Venture Capital Investor Behaviour in the Backing of UK High Technology Firms: Financial Reporting and the Level of Investment

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Abstract

This paper is an empirical investigation into the ways in which venture capitalists value (and invest in) high technology firms, focusing on financial reporting, risk disclosure and intangible assets. It is based on questionnaire returns from UK investors in diverse sectors, ranging from biotechnology, through software/ computer services, to communications and medical services. This evidence is used to examine: (a) the usefulness of financial accounts; (b) the implications of technopole investment; (c) the extent of investor control over the investee's AIS; and (d) the role of investor opinion (e.g. on disclosure, due diligence and risk reporting) in determining the level of equity provision.

Key Words: venture capital, high technology, accounting information, intangible assets

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1. Introduction

The general purpose of this article is to examine the conduct of UK investors (Bushrod, 2002; Murray and Lott, 1995; Murray and Mariott, 1998), in their provision of finance capital (in venture capital or private equity form (Campbell, 2003; Robbie, 1998)) to firms producing or developing high technology products. Its specific focus is on the valuation of such companies (Brown and Cliff, 2005) and, in this process, the utilisation of financial reporting, risk reporting (Kothavala, 2003) and information on internally developed intangible assets (Brown and Cliff, 2005; Brynjolfsson et al., 2002; Meuller and Supina, 2000), ultimately to determine the level of provision of funds to investees.

The key features of our approach involve: (a) the extraction and use of new primary source data (cf. Bailes et al., 1998; Wong, 2003 on use of survey data and investor sentiment) on UK investor behaviour; (b) the detailed exploration of investor attitudes (Ruchala, 1999) in terms of perceived utility of the structure of reporting (e.g. risk disclosure) in seeking to value high-technology firm (Eckstein et al., 1998); (c) explicit statistical analysis of factors which contribute to perceived superior investor conduct (e.g. financial accounts, location in science parks, control over investees' AIS); and (d) the impact of investor attitudes (Barkham and Ward, 1999; Brown and Cliff, 2005; Fisher and Statman, 2000) on the level of private equity they are willing to provide to investors.

Whilst the approach is provisional, we believe it is of some novelty, and that it can lay the basis for a broader and more general adoption of our methodologies and techniques. In turn, this academic development may have the potential for a positive

impact on the practitioner side. Since events like the dot.com meltdown of 2000, when investors hung back from high-technology investments (Poynder, 2001), we have been more acutely aware of how a change in investor attitudes – what might be called 'investor sentiment' – can be to the detriment of commercialising products from the science base. Behind such sentiment, as we shall aim to demonstrate, are quite specific (and malleable or controllable) features of AIS. In turn, these attitudes drive investment levels, as our econometric analysis demonstrates.

The academic points of departure for this paper are the extant literature on venture capital investing (e.g. Florou, 2005; Jelic et al., 2005; Khurshed, 2000; Robbie, 1998; Weber and Willenborg, 2003), financial and risk reporting (Ruchala, 1999), intellectual property (Eliasson and Wihlborg, 2003), intangible asset valuation (Garcia-Ayuso, 2003; Gelb and Siegel, 2000; Hand, 2002; Holland, 2001; Mueller, 2004), and investment decision-making (see Schroeder and Gibson (1990) for analysis of comprehension of management discussion and analysis (MD&A), and Zacharakis and Meyer (2000), in an explicitly venture capital investment context). These different strands of thought are combined in an inter-disciplinary way to create a new view on investment decisions and their predication on reporting protocols. Of especial concern to us is the valuation of internally generated intangible assets, typical assets for high-technology firms, being protected through devices like patents (Hall et al., 2005), copyrights and brands, or simply through trade secrecy.

The methodology we adopt combines questionnaire analysis with statistical and econometric analysis. Briefly, new primary source data were generated by a postal questionnaire (with call-back) to the UK's most active investors in high-technology firms. The data gathered concerned investment type and sector; utility of financial reporting; disclosure of risk (Kothavala, 2003); and management accounting and

performance (Engel et al., 2002; Florou, 2005; Jelic et al., 2005). Statistical analysis is used to examine the utility of financial reporting in assessing company risk. Finally, econometric analysis involves estimating a multiple regression model which explains the level of investment in high-technology firms by investors' attitudes. The dimensions of the latter involve attitudes to: extent of disclosure (Maines et al., 2003); standardised risk reporting; and compulsory information provision (Schroeder and Gibson, 1990).

The paper develops its ideas in the following way. It has three substantive sections: methodology, covering the sample and questionnaire; evidence, covering key features of the new data gathered; and statistical/ econometric evidence, covering correlation analysis and multiple regression analysis.

Briefly, our key findings are as follows: first, investors prefer to rely on their own procedures and processes, do not find financial reporting particularly useful, yet do not favour (for competitive reasons) greater provision of financial information. Second, investors' attitudes do correlate with their overt practice, which may be summarised as being proactive, information intensive and risk-managing. Third, investors' attitudes to information provision and risk reporting have a significant (and measurable) impact on the volume of funds they will allocate.

2. Methodology

More broadly, our work provides insights into the problems that investors in high-technology firms face, when using such firms' financial accounts, prepared in accordance with Generally Accepted Accounting Principles (GAAP), especially as regards the valuation of intangible assets (Peneder, 2002) and goodwill (Canibano et al., 2000; Meuller and Supina, 2002; Statement of Financial Accounting Standards

No.142). Against this background, this section considers how the sampling frame of UK investors was constructed, how sampling was performed, and how the questionnaire was designed and administered.

2.1 Sample

A sampling frame was created by drawing upon two sources: first, the membership list of the British Venture Capital Association (BVCA); and second, the listing of UK investors provided by the Venture Capital Report (VCR). Given the theme of our research, we screened for investors who had an expressed interest in backing high-technology companies. Using web site resources for these two organisations, a sample of 114 investors was identified who satisfied our criteria. A response rate of 27% was achieved, which is quite typical for postal surveys of this sort.

[Figure 1 near here]

Figure 1 indicates the sectoral representation of the sample. Investors were asked to identify their five most favoured high-technology sectors, out of a set of nineteen, and then to rank these five in order of preference (coded as 1 = low to 5 = high) (See Q.1.3 of Questionnaire, Appendix). Using these scores, mean responses over the nineteen sectors were computed, as indicated in Figure 1. Essentially, each bar height indicates the average desirability of investment involvement in a specific sector (e.g. biotechnology, software). Desirability scores can drop below an average of unity, as sectors which were not nominated had an assigned score of zero. Taking unity as a threshold value, we see that seven sectors stand out as being most desirable, in terms of the perceptions of UK investors, namely: biotechnology, medical/ health related, communications, information technology hardware, software and computer services, internet technology, and electronics. Of these, software and computer services was by

far the most preferred. Some of the surprising 'ugly sectors' included chemicals and materials, industrial automation, and energy. Although patenting is traditionally high in these technologies, they may be perceived as older generation investment types, compared to the knowledge intensive products currently finding favour.

[Figure 2 near here]

The preference of investors by stage of investment is indicated in Figure 2. For high-technology contexts, investors were asked to rank their five most common stages of investment involvement (e.g. start-ups, MBO) (See Q.1.4 in Questionnaire, Appendix). Coding of responses was 0 = irrelevant; 1 = low through to 5 = high). It is of great interest that seed corn, start-up, early-stage, and expansion are by far the most common investment involvements. UK 'venture capital' is legendary for favouring development capital opportunities, with a focus on company turnaround, MBO and MBI investment involvements. These are, certainly, forms of private equity provision, but arguably, not properly classified as true business venturing. However, so far as high technology is concerned, the clear picture is that UK investors behave like true 'adventurers', and commonly go in at the high-risk end of equity provision, with early stage (other than seed corn and start-up) being the commonest type of investment involvement. Of the remaining wide range of investment involvements, the MBO is the most common; but it is relatively unimportant compared to the broad range of early stage involvements that UK venture capitalists in high technology areas now favour.

