

Mixed signals: Why investors may misjudge first-time high technology venture founders

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Abstract

This paper seeks to explain an unexpected result of a previous quantitative study which suggested sub-optimal evaluation by investors of the human capital of first time high tech venture founders. A literature review revealed two possible reasons for this finding: biases/heuristics and signaling. Six investors across three countries (one venture capitalist and one business angel each from the US, UK and Israel) with experience in investing in early stage high technology ventures were interviewed using an identical semi-structured interview protocol. This research design is appropriate for research that seeks to reflect back unexpected findings of previous quantitative research on the subjects of research. Interviewees were first asked to state their own investment criteria, and then presented with the results of the quantitative study and asked for their views. Previous research suggesting a gap between in-use and espoused criteria, and extensive use of gut feeling in decision-making, was supported. Interviewees focused on harvest potential and de-emphasised measures of founder technology capability that predicted early survival and growth in the earlier study. The paper concludes by suggesting how investors might improve funding decisions in high tech ventures led by first-time entrepreneurs, noting the study's limitations and making recommendations for further research.

Keywords: investor decision-making, biases and heuristics, signaling, human capital, first-time founders, high technology ventures

Introduction

The subject of this paper is how investors in early stage high tech ventures make investment decisions, with special emphasis on *why* investors may misread the technology capability of first-time venture founders. The subject of *what* criteria venture capitalists (VCs) use in investment decision-making has been extensively studied for decades (Wells 1974; Poindexter 1976; Tyebjee and Bruno, 1984; MacMillan, Siegel, and Subbanarasimha 1985; MacMillan, Zemann, and Subbanarasimha 1987; Bygrave and Timmons 1992; Fried and Hisrich 1994; Wright, Robbie, and Ennew 1997; Zacharakis and Meyer 1998; Zacharakis and Shepherd 2005; Zacharakis, McMullen, and Shepherd 2007). Studies have also been conducted on the investment criteria of business angels, another major category of equity investor in new firms, though not as extensively or for as long (Wetzel 1981; Haar, Starr, and MacMillan 1988; Mason and Harrison 1996; van Osnabrugge 1998; Feeney, Haines, and Riding 1999; Mason and Stark 2004; Sudek 2007). In this paper, we seek to explain a puzzling finding in a quantitative study of investment by VCs and business angels in early stage high technology-based firms founded by first-time entrepreneurs nurtured in the Israeli Technology Incubator Programme. That research (Gimmon 2006) suggested that investors ignored certain aspects of human capital that appeared to predict early survival and growth, while selecting on another signal of human capital that the same research found not to have any significant effect on early survival and growth.

Essentially this paper reports on the second stage of a mixed-method study the first stage of which was quantitative research that produced some unexpected but interesting results (Gimmon 2006). We summarize the first stage results below and then focus on the second stage which is qualitative in nature. Thus our research design fits the third of four possible

mixed methods designs as outlined by Morgan (1998: 369-370). Morgan commented on this design as follows:

‘Here, the qualitative methods typically provide interpretive resources for understanding the results from the quantitative research... For example, if the results of a survey contradict the original hypotheses, it may make sense to seek an explanation from the respondents who provided the data rather than engage in isolated speculation about what went wrong.’

According to Morgan, such research designs ‘are increasingly common among survey researchers, who use follow-up interviews to expand on what was learned from the analysis of their questionnaires’.

Qualitative follow-up studies of quantitative research findings are relatively rare in the management literature (for recent exceptions see Veryzer 2005; Burgess, McKee, and Kidd 2005; Loane, Bell, and McNaughton 2006; Alkaraan and Northcott 2007). However, they have been conducted in health research for some time (e.g. Ornstein et al. 1993; Stange et al. 1994) to investigate why health interventions did not work as expected. There is a direct correspondence from the health research context to the context of the current study, in which investment decisions (analogous to patient response) within a certain controlled context (analogous to treatment) did not operate as expected. In our case, the findings of a quantitative study suggested that investors were missing valuable cues to relevant human capital, but the reasons why were not readily apparent from the quantitative data.

By directly interacting with individuals that are the subject of the study, we aimed to gain their reflections on the research findings, and on our interpretations of the findings, and achieve a resolution of what Morey and Luthans (1984: 28) call the ‘insider’s view’ and the ‘outsider’s’ view of a phenomenon, resulting in a plausible explanation for the original unexpected findings, ‘based as much as possible on the perspective of those being studied’

(Elliott, Fischer, and Rennie 1999: 215). We also wished to find out if the phenomenon might exist beyond the original sample context.

In the next section, we review the literature on investor decision-making and briefly summarize the results of the quantitative study in order to set the stage for the qualitative follow-up study that is the main focus of this paper. We then outline the methodology we used to reflect on the first stage results with investors, which consisted of in-depth interviews with multiple investors chosen using a replication logic. Next, we described the results of the interviews. Finally, we discuss the results and conclude with recommendations for investors and for further research.

