the *qenv* facility available in Stata for each regression as shown in the figures below. The plots only show little or no deviation from the boundaries. Therefore we concluded that the residuals carried out in the regression show no deviation from the normality assumption.

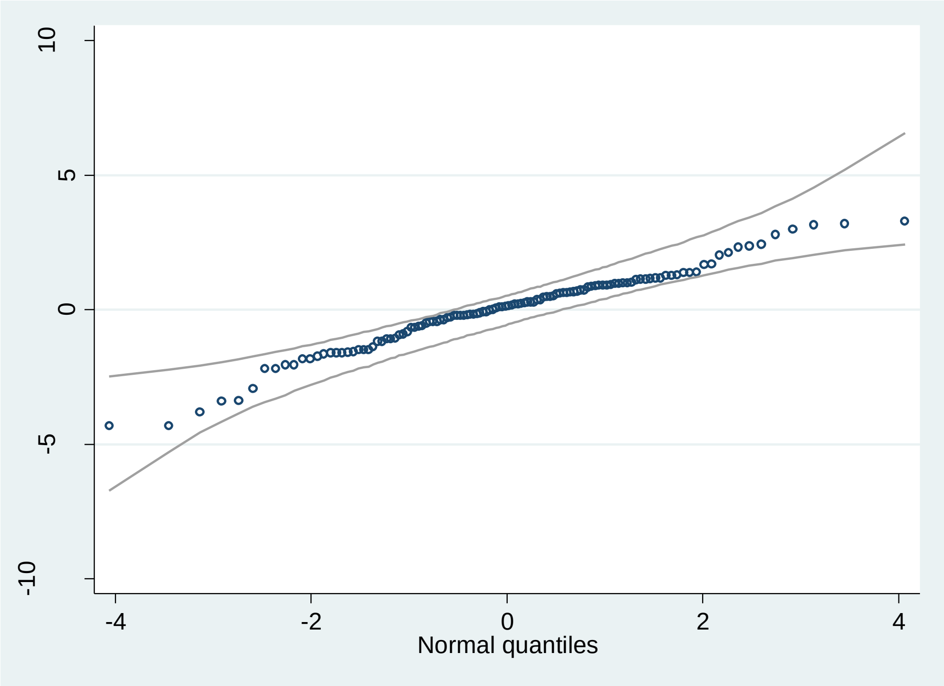

Figure I-1: Q-Q Plot for regression [2] shown in Table 5-5

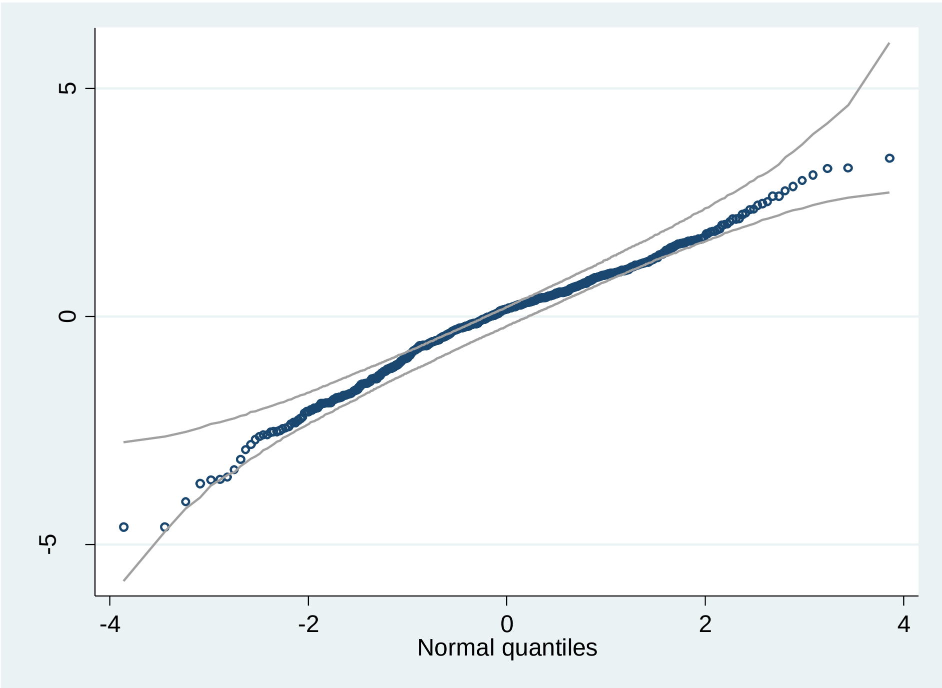

Figure I-2: Q-Q Plot for regression shown in Table 5-6