Within the class of early stage investments, one does find a ranking of prevalence which corresponds to well known rankings of high risk investment propositions.[1] Thus seed corn backing is less common than other early stage, indicating a reverse ranking by risk exposure. However, there does seem to be a de-coupling of risk

attitude when it comes to the remaining wide range of investment types by stage, ranging from mezzanine financing to replacement equity. The latter are all, more obviously, the domain of private equity investing and are much less prevalent investment forms when it comes to high technology backing. In sum, investors are bullish about the prospects of high-technology firms and are bold in seeking high risk investment involvements, in their pursuit of high investment returns. Within this broad category of investment (*viz.* high-technology) this represents a welcome change of UK investor sentiment, in contrast to the aversion to the 'bleeding-edge' of technology so fearfully stylised ten to fifteen years ago.

[Figure 3 near here]

Finally, Figure 3 reports on UK investors' preferences by market extent. The data were generated by a question asking investors what geographical preference they had, when deciding whether or not to make an investment. Five options were allowed, ranging from local to worldwide (See Q.1.1 in Questionnaire, Appendix). In effect, these options comprise a nesting of the desired extent of the market for the dispensing of investible funds. Thus the pie-chart denotes preference for market extent, rather than allocation of funds by regions. Surprisingly, the preferences of UK investors over market extent are quite diverse. In particular, proximity does not appear to play as large a role as one might suspect, with preferences, on balance (52.6%), being for investments beyond the local or regional area. As contrasted with US experience, where proximity does seem to be important, UK investors appear to be willing to go to wherever the deal is favourable. This is not just because the UK is geographically small, as over one quarter of investors (27.4%) have preferences for investing internationally (either in Europe, or in the rest of the world).

2.2 Questionnaire

The investors of our sampling frame, as described above, were approached directly (using addresses from the VCR) by post, using a pre-letter (explaining the scope and purpose of the study) and a hard copy of an eight-page questionnaire (see Appendix). Briefly, this questionnaire investigated: the general background of investors (e.g. desired investee location, sector, stage, type); ways of assessing, managing and accounting for intangible assets in high technology companies; and investor influence on investees' internal management and reporting. Most questions were qualitative in purposes, and measured importance, extent of agreement, significance *etc* from an investor standpoint, using a Likert scale. In the event of non-response, a follow-up copy of the questionnaire was sent by email. After both mailings had been concluded, our raw response was thirty-one investors, which included the great bulk of the leading UK investors in high-technology companies.

[Table 1 near here]

Table 1 provides summary statistics on key attributes of the investors who made returns. Several points are noteworthy. First, very high levels of funding are being allocated, even at the small end of the market, to high technology enterprises. The average minimum investment across investors was £857k and the average maximum investment was £4,459k. Overall, the average investment in a high technology firm was £2.6m. Typically (91%), staged financing was used in disbursing these funds, but lump sum payment was a common alternative (64%), where, as we shall see below, the willingness to take this simpler route being predicated on the information and control systems to which investees were subject. We see that high technology investing is by no means intrinsically a science park or technopole phenomenon, with less than one fifth of investors (18%) specifically targeting such geographic clusters.

When technopoles or science parks were named, they were diverse, ranging from Oxford, Cambridge and Manchester to East Midlands, Merseyside in the UK, and from Bavaria to Boston and Bay Area, CA, outside the UK. Finally, intangibles are much more likely (75%) to be valued at estimated market value, rather than at current replacement cost (25%), suggesting some refinement in the valuing of intangibles, and perhaps also a need to prove the worth of the firm (e.g. as a development company, creating intellectual property (Lewis and Lippitt, 2005), but with no product to market, as yet) to potential venture capital backers and other possible funders (e.g. local, regional or central governments).

Turning now from key results elicited by the questionnaire, we shall briefly consider elements of its design. The general approach to instrument design was to create questions which would reveal things about investor attitudes or preferences that would not be available in any other way, using regular data resources.

[Table 2 near here]

Table 2 indicates the three main components of the postal questionnaire: (a) background information on location, size and stage of investment; (b) the utility of reporting (Gelb and Siegel, 2000; Hand, 2002; Mueller, 2004; Schroeder and Gibson, 1990); and (c) information systems (Wright et al., 2004; Mitchell et al., 1995), especially as regards company valuation and its risk sensitivity (Fiet, 1995; Ruhnka and Young, 1991; Uher and Toakley, 1999). Full details are given in the Appendix, which sets out the complete questionnaire in its original layout. The typical question design elicits information on *attitudes* (e.g. preferred investee location, preferred industrial sector), *utility* (e.g. of scorecarding for risk appraisal), or *preference* (e.g. of method for valuing intangible assets). In that sense, the focus of this instrument is also on eliciting qualitative information about patterns of investor behaviour. By

scoring the responses (e.g. typically on a five point scale) they can be converted into quantitative data (e.g. of the type used to construct Figures 1, 2 and 3).

3. Evidence

In this section, we shall consider the substantive evidence obtained from the questionnaire described above, as it relates to financial reporting, risk disclosure and intangible assets. Here, the main purpose is to establish the general behavioural features of UK investor conduct. It will be left to Section 4 to consider how this behavioural evidence can be put into an inferential framework.

3.1 Financial Reporting

First, investors were asked the extent to which the standard financial accounts they received from potential investees, active in the high technology area, were useful in assessing their company's value (see Q.2.1 in Appendix). Scoring was from zero ('completely useless') to 4 ('very useful'), thus creating the *FinAcUse* variable. As the value of high technology companies is difficult to assess, given that much of their prospective value is tied up in intangible assets, typically based on intellectual property, like patents and brands, investors were asked how they assessed, managed and accounted for such intangible assets. Figure 4 presents a histogram of the responses. This indicates that the modal response by investors was that standard financial accounts were fairly useless for assessing the value of investee companies. The mean response was 1.4, which is only slightly better than 'fairly useless'.

[Figure 4 near here]

This finding might be indicating a potential 'market failure', due to the information asymmetry (Chen et al., 2003; Wong, 2003) arising from investors having inferior

access to value relevant information, compared to investees. However, if the prime purpose of financial reporting is to satisfy statutory reporting requirements, representing, in some sense, information deemed suitable for accountability and exterior audit, rather than investible value calculation, then this critique has less force. Indeed, investors themselves appear fairly sanguine about the lack of utility of financial reporting for value estimation, and are inclined to focus on their own skills in performing their own due diligence, or in buying-in relevant third-party due diligence. Looked at in this way, they regard their performing of such financial intermediation functions as resolving problems of information asymmetry. Explicit statements made by investors, mentioned below, support this conclusion.

3.2 Risk Reporting and Disclosure

Figure 5 reports on the answers to a question about risk reporting and disclosure (see Q.2.10, Appendix). A range of options had to be calibrated, in terms of investor agreement. As the legend to Figure 5 indicates, this covered adequacy of financial accounts, need for more information, adequacy of due diligence, and risk reporting. Degree of agreement was calibrated from unity (complete disagreement) to five (complete agreement). Taking 3.0, the central point of our scale, as indicating neutrality on the issue, investors were approximately neutral about 'the information currently provided in financial accounts is sufficient for our purposes' (*Risk1* = 2.95) and 'requiring more disclosure in published information would provide too much information to rivals' (*Risk3* = 3.11). So, sufficiency of information and excessive disclosure are not issues. However, there was general disagreement of views on the desirability of more compulsory information (*Risk2* = 2.11), the supposed benefits of risk reporting for comparing investees (*Risk5* = 2.00), and on the potential for

improving risk capital allocation (*Risk6* = 2.00). To illustrate, one investor said "I do not feel standardised risk reporting would help. It might do the opposite, as it is almost impossible to achieve accuracy". Finally, it is clear that there was general agreement with the view that investors' 'own due diligence is enough to enable us to assess high technology investments' (*Risk4* = 4.05). Overall, reinforcing the above analysis of information asymmetry, the picture emerging is of considerable confidence by investors in their own capabilities, and a general aversion by them to further regulation (including extended statutory requirements) of information provision. Given the sharp behavioural picture provided by this evidence, the principal and, we believe, novel question we ask in the econometric part of this paper (section 4 below) is: what impact does behavioural attitude have on actual investment provision by investors?

