Why is it so Hard to Value Intangibles?
Evidence from Investments in High-Technology Start-Ups

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Abstract

The paper uses a range of primary-source empirical evidence to address the question: ‘why is it so hard to value intangible assets?’ The setting is venture capital investment in high technology companies. While the investors are risk specialists and financial experts, the entrepreneurs are more knowledgeable about product innovation. Thus the context lends itself to analysis within a principal-agent framework, in which information asymmetry may give rise to adverse selection, pre-contract, and moral hazard, post-contract. We examine how the investor might attenuate such problems and attach a value to such high-tech investments in what are often merely intangible assets, through expert due diligence, monitoring and control. Qualitative evidence is used to qualify the more clear cut picture provided by a principal-agent approach to a more mixed picture in which the ‘art and science’ of investment appraisal are utilised by both parties alike.

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

JEL Codes: G11, G24, M41, O3

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1. Background
Any study of a venture capital deal structure lends itself quite naturally to analysis within an agency framework (Reid, 1998; Reid and Smith, 2007; Smith, 2005). Viewing the investor as principal and his entrepreneurial investee companies as agents, there arise problems of adverse selection and moral hazard which we observe within any principal-agent setting (Chen and Steiner, 2000). For example, investors are risk specialists, with detailed knowledge of finance and business management. They have skills in, and knowledge of, financial structuring, and the ways in which they assess and manage risk might therefore differ from their investee companies (Cohen et al., 2000; Cohen and Holder-Webb, 2006). Entrepreneurs, on the other hand, are product specialists, perhaps even technology specialists, who know a lot about the daily workings of their own business, but less about financial structuring. The information asymmetry that is inherent in such relationships leads to the problems identified above (Li and Balachandran, 2000). However, these can be overcome (or attenuated) by, for example, the investor exercising due diligence (including third party due diligence, on technology, pre-contract) and implementing effective systems of monitoring and control, post-contract (Hand, 2005).

While researchers have previously analysed venture capital relationships within such agency frameworks (e.g. Sapienza, 1989), what has been less explored is the extent to which the accounting profession might be in a position to have an impact upon the deal-making process in (especially) high technology entrepreneurial ventures. The nature of such companies poses particular problems when the venture
capital investor is considering his or her investment. They have no track record, and may not yet even have a product to introduce to the marketplace and are often, in fact, development companies rather than fully fledged manufacturers of a product. The main problem, therefore, faced by any potential investor, is what value to place on such a business (Holland, 2001; Oliveira et al., 2006; Wyatt, 2005).

The British Venture Capital Association (BVCA) offers some advice to entrepreneurs on how to value their business, admitting that there is ‘no right or wrong way’ to do so (BVCA, 2005). For example, they suggest the use of yardstick comparison, calculating the value of the entrepreneur’s company and comparing it to the values of similar companies quoted on the stock market. In order to do this, they recommend calculating the company’s price/earnings ratio, using profits after tax to establish the company’s capital value (cf. Olsen et al., 2007). This makes the fundamental (but, arguably, flawed) assumption that the entrepreneur’s company has tradable shares. In reality, many high-tech companies seeking venture capital investment will still be in the research and development phase, which can be several years before their becoming a profitable entity (Garcia-Ayuso, 2003; Mueller, J.M., 2004). Other methods of valuing a company, noted by the BVCA, include those methods based on an evaluation of existing net assets or their realisable value. However, whilst that might be useful for physical assets, which, for example, could be valued on a second-hand market, in early-stage developmental companies, the assets may be intangible, and therefore more difficult to value.

In addressing the problem of valuing intangible assets, the accounting profession may have something useful to offer, in terms of tools and techniques (Canibano et al., 2000; Gelb and Siegel, 2000; Maines et al., 2003; Stolowy and Jeny-Cazavan, 2001; Winston and Sharp, 2005). For example, with reference to relevant International
Accounting Standards (IAS), IAS 38 Intangible Assets gives guidance on valuing intangible assets, defined as ‘an identifiable non-monetary asset without physical substance’. A company can recognise such an asset if it is likely that future economic benefits will flow to the entity because of its existence (e.g. the grant of a patent) and the cost of the asset can be measured reliably (e.g. the laboratory development costs). Of particular relevance to those high-technology start-up companies who are seeking venture capital investment, are the guidelines surrounding the valuation of internally generated intangible assets. There are stringent requirements to be met if a company is to be permitted to recognise an internally developed intangible asset. First, they must be able to demonstrate that it is technically feasible that the asset can be created and made available for sale, and that the company does in fact intend to create and to sell or to use the asset. Second, the company must also be able to show how future economic benefits will accrue, and that it has the technical, financial and other resources (e.g. in-house competence in a technology) necessary to bring it into being. Finally, it should be able to measure reliably the expenditure incurred on the development of the intangible asset.

While the above guidelines offered by the International Accounting Standard may be useful for venture capital investors seeking to invest in companies which are incorporated, which can, therefore, provide regular financial reports, they are less obviously useful when the potential investee is an unincorporated research and development company, as typified, for example, by a university spin-out (see, for example, two Scottish examples: Case F, infrared detectors, and Case G, animal robotics, in Reid and Smith, 2006). Very often, such businesses are not required to provide financial accounts, so there is no publicly available information upon which to base an evaluation of the business (e.g. in terms of value, profitability, and
performance) (Luft and Shields, 2001). In such circumstances, the investor must rely upon their own specialist knowledge, a certain amount of due diligence, site visits, evaluation of the technologies employed (e.g. by commissioning reports from technology foresight specialists) and an assessment of the management team in place. However, in order to commit to an investment in the business, they still need to derive methods for making an evaluation of the potential investment value in the firm, in order to structure the deal (e.g. the staging and pricing of equity injections). So how do they do this, and on what information do they base their evaluation?