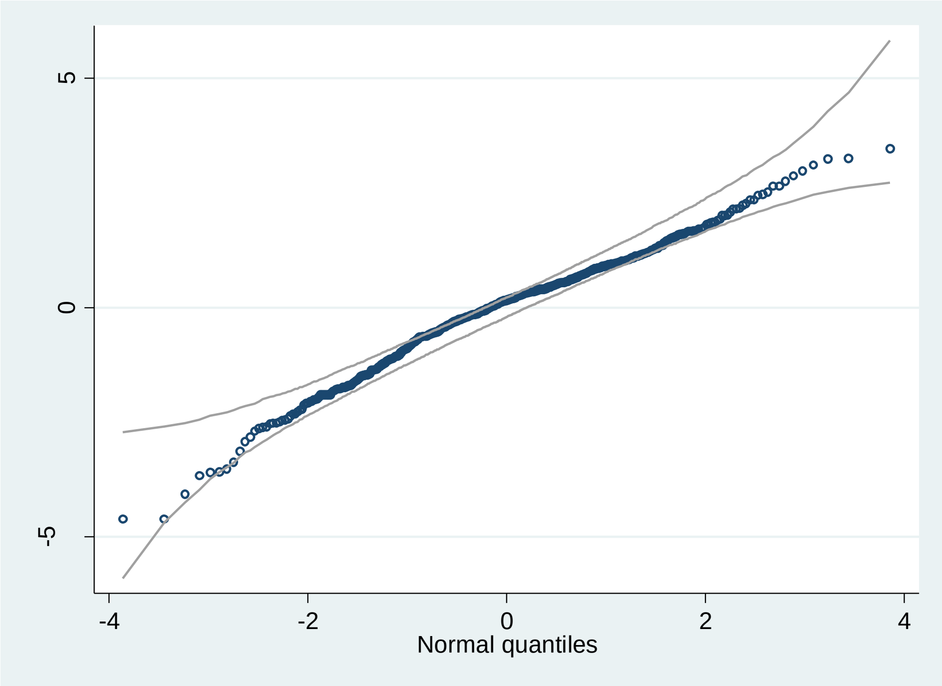

Figure I-3: Q-Q Plot for regression shown in Table 5-7

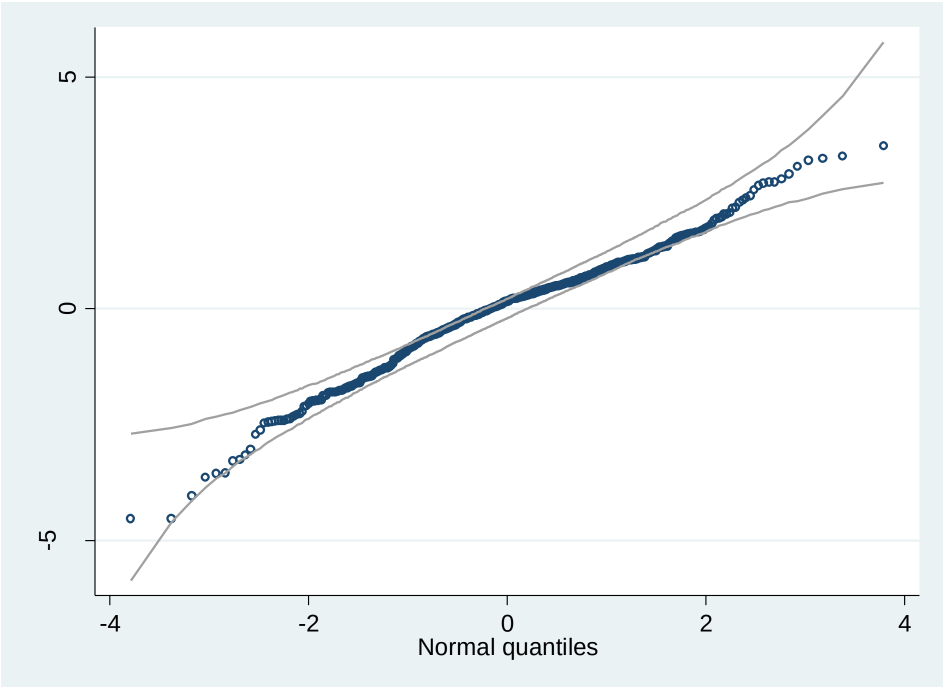

Figure I-4: Q-Q Plot for the full sample regression [1] shown in Table 5-8

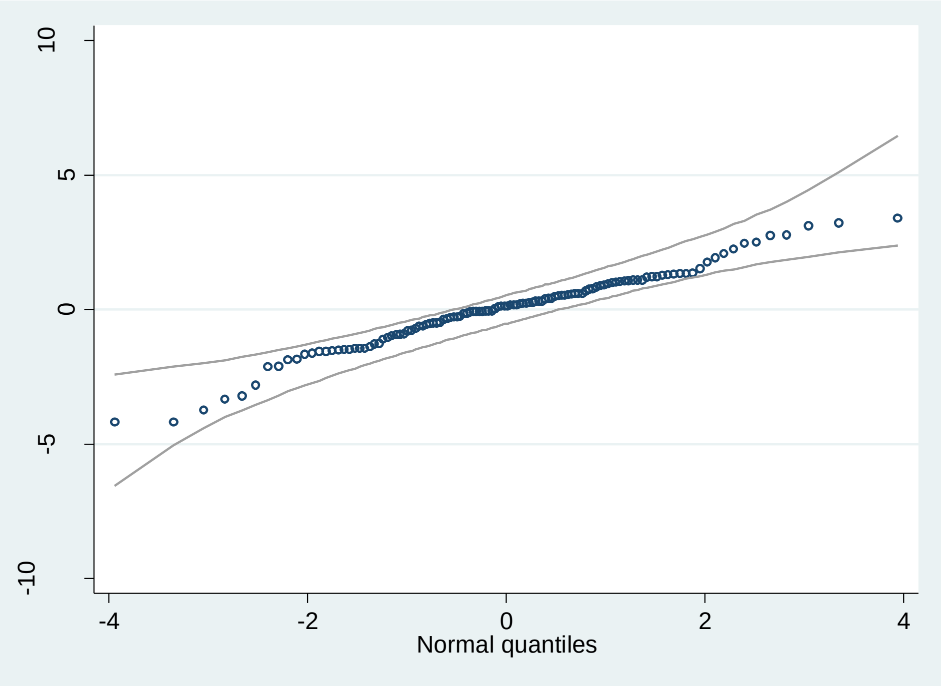

Figure I-5: Q-Q Plot for the subsample regression [2] shown in Table 5-8

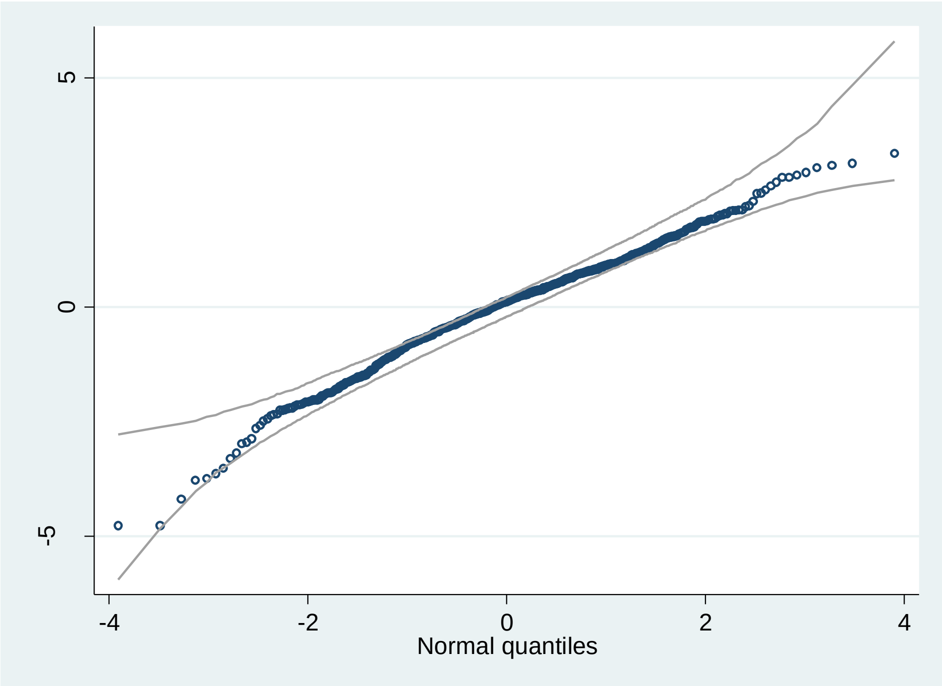

Figure I-6: Q-Q Plot for regression shown in Table 5-9

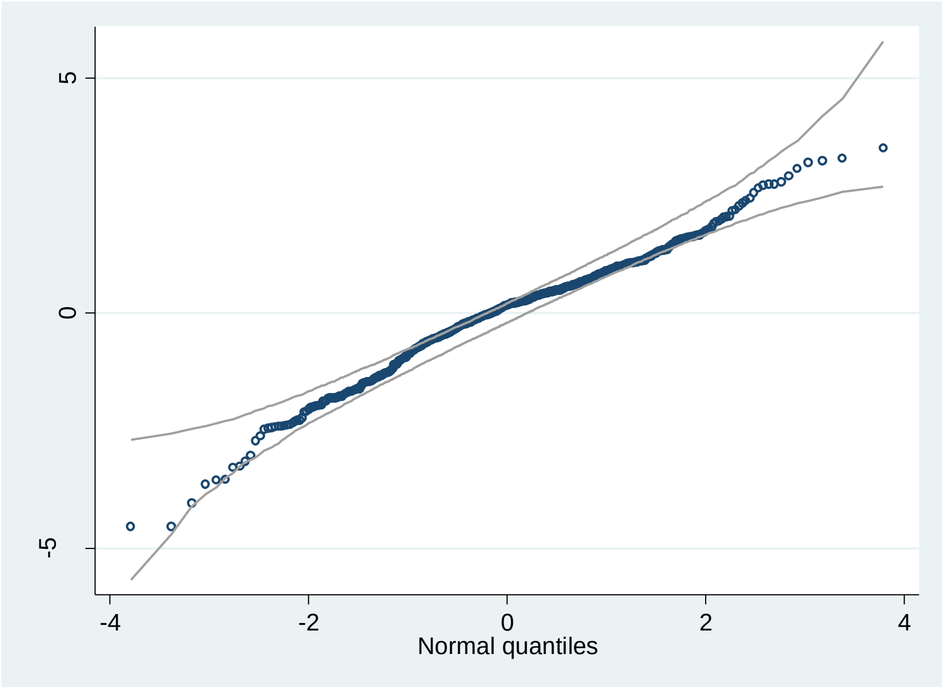