[Figure 5 near here]

3.3 Benefit from Required Publishing of Financial Accounts

The evidence of Figure 5 prompts the question, what particular aspects of financial accounts *do* investors think would benefit from required publishing? We address this issue in Figure 6. Responses to the question (see Q.2.9, Appendix) relate to the categories of financial risk (*ReqFinR*), people risk (*ReqPeopR)*, technology risk (*ReqTechR*), market risk (*ReqMktR*) and valuation of intangible assets (*ReqIntR*) (see an example of its impact on the cost of replacing assets in the semi-conductor industry (Megna and Klock, 1993)). Attitudes to the question were measured on a five point scale, from unity (not at all important) to five (crucial). Figure 5 displays barcharts of response categories against mean responses. Again, the value 3 is neutral. Taking that as a benchmark value, marked with the dotted horizontal line in Figure 6, we see that

investors generally were of the view that it was not important to have risk disclosure of several attributes (notably of markets, of people, and of intangible assets) in financial reports. They were neutral, on average, about there being required reporting on technology.

[Figure 6 near here]

Thus, in terms of agency theory, investee (*viz.* agent) knowledge (e.g. of markets, people, intangibles) of an insider nature, which is a prime source of information asymmetry (Barkham and Ward, 1999), is not something investors want to see resolved by compulsory financial reporting. Presumably, they feel that resolving this information asymmetry, by their own due diligence (e.g. with respect to markets, people and intangibles), or by third party due diligence (e.g. with respect to technology) is part of their financial intermediation function. Essentially, this is part of their competitive advantage as allocators of risk capital, and it is this which would be diminished by more extensive risk reporting requirements. This is reinforced by the finding (far left column, Figure 6) that the only area in which investors are likely to be quite well informed (*viz*. on the financial side) is also the sole one that they would rate as important to risk disclosure, in terms of more detailed publishing.

This view of investor conduct and behaviour is reinforced by our qualitative evidence. Emphasising the relatively neutral attitudes displayed in Figure 6, one investor said "I have no view – the companies we invest in won't have published any accounts at that time. We sit on the Boards of all investees and so have exposure/ visibility of the broad range of activities, and can exert influence across that range". This quote precisely characterises the monitoring and control function of the investor, as principal, and suggests how this function can attenuate information asymmetry. Another relevant investor quote is: "I seem to disagree with your basic premise. The

sort of businesses we deal with are mainly concerned with market risk – they've invented the world's best mouse-trap, now can they sell it? I don't see how you can account for that". This quote emphasises that investors feel that investees too would rather communicate market sensitive information to entrusted insiders (like the investor, post-contract) rather than to the wider world (including other investors) through more extensive financial reporting. Indeed, the general investor aversion to calibration of the sort envisaged by more extensive risk reporting is perfectly captured in the comment: "It's more an art than a science, and should be kept that way for private companies".

3. Intangible Assets

Finally, we turn to the evidence in Figure 7. This was generated from a question (see Q.2.2 in Appendix) which asked about internally developed assets (see Hand, 2002; Maines et al., 2003; Mueller, 2004; and the literature review of Canibano et al., 2000) which may have been valued by a potential investee company in a way which was less than transparent. Specifically, it asked of investors: for which of a set of internally developed intangible assets would they require a comment to provide valuation information. This set included patents, franchises, licenses and so on, as listed in Figure 7 (Hall et al., 2005). Responses were coded as unity if companies requested valuation information, and zero if it was thought that the valuation information in financial statements was adequate. The bar chart of Figure 7 has bar heights based on average responses across investors' mean responses, and they range from zero to unity.

[Figure 7 near here]

The evidence of this figure is particularly revealing. Investors are unanimous in their view that financial statements do not provide adequate valuation information about patents, copyrights and brands, and that therefore they would ask investee companies specifically to provide such valuation information. A clear majority view was also in favour of receiving such information about customer lists and trademarks. Investors were equivocal concerning franchises and quotas.

The interpretation of Figure 7 should be done in the light of the evidence in Figure 5, that investors do not generally favour more information regulation, and in Figure 6, that investors relish information asymmetries that make their own due diligence skill more valuable. This suggests that it would be wrong to interpret the data of Figure 7 as suggesting an investor desire for more *public* information on key intangible assets like patents, copyrights and brands. Rather, they are admitting that they would prefer to pursue such information, as and when needed, from investees, during the due diligence process, and probably post-investment as well. Thus, at least as far as private (rather than public) gains and losses are concerned, the investor view is somewhat conservative and not likely to be a driver of change in financial reporting.[2]

4. Statistical and Econometric Analysis

This section moves from the descriptive and analytical concerns of sections 2 and 3 to explicit inferential methods. It has essentially two parts. First, it uses correlation analysis to investigate links between: usefulness of financial accounts and stage of investment and performance; technopole investment and disclosure of risk over various attributes (e.g. finance, markets, health & safety); and influence by investors on investees' information systems (Mitchell et al., 1997; Wright and Robbie, 1996) and stage, sector, risk reporting *etc* (Reid et al., 1997; Uher and Toakley, 1999).

Second, it uses multiple regression analysis to examine the impact that investor opinion has on willingness to allocate greater or lesser volumes of funding to high technology firms. Both approaches are unusual in that they focus on investor opinion (elsewhere, as in financial journalism, known as 'investor sentiment') as determinants (or correlates) of 'real' outcomes, like return on investment, or level of funds allocated. The contribution of this work is therefore to make outcomes directly behaviourally determined, rather than indirectly determined (e.g. intermediated by financial structure, such as gearing) (see Brown and Cliff (2005), Fisher and Statman (2000), and Wong (2003), which focus on investor sentiment).

4.1 Statistical Analysis

What follows is a set of interesting correlations between behavioural variables, like the usefulness of financial accounts, and objective variables, like return on capital employed (ROCE). The measure of association we report is the conventional Pearsonian product moment correlation coefficient, though the findings are similar if the nonparametric Spearman rank correlation coefficient is used. Although these correlations are associative, rather than causal relationships, they are suggestive of what might be consistent with causal reasoning, and therefore lead logically to the more causal modelling of the following section 4.2, on econometric analysis.

4.1.1 Usefulness of Financial Accounts

Table 3 presents Pearson correlation coefficients, their significance, and the sample size (N). Given no *a priori* knowledge, two-tailed tests are reported. The key variable is the usefulness of standard financial accounts (*FinAcUse)*, as appraised by investors, in evaluating the value of high technology investments. This variable

(which is larger, the more the usefulness) was correlated with three measures of potential value, *Staged, ROSF* and *ROCE*.

[Table 3 near here]

Staged measures investor preference for staged (=1) over lump sum (=0) investments. Thus the higher is *Staged* for the sample average, the greater is investor preference for this investment mode. Furthermore, the lesser is the value of *Staged*, the greater is the implied value of the investee firm, because a preference for lump-sum investing implies greater confidence that an investment will work out, without the precaution of the staging of financial support for it. *ROSF* is, as usual, return on shareholders' funds; and *ROCE* is return on capital employed. Both *ROSF* and *ROCE* are conventional performance measures, each looking at investors' returns in slightly different ways.

We find that Table 3 presents a consistent picture: the more useful are financial accounts, the better is company performance. All three correlations are significant at the 5% level with, as expected, positive correlations with *ROCE* and *ROSF*, and negative correlations with *Staged*. It may be that better run firms both perform well and report more usefully. Reverse causality is also possible, with more useful financial accounts leading to a better allocation of investible funds, and thereby better performance.

4.1.2 Technopoles: Investment Stage and Risk Disclosure

The correlations of Table 4 relate to a key variable, *Technopole* (see Q.1.2 in Appendix). This asks whether investors do (=1) or do not (=0) specifically target investments in science parks or technopoles. About 18% of investors replied in the affirmative. Our interest is in whether such an intention correlates with particular

sectors, stages of finance, or requirements on risk disclosure. The results of Table 4 are clear and revealing. From a sectoral standpoint, only in the case of industrial automation (*Indus07*) is there significant evidence of targeting by technopole investors (Prob. Value = 0.008). In terms of stage of investment, both institutional buyouts (*Stage11*) and mezzanine finance (*Stage13*) were significantly (positively) correlated with targeting technopoles (Prob. Values = 0.030 and 0.030, respectively). These two are amongst the less common forms of investment types, certainly not associated with early stage investing, and typically falling within a prudential investing category.

