

How do Venture Capitalists Handle Risk in High-Technology Ventures?

Gavin C Reid (University of St Andrews)

Julia A Smith (Cardiff Business School)

Abstract

This article presents new empirical evidence, obtained by fieldwork methods, on investor risk-handling practice in the UK venture capital industry. Its focus is on high-technology firms and the techniques their venture capital backers use for risk management. The active areas of risk management are explored under the headings of risk premia, investment time horizons, and sensitivity analysis. As an organising framework, risk is divided into ‘agency risk’, ‘business risk’ and ‘innovation risk’.

JEL Classification: G24, D81, L84, M21, L21

Key Words: Venture Capital, Risk Management, High-Technology, Fieldwork

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1. Introduction

This article reports upon a field work investigation [Sekaran (1992, Ch. 4)] into the risk appraisal methods used in investment contexts, when venture capitalists back high-technology new ventures. The main evidence is based on face-to-face interviews [Oppenheim (1992, Ch. 6)] with eighteen leading UK investors in the year 2001. Each investor participated in a semi-structured interview involving eight key issues: risk premia; investment time horizon; sensitivity analysis; expected values; predicted cash flows; financial modelling; decision making; and qualitative risk appraisal.

The article focuses on the first three of the above agenda items, with some cross-reference to other agenda items. It first provides a background treatment of the relevant UK venture capital context, then deals with general problems of risk appraisal in high-technology ventures, moves on to an account of the fieldwork methodology, and then provides results in a preliminary form under the headings risk premia, investment time horizon and sensitivity analysis.

The main finding is that actions taken by investors under the various agenda headings can all be viewed as risk management strategies with three main components: 'agency risk', 'innovation risk', and 'business risk'. We find that the three categories of risk identified as important, innovation, agency and

business risk, have pervasive influences on investor conduct in the UK. Their form of influence was traced under the agenda headings of risk premia, investment time horizon, and sensitivity analysis. It was found that the riskiness of investment types (e.g. seed, MBO etc) could be clearly ranked by investors. These rankings were found to be generally consistent with principles of financial economics. Investors were also asked what factors were most important to their risk appraisals, for given high technology investments. Of a wide range of factors, it was found that the most important to risk appraisal could be directly related to our categories of 'agency risk' and 'business risk'. It was found too that the time profiles of investments and their sensitivity to changed assumptions could be approached using our three risk categories. Of these, 'innovation risk' was thought to be particularly high, implying various forms of adaptation by investors, including setting very high hurdle rates of return and deploying radical stress tests of investment models.

2. The UK Venture Capital Context

The background to this empirical work is the UK venture capital market. Here, we use the term venture capital in its broad sense, which accords with European practice, VCR Guide (2000, p. 80). More narrowly, particularly in US terminology, venture capital is that part of private equity that is used to finance the launch, early growth and expansion of entrepreneurial firms. We adopt a broader definition, which includes MBO and MBI activity, for example. Some ten years ago, when one of the authors was first engaged in the analysis of UK venture capital markets, it was said by many investors that they avoided

investments at the 'leading edge'. They were too risky, and were referred to, in somewhat jocular terms, as the 'bleeding edge'. This picture is now rapidly changing, and UK investors are increasingly willing to contemplate more risky investments by stage (e.g. start-up) and by sector (e.g. high-technology).

The UK venture capital industry is second only in importance to the USA, and currently is responsible for placing about one half, by value, of European venture capital investment. Almost one half of its investment is in venture capital financing for expansion, which is generally perceived to be a relatively low risk area of venture capital involvement. This perhaps explains the US perception of the UK scene as being biased towards the provision of private equity. However, there has been a recent shift of interest in the UK to seed corn and start-up activity. Further, the technology field, previously starved of funds, is becoming quite vigorous. In 1999, over £1 billion was invested in UK high technology companies, and in that same year a similar amount was also raised, in the form of new funds, for future investment in such companies.