Figure I-7: Q-Q Plot for the full sample regression [1] shown in Table 5-10

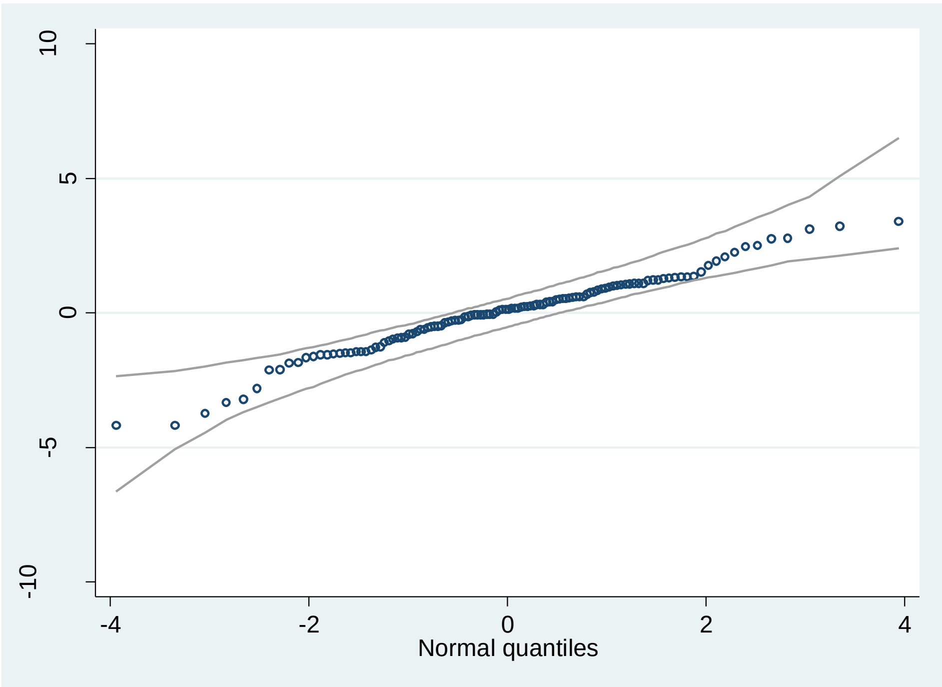

Figure I-8: Q-Q Plot for the subsample regression [2] shown in Table 5-10

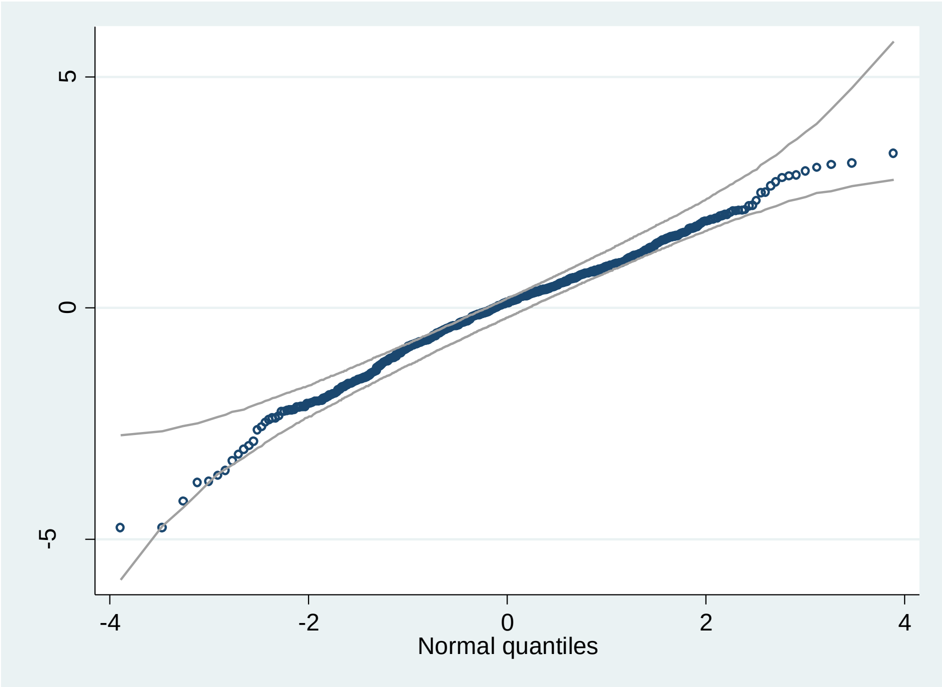

Figure I-9: Q-Q plot for the regression shown in Table 5-11

Linearity

We also plotted a number of component plus residual curves for some of the independent variables to assess linearity. Although there is some evidence of curvature towards the end, we note that more