2. Data and methodology

The evidence used in this paper is a variety of primary-source evidence obtained in the field (Woolcott, 2005) from both investors and entrepreneurs in high-technology enterprises in the UK and (to a limited extent) the USA. The initial sample of principals was gathered through face-to-face interviews with twenty venture capital investors across the UK, including all the major allocators of equity to high-technology firms. This was supplemented by an additional ten face-to-face interviews with entrepreneurs (agents) in high-technology companies in both the UK and USA. Finally, a mailed questionnaire provided additional feedback from a further twenty investors. Essentially, against a principal-agent background, we were interested in investigating the attitudes of investors and entrepreneurs to risk, and in gauging the impact these attitudes had on the relationship between the investor (the principal) and entrepreneur (agent).

The initial sampling frame for the investors was provided by a listing compiled by the British Venture Capital Association (BVCA). Although this captures most UK activity, it limits the sample to only those who are members of the BVCA. Therefore,
the sample was later extended to incorporate additional investors who were not members of the BVCA but who were nonetheless known to play an important role in providing outside equity investment to high-technology companies. The entrepreneurs (agents) which we interviewed were found from an intensive search of patent databases. Our selection criteria were that they should run patent-intensive companies and that they had received venture capital backing.

The face-to-face interviews were conducted around the framework of a specially-designed semi-structured interview. The agenda was similar for both investor (principal) and entrepreneur (agent). Each was asked about: the use of risk premia in potential and actual investments; the time horizon of investments; the use, or otherwise, of sensitivity analysis; the use of expected values (EV) in assessing potential investments; the discounting methods used to analyse cash flows; the sophistication of financial models; the methods of decision-making; the technique of qualitative appraisal utilised; and the form of financial reporting for ‘accounting for risk’. An appropriately crafted postal mailed questionnaire was also developed for enlarging our sample of investors (principals). This addressed the same issues as described above, but in a shorter format.

[Table 1 near here]

For the purposes of this paper, we are primarily interested in the valuation issues surrounding investments in high-technology companies (Garcia-Ayuso, 2003). However, we shall focus first, briefly, on presenting a statistical picture of the average, or representative, investor who participated in our study (see Table 1). All were based in the UK, and (considered as companies themselves) they ranged in size from very small, with just three employees, to very large, with 797 employees and many branches throughout the country. The average investor had 35 full-time venture
capital executives. The number of proposals, or requests for funding, ranged from 150 to 4000 per annum, with an average of 811. Of these, between 25 and 1000, or an average of 258, passed the initial screening and were seriously reviewed by the investors in a year. The number of investments actually made in any particular year ranged from 4 to 320, with the average company making 50 investments a year. At the time these investors were approached, they were making an average of 320 active investments per investor, with an average of £631 million funds invested. An average of £707 million funds were managed per investor, with £236 million available to invest. These financial figures are heavily positively skewed by one or two massive investors (for example, 3i). By contrast to these, the smallest investor managed funds worth only £4 million.

3. Evidence of Information Asymmetry Between Investor and Entrepreneur

A key premise of this paper is that information asymmetry exists between investor and entrepreneur, and that this asymmetry leads to difficulties when it comes to assessing the value of a high-technology start-up (cf. Reid, 1998; Cohen and Holder-Webb, 2006). In turn, this may lead to contractual impediments between the two parties. If each party to the venture capital relationship has different approaches to risk assessment and management, then we might expect them to have different methods of valuing a particular technology (cf. Cohen et al, 2000). Our new evidence allow us (uniquely) to examine whether such differences do exist between investor and entrepreneur, when it comes to their assessing financial risk. For reasons of brevity, we discuss only those aspects of the questionnaire that illuminate differences in response between our investors and entrepreneurs.

[Table 2 near here]
Table 2 is the first of a number of tables which report upon statistical evidence concerning differences between mean responses from investors and entrepreneurs. Underlying these tests were questions in the administered or postal questionnaires which were suitably crafted to take account of whether an investor or an entrepreneur was being interviewed. For example, if we were asking about investment we might pose the question to the investor as if he were considering investment in a high-technology firm. On the other hand, if the question were asked of an entrepreneur, we might couch it in terms of investment in a new high-technology product. Throughout, we tried to ensure that the responses would enable us to compare the attitudes of each party to a potential investment, each from their own standpoint.

First, we report evidence on responses to the question ‘do you attach a risk premium to the discount rates you use in high technology investments?’ The context was suitably adapted to each respondent. The variable riskprem measures responses to this question. As we see from Table 2, the investor was more likely to attach a risk premium to investment decisions (riskprem = 0.84) than the entrepreneur (riskprem = 0.40), [t-stat. = 2.396; Prob.Val. = 0.031], which is statistically significant at the 5 per cent level. This is what we would expect; as we discussed above, for the investor is a risk and finance specialist, and is therefore more likely than the entrepreneur (who is a technology specialist) to use sophisticated financial techniques to assess any investment (cf. Hand, 2005).

Two additional variables provide further evidence of key differences between the investor and the entrepreneur. They both relate to variables that describe factors which are taken into account when making risk appraisals. These measure, respectively, the importance of market opportunities (appraisa) and the importance of information system capabilities (appraisn). These features were measured on a Likert
scale ranging from 1 to 5, with 5 representing ‘high’ importance. As Table 2 shows us, the entrepreneur rated market opportunities as more important than did investors [t-stat. = -1.954; Prob. Val. = 0.062]. Conversely, the investor rated information system capabilities as being more important than the entrepreneur [t-stat. = 2.925; Prob. Val. = 0.014]. Again, this accords with our earlier assessment, based on a principal-agent perspective: entrepreneurs concern themselves more with the product, and with seeking out market opportunities; whereas investors are more concerned to ensure a flow of information that will enable them to assess their investments and to improve their systems of monitoring and control. Here, of course, their goal is to reduce information asymmetry, and thereby to attenuate adverse selection, pre-contract, and moral hazard, post-contract (cf. Reid, 1998; Reid and Smith, 2007).