To get a contemporary sense of where the UK venture capital industry is now heading, the first step in our research was to engage in relatively unstructured, qualitative field work, Oppenheim (1992, Ch. 4). Here, the goal was simply to go into the field with an open mind, and to get a feel for what were now the main trends, the important issues, and the leading influences. At the earliest opportunity, we contacted two of the major figures in the UK venture capital industry: a Director with the 3i Group in London; and the new Chairman of the British Venture Capital Association (BVCA). The BVCA was founded in

1983, with 50 members, and now has over 120 members. They collectively account for almost all the venture capital finance provided in the UK. 3i is Europe's leading venture company, having evolved from being the UK's sole provider of venture capital funding (as the ICFC) during the period 1945-80. It remains the dominant player in the UK industry, and currently has a total of over £2 billion in venture capital funds under management.

Meetings were held with senior personnel at 3i and the BVCA at their places of work. Their purpose was to exchange ideas, and to suggest approaches that the research might usefully take. These initial meetings were helpful in 'setting the scene' concerning recent developments in UK venture capital markets. For example, if we are to compare the UK to the US, we should first be aware that investors' experience is obviously longer and deeper in the US. The Nasdaq, since its introduction as the world's first electronic stock market, has been at the forefront of innovation and is now the fastest growing major stock market in the world. It is home to over half of the companies traded on the primary US markets. As the Director at 3i explained, "Venture capital funds deliver very attractive returns - everyone wants to be in it. It's a matter of supply and demand, and the willingness of some people to take healthier views of risk. In the UK, we are relatively young in investing in high-technology. The pricing of 3i deals has increased, and returns are coming down. US funds, such as CISCO and Intel, are serious investors in technologies".

The Chairman of the BVCA referred to the history of venture capital investment in the UK. He stated that, "Until recently, the UK venture capital

scene has been directed predominantly towards buyouts, and to revitalising British industry. Now, however, about half of venture capital funding is in (predominantly) early stage technology. The venture capital industry in the UK is growing, partly due to Government encouragement, and partly because the internet breaks down big business - it has a beneficial effect on speed to market. It now knows no national boundaries. New types of venture capital are emerging e.g. incubators are having an impact, and this is due to personal wealth and international investors. The regulators want to ensure that venture capitalists adhere to the right professional standards.”

In the last decade, the UK venture capital scene has changed a lot, and now, instead of there being an aversion to technology involvement, between a third and a quarter of new fund allocation is to the technology sector. To illustrate, in the Cambridge area alone, there are over 1, 500 young, small high-technology companies, all anxiously seeking to secure venture capital funding, with varying degrees of success. Corresponding to this new enthusiasm for involvement by venture capitalists in a more risky type of investment deal, has been a development in their methods and practice. The broader purpose of this article is to explore this development.

3. Risk in High Technology Ventures

New high-technology ventures are troublesome business propositions. Certainly, they involve high ‘business risks’ (caused by an uncertain competitive environment) and high ‘agency risks’ (caused by incomplete alignment of investor and investee interests). They also, singularly, involve high ‘innovation

risk' (caused by ignorance of what value new technology can create, and when). The first two, to some extent, and the last, to an almost exclusive extent, are not amenable to standard methods of risk appraisal (which appeal to the so-called 'frequency limit principle'). However, when one is dealing with essentially new events (of which an innovation is an example) the notion of frequency limit becomes irrelevant. This is especially true of 'innovation risk', because there is no statistical track record to appeal to for completely new technologies. The computation of actuarial risk is therefore just not possible (as it is, for example, in C-V-P analysis, see Ezzamel and Hart (1987, Chapter 8).

Instead, subjective appraisal of risk is necessary. This may appeal to evidence like the best available yardstick comparisons (e.g. related technologies), and to expert evaluations made by technology specialists. Then, assigning new technologies to risk classes (e.g. high, medium, low) may be the best that can be done, though the subjective (rather than statistical) assigning of numerical probabilities, with the usual properties, is also possible.

In Murray and Lott (1995) it is suggested that UK investors are reluctant to back new technology-based firms. These authors believe that high-technology investments make more demands on risk management capabilities than other investments [see also Murray (1995)]. As a consequence, higher (risk adjusted) IRR thresholds are set for investments in new technology projects, than elsewhere. Thus hurdle rates of return as high as 40 per cent, or even more, can be set. It seems UK investors use, at least, different, perhaps more exacting, criteria in investment appraisal than their US counterparts. Such conduct is

supported by the evidence that they allocate proportionally far less (perhaps as little as a third) venture capital finance to new technology-based firms, compared to US investors.