[Table 4 near here]

Finally, Table 4 reports on the targeting of technopoles and requirements on risk disclosure in terms of hard (*viz.* quantitative) reporting, over the dimension of technology (*TechFin*), people (*PeopFin*), market (*MarkFin*), financial (*FinQual*), and health & safety (*HnSFin*). The correlations were significant (and positive) for four out of five of these categories, namely technology (Prob. Value = 0.004), people (Prob. Value = 0.000), markets (Prob. Value = 0.044) and health & safety (Prob. Value = 0.004). Although *quantitative* risk disclosure was not significant for finance, *qualitative* assessment (*FinQual*) of financial risk *was* significantly correlated with targeting technopoles (Prob. Value = 0.018).

The picture that emerges here is of limited special requirements for technopole targeting by sector and mode of finance, but a highly structured (and comprehensive) approach in this case to risk reporting, with an emphasis on quantitative reporting, except in the case of financial risk alone, for which qualitative reporting is preferred.

4.1.3 Influence over Internal Management

To conclude our discussion of correlations with key variables, consider Table 5, which focuses on investors' influence on investees' internal management. The variable on information flow (*InflInfo*) is based on a question which asks how strong an influence investors have on investee companies' internal information systems (see Q.3.1 in Appendix). Strength of influence was calibrated from little influence (=0) to complete control (=5).

[Table 5 near here]

It should be noted that the extent of control by investors is not generally correlated with industrial sector, though there is slight evidence of negative correlations with sectors such as media and photography (*Indus12*; Prob. Value = 0.037) and services (*Indus19*; Prob. Value = 0.001), which, by their nature, are sectors in which person to person, creative and low authority milieus prevail.

On stage of investment, several negative impacts of control were found, specifically From MBOs (*Stage9*; Prob. Value = 0.005), MBI (*Stage10*; Prob. Value = 0.025), LBOs (*Stage12*; Prob. Value = 0.048), and public to private investments (*Stage14*; Prob. Value = 0.023). The characteristic of all these investment forms is that the investor has necessarily an attenuated influence, because of other persons (e.g. management teams) or institutions. On the other hand, a strong positive influence (r = 0.590; Prob. Value = 0.013) was found between extent of investor control and the use of quantitative risk disclosures (e.g. using sensitivity or probability analysis) as it relates to markets (*MarkSens*).

Turning to risk, Table 5 has two very revealing results. First, there is a positive (r = 0.656) and highly statistically significant (Prob. Value = 0.002) correlation between investor control and their confidence in their own due diligence (*Risk4*). This

reinforces the finding of Section 3.2, on *Risk Reporting and Disclosure*, as it relates to the quantitative evidence of Figure 5 (on *Risk Reporting in Financial Accounts*) and qualitative comments like "our own due diligence is enough". Given a free hand, investors are confident in their ability to value companies. Second, there is a negative (r = -0.516) and statistically significant relationship (Prob. Value = 0.024) between investor control and the view that standardised risk reporting facilitates the allocation of risk capital (*Risk6*). In a sense, this is the reverse side of the coin, as regards the *Risk4* variable on due diligence. It too is buttressed by the evidence of Figure 5 above, and by qualitative comments like "I do not feel standardised risk reporting would help. It might do the opposite". The overall picture that emerges is of proactive, self-confident investors who, if they have good control, are able to find what information they require, and are not convinced that standardised financial accounts can meet their information needs.

Finally, Table 5 is insightful on the relationship between investor influence on investees' information system (IS) and the exerting of control over specific features of internal management. Thus there are high (and significant) positive correlations between investor influence on IS in general and influence on other factors like management accounting (*InflMgt1*; Prob. Value = 0.004), decision-making processes (*InflDec*; Prob. Value = 0.006), control of staff (*InflStaff*; Prob. Value = 0.032), control of management (*InflMgt2*; Prob. Value = 0.004) and product development (*InflProd*; Prob. Value = 0.043). Thus, in relatively unfettered settings (e.g. free of the likes of MBO and MBI settings) the strength and scope of investor influence over the investee is considerable.

4.2 Econometric Analysis

Although the evidence of 4.1 above provides insight into investor behaviour towards the investee in high technology settings, and provides important interpretative clues about the relationship between investor influence and the investee firm's internal structure, it provides little guidance on cause and effect. It may be, as we have indicated, that there is often a situation of mutual causality. This is often so when performance is involved. Thus better information systems can improve performance; and better performance allows information systems to be enhanced.

However, in some cases, the causal connections are more clear cut, and it is to one such instance that this last substantive section turns, the determination of the level of investment that an investor is willing to commit to a business. Our approach is direct, which is only made possible by two unique features of our work: our use of new primary source data; and utilisation of this data in a new way. Our view is that, ultimately, it is 'investor sentiment', or investor judgement (Luft and Shields, 2001), that determines the allocation of investible funds to high technology enterprises. The key component to that exercise, we would argue, is judgements about risk (see Bhattacharyya and Leach (1999), in a capital budgeting context, and Hardman and Ayton (1997), in the context of qualitative risk assessment).

We return, therefore, to the evidence of Figure 5 (on risk reporting) to use it in a new explanatory framework (see Q. 2.10 in Appendix). In Figure 5, the evidence related to investor opinion (on a spectrum of complete disagreement to complete agreement) about matters like information provision, due diligence and risk reporting. We will now use these underlying opinions (embodied in variables *Risk1* to *Risk6*), *per se*, to explain the level of funds allocated to a high technology investee. This

behavioural approach bypasses more traditional measures of investment intention (e.g. those that are financial ratio- or capital structure-based).

The dependent variable chosen is either an investor's average investment (*Average*) or his minimum investment (*Min*) in a high technology enterprise (see Q.1.5 in Appendix). The independent variables are *Risk1* to *Risk6*. Models 1 and 2, respectively, in Table 6, refer to the use of either the *Average* or *Minimum* level of investment made, respectively. Essentially, the underpinning of each model is the control relationship:

$$\textit{Level of investment funds allocated} = f(\textit{investor attitude to risk}) + \varepsilon \qquad \textbf{(1)}$$

where ε is a random error term. The model of equation (1) is estimated by multiple linear regression, using least squares on our cross-section of data on investors, as reported in Table 6.

[Table 6 near here]

We observe, first, that both models explain over fifty per cent of the variation in level of funds allocated (either average or minimum). Each regression is highly statistically significant, with F values of 4.098 (Prob. Value = 0.018) and 4.830 (Prob. Value = 0.010), respectively (for k=6, n-k = 12 degrees of freedom). Table 6 gives estimated coefficients, and their corresponding t-statistics and Prob. Values. Not surprisingly, given the small sample size, high significance levels are hard to achieve for individual coefficients, given the sample size and limited degree of freedom.

Even so, the results are of interest. Most reassuring, all coefficients have the same sign in each model, with the exception of that attaching to the variable *Risk6*. Indeed, this variable, and that of *Risk5* too must be considered insignificant, on any reasonable interpretation of probabilities. That is, investors' views on risk reporting do *not* determine levels of investment. This result is robust across the two models. Note this

evidence is not inconsistent with the finding of Figure 5, that investors generally (*viz.* on average) disagree with the view that standardised risk reporting could either facilitate the comparison of potential investees (*Risk5*) or facilitate the allocation of risk capital (*Risk6*).

Of the other independent variables, the interpretation of *Risk2* ('more information should be compulsory') and *Risk4* ('our own due diligence is enough') are equivocal, given the probability levels. Perhaps the only interpretation one could reasonably confidently lean upon is that minimum investment is lower (Model 2) the greater is the confidence in due diligence (*Risk4*). This suggests that investors' due diligence does not, on average, favour the investible position of UK high technology firms. Given the fixed costs of due diligence are considerable, this may be filtering out prospects of small companies.

Finally, we turn to the independent variables *Risk 1* ('current provision of financial information is adequate') and *Risk3* ('more disclosure would provide too much information'). These variables both calibrate conservative investors' positions. They are both are positively correlated with higher levels of investment, both average and minimum. The strongest result related to *Risk3*. The finding is consistent with what we know of investment practice. If investors know more about target investees than rival investors, and due diligence is (on average) rigorous, they will allocate higher levels of investible funds, both in minimum terms, and on average, over deals divested at such targets. The behaviour implied by the *Risk1* variable is, arguably, consistent with that of the *Risk3* variable, as it suggests that investors who perceive themselves to be capable of eliciting greater deal-sensitive information from investees than rivals will be willing to invest more, and will not want current financial accounting practice to be enhanced.