[Table 3 near here]

Table 3 presents evidence on ‘making the investment’, which permits a comparison to be made between the approaches to investments of investors and entrepreneurs. Here, the underlying variables are binary (yes/no) rather than attitudinal (as in Table 2). The first variable, cashflow, measures responses to the question ‘do you use discounted cash flows?’ A t-test shows that the entrepreneur was more likely to use DCF methods than the investor [t-stat. = -2.077; Prob. Val. = 0.049]. The interpretation we would put on this is as follows. Cashflow is often the financial aspect of the firm that the entrepreneur will most readily understand. It is also the most important indicator of the firm’s financial viability, and therefore one which the entrepreneur will want to monitor closely. The investor, by contrast, is more concerned with longer term, more strategic issues than shorter term, operational and tactical issues. These differences are reflected in the statistical evidence on the rate of return variable, ROR. This asks whether a target rate of return is set on investments.
Here, we see the investor is more likely to be setting such targets than is the entrepreneur, and this difference is statistically significant [t-stat. = 2.066; Prob. Val. = 0.059].

Given that the investor typically has greater experience in managing risk, and would focus on economic outcome, rather than on technical commitment, we see next that he is more likely than is the entrepreneur to see an earlier, rather than a later payback on a project (earlypay), the riskier is the technology being developed [t-stat. = 2.340; Prob. Val. = 0.029]. Thus the controls the investor will put on investments are tighter, the greater is the perceived investment (cf. Holland, 2001). By contrast, the entrepreneur, being more focused on technological development, is more willing to allow the product to develop, before seeking a return on their investment. This finding is consistent with our earlier contention that the entrepreneur has greater knowledge about the technology and the products which can be developed from it, and is therefore more willing to bear the risk associated with waiting for it to be fully developed than is the investor. It also supports the principal-agent perspective set out above. This focuses on the information asymmetry between the two parties: thus the investor knows less about product development than does the entrepreneur, who may indeed shroud the product development in extreme secrecy, and bolster this with patent protection. By contrast the investor is inclined, in a sense, to bear additional costs (in terms of early payback) to compensate for his inferior knowledge (cf. Chen and Steiner, 2000; Cohen et al, 2000). The variable wide measures the extent to which respondents would allow variables to range when undertaking sensitivity analysis on projects, given as a percentage. The mean responses are 130 per cent for the entrepreneur and 34 per cent for the investor [t-stat. = -4.710; Prob. Val. = 0.007]. In other words, entrepreneurs were more exploratory when considering the range of
possible outcomes for projects than were investors, who preferred a more tightly
tested assessment. This is in accord with the results above on payback. It shows
entrepreneurs again as being more focused on project management and investors more
focussing on the most likely outcome.

The variable *diffmeth* measures responses to the question ‘do you use different
methods of assigning expected values in any given year, depending on whether a cost
or a revenue is being considered?’ We see that entrepreneurs are more likely than
investors to use a variety of methods for assigning expected values [t-stat. = -1.961;
Prob. Val. = 0.063]. This is befitting, because of the wide diversity of types of firms
(and indeed of projects therein), on the entrepreneurial side, as contrasted with the
desire not to micro-manage by investors, and their relative uniformity of training and
background, on the investor side. Respondents were also asked whether they would
estimate the chances that the present value of cash inflows might be less than the
project cost; in other words, the probability that any given project would run at a loss
(*runloss*). The entrepreneur was more likely to do this than the investor [t-stat. = -
1.814; Prob. Val. = 0.083], which is consistent with greater risk aversion by the
entrepreneur, as well as a better capacity to calibrate the downside of projects.

*Futprof* gives an indication as to whether or not the respondent could estimate the
future profitability of the firm or investment portfolio. Entrepreneurs were extremely
confident that this could be done, whereas investors were much more wary, to a
statistically significant degree [t-stat. = -1.844; Prob. Val. = 0.083]. This again
suggests the superior market and financial awareness of the investor. Next,
respondents were asked whether simulation methods (*simulate*), for example Monte
Carlo techniques, were used to examine possible performance tracks of the firm or
investment over time. Some entrepreneurs were able to use such techniques, but none
of the investors were willing to consider this as an option [t-stat. = -1.964; Prob. Val. = 0.081]. Perhaps this is natural, as the science-based entrepreneurs (e.g. engineers) might take to this line of enquiry quite naturally, as it is system-based, whereas investors are rather less interested in the firm as a system, but rather in its outputs.

[Table 4 near here]

Finally, in terms of quantitative evidence, we refer to Table 4, which gives the results for some additional considerations that might be taken into account when making investments (Olsen et al, 2007). Nonfin (as with several other variables in this table) was measured on a Likert scale from 1 (representing low) to 5, representing high. In this case, the scale measures the degree of importance of the non financial indicator, product quality, when undertaking risk appraisals. We see here again, as before, that aspects of product quality are regarded as more important to the entrepreneur (the product specialist) than to the investor (the finance specialist) [t-stat. = -2.142; Prob. Val. = 0.043]. The variable scenario (a binary variable) arises from the question ‘do you use scenario analysis to create a ‘best’, ‘middle’ (most likely) and ‘worst’ case scenario for a new high technology product/investment?’ As we can see from Table 4, the entrepreneur would do so without fail, whereas the investor was less likely to resort to such qualitative appraisals [t-stat. = -2.557; Prob. Val. = 0.020]. This suggests more risk averse, and less sophisticated attitudes on the part of entrepreneurs, compared to investors.

Respondents were also asked to rate the importance of a number of features of innovation when considering the launch and/or development of a new product. The one which showed a significant difference in the opinions of investor and entrepreneur was innovc, which measured the rate of new product innovation compared to that in the firm’s strategic plan. The evidence suggests that this was
more important to the investor (who focuses on outputs) than to the entrepreneur (who focuses on projects) [t-stat. = 1.855; Prob. Val. = 0.085]. The former incentivises his investee companies by setting targets or hurdles which, when met, will allow the entrepreneur to achieve, for example, an increase in salary or share options. Thus it will be important to ensure that the entrepreneur is motivated to meet the deadlines which are set in the strategic plan. The entrepreneur, however, while motivated, will tend to be more interested in making sure that the product does actually achieve its milestones than in the rate at which these are achieved.