central parts do not show this curved pattern and follow regression model (Hamilton, 2005), and therefore there is not sufficient evidence of nonlinearity.

Partial regression plots (Figure 5-6) for each independent in the equation were plotted, similar to what was previously done in Section 5.2.8. We find no evidence of non-linearity.

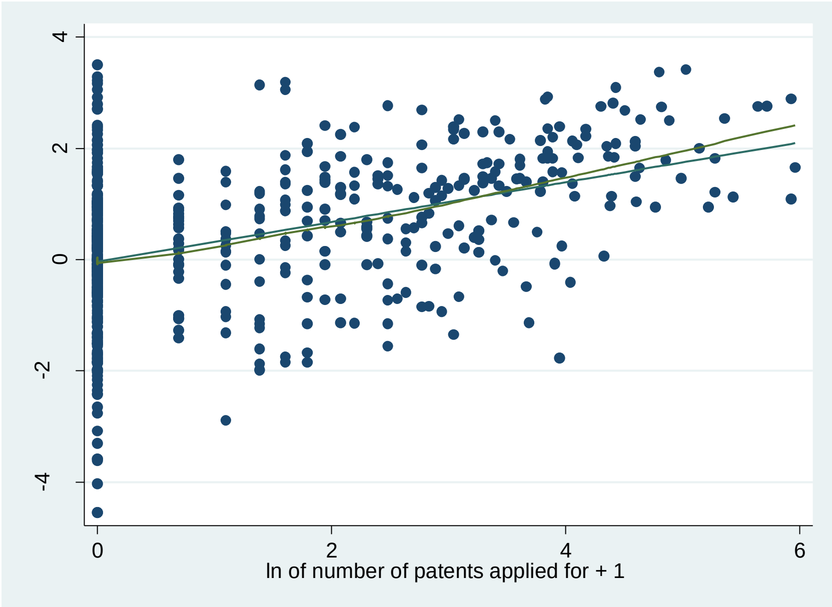

Figure I-10: Augmented component plus residual plot for the ln of the number of patent applications