Overall, these results, and their interpretation, suggest the potential fruitfulness of an approach to explaining levels of investment by focusing on behavioural variables (attitudes to information, risk disclosure etc), rather than on structural variables (e.g. gearing, assets etc).

5. Conclusion

This paper aims to advance the methodology of analysing investment practice, using the setting of UK venture capital investing in high technology companies. The paper presents a statistical and econometric analysis of questionnaire returns from the UK's leading high-technology investors, focusing on financial reporting, risk, information and level of investment. We find that:

- Investors prefer to rely upon their own procedures and processes (rather than those of investees) when evaluating potential investments in high technology companies.
- Financial accounts appear to have little to offer to investors, in terms of risk disclosure or the valuation of intangible assets such as intellectual property.
- It does *not* seem that investors would welcome compulsory risk disclosure, as they judge that this is likely to provide too much information to rival investors.
- Two alternative models provide explanations of the level of investment in high technology companies, using risk-based behavioural variables.

Acknowledgements

We are grateful to the Carnegie Trust for funding the research upon which this paper is based. We also acknowledge with gratitude the full flow of information provided by many UK investors. The paper has benefited from being presented in an earlier form to the British Accounting Association (BAA) meeting, Heriott-Watt University, in March 2005. The authors remain responsible for any errors of omission or commission that this paper may yet contain.

Notes

[1] See, for example, the introductory chapters to the *Venture Capital Report*.

[2] This view is influenced, at least in part, by the fact that many high-technology companies will still be in their early start-up or development phases, and may not, as of yet, have produced any financial accounts.

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1. Background

1.1 What geographical preferences do you have when deciding whether or not to make an investment? Please rank your preferences below, from 1 to 5 (where 1 is most important, 5 is least important).

Geographical Preference	Rank (1 to 5, with 1 most important)
Local	
Regional	
National	
International (Europe)	
International (world wide)	

1.1 Do you specifically target investment in science parks or technopoles? Yes ☐ No ☐

If yes, please identify which:

_____

_____

1.2 Please identify below your five preferred industrial sectors for investment, ranked from 1 to 5 (where 1 is most important, 5 is least important).

Industry	Top five rank (1 most important)
Biotechnology	
Medical/health related	
Chemicals and materials	
Energy	
Construction and building products	
Financial services	
Industrial automation	
Industrial products & services	
Manufacturing	
Transportation	
Communications	
Media and photography	
Information technology hardware	
Software and computer services	
Internet technology	
Electronics	
Leisure and entertainment	
Other consumer related	
Services	

1.3 Please identify below your five most common stages of investment, from 1 to 5 (where 1 is most important).

Stage of Investment	**Most common (from 1 to 5)**
Seed	
Start-up	
Other early stage	
Expansion	
Bridge financing	
Refinancing bank debt	
Secondary purchase/Replacement equity	
Rescue/turnaround	
Management buy-out (MBO)	
Management buy-in (MBI)	
Institutional buy-out (IBO)	
Leveraged build-up (LBU)	
Mezzanine finance	
Public to private	
Purchase of quoted shares	

1.4 What are the minimum, maximum and average size of investments you make in a year?

Minimum	£
Maximum	£
Average	£

1.5 Do you have a preference for lump sum or staged investments, or a combination of the two? [please tick relevant box below]

Lump sum ☐

Staged investment ☐

Combination ☐

---

2. High Technology and Financial Accounting

High-technology companies are difficult to assess, because much of their value is tied up in so-called 'intangible assets', such as intellectual property, brands, patents, and so on. This section therefore examines the ways in which you assess, manage and account for intangible assets in high-technology companies.

2.1 To what extent are the standard financial accounts you receive from potential high-technology investees useful in assessing their value?

Completely Useless	**Fairly Useless**	**Neutral**	**Useful**	**Very Useful**

2.2 Certain internally developed assets may have been valued by the company in ways which are not transparent.

In this context, for which of the following ***internally developed intangible assets*** do you ask investees to provide such valuation information?

Intangible Asset	*[Please tick one box for each case below]*		
	We request information on how these have been valued	**The financial statements provide sufficient information**	**Not relevant**
i. Patents			
ii. Copyright			
iii. Brands			
iv. Licenses			
v. Franchises			
vi. Quotas			
vii. Customer lists			

2.3 To what extent is the following information you receive from potential high-technology investees adequate for the purposes of assessing the value of their company?

Category	*On a scale from 1 to 5, where 1 is insufficient and 5 is full and complete information, please tick the relevant box for each item.* Insufficient …… Full/complete				
	1	**2**	**3**	**4**	**5**
i. Training					
ii. Marketing					
iii. Strategy					
iv. Development costs					
v. Concessions					
vi. Patents					
vii. Licenses					
viii. Trademarks					
ix. Goodwill					
x. Payments on account					

2.4 When assessing the value of intangible assets in high-technology companies, do you favour valuation at current replacement cost or at estimated market value? *[tick one]*

We favour current replacement cost ☐

We favour estimated market value ☐

2.5 How significant are the following costs to you, when evaluating the worth of a high-technology investment.

Category	*On a scale from 1 to 5, where 1 is insignificant and 5 is highly significant information, please tick the relevant box for each item.* Insignificant …… Highly Significant				
	1	**2**	**3**	**4**	**5**
i. Time our own workforce spends on assessing the technology					
ii. Employment of technology foresight specialists					
iii. Use of other external consultants *[please give examples]*……					

2.6. How extensive are your requirements on disclosure of risk under the following categories?

Category	*On a scale from 1 to 5, where 1 is not at all and 5 is very extensive, please tick the relevant box for each item.* Not at all ……Very Extensive				
	1	**2**	**3**	**4**	**5**
i. Technology					
ii. People					
iii. Market					
iv. Financial					
v. Health & Safety					

2.7. Is the risk information that you require from investees quantitative, qualitative, or both? *[Please tick all that apply]*

Category	Risk disclosure must be … *[tick all that apply]*		
	Quantitative (in monetary terms)	**Quantitative (in % terms, or with sensitivity or probability analysis)**	**Qualitative**
i. Technology			
ii. People			
iii. Market			
iv. Financial			
v. Health & Safety			

2.8 Do you use score-carding methods to appraise the risk in potential investee companies?

Yes☐ No☐

If yes, how important are each of the following items?

Category	*On a scale from 1 to 5, where 1 is not at all important and 5 is crucial, please tick the relevant box for each item.* Not at all important …… Crucial				
	1	**2**	**3**	**4**	**5**
i. Technical skills					
ii. Operations					
iii. Production					
iv. Support					
v. Cost estimating					
vi. Benefit estimating					
vii. Scheduling					
viii. Management					
ix. Funding					
x. Stakeholders					
xi. Information security					
xii. Human factors					
xiii. Safety					
xiv. Other *[please specify]*					

2.9 In your view, how important is it that the following be **required** in published financial accounts?

Category	*On a scale from 1 to 5, where 1 is not at all important and 5 is crucial, please tick the relevant box for each item.* Not at all important ……..… Crucial				
	1	**2**	**3**	**4**	**5**
i. Financial risk					
ii. People risk					
iii. Technology risk					
iv. Market risk					
v. Valuations of intangible assets					

2.10 To what extent do you agree with the following statements about risk in high-technology investee companies?

	On a scale from 1 to 5, where 1 is completely disagree and 5 is completely agree, please tick the relevant box for each item. Completely disagree…….Completely agree				
	1	**2**	**3**	**4**	**5**
i. The information currently provided in financial accounts is sufficient for our purposes					
ii. More information should be provided compulsorily					
iii. Requiring more disclosure in published accounts would provide too much information to rivals					
iv. Our own due diligence is enough to enable us to assess high-technology investments					
v. Standardised risk reporting would facilitate the comparison of potential investees					
vi. Standardised risk reporting would facilitate the allocation of risk capital					

3. Management Accounting and Performance

3.1 How strong an influence do you have over your investee companies' internal management, under the headings below?

	On a scale from 1 to 5, where 1 is 'little influence' and 5 is 'complete control', please tick the relevant box for each item. Little influence……...Complete control				
	1	**2**	**3**	**4**	**5**
i. Information systems					
ii. Management accounting					
iii. Financial reporting policies					
iv. Decision-making processes					
v. Control of staff					
vi. Control of management					
vii. Product development					
viii. Marketing					

3.2 On average, how often are you in contact with both low and high performing investee companies? [please tick relevant box for each of 'low' and 'high' performers below]

Frequency of Contact	**Low Performers**	**High Performers**
Several times a day		
Daily		
Weekly		
Monthly		
Quarterly		
6-monthly		
Annually		

3.3 How regularly do you require reports from your investee companies on each of the following items?

	daily	**weekly**	**monthly**	**quarterly**	**annually**
i. Information systems					
ii. Management accounts					
iii. Financial accounts					
iv. Decision-making processes					
v. Control of staff					
vi. Control of management					
vii. Product development					
viii. Marketing					

3.4 Please use the space below to provide us with any further comments you may have on the problems of measuring and managing risk in high-technology ventures.