Finally, respondents were asked to identify how extensive were the forms of risk disclosures under a number of different categories. The one on which investors and entrepreneurs differed most significantly was on the disclosure of technology risk (extra). Graded on a Likert scale from 1 to 5, with 5 representing high disclosure, the investor required greater disclosure than the entrepreneur was likely to give [t-stat. = 1.793; Prob. Val. = 0.088]. This accords with our expectations of how investors will behave (cf. Gelb and Siegel, 2000). As risk specialists they like to limit the downside risk of investments by performing rigorous due diligence and by requiring the disclosure of information pertaining to the riskiness of their investment involvements. However, entrepreneurs are naturally cautious about disclosing too much information, especially where matters of intellectual property may be concerned (cf. Oliveira et al, 2006), and this caution in information provision is being delicately balanced against the need to provide sufficient information to the investor that a risk-sharing deal is both concluded and sustained.

4. Qualitative Evidence on Accounting for Intangibles
We saw above that high-technology companies are particularly difficult to assess, because much of their value is tied up in intangible assets, such as intellectual property, brands, patents, and so on (cf. Wyatt, 2005; Canibano et al, 2000). To provide further than the statistical analysis permitted, we decided to extend our research into the field through face-to-face interviews. Amongst other things this involved asking explicitly how entrepreneurs in high-technology firms account for intangible assets. We began by asking them the extent to which they believed that standard financial accounts were useful to investors who wished to assess the value of the entrepreneur’s company. Somewhat to our surprise, the responses were equivocal (cf. Stolowoy and Jeny-Cazavan, 2001). Some respondents described financial accounts as ‘irrelevant’, or said that they were ‘not at all useful, [as] there’s no way for accountants to put people in the balance sheet, which is a key consideration in any technology start-up’. One respondent said that, ‘with regard to intangibles, it’s [viz. representation in financial reports] completely useless. For example, on goodwill and patents. For the silver bullet, how do you put a price on it? Buyers today don’t really care about intellectual property. They look at EBIT\(^1\) and EBIT growth. Accounting gives you an historical perspective, but not a true sense of where the business is going or where it is’. On the other hand, some entrepreneurs thought that standard financial reports would be helpful, saying ‘they are absolutely useful, and investors think that they are useful too’, and ‘I think they’d be very useful. We maintain 12 month cash flow projections with expectations/risks associated with sales, cashflow, balance sheet, and so on’.

One investor gave his opinion on the problems of measuring and managing risk in high-technology ventures as follows: ‘Although risk can be expressed as a factor

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\(^1\) Earnings Before Interest and Tax
applied to anticipated returns (like a price/earnings multiple), it can’t be derived from a quantitative analysis of measurable factors in the business. Too much of it is about the way that management assesses and reacts to external factors; such as market demand, pricing and development costs and the way that they set about building a risk minimising business plan’. Another agreed, stating that ‘making good returns out of technology depends to a large extent on a combination of the markets selected, applications knowledge, the business model being adopted and the ability of the team to execute the business model successfully. I don’t believe that these are issues on which is it possible to place a meaningful value in accounts or to be assessed by accountants’ (cf. Winston and Sharp, 2005; Gelb and Siegel, 2000).

In qualitative terms, we see that entrepreneurs do express some uneasiness about the usefulness of financial accounts for investors seeking to value high-technology companies. However, they are not, on the whole, so negative about standard financial accounts, and the reason for this may be twofold. On the one hand, they may lack the technical expertise to criticise methodologies for valuing intellectual property. On the other hand, they may slightly favour an ambiguity of information and/or practice relating to such valuations, which potentially allows them greater scope for sustaining their own views against those of the investors about the value of what they are producing, or expect to produce.

The rest of this qualitative section looks at, in sequence: internally developed intangible assets; assessing the value of the company; evaluating the worth of investments; risk disclosures to investors; and provision of information in financial accounts. Throughout, the focus is more on getting a feel for the nature of entrepreneurs’ opinions (and, hopefully, their rationale), rather than engaging in a
variable by variable comparative quantitative analysis of investor/entrepreneur opinions.

*Internally Developed Intangible Assets*

One problem with high technology companies is that certain internally developed assets may have been valued by the company in ways which are not transparent (Garcia-Ayuso, 2003). These might include things like patents, copyright, brands, licenses, franchises, quotas, customer lists, trademarks, and so on (Macqueen et al, 2008). In this context, we next asked, for which internally developed intangible assets did the entrepreneur provide valuation information to existing or potential investors. For example, did they provide information on how these had been valued, or did they think that the financial statements provided sufficient information (cf. Garcia-Ayuso, 2003; Maines et al, 2003)? One entrepreneur admitted that ‘at our first investment – 1 year ago – the company was valued at £2.1m pre-money [i.e. pre investment], based on one patent – we didn’t even own a chair – and £1.8m post-money [i.e. post investment], but [the patent] doesn’t appear anywhere in our accounts’. Another entrepreneur said that, in relation to valuing a patent, ‘I’m not sure of its value, but it’s a means of recognising there’s a value. For our patent portfolio, value has to be justified ... [it’s] what I can justify. That is, the cost of our patent agent, and the value of our intellectual property’. In the above, we find a considerable scepticism on the part of entrepreneurs about the valuing of patents, first, in terms of the techniques for doing so and second, for the way in which patents appear in company accounts (if at all). True, they recognise there is value there, and that valuations have to be justified. But they are dubious about the efficacy of these approaches.
Other entrepreneurs, while accepting that there was value in patenting, were less able to estimate what how this value might be recorded (cf. Olsen et al, 2006; Mueller, 2004; Luft and Shields, 2001). For example, one said, ‘I don’t think they [the investors] pay too much attention to it, to be honest. The interest is really in the products – what have we got to actually sell? It’s actually quite difficult for us to convey the advantages that some of our technologies have. I think a lot of it is the viewpoint of the investors, from a financial standpoint. They look at the top line, not the bottom line. We don’t place any value on brands or trademarks – our patents don’t appear on our balance sheet. In January we had a review back saying that one patent will be granted (out of 5 that are on-going). Even when it’s granted, we won’t put it on our balance sheet’. Another said that he would not try to estimate the value of a patent, and added that ‘we own a lot of intellectual property, but we don’t try and place a value on any IP. But they [investors] do realise it’s valuable. Both we and they recognise this. It’s almost so intertwined with the company and the people – without some sort of IP protection, the company is worth a lot less than with the protection’.