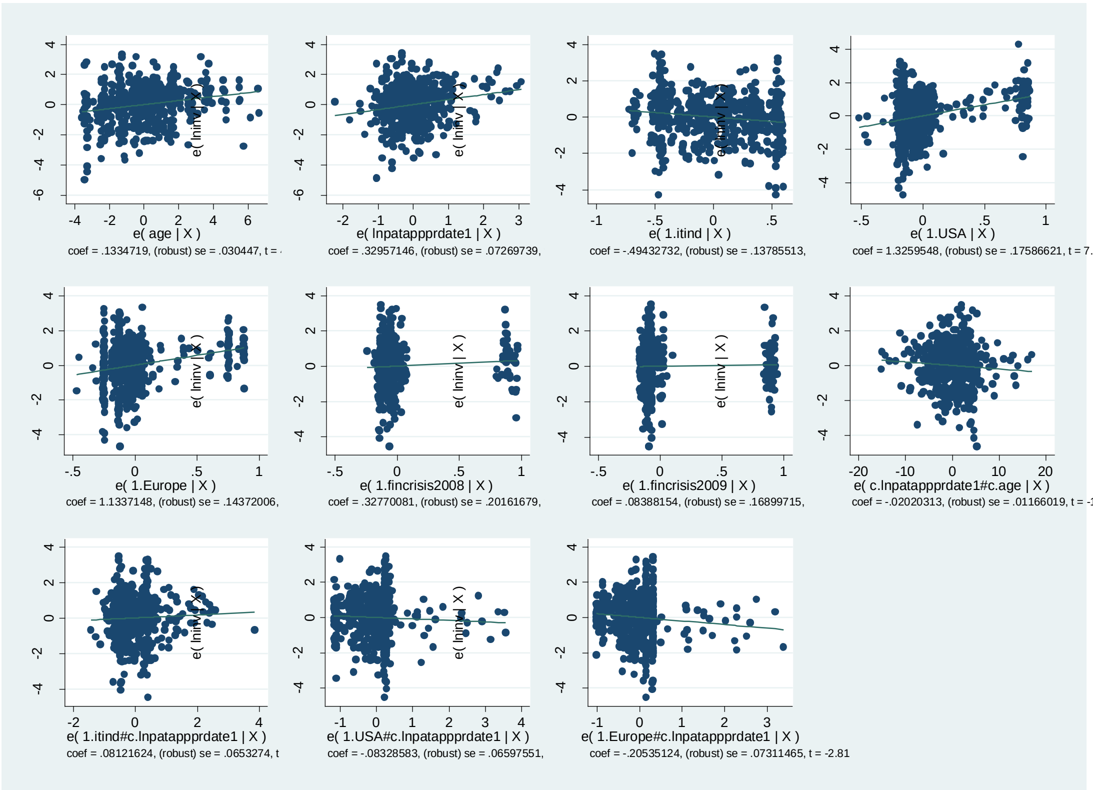

Figure I-11: Partial regression plots for the regression with the full sample, which has the number of patent applications as independent variable

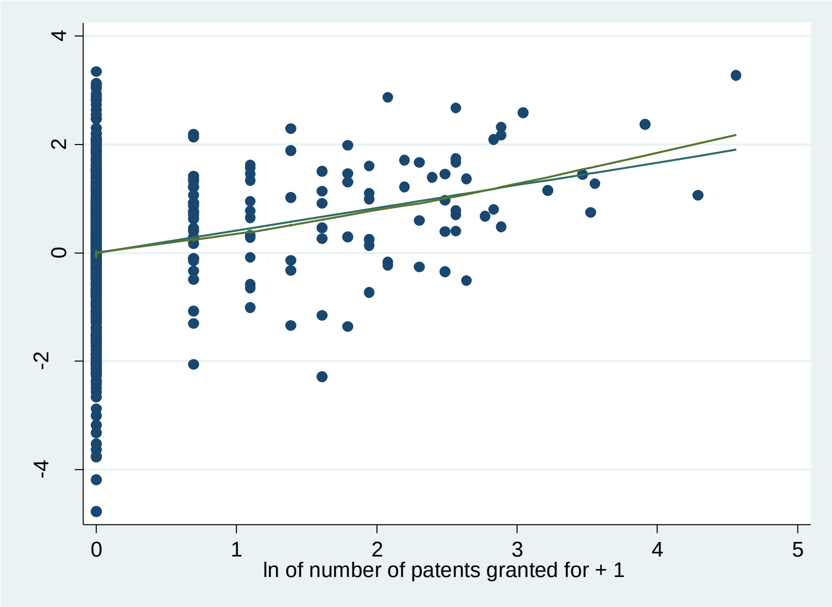

Figure I-12: Augmented component plus residual plot for the ln of number of patents granted