4. Research Methodology

For the purposes of this article, the three initial stages of our research involved: a) unstructured, preliminary, qualitative field work; b) the determining of an appropriate sampling frame for selecting our sample of venture capitalists; and c) the designing of an administered questionnaire schedule, suitable for face-to-face interviews with investors, based on the extant risk and venture capital literature. The final, and substantive stage of the research involved interviews with venture capitalists, in the field, working through the agenda of the questionnaire schedule, with one researcher as interviewer, and the other as rapporteur. A detailed consideration of how these stages were undertaken would be too extensive to report upon here, so the treatment below will be brief.

We derived early benefits from making our first approach to the institutions mentioned above, like the BVCA and 3i. The acceptance by the likes of the BVCA and 3i of the legitimacy of what we aimed to do, made them valuable ‘high communicators’ in the network of UK venture capitalists. In seeking ‘ports of access’, the authors also benefited from both their previous acquaintance with major players in the UK venture capital world, and their earlier success in making contact with target individuals and eliciting their co-operation. Investors were selected by determining, from the VCR Guide (2000), which UK

investors were active in high-technology deals, and then making a random selection from this list.

The instrument with which the investors were investigated was an administered questionnaire of the semi-structured interview format. This involved working through an eight point agenda, of which respondents had prior notice. Previous work on risk appraisal in a venture capital context [Fiet (1995)], using US data, has used a postal questionnaire. Although this has convenience and economy to recommend it, our intention was that a custom designed questionnaire should be administered in face-to-face interviews with investors (and, at later point, investees). It was felt that use of face-to-face interviews has major advantages over the postal questionnaire method, see also Sapienza (1989). It avoids a variety of serious non-response biases, particularly on the venture capital side, and also facilitates a more ambitious and thorough investigation of how types of risk are handled.

Concerning risk analysis, a considerably more refined approach is possible, compared to those available using postal surveys. Probably most important is the avoidance, wherever possible, of the more technical terms of risk analysis in the questionnaire itself, a weakness of previous work in this area. Such specialist terms (e.g. 'degree of risk aversion') have many ramifications, few, if any, of which are likely to be familiar to the respondent. An appropriately designed instrument should seek to elicit data on the subject matter with no requirement that the respondent understands the disciplinary base of the investigation. On the other hand, one is frequently dealing with relatively

sophisticated business personnel in interview contexts, many of whom are trained in economics, accountancy and cognate areas, so the depth of discussion can be quite considerable. Both concrete data on risk handling should be gathered, as well as attitudinal data. For example, one is interested in both concrete facts like ‘which variables are used in sensitivity analysis?’, and also in attitudinal variables like ‘how important is staff morale to risk appraisal?’.

A significant aspect of the novelty of such research work is embodied within the questionnaire design itself. Such work should be ‘state of the art’, in terms of reflecting the current literature, yet free of any assumption that the respondent is familiar with the terms of reference of the enquiry. With the exception of work by Ruhnka and Young (1991), little attention has been paid to the analysis of risk management in venture capital contexts, so there is not much to guide us in the explicit format of our instrumentation. This article aims to help to remedy this deficiency in the literature. Reid (1998) provides the base from which this further work is undertaken. In approaching the problem of designing new instrumentation, the authors were able to draw on considerable prior experience in prototyping, piloting and constructing successful administered and semi-structured interview schedules [Reid (1993, 1998), Smith (1997)].

Also of relevance to instrument design is the distinction between ‘hard’ and ‘soft’ analysis. Both types are relevant to our work. For example, we ask the investor what variables are used in the sensitivity analysis she applies to her model of the business. This is a type of ‘hard’ analysis. We also ask the investors how she goes about determining a ‘reference point’ or ‘base case’ of

what she expects to happen. This is a type of ‘soft’ analysis. As in previous work by the authors on risk in the UK venture capital industry, we aim to combine such ‘hard’ and ‘soft’ analysis, see Reid, Terry and Smith (1997).

5. Results

The instrument developed for gathering information from investors was a semi-structured questionnaire. This took investors through an agenda which covered: risk premia; investment time horizon; sensitivity analysis; expected values; predicting cash flows; financial modelling; decision making; and qualitative appraisal. Over eighty numerical responses, and over forty qualitative (text) responses were generated by this instrument.