So, on the whole, entrepreneurs saw the value in having patents, though not especially in having them valued on the company’s balance sheet, because ‘so much of that [patenting, copyrighting] is art, not science, in valuation. If you gave these to three different evaluators, the way they do it is going to vary’. Instead, the value of patents was seen to lie in the fact that they offered protection of intellectual property (‘the Patent Office is a great way of getting documents recorded – establishing a priority date’); though, even then, not in every case, because ‘in the software industry [where copyright is the relevant form of IP protection], it’s far easier for people to copy what you’re doing without infringing on your patent’.
From an investor’s standpoint, some evaluated patents, and others did not. For example, one said that ‘we assess patents (and licenses) and estimate their uniqueness and market relevance’. The same investor would also assess customer lists as part of their commercial due diligence. Another said that patents or intangibles were ‘not usually assessed from a strictly financial viewpoint’, but that it was ‘more to do with protection of the business’. Another investor, from the extreme end of the spectrum, said bluntly ‘we don’t formally measure risk. We don’t receive accounts. We don’t value intangible assets’.

We may summarise the above by saying that entrepreneurs recognise patents as being potentially valuable, but were reluctant to see them on the company’s balance sheet; whereas investors were certainly more willing to engage in a valuation process, although they understood that it was not always possible to do this, using either strictly financial criteria or formal measures of risk.

Assessing the Value of the Company

Entrepreneurs were asked to identify to what extent they thought that the information they provided to (potential) investors was adequate for the purposes of assessing the value of their company. Responses to this varied. For example, one said that ‘we’ve got a very loose relationships with our investors – monitoring is very lax. We send profit and loss accounts and balance sheets on a monthly basis. We only have quarterly Board meetings’. Another thought that the information they provided was valuable in terms of assessing the value of the company, for example, incorporating development costs.

One entrepreneur was quite open about the information provided to investors, explaining that it ‘narrative rather than financial information. We were admitted to
AIM [Alternative Investment Market] last year, and submitted a full patent report, to give a means for readers of the prospectus to value the company. We have 14 patents – one is granted and the rest are in process. Our patents lie in how the fundamental technology is taken to a product both as a product and as a technology. We also have some defensive patents, as a ‘smokescreen’

Here, the qualitative evidence seems to suggest that entrepreneurs are given a relatively loose rein by some investors, when it comes to company valuation. It was admitted that monitoring might not be tight and that, often, narrative would be reported, rather than strictly financial data. There is also evidence of strategic concealing of the extent to which patents are valuable, by using what the respondent calls ‘defensive patents’ for a ‘smokescreen’ – sometimes described elsewhere as patent thickets.

Entrepreneurs were then asked explicitly how they valued intangible assets (cf. Olsen et al, 2007), for the purposes of financial reporting (cf. Hand, 2005). For one respondent, his main intangible asset arose from the license (or acquisition cost) from their product. Otherwise, as regards patents, the intangible costs were ‘those costs that our auditors can vouch are our patent agents’ costs’ (cf. Mueller, 2004). Often, it was a matter of judgement how intangibles were valued. A typical response was that ‘I’d probably be as prudent as possible … whichever was the lowest at the time. I guess we’d use ‘know-how’ to determine the value. For example, one of our guys is an expert on ‘drivers’. If he left, we would value at the cost of getting someone trained up. It’s not an easy thing to do. Actual intellectual property is worthless without some of the other things we’re doing’. The views expressed for valuing intangible assets for the purposes of financial reporting were complex. While certain costs, like those of patent agents, are readily pinned down, other costs (e.g. opportunity costs within the firm) are harder to pin down and, therefore, it takes what
one respondent called ‘know-how’ and expertise to determine the value of IP. As one respondent points out, a key cost driver would be the wage bill attaching to getting individuals trained to a sufficient level to be able to reproduce the intellectual property, and even this would fail to capture complementary activities e.g. sourcing materials, specialised instrumentation, and promoting and marketing products produced using new IP.

Some would be a little more scientific about how they approached valuation, if they felt the need to do so in the first place. For example, one said ‘I guess I would look at actual cost, if someone asked me to do it. How many man years, how many development dollars etc? I look at what it would cost me to do it the first time’. And another would try to work out a value, to the extent that it might be possible, saying ‘for example, if you look at a patent and try to value it, how much do you think you could get if someone violated it? Do you have the resources to protect it? There are other ways to protect intellectual property. Patents reveal too much’.

From an investor’s point of view, valuation formed part of their due diligence. For example, one said that ‘the companies we invest in won’t have published any accounts at that time. We sit on the Board of all our investees and so have exposure to and visibility of the broad range of activities, and can exert influence across that range’ (cf. Holland, 2001). Another added that ‘this is a very qualitative process!’

Again, there is a tension between the desire of entrepreneurs to use a scientific approach to valuation where, here, the wage bill and opportunity costs figure in their reasoning, and the view held that, despite all efforts and monitoring of activities by investors, it remains difficult to avoid significant qualitative inputs into decision-making, despite the preference of investors for something more formal and quantitative.
Evaluating the Worth of an Investment

Entrepreneurs were asked to identify how significant were various categories of costs, when evaluating the worth of an investment, first, in relation to the time that their own workforce would spend on assessing the technology involved. On this, in general, entrepreneurs thought that the cost was of moderately low importance, or at least ‘not all that significant’ as it was merely ‘a cost of doing business’. Further, the employment of technology foresight specialists was not particularly common, possibly because of the costs involved, with a typical response being ‘we very rarely, if ever, do that, [though] we try to be open to people giving us a hand’. Where they were used, the rationale behind it was that ‘it’s difficult when you’re in a new field. One of the things we did in the early stages of the company was to have one of [our investor’s] founders on our Board. So it is important.’