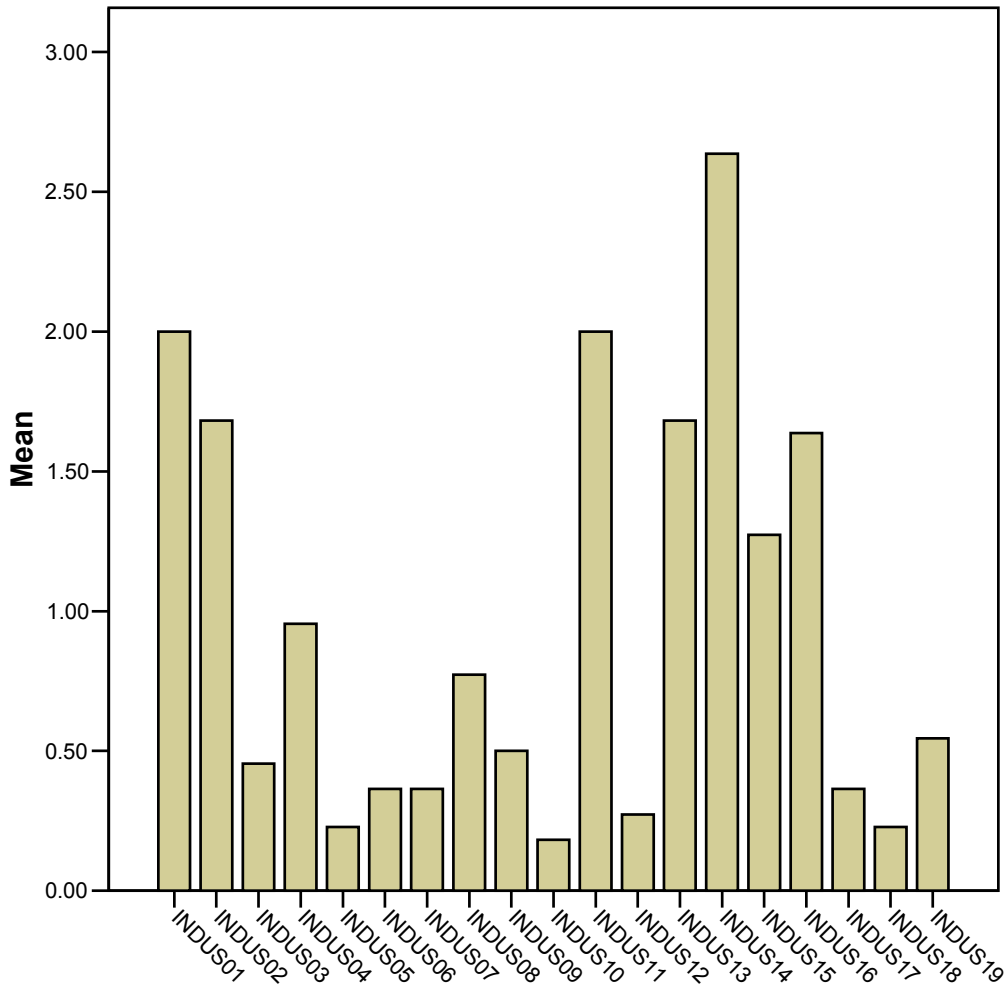
Many thanks for your cooperation in completing this questionnaire. If you are interested in receiving summary results from our project, in due course, please tick the box.			
	Dr Julia A Smith *Cardiff Business School* *Tel: 029 2087 6652*		*Professor Gavin C Reid* *University of St Andrews* *Tel: 01334 462431*

Please return completed questionnaire to:

Dr Julia A Smith
Cardiff Business School
Aberconway Building
Colum Drive
Cardiff CF10 3EU

Office use only: _____

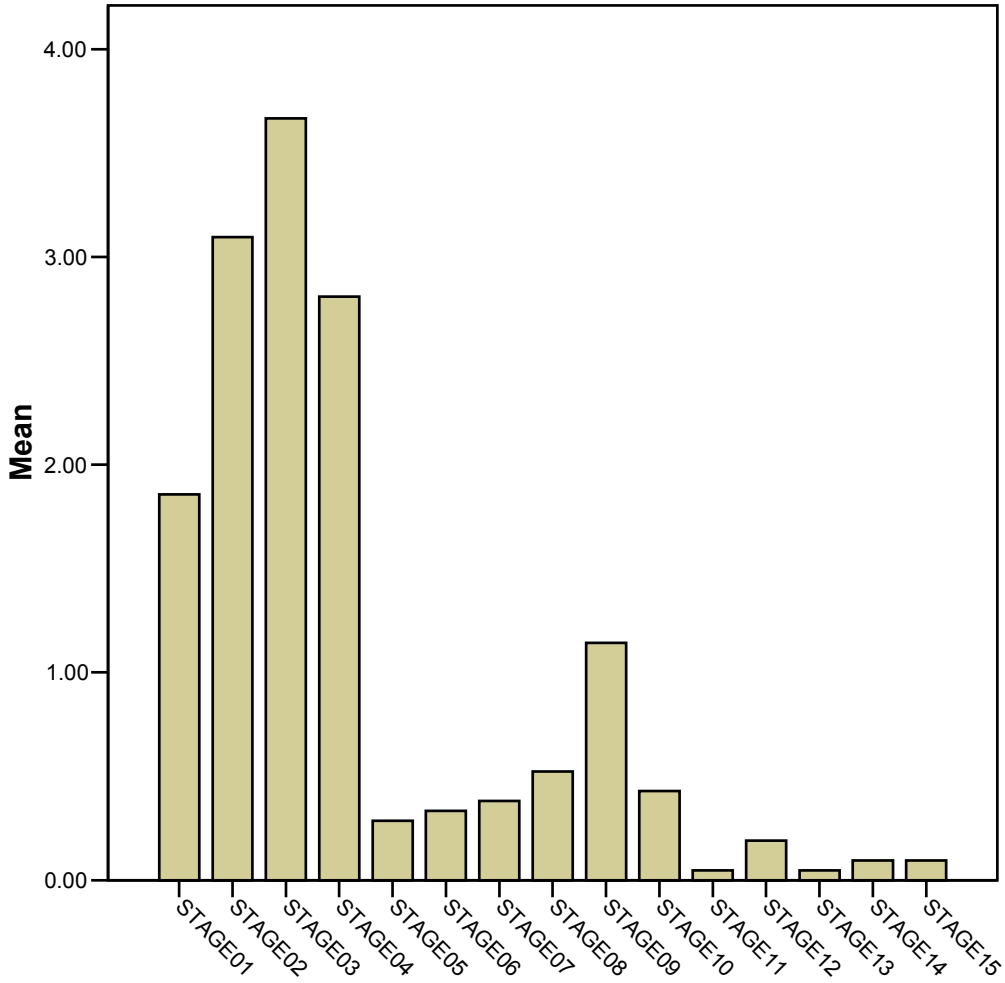
Figure 1: Investment Preference by Technology



Legend of Technologies

01 Biotechnology	11 Communications
02 Medical/health related	12 Media and photography
03 Chemicals and materials	13 Information technology hardware
04 Energy	14 Software and computer services
05 Construction and building products	15 Internet technology
06 Financial services	16 Electronics
07 Industrial automation	17 Leisure and entertainment
08 Industrial products & services	18 Other consumer related
09 Manufacturing	19 Services
10 Transportation	