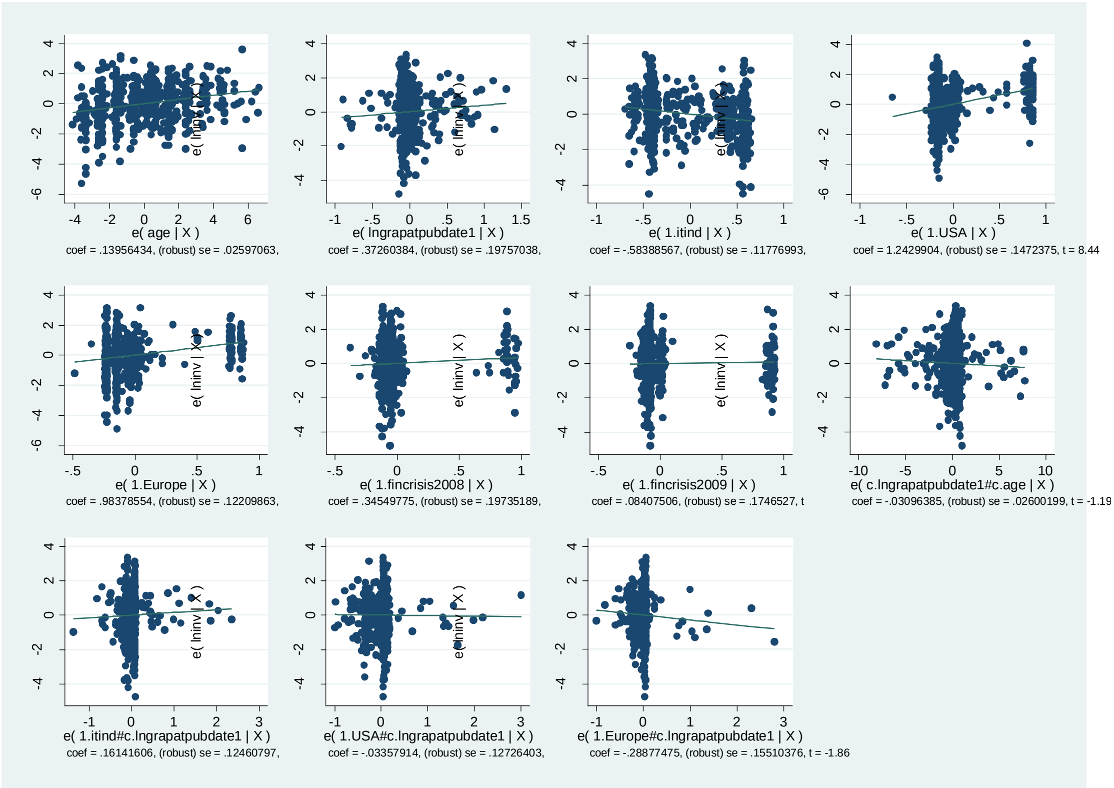

Figure I-13: Partial regression plots for the regression with the number of patents granted as an independent variable

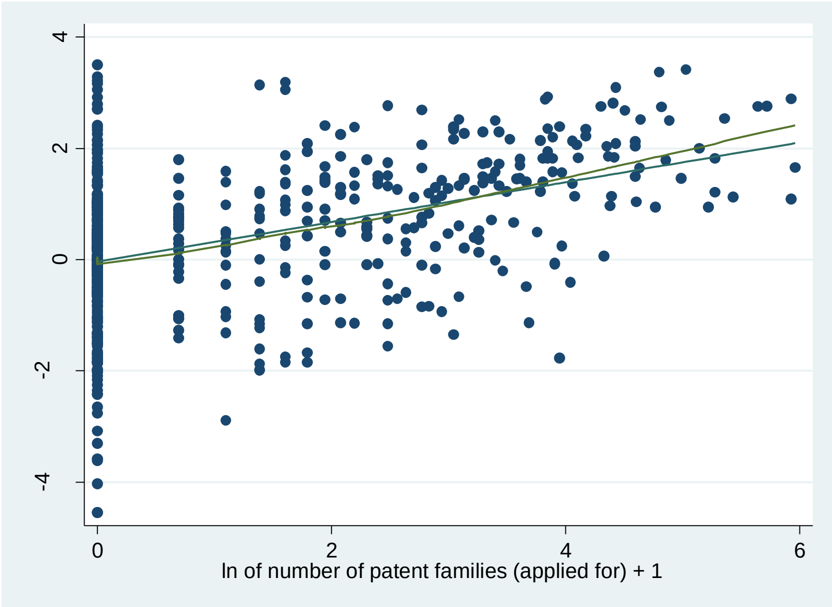

Figure I-14: Augmented component plus residual plot for the ln of number of patent families (based on patent applications)