Responses were mixed on whether the cost of employing external consultants were a significant factor when considering the worth of an investment, with some using them, and others choosing not to. Of those who would employ such specialists, their reasons were as follows: ‘we outsource a lot of design work and bring in consultants to improve our own processes. We now have a product going into production, and have realised that we need to make a change in our processes’; ‘we’re wondering what’s going to be the next technology – we don’t want to be blindsided by a technology’; and ‘from the perspective of today, so much of business is about mitigation. Motivations can be mixed, internally. So it’s often helpful to have an external perspective.’ Where they were not used, respondents justified this decision by saying ‘we’re at the leading edge, but they don’t know. They might know how we
would apply our technology’; and ‘for us, there is not a lot of scope in that from a fundamental technology point of view’ (cf. Garcia-Ayuso, 2003).

Typical responses from investors on this sort of question were, for example, ‘we are very early stage investors as we set up new companies – we cannot invest in companies that have traded, so we invest before they have financial accounts’; or ‘fortunately, it’s more of an art than a science, and should be kept that way for private companies’. One investor gave a more detailed explanation as to how he would value a potential investment in a high technology company: ‘I try to evaluate the profits which the combination [of technology and management team] is likely to produce, what value this is likely to produce for the company (and hence the value of my investment) and judge whether the latter represents a reasonable return in relation to my perception of the risk taken. I adopt a very simple rule of trying to invest only in companies which I think will produce a 10 times return over ten years i.e. a compound return of over 25 per cent per annum’ (cf. Olsen et al, 2007).

To summarise, entrepreneurs and investors had rather different approaches to evaluating the worth of an investment. Entrepreneurs would tend to think in terms of the cost of doing business, which would factor in the use of external consultants and the services of technology foresight specialists. Investors, by contrast, aim to be profit-driven, and think in terms of specific rates of return and time horizons, but realise that it is difficult to juggle varied dispositions of resources like technology and management and that, therefore, part of the process is more art than science.

**Risk Disclosures to Investors**

The next line of questioning turned to the extent of risk disclosures entrepreneurs would make to investors, again under a number of different categories (cf. Chen et al,
Firstly, on technology, disclosure appeared to be fairly free and open. For example, one explained that ‘it is probably appropriate to comment on our admission [to the Alternative Investment Market] document. We did fairly extensive risk analysis. Disclosure was honest and extensive.’ Further, investors appeared to be proactive in requesting such information on a regular basis: ‘we have to write disclosure letters, and list everything that could go wrong with the technology’; and ‘as a company goes through different stages – in the first two years, all the risk was technology. Now, it’s more like, we need a machine that works reliably.’

In terms of disclosures about ‘people risk’, or the risk inherent in working with a management team that the investor knows very little about (cf. Cohen et al, 2000; Chen et al, 2000), one entrepreneur in particular was quite vocal. He explained that ‘one of the things I’ve always expressed, when recruiting into early-stage companies, is that I’m looking for someone who’s not going to be spooked. I want people who have travelled extensively, and to know what their interests are from a sports point of view. From early stage to volume manufacturer, the type of person will change. It is appropriate to be open and honest with those people. I hope investors are aware of that and are more knowledgeable about it. Venture capitalists are looking for an acknowledgement that the people who founded the company or who were there in the early stage might not be running it forever, but venture capitalists also want to lock them in at stages when they recognise these people will be important to the company. All companies should recognise it as a risk and it’s not something that needs to be enclosed.’

The overall picture that emerges from the qualitative evidence on risk disclosure to investors is that stage of investment is especially important. For example, at an early stage, technology risk may dominate market risk. For that reason, personnel need to
be flexible in their outlooks, as the company develops, and this extends to senior people, including founders, whose roles may change significantly through time.

Market risk was generally thought to be quite important, and entrepreneurs would disclose to investors ‘as much as we know’, explaining that ‘the market risk is understanding that customer’. One in particular thought that ‘this is important, particularly for young technology companies. It is important to innovate technology, but also to apply it to a particular market opportunity. I don’t think you’re fundable unless you tell them how you’re applying your technology’. Financial risk, too, was thought to be important, and entrepreneurs would typically tell their investors ‘as much as we know’ because ‘it has to be open book ... there is no scope or need for hiding anything’. Here, the entrepreneurs seem concerned to communicate to investors on market risk, to try to explain technology risk and to be as open as possible about financial risk.

One aspect of risk disclosure, on health and safety issues, which we might have expected to be important was less so than anticipated, with entrepreneurs explaining that ‘it’s not really an issue’, ‘it doesn’t figure, [and] we have very comprehensive health & safety policy – the investors have no idea about it’, or it ‘hasn’t been applicable.’ One said that health and safety represented a medium to low risk, explaining further that ‘our machine is generating x-rays, we had an investor ask if we’d had it shielded, and we did, so it was OK.’ Only one respondent said that providing risk information on health and safety was a significant issue: ‘it’s important for us because we use some quite strange products in the cleaning room. You have to have these disciplines in place. We proactively provide it.’

The nature of the information on risk that was provided to investors was usually a combination of qualitative and quantitative information. For example, one
entrepreneur said that ‘we highlight everything that isn’t fact (i.e. that is opinion) for our investors. That should be enough to figure out where the risk lies.’ Our evidence is that health and safety issues appeared less important than we thought, not because they were ignored but, rather, because they were intrinsically bound up with the operations of the companies we examined. This attitude extended from quantitative to qualitative reporting on health and safety issues.

Pursuing our agenda, we turned to the requirements for risk disclosure in published financial accounts (cf. Canibano et al, 2000; Hand, 2005). How important did respondents feel it to be that various aspects of risk disclosure should be required in their financial reporting? There was general agreement that financial risk should be reported, as it was seen to be ‘the foundation of the company’ and therefore very important. People risk was thought to be relatively difficult to assess, and therefore there was little support for making its disclosure a requirement. In terms of technology risk, respondents usually thought that it should be communicated to investors, but were not in agreement about how this should be done, saying, for example, ‘it’s good to report it, but not in the financial report’. Market risk was thought to be important and therefore it was relevant to require its disclosure. On how intangible assets were valued, respondents usually agreed that this should be disclosed, but also thought that the investor should make their own assessment. For example, one said ‘it’s for them to assess the risk ... it becomes qualitative too;’ and another added that ‘we don’t put those in – if you put a figure on your intangible assets you’re making the company look better, [so] you should be as conservative as possible.’