Figure 2: Investment Preference by Stage



Legend of Principal Investment Stages	
01	Seed
02	Start-up
03	Other early stage
04	Expansion
05	Bridge financing
06	Refinancing bank debt
07	Secondary purchase/Replacement equity
08	Rescue/turnaround
09	Management buy-out (MBO)
10	Management buy-in (MBI)
11	Institutional buy-out (IBO)
12	Leveraged build-up (LBU)
13	Mezzanine finance
14	Public to private
15	Purchase of quoted shares

Figure 3: Preferences for Investment by Market Extent

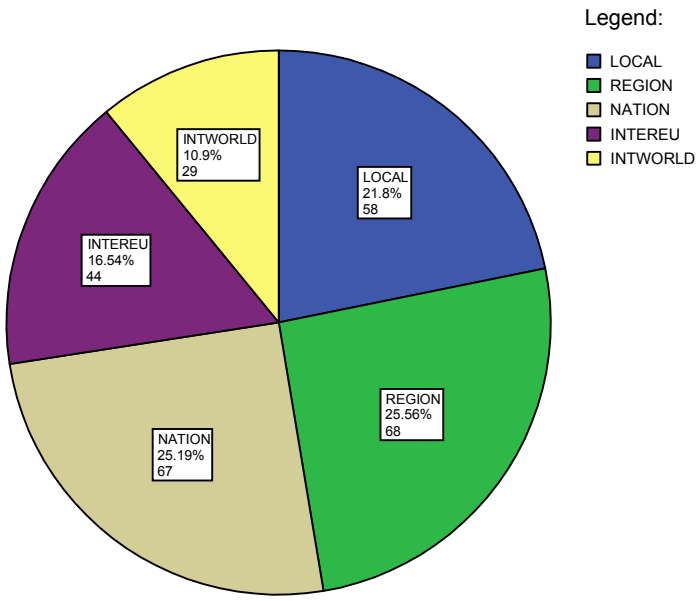


Figure 4: Usefulness of Financial Reports in Assessing the Value of High-Technology Firms

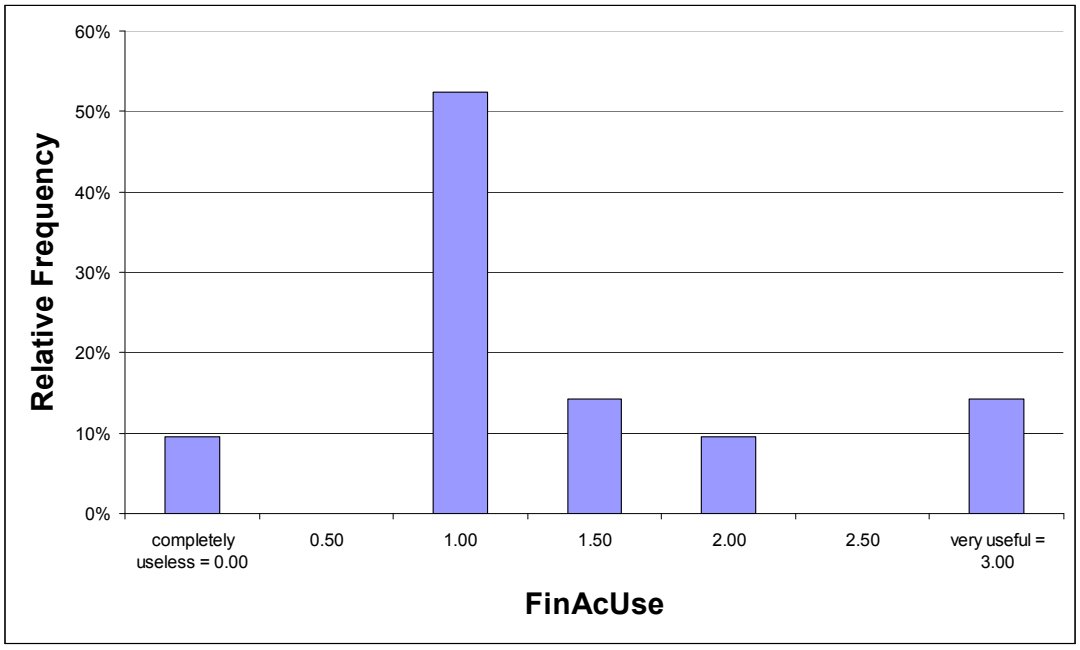
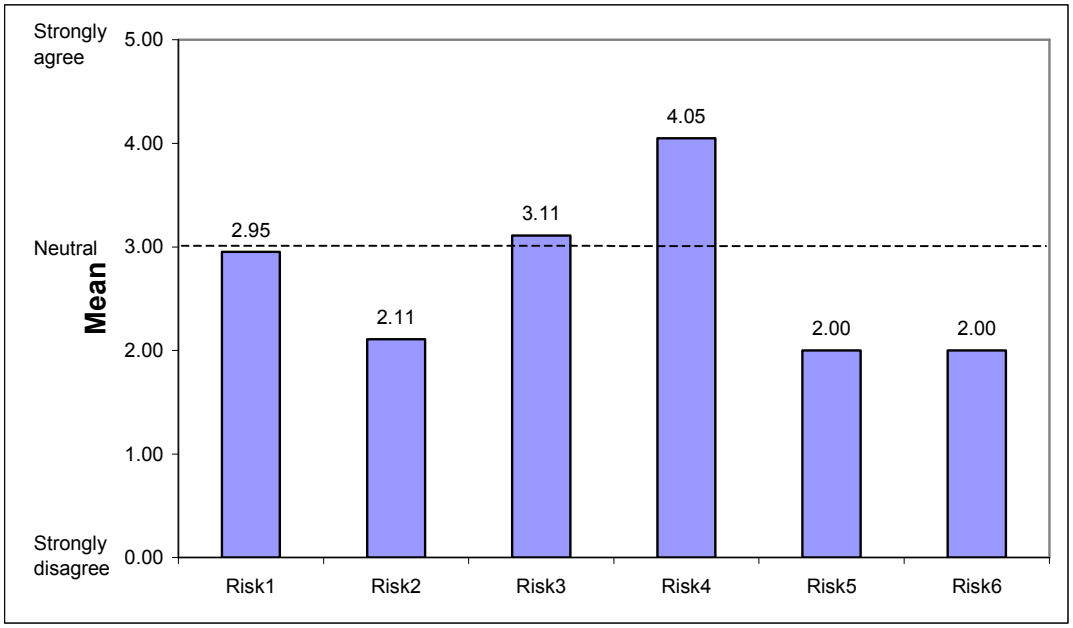
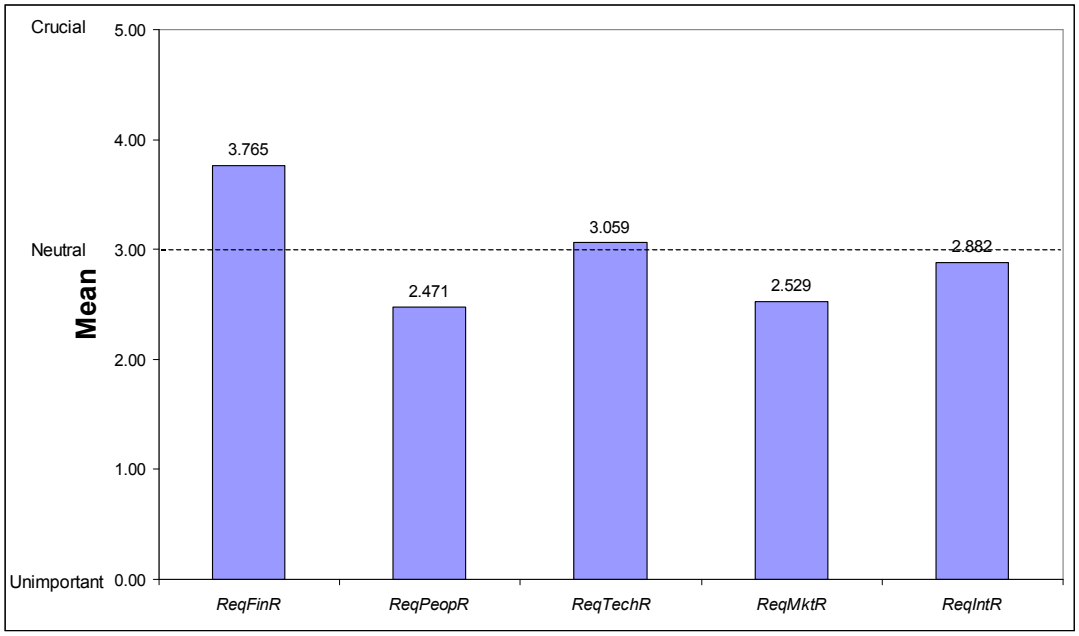