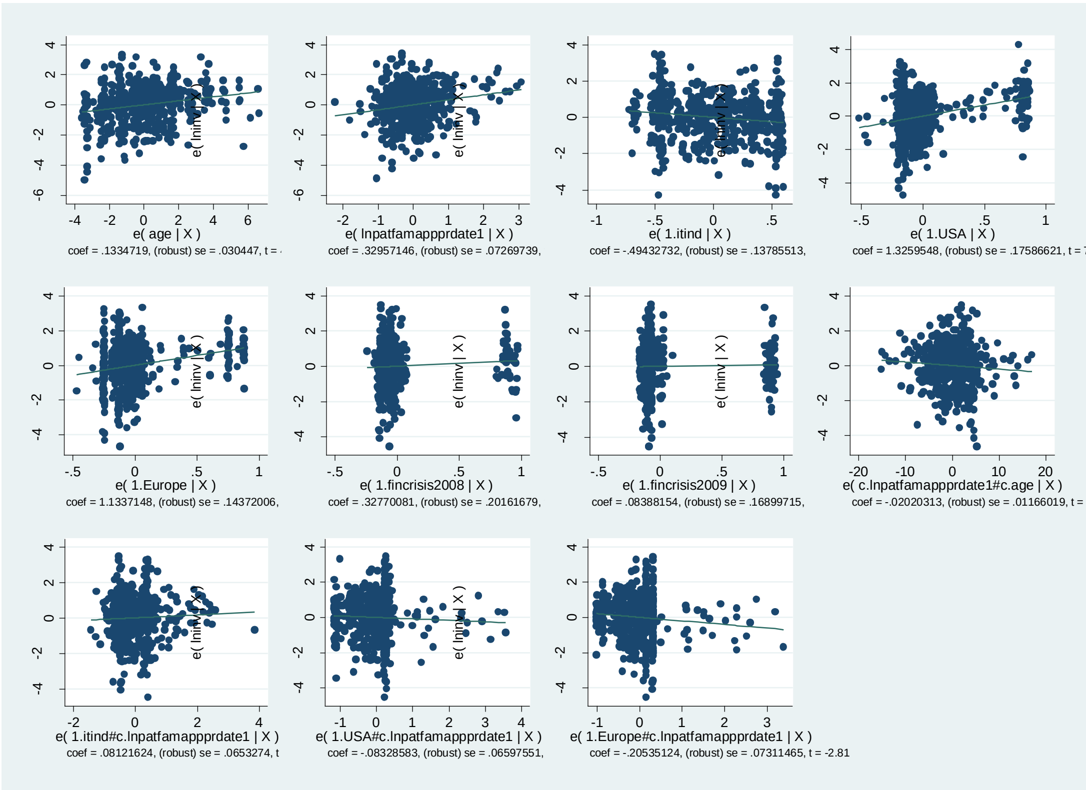

Figure I-15: Partial regression plots for the regression with the number of patent families (based on patent applications) as an independent variable

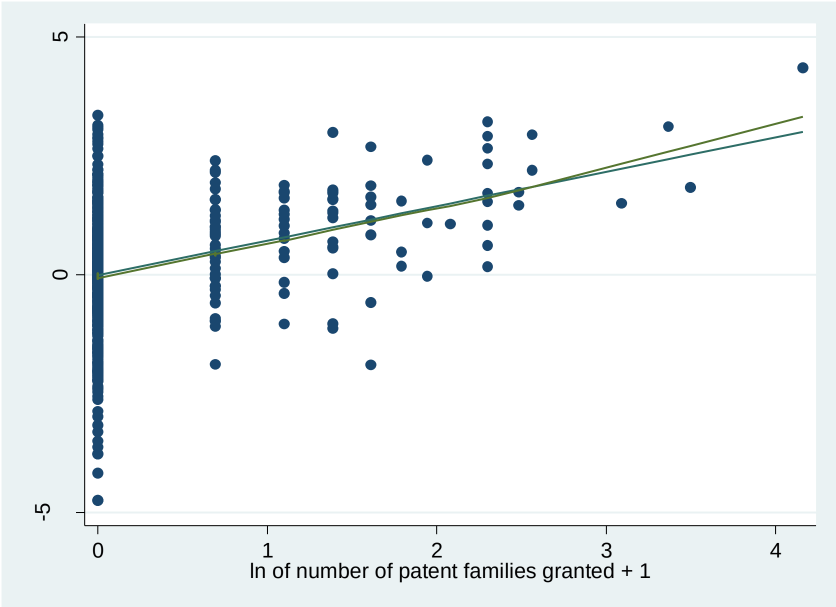

Figure I-16: Augmented component plus residual plot for the ln of number of patent families (based on patent granted)