Given editorial space limitation on the length of our article, we have focused on the first three agenda headings, Risk Premia, Investment Time Horizon, and Sensitivity Analysis. As appropriate, though, we have also drawn on evidence appearing under later headings, when such cross-referencing makes analytical sense. Our findings are preliminary in form, but already do seem to indicate some notable features of the evidence gathered. As an overarching principle, we have tried, wherever possible, to refer to the general categories of ‘agency risk’, ‘business risk’ and ‘innovation risk’.

5.1 Risk Premia

A risk premium is defined in our schedule as the additional return which an investment must offer, to compensate investors for accepting the additional risk. A clear majority, 84 per cent of the respondents, said that they did attach risk

premia to their discount rates. However, when they did so, the cost of capital was not usually used as a reference point. Indeed, only 33 per cent used the cost of capital as a reference point. The reason for not proceeding in this way was usually something like having considerable ‘head room’ in the risk management plan, which made cost of capital play a minor part. The actual methods used in determining risk premia varied, but the following explanation is quite typical: “We do it on the basis of IRR calculations. Early-stage technology companies require a higher rate of return ... you’re looking at about 60 per cent per annum. We double the IRR because we’re in a high risk sector”. This quote anticipates the use of the idea of a risk class by investors, and also makes clear that when the ‘innovation risk’ is high and compounded with early stage involvement, the required rates of return reflect high risk premia.

In the interview schedule, risk classes were defined as categories of similar degrees of risk, into which projects could be grouped for effective risk management. Investors were asked if they recognised investment opportunities as lying in risk classes, and if they used such classes for setting risk premia. Nearly all investors (95 per cent) identified their investments as lying in such risk classes. A common response was “we would do it by stage of investment”. Another was “we’d look at risks in specific areas - for example, technology, market and manager (people) risk”. The last quote is particularly telling, making reference, in effect, to our chosen three risk categories viz. ‘innovation risk’, ‘business risk’, and ‘agency risk’.

FIGURE 1 ABOUT HERE

This way of proceeding is borne out by the responses to an additional, attitudinal question (see results in Figure 1). This required investors to refer to their experience of the high technology area. It asked them to assess, on a six point Likert scale [Oppenheim (1992, Ch. 11)], from low = 0 to high = 5, how risky they thought certain investment types were. On the schedule, these were ordered as follows: seed, start-up, other early stage, expansion, MBO, MBI, turnaround, replacement, follow-on. Average scores, for the perceived risk of each investment type, are indicated by the length of the horizontal bars in Figure 1.

Seed-corn, start-up, and turnaround were ranked by investors as being the three most risky investment involvements, in that order. Why this is so, is suggested by theories of both venture capital investment [e.g. Chan (1983), Chan et al. (1990)] and of entrepreneurial firms [e.g. Jovanovic (1982), Frank (1988)], which emphasise the importance of market experience. The entrepreneur learns to run her firm by doing it, and her learning curve can be quite steep. In the start up phase, the learning process has scarcely begun, and the entrepreneur is least equipped to handle unexpected shocks to the firm. Further, the investor has little evidence to go on, in evaluating the fitness of the entrepreneur, and no experience of aligning her interests with his own, so agency risk is high. Thus seed-corn and start-up are perceived to be especially risky. Turnaround also appears to be high in risk, because it is usually associated with the poor earlier performance of a firm, and the need for its radical re-structuring, in order to improve performance.

The converse side of the coin, is that the MBO is seen to be by far the safest investment type, involving as it does, ample evidence of what the company can do, and who will run it. Logically, the MBI, which involves a bit more of a ‘shot in the dark’, in bringing in a new team, is ranked as being more risky than the MBO. Follow-on investment had a mixed response. On average, it ended up having a fairly low perceived risk. But, as several investors observed, ‘it all depends on the follow-on’. That is to say, follow-on is not intrinsically less risky than other investment types; it is more that risky follow-on opportunities will tend to be rejected by investors. A similar remark was also made about replacement capital, which although being appraised as having relatively low risk (on average) was thought to be potentially highly risky, in certain critical replacement situations.