Investors were aware that their investee companies might not always give the truest picture of how the company was performing, and so would manage away this risk.
through either diversification or monitoring. For example, one would ‘manage the risk process through share option schemes’. And another recognised that ‘90 per cent fail, so a portfolio is needed – to be sensible, at least ten to twelve, in the hope of finding a star’ (cf. Cohen et al, 2000).

To summarise, there appeared to be a general willingness to communicate risk disclosure to investors on the part of entrepreneurs, but the reliability of information provided, e.g. on ‘people risk’, can be quite variable. By contrast, certain categories of risk, e.g. health and safety, were both relatively easy to calibrate (e.g. in terms of actuarial values) and relatively easy to implement (e.g. in terms of specified legal conditions and skills training directed towards meeting these conditions).

*Provision of Information in Financial Accounts*

Our final section of the questionnaire enquired as to the nature of information currently provided in financial accounts, and whether or not this was thought to be adequate (cf. Wyatt, 2005). We asked entrepreneurs whether they thought that the information currently provided in financial accounts was sufficient for investors’ purposes, or whether more information should be provided compulsorily. One respondent replied that ‘I don’t think it is sufficient, but I’m not sure it should be compulsory. It should come out in due diligence’. Another agreed that ‘it is absolutely not sufficient. You should provide more, in a lot of the areas we’ve just talked about. GAAP gives a page or two about the business. From the standpoint of an investor, you can’t really read much about the company.’

On the other side of the coin, providing more disclosure in published accounts could be seen to provide too much information to rivals (cf. Hand, 2005). Some agreed that the sectoral information would be too sensitive for them to want to disclose it, in case
that informant became known to rivals: ‘I wouldn’t want competitors to know which products, geographical location, sectors etc we’re working on.’ Another described their reluctance to disclose too much information: ‘we only put out abbreviated accounts to Companies House. We invest so much in R&D that we realise our accounts provide a very bleak picture, so we always include a Chairman’s Report. We’re not too sensitive about competition, but we are very sensitive about our customers. There’s a lot of antagonism in the industry.’

Both entrepreneurs and investors were somewhat cagey about compulsory provision of information. Although it was thought that some information was useful, there was caution about the excess of provision of information. This was partly a matter of understanding the value of trade secrecy on the part of both investor and investee. This trade secrecy, which is outside of the usual IP net, remains in place and is a matter of sensitivity because of the competitive pressure from rivals.

Respondents did not agree on the extent to which standardised risk reporting would help them to compare and evaluate potential investment opportunities (cf. Stolowoy and Jeny-Cazavan, 2001; Wyatt, 2005; Maines et al, 2003). Of those who were in favour of such an initiative, typical responses were ‘it was helpful to us – we looked at other prospectuses for US companies to see what they disclosed. It’s nice information to have, but I’m not sure I’d want to give it to other companies’, ‘I think it would help a great deal’, and ‘it would be helpful ... I just don’t know how you’d do it.’ On the other hand, those against standardised risk reporting too that stance because ‘I can’t begin to think how you could create apples and apples, rather than apples and oranges in a standard set of accounts. At the end of the day, pound notes you can compare. It would be too diverse’; and ‘I think it would probably just slow
finally, on the standardisation of risk reporting, respondents were asked to identify what might be its impact on the allocation of risk capital (cf. hand, 2005). some thought it would be helpful, saying that they thought it would provide a (significant) improvement in efficiency, and admitting that, if information were available through more open reporting, the providers of risk capital would be likely to follow it. however, there were others who did not think that it would be possible to provide standardised risk reports that would enable them to compare or evaluate alternative potential investments in any meaningful way. one summarised his thoughts as follows: ‘i think, if it came, we would respond to it and we would be able to justify ourselves, [but] it would just make our lives more difficult.’

investors generally thought that standardised risk reporting would not be particularly useful from their standpoint, saying, for example, ‘i do not feel [it] would help – it might do the opposite, as it is almost impossible to achieve accuracy’. another agreed, saying that ‘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!’ yet another was fairly scathing on the contribution of accountants to the investment process, saying that ‘accounts are the product of accountants. the latter have an appalling record of due diligence on high technology ipos where fortunes have been spent on professional fees in respect of companies which have delivered no value to investors’ (cf. stolowoy and jeny-cazavan, 2001).

to conclude this section of qualitative analysis, we should say that the various comments of investors and entrepreneurs alike are meant to support, to illuminate and
to inform the mere numbers and significance levels of the prior section, which dealt with statistical analysis. Investors and entrepreneurs certainly think somewhat differently, but both are inclined to the view that quantitative analysis alone cannot provide a complete picture. There is recognition too that, in trying to enrich the information surrounding contracting, an element of specialisation must occur, with entrepreneurs being more worried about technology risk and getting appropriate recognition for their inventions (e.g. by patents or by copyrights), but that financial imperatives could not be pushed aside, in terms of rates of return, nor could business risks be safely left in the hands of the producers – the investor’s influence here (both qualitative and quantitative) was important to sustaining a framework of business reality about the activities of high-technology firms. Finally, there were some areas of relatively little ambiguity, including the simplicity of compliance, so far as health and safety regulations went (and the relatively minor risks attaching to achieving compliance), and the relatively ‘spotty’ record of using varieties of contracted out advice, including third-party due diligence and technology foresight advice. In the UK at least, there seems ample scope for new market providers of top quality services in these areas.

5. Conclusions

We have explored new primary-source data, gathered from venture capital investors and their entrepreneurial high-technology investee companies. Our aim was to identify how and why it might be difficult for both parties to evaluate intangible assets within such companies. We started our investigation within a principal-agent theoretical framework (Chen and Steiner, 2000), which classified the investor as the principal and his entrepreneurial investee as the agent, in order to explore further
whether agency issues added to the difficulties encountered in evaluating high-technology firms.