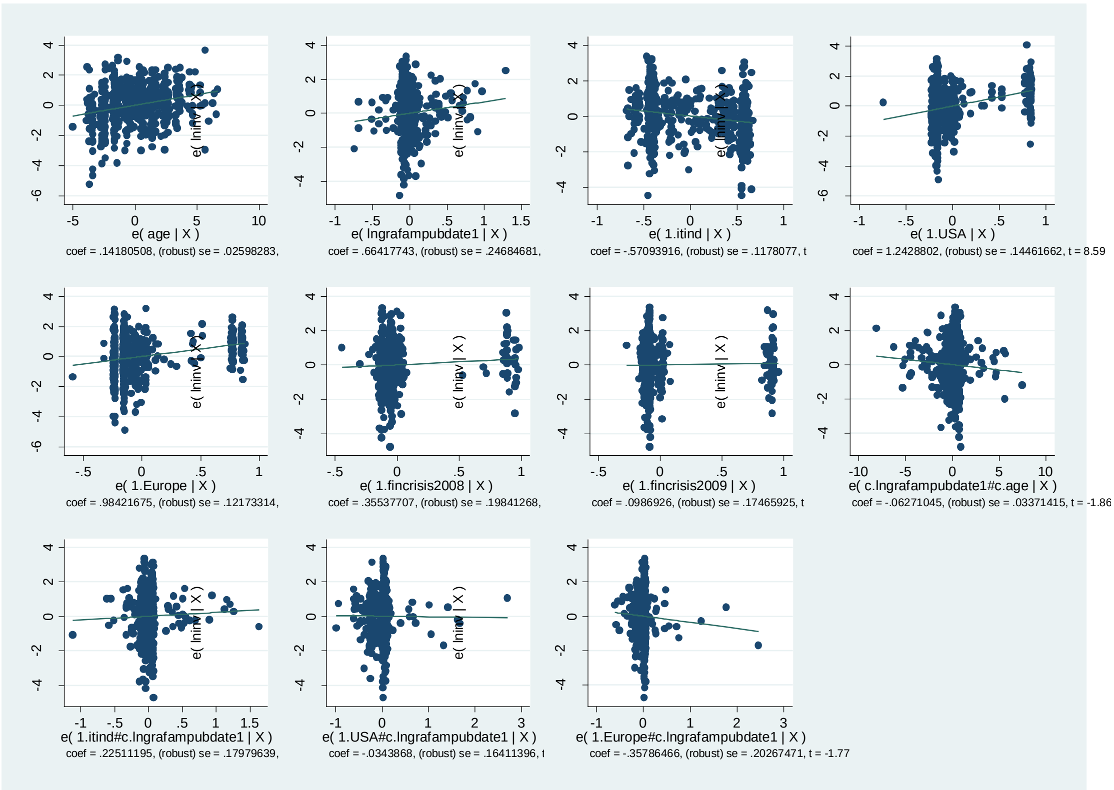

Figure I-17: Partial regression plots for the regression with the number of patent families (based on patents granted) as an independent variable

Multicollinearity : Variance Inflation Factors (VIF)

We considered the variance inflation factor for each regression. All of the variables are below the threshold of 10 with the exception of two variables relating to the number of patents granted / number of patent families (relating to patents granted). The issues relating to these two cases are discussed further in section 5.2.5 and section 5.2.6 of the main text. The tables below show the VIFs for each independent variable, in each of the regressions considered.

Table I-1: VIF for regression of the subsample [2] shown in Table 5-5

Variable	VIF
1.binpatapp	2.16
1.itind	1.57
1.USA	1.29
1.Europe	1.56
1.fincrisis2008	1.05
1.fincrisis2009	1.17
binpatapp#itind	2.99
binpatapp#USA	1.37
binpatapp#Europe	1.83
Mean VIF	1.67

Table I-2: VIF for regression shown in Table 5-6

Variable	VIF
age	1.50
1.binpatgrant	6.90
1.itind	1.23
1.USA	1.32
1.Europe	1.25
1.fincrisis2008	1.04
1.fincrisis2009	1.02
binpatgrant#c.age	7.15
binpatgrant#itind	1.68
binpatgrant#USA	1.32
binpatgrant#Europe	1.55
Mean VIF	2.39

Table I-3: VIF for regression shown in Table 5-7

Variable	VIF
age	2.13
1.multiplepat	4.75
1.itind	1.73
1.USA	1.84
1.Europe	1.70
1.fincrisis2008	1.03
1.fincrisis2009	1.02
multiplepat#c.age	5.74
multiplepat#itind	1.95
multiplepat#USA	2.04
multiplepat#Europe	1.83
Mean VIF	2.34

Table I-4: VIF for the full sample regression [1] shown in Table 5-8

Variable	VIF
age	1.91
lnpatappprdate1	5.86
1.itind	1.63
1.USA	1.68
1.Europe	1.64
1.fincrisis2008	1.04
1.fincrisis2009	1.02
lnpatappprdate1#c.age	6.60
itind#lnpatappprdate	1.64
USA#lnpatappprdate	2.00
Europe#lnpatappprdate	1.83
Mean VIF	2.44

Table I-5: VIF for the subsample regression [2] shown in table 5-8

Variable	VIF
lnpatappprdate1	1.42
1.itind	1.43
1.USA	1.24
1.Europe	1.28
1.fincrisis2008	1.04
1.fincrisis2008	1.10
itind#c.lnpatappprdate1	1.58
USA#lnpatappprdate1	1.28
Europe#lnpatappprdate1	1.35
Mean VIF	1.30

Table I-6: VIF for regression shown in Table 5-9

Variable	VIF
age	1.35
lngrapatpubdate1	12.47
1.itind	1.18
1.USA	1.25
1.Europe	1.20
1.fincrisis2008	1.05
1.fincrisis2009	1.02
c.lngrapatpubdate1#c.age	11.96
itind#c.lngrapatpubdate1	1.46
USA#c.lngrapatpubdate1	1.65
Europe#c.lngrapatpubdate1	1.47
Mean VIF	3.28

Table I-7: VIF for the full sample regression [1] shown in Table 5-10

Variable	VIF
age	1.91
lnpatfamappprdate	5.86
1.itind	1.63
1.USA	1.68
1.Europe	1.64
1.fincrisis2008	1.04
1.fincrisis2009	1.02
c.lnpatfamappprdate#c.age	6.60
itind#c.lnpatfamappprdate	1.64
USA#c.lnpatfamappprdate	2.00
Europe#c.lnpatfamappprdate	1.83
Mean VIF	2.44

Table I-8: VIF for the subsample regression [2] shown in Table 5-10

Variable	VIF
lnpatfamappprdate	1.42
1.itind	1.43
1.USA	1.24
1.Europe	1.28
1.fincrisis2008	1.04
1.fincrisis2009	1.10
itind#c.lnpatfamappprdate	1.58
USA#lnpatfamappprdate	1.28
Europe#lnpatfamappprdate	1.35
Mean VIF	1.30

Table I-9: VIF for the regression shown in Table 5-11

Variable	VIF
age	1.36
lngrafampubdate1	11.04
1.itind	1.19
1.USA	1.22
1.Europe	1.19
1.fincrisis2008	1.05
1.fincrisis2009	1.02
c.lngrapatpubdate1#c.age	11.37
itind#c.lngrapatpubdate1	1.47
USA#c.lngrapatpubdate1	1.67
Europe#c.lngrapatpubdate1	1.49
Mean VIF	3.10