Following some discussion in the interviews about the risk-return relationship (not reported here), investors were then asked to consider the importance (on a six point scale of 0=low to 5=high) of the many factors which might be important to their risk appraisal of an investment opportunity. We presented fifteen factors for investors to consider in this way. These included: market opportunities, the global environment, the local environment, the quality of the proposal, the management model, the business model, the sales model, the scale of the business, and so on. They were presented in that order in the interview schedule. The results of this part of our enquiry are given in Figure 2. The length of a bar indicates the average, across of investors, of the perceived importance of the fifteen factors. It will be noted that this rank order by

importance is very different from the rank order of factors listed in the interview schedule.

FIGURE 2 ABOUT HERE

The management team was thought to be, on average, the most important factor (first ranked) in the risk appraisal of an investment opportunity. Other related factors of importance were: the extent of motivation and empowerment (third) within the potential investee company; and employee capabilities (fourth). This suggests that agency risk comes high in the overall risk appraisal. Broadly speaking, agency risk arises from the operation of superior/subordinate relations between people within a firm. The management team drives the direction of the firm, but the success or otherwise of their actions depends on their skills, in the face of incomplete information and uncertainty, and on the compliance of the employees with managers' wishes.

In turn, there is an agency relationship between the investor and investee (owner-manager), involving similar forces, see Reid (1996, 1998, 1999). If the management in place in the investee firm were not thought to be appropriate, then the investor would often reserve the right to make changes as and when necessary, Chan et al. (1990). In the post-investment phase, the prospect of moral hazard might arise in the relationship between investor (as principal) and the investee (as agent). One way of attenuating the effect, which arises from the desire of the investee to push all the risk on to the investor, post-investment, is to extend the frequency and range of information about investee activity that the

investor requires, see Mitchell, Reid and Terry (1995, 1997, 1999). Our evidence suggests intense post-investment scrutiny to manage ‘agency risk’. Under the interview agenda heading of ‘predicting cash flow’ 72 per cent of investors said they modelled inter-relationships between variables. Further, 95 per cent then used these models for planning. As one investor put it: “We do a lot of investment monitoring - especially where the funds are investing. We’re always working with the managers very closely. We measure profit against initial financial projections.” Such models were used by 83 per cent of investors to estimate the future profitability of the firm; and of these, all used it to influence the firm’s long-run strategy. In pursuing the modelling side, investor and investee often worked together. As another investor put it: “The assumptions you input to produce the model are assumptions about how the business will run. It’s an interactive process.”

Also of note in Figure 2 are the relatively high importance, for risk appraisal, of factors like: market opportunities (second); the business model (fifth); the quality of the proposal (sixth); and the sales model (seventh). All these factors relate to ‘business risk’, which arises from the uncertainty of market opportunities, and, therefore from the uncertain future value of the business. Further risk elements of this sort arise from the relatively untested ability of the investee (as compared to rivals) to exploit these market opportunities, in the face of competitive pressure. The business and sales models, and the quality of the proposal should help the investor to gauge how strong the investee firm will be when competing head-to-head with rivals. These factors, along with the analysis

of market opportunities, will show how well adapted the investee firm will be to action-reaction effects, of an oligopolistic nature, in the market place.

In undertaking analysis which relates to the ‘business risk’, the use of ‘sensitivity analysis’, as dealt with third in our interview agenda, is also important. As one investor put it: “From market assessment you can work out what a reasonable revenue and cost line would be. Management as a whole does the market analysis and we take a top down approach. We tend to be quite rigorous in doing a careful analysis of the market.” That is, the handling of ‘business risk’ involves an interaction between investee and investor, as in the handling of ‘agency risk’. In a similar vein (as we discovered while posing questions under the ‘cash flow’ interview agenda heading) the desirability of having a positive interaction between investor and investee, in order to handle ‘business risk’ better, is well recognised. A typical investor comment reflecting this is: “What you try and handle is your response to the ‘catastrophic’ things when they come up. There’s a lot you can do to help the company cope with what might happen. You might put two non-executive directors on the Board instead of one, for example.”

To conclude: that ‘agency risk’ (the management side) and ‘business risk’ (the market side) are important, is evident from the responses given in Figure 2. It is also backed up by qualitative evidence. Typical of the comments made by investors was the following, which was also uttered when we were making enquiry under the ‘cash flow’ part of the interview agenda: “The key things for us are the management team and the market - hopefully a global market”.