Figure 5: Risk Reporting in Financial Accounts



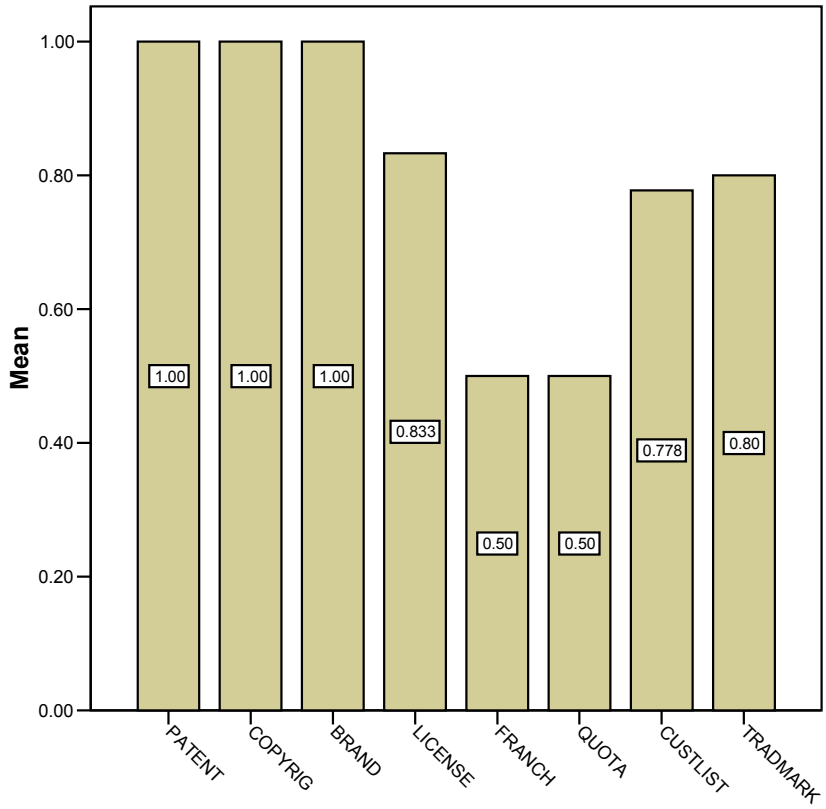
Variable	Statement
Risk1	The information currently provided in financial accounts is sufficient for our purposes
Risk2	More information should be provided compulsorily
Risk3	Requiring more disclosure in published accounts would provide too much information to rivals
Risk4	Our own due diligence is enough to enable us to assess high-technology investments
Risk5	Standardised risk reporting would facilitate the comparison of potential investees
Risk6	Standardised risk reporting would facilitate the allocation of risk capital

Figure 6: Importance of Disclosure in Financial Reports



Variable	Risk disclosure should be required as it relates to:
ReqFinR	Finance
ReqPeopR	People
ReqTechR	Technology
ReqMktR	Marketing
ReqIntR	Intangible assets

Figure 7: Requirement for Valuation Information



Variable	Information is requested on the valuation of:
Patent	Patents
Copyrig	Copyright
Brand	Brands
License	Licenses
Franch	Franchises
Quota	Quotas
CustList	Customer lists
TradMark	Trademarks

Table 1: Summary Statistics on Investor Conduct

	Minimum	***Maximum***	***Mean***
Minimum investment (£)	5,000	10,000,000	856,818
Maximum Investment (£)	100,000	50,000,000	4,459,091
Average investment (£)	80,000	30,000,000	2,565,714
Percentage who invest in technopoles			18%
Percentage who invest a lump sum			64%
Percentage who use staged finance			91%
Percentage who value intangibles at current replacement cost			25%
Percentage who value intangibles at estimated market value			75%

Table 2: Outline of Postal Questionnaire

1. Background

- Geographical preference
- Science park investing
- Preferred high technology sector
- Most common investment stage
- Size of investment
- Preference for lump-sum vs staged investment

2. High Technology and Financial Accounting

- Utility of standard financial accounts
- Required valuation information on internally developed intangible assets
- Adequacy of investee information for company valuation
- Current replacement cost vs estimated market value of intangible assets
- Significance of costs in evaluating investment worth
- Extent of requirements of risk disclosure
- Qualitative vs quantitative risk information
- Use of score-carding for risk appraisal
- Necessity of required elements in financial accounts
- Degree of agreement on risk reporting and disclosure

3. Management Accounting and Performance

- Extent of influence on firm's internal management
- Extent of contact with high vs low performing firms
- Required reporting frequency in firm's AIS
- Problems of measuring and managing risk

Table 3: Correlations with the Usefulness of Financial Accounts

FinAcUse	*Staged*	*ROSF*	*ROCE*
Pearson Correlation	-0.449*	0.509*	0.553*
Prob. Value	0.041	0.044	0.028
N	21	16	16

*Correlation is significant at the 0.05 level (2-tailed)

Table 4: Correlations with Investment in Technopoles

Techpole	*Indus07*	*Stage11*	*Stage13*	*TechFin*
Pearson Correlation	0.547*	0.463*	0.463*	0.494*
Prob. Value	0.008	0.030	0.030	0.044
N	22	22	22	17
Techpole	*PeopFin*	*MarkFin*	*FinQual*	*HnSFin*
Pearson Correlation	0.789**	0.494*	0.566*	0.658**
Prob. Value	0.000	0.044	0.018	0.004
N	17	17	17	14

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 5: Correlations with Influence over Management Accounting

InflInfo	*Indus12*	*Indus19*	*Stage09*	*Stage10*
Pearson Correlation	-0.447*	-0.667**	-0.577**	-0.478*
Sig. (2-tailed)	0.037	0.001	0.005	0.025
N	22	22	22	22

InflInfo	*Stage12*	*Stage14*	*MarkSens*	*Risk4*
Pearson Correlation	-0.426*	-0.481*	0.590*	0.656**
Sig. (2-tailed)	0.048	0.023	0.013	0.002
N	22	22	17	19

InflInfo	*Risk6*	*InflMgt1*	*InflDec*	*InflStaff*
Pearson Correlation	-0.516*	0.593*	0.567**	0.458*
Sig. (2-tailed)	0.024	0.004	0.006	0.032
N	19	22	22	22

InflInfo	*Inflmgt2*	*InflProd*
Pearson Correlation	0.593*	0.436*
Sig. (2-tailed)	0.004	0.043
N	22	22

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 6: Regressions explaining Levels of Investment

	Model 1		**Model 2**	
Dependent Variables	*Average Investment*		*Minimum Investment*	
Independent Variables	**Coefficients**	**t-statistic (Prob. Value)**	**Coefficients**	**t-statistic (Prob. Value)**
Risk1	1506.10^3	1.875 (0.085)	5637.10^2	2.163 (0.051)
Risk2	1201.10^3	1.598 (0.136)	4020.10^2	1.646 (0.126)
Risk3	2566.10^3	2.635 (0.022)	9269.10^2	2.932 (0.013)
Risk4	-2657.10^3	-1.652 (0.124)	-9656.10^2	-1.849 (0.089)
Risk5	4282.10^2	0.171 (0.867)	6138.10^2	0.755 (0.465)
Risk6	3372.10^2	0.125 (0.903)	-4373.10^2	-0.499 (0.627)
Constant	2952.10^3	-0.399 (0.697)	-9092.10^2	-0.378 (0.712)
Adjusted R^2		0.508		0.561
F-Statistic		4.098		4.830
Prob. Value		0.018		0.010

Variable	**Statement**
Risk1	The information currently provided in financial accounts is sufficient for our purposes
Risk2	More information should be provided compulsorily
Risk3	Requiring more disclosure in published accounts would provide too much information to rivals
Risk4	Our own due diligence is enough to enable us to assess high-technology investments
Risk5	Standardised risk reporting would facilitate the comparison of potential investees
Risk6	Standardised risk reporting would facilitate the allocation of risk capital