What we have found generally supports the view that such relationships can be readily analysed within a principal-agent setting. For example, we found empirical support for the investor as risk specialist, who used risk premia to evaluate potential investments (Cohen et al., 2000; Cohen and Holder-Webb, 2006). He typically valued information systems, and required a consistent flow of salient information to monitor his investments. He focused on long-term strategy and a high rate of return on investments, and monitored his investment involvement very tightly (Hand, 2005), requiring earlier returns for higher risk situations. All of this enabled him to attenuate agency problems of adverse selection, pre-contract, and moral hazard, post-contract, both, of course, arising through information asymmetry (Li and Balachandran, 2000). The investee, or high-technology entrepreneur, focused more clearly on shorter term goals (e.g. cashflow), and was, to a certain extent, secretive about new product development and future plans. His concern was primarily with the product, and with seeking new market opportunities wherever possible.

Our more qualitative evidence suggests reasons why investors, and indeed, entrepreneurs themselves, have difficulties when it comes to valuing their intangible assets (cf. Canibano et al., 2000; Gelb and Siegel, 2000; Maines et al., 2003; Stolowoy and Jeny-Cazavan, 2001; Winston and Sharp, 2005). Firstly, such high-technology firms are often in their very early development stages; they may feel they know they have the best scientists, the best invention, the best new product design, but they do not know how to value this, and standard financial accounts provide little support, helping them to construct a rational valuation. For that reason, investors have to make many judgements, based on their own due diligence procedures (and, very
often, advanced third party due diligence in technological matters), in order to place a value on a potential investment. For this reason, the narrative explanation (as reported above) given by entrepreneurs about the value of their products, patents, and so on, was often more valuable to investors than the information contained in their financial reports.

Overall, our results are perhaps best summarised in the words of one of our investors, as follows:

‘Making good returns out of technology depends to a large extent on a combination of the markets selected, applications knowledge, the business model being adopted, and the ability of the team to execute the business model successfully. I don’t believe that these are issues on which it is possible to place a meaningful value in accounts or to be assessed by accountants. However, it is possible to produce assessments and/or evaluations reflecting these factors so that the relative merits of different investment opportunities can be compared, but the judgements need to be made by business people, preferably with industry relevant and successful P&L responsibility track records.’

Perhaps, if the accounting profession is to be of assistance in providing such meaningful analysis, future research needs to take account of statements like that above, and the profession needs to work more closely with (high-technology) businesses when developing new standards and protocols, especially as they relate to intangible assets. Maybe then it will be more readily accepted by those users who stand to benefit from it most.
References


<table>
<thead>
<tr>
<th>Table 1: Summary Statistics for Venture Capital Investors</th>
</tr>
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<tbody>
<tr>
<td>minimum</td>
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<tr>
<td>Employees</td>
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<td>Full time venture capital executives</td>
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<tr>
<td>Proposals received</td>
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<td>Proposals reviewed</td>
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<tr>
<td>Investments per annum</td>
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<td>Total funds invested</td>
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Table 2: Risk Appraisal

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<th>Investor</th>
<th>t-statistic</th>
<th>Prob. val.</th>
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<tr>
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<td>0.84</td>
<td>2.396</td>
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<td>4.56</td>
<td>-1.954</td>
<td>0.062</td>
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<td>appraisn</td>
<td>1.85</td>
<td>3.11</td>
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<td>0.014</td>
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Table 3: Making the Investment

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<td>0.049</td>
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<td>ROR</td>
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<td>earlypay</td>
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<td>2.340</td>
<td>0.029</td>
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<td>wide</td>
<td>130.00</td>
<td>33.75</td>
<td>-4.710</td>
<td>0.007</td>
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<td>diffmeth</td>
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<tr>
<td>futprof</td>
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<td>0.83</td>
<td>-1.844</td>
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<td>simulate</td>
<td>0.30</td>
<td>0.00</td>
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### Table 4: Additional Considerations

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<td>3.61</td>
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<tr>
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<td>4.00</td>
<td>4.38</td>
<td>1.793</td>
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## Appendix: Definitions of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
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<tr>
<td>appr isa</td>
<td>How important are <em>market opportunities</em> when you make a risk appraisal within your firm? =0 (‘not at all’) to 5 (‘highly’) important</td>
</tr>
<tr>
<td>appr is n</td>
<td>How important are <em>information system capabilities</em> when you make a risk appraisal within your firm? =0 (‘not at all’) to 5 (‘highly’) important</td>
</tr>
<tr>
<td>cashflow</td>
<td>Do you use discounted cashflow methods? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>diffmeth</td>
<td>Do you use different methods of assigning expected values in any given year, depending on whether a cost or a revenue is being considered? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>earlypay</td>
<td>Do you require the payback period to be earlier, the riskier the high technology you are developing/ investing in? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>exta</td>
<td>To what extent do you think the information you provide to (potential) investors is adequate for the purposes of assessing the value of your company, 0 (‘not at all’) to 5 (‘completely’) adequate</td>
</tr>
<tr>
<td>futprof</td>
<td>Can you estimate the future profitability of your firm? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>innovc</td>
<td>Could you please indicate the importance to you of the <em>rate of new product introduction compared to plan</em> when you are considering developing and launching a new high-technology product, =0 (‘not at all’) to 5 (‘highly’) important</td>
</tr>
<tr>
<td>nonfinc</td>
<td>Could you please indicate the importance to you of the <em>product quality</em> when you undertake risk appraisals, =0 (‘not at all’) to 5 (‘highly’) important</td>
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<tr>
<td>riskprem</td>
<td>Do you attach a risk premium to the discount rates you use in high technology investments? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>ROR</td>
<td>Do you set a target rate of return on investments? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>runloss</td>
<td>Do you estimate the chances that the present value of cash inflows might be less than the project cost (i.e. the probability that the project will run at a loss)? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>scenario</td>
<td>Do you use scenario analysis to create a ‘best’, ‘middle’ (most likely) and ‘worst’ case scenario for a new high technology product/investment? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>simulate</td>
<td>Are simulation methods (e.g. Monte Carlo techniques) used by you to examine possible performance paths of your firm over time? = ‘yes’, =0 ‘no’</td>
</tr>
<tr>
<td>wide</td>
<td>How wide do you let variables range in your sensitivity analysis? (%)</td>
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