5.2 *Investment Time Horizon*

The section of the interview schedule (the second) that dealt with investment time horizon started with a definition. It defined the payback period as ‘the length of time it takes to recover the initial cash outlay on an investment from its cash flow returns’. Just over half (53 per cent) of investors said that they took account of payback periods in their investment decisions. On average, they would be looking for their investment to payback within thirty-two to fifty-one months. Time horizons, which were generally thought to be important, tended to be mentioned in the context of stage and/or technology. One investor explained his long time horizon by saying he adopted it: “because it’s early-stage and it often takes that long before it’s successful and proving itself. Even if it floats, you’re often locked in for one or two years”. Another investor considered the issue of time horizon *and* technology together, explaining his approach by saying: “we expect money back in year 6, 7 or 8. If you had an early-stage technology company you could probably exit in a year to 18 months. But we believe that technology investments will have a longer time horizon and need more money - maybe two to three years to payback.”

‘Innovation risk’ was often thought to be very high, *cf.* Murray and Lott (1995). Eighty four per cent of investors said they would back off if the investment were perceived to be too risky or (usually an equivalent notion) too complex. Complexity was often interpreted as ‘too novel a technology to be able to understand its potential’. As one investor put it, he backed off from an

investment opportunity “when we can’t comfortably model it, and get our heads round about where the business is going to go.”

One method which investors used in dealing with high ‘innovation risk’ was to scrutinise the profile of returns, and modify investment conduct in the light of its shape. As one investor put it: “If we saw a return in 18-24 months we’d want to double or triple the investment. In 6 years we’d want 10 times - we have to see the capacity to multiply our investment.” Further, if there were an element of investment ‘lock-in’ to the technology, a higher return would be expected. Reflecting this, another investor said: “If we’re going to be in there for longer we’d be looking for a better multiple. From the outset, if you were expecting to be in there longer, you would be expecting a higher multiple.” Under the seventh agenda heading of ‘decision making’ in the interview schedule, a related type of reference was made to timing issues. A rational way to handle ‘technology risk’, could be to defer investing, and to wait and see where the technology is going. Exemplifying this approach was the investor who said: “take the Internet - the people who held back and looked at the market will have made a sound decision.” A similar comment by another investor, in the same context, was: “We might be looking at a possible investment which we would put on hold until we’d had a peer review of the individual and the research he intends to use.”

5.3 *Sensitivity Analysis*

In the interviews with investors, the use of ‘sensitivity analysis’ was explored under our third agenda heading. It was defined by saying that it ‘tests how a

project's expected outcome (e.g. NPV, IRR) changes in response to changes in project variables (e.g. sales, price). It aims to identify the variables which have most effect on the expected outcome'. Our interest was in how models used to evaluate the potential value of risky high technology investments were subjected to tests of robustness. We found from our enquiries into modelling (the sixth agenda item) that ninety per cent of investors constructed an explicit model of the firm, and this was generally spreadsheet-based. Essentially, we wanted to know how sensitive these models were, to the assumptions used, and to the values of key parameters. The initial question we asked investors was: how important is use of sensitivity analysis to the investment decision. Again, 'importance' was calibrated using a six point Likert scale (from 0=irrelevant, 1=unimportant to 5=very important). The average value of responses to this question, across all investors, was 3.6. That is to say, sensitivity analysis was perceived to be important.

Investors were also asked how widely they let variables range in their sensitivity analyses. We found that variables were allowed to range from between 15 per cent to 50 per cent, with an average range adopted of 34 per cent. In other words, quite severe tests of robustness were implied by the variations which investors typically imposed in their sensitivity analyses. There was keen awareness that sensitivity analysis was necessary for checking the robustness of the models used. Thus one investor said: "We would look at reasonably wide variation. We know from experience that people don't always get their forecasts right." Elsewhere (in the part of the interview concerned with modelling) it was made clear that sensitivity analysis was put to other uses as well, of which

scenario analysis was important. One investor suggested it was not that any faith was put in specific predictions from models, but rather that: “It’s more the scenarios - how they would propose to do it, then we tear it apart and propose a different model”. In a similar, but less radical way, another investor said: “It’s scenario-based. Maybe a downside case, and sometimes an upside case.”

We also asked investors what variables they used in their sensitivity analyses. Here, to judge by our qualitative responses, choice of variables could vary widely. This seemed to depend on the type of market in which the investee firm was active, and on the ‘technological intensity’ of their firm. One brief reply, emphasising ‘business risk’ was from an investor who said: “Revenue – it’s almost all top line. We sensitise and push it through. Time horizon. Costs are not normally the key driver as they tend to follow the revenue.” Another investor gave a more detailed reply, emphasising ‘innovation risk’, when asked what variables were used in sensitivity analysis. This investor said that what counted was: “Whether or not the technology or drug either succeeds in getting to market or to the suitable stage at which we would exit. I guess the technology can either succeed ‘to plan’, take longer, or fail. The main sensitivity is: what would happen if it failed? We could factor it in, taking longer. If it hits problems and takes longer, it probably means it will need more money. Do you raise more money and dilute what you put in at the beginning?”

Finally, investors were asked if they constructed their sensitivity analyses around a ‘reference point’. There was general assent to this, with 89 per cent of investors saying that they performed the sensitivity analysis around a reference

point, or 'base case'. However, the methods of constructing base cases were diverse, to judge by the qualitative evidence we gathered on this issue. They seemed to reflect different 'house styles' or 'investment philosophies'. This was partly dependent on the technology or the sector which the investor usually handled. One detailed response was as follows: "Base case? From market assessment, you can work out what a reasonable revenue and cost line would be. Management as a whole does the market analysis, and we take a top down approach. We tend to be quite rigorous in doing a careful analysis of the market. Early-stage, financial analysis is not the driver. The most crucial work we do is commercial analysis."

This quote emphasised the importance of managing 'market risk' and 'agency risk'. Another quote, a reply by a different investor to the same enquiry, emphasised 'innovation risk'. When asked what factors were taken into account in constructing the 'base case', he said: "Some of the issues we have discussed – the complexity of the technology, the extent to which we have a clear field through intellectual property, the extent to which other people have products which could compete. We wouldn't expect to get into areas where there was just an incremental improvement. We want a novel technology. There's a downside of getting that wrong. [Interviewer interjection, saying: "Do you refer here to a radical technological change?"]. It's not a term we use, but we probably would, if we were economists." These nuggets of qualitative evidence display well how, in practice, all three categories of our categories of risk are managed, 'business risk', 'agency risk' and 'innovation risk'.

6. Conclusion

The purpose of this article has been to introduce new evidence on the risk appraisal of high technology new ventures in the UK. Here, we focussed on the venture capital investor. The article developed the evidence under the headings of risk premia, investment time horizon, and sensitivity analysis. The organising principle of the analysis was a decomposition of total risk into ‘business risk’, ‘agency risk’ and ‘innovation risk’. This organising principle generally encompassed the evidence found under each agenda heading.

Acknowledgements

This research has enjoyed the support of the Research Foundation of the Chartered Institute of Management Accountants (CIMA), to whom grateful acknowledgement is made. This article was prepared for the Workshop on Performance Measurement and Management Control, EDHEC School of Management, Nice, October 2001, and we are grateful to the British Academy for providing sponsorship to enable the authors to attend the meeting. We should also like to thank the numerous investors and related personnel in the UK venture capital industry for so generously giving us part of their scarce time. The authors remain responsible for all the views expressed in this article, including any errors of omission or commission that it may contain.

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Figure 1

INVESTORS' ATTITUDES TO RISK

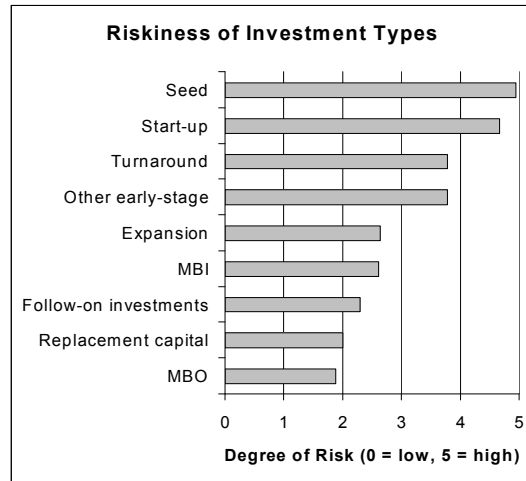


Figure 2

MOST IMPORTANT FACTORS IN RISK APPRAISAL