Venture investor decision-making

Research on decision-making by investors in early stage ventures is complicated by the finding that ‘espoused’ criteria may not match ‘in-use’ criteria (Zacharakis and Meyer 1998; Shepherd 1999). This may be one reason for the divergence of views in the investor decision-making literature about the relative importance of the entrepreneur and the market as investment criteria¹. Some researchers and investors have argued that the capabilities and the attitudes of founding entrepreneurs are critical factors in the performance of new ventures (Rock 1987; Hart, Stevenson, and Dial 1995: 92; Greene, Brush, and Hart 1999) and in investors’ decisions (MacMillan, Siegel, and Subbanarasimha 1985; Muzyka, Birley, and Leleux 1996; Sudek 2007). Others suggest that VCs seek good industries (Zider 1998) or good markets (Zacharakis and Meyer 1998) over good people. There does seem to be general

¹ Another reason may be that the relative importance of different criteria may shift over time.

We discuss this further in the concluding section.

agreement, however, that judging the quality of the entrepreneur is difficult for VCs (Kozmetsky, Gill, and Smilor 1985; Zacharakis and Meyer 1998; Smart 1999). For example, Bygrave and Timmons (1992: 6) quote the veteran venture capitalist Arthur Rock as saying ‘nearly every mistake I’ve made has been in picking the wrong people, not the wrong idea’. In another example, the Silicon Valley VC Michael Moritz of Sequoia Capital, in an interview for the business newspaper *Globes* (Feldman 2005: 12, our translation), indicated that ‘VCs have great difficulties in a-priori evaluation of entrepreneurial characteristics and thus quite often they make mistakes in relation to these judgments’. In summary, evaluating entrepreneurial human capital is a vital skill for investors, but investors recognise their failings in this area and therefore more research is needed (Smart 1999: 72; Barney, Wright, and Ketchen 2001: 634; Riquelme and Watson 2002: 395).

The literature provides two possible theory-based explanations for suboptimal judgment of human capital by investors: use of biases and heuristics (Tversky and Kahneman 1974; Zacharakis and Shepherd 2001) and signaling (Merton 1968; Spence 1974; Levy and Lazarovich-Porat 1995; Podolny 2005). They are reviewed separately in the next two subsections.

Biases and heuristics

It has long been asserted that VCs often rely to a large extent on their intuition (Dominguez 1974), and recent research suggests that angels do too (Sudek 2007). VCs may match proposals to past successful or failed investments, demonstrating an ‘availability bias’ that can lead to overconfidence in evaluating new ventures which may lead to wrong investment decisions (Zacharakis and Shepherd 2001). Even highly experienced VCs may be susceptible

to various forms of bias and error due to their intuitive drive and heuristic processing (Shepherd, Zacharakis, and Baron 2003). These research findings fit with theories of bounded rationality (Simon 1955) and psychological economics theory (Tversky and Kahneman 1974; Kahneman and Riepe 1998: 53). Biases and cognitive illusions in intuitive judgment such as overconfidence, optimism, hindsight, and overreaction to random events could cause financial investors to disregard certain types of human capital and pay attention to other types that might have no value in that context. Zacharakis and Meyer (2000) suggested that research-based actuarial models could aid investors to avoid such problems and thereby improve their decision-making.

Signaling theory

Founders communicate and signal their human and other forms of capital to financial investors in order to attract funds for their ventures (Busenitz, Fiet, and Moesel 2005), although they may not be aware which signals are important to investors and which are not². For their part, VCs and business angels encounter information asymmetry problems when evaluating investment opportunities (Mason and Stark 2004). Economics-based signaling theory (Spence 1974) has been used to explain why financial investors use indirect measures of risk, such as founders' own financial investment in the venture, as 'signals' of risk when more direct measures of risk are absent (Levy and Lazarovich-Porat 1995). It could also be used to explain why VCs prefer serial entrepreneurs (MacMillan, Siegel, and Subbanarasimha 1985; Wright, Robbie, and Ennew 1997). Founders could create false signals, however, or

² This is suggested by the remarks of many commentators on the VC scene who decry the poor quality of many pitches and business plans. As an example, Guy Kawasaki (2004: 45) attributes his tinnitus to 'listening to thousands of lousy pitches'.

investors could choose inaccurate signals. Indeed, some studies have shown no particular performance advantage of serial entrepreneurs over inexperienced entrepreneurs (Birley and Westhead 1993; Wright, Robbie, and Ennew 1997; Westhead, Ucbasaran, and Wright 2005). One way in which investors can minimize false signals is to deal with entrepreneurs they know. Both Shane and Stuart (2002) and Hsu (2007) found that prior links with VCs increased the chances of an entrepreneur receiving VC funding. This seems to fit sociology-based signaling theory, which emphasises the social character of economic exchange under conditions of market uncertainty (Podolny 1994) and reinforces the view that assessing entrepreneurs is a real issue for investors.

What do investors do if they are faced with a 'market' of only first time entrepreneurs of early-stage high technology ventures? Such a market would be a very uncertain one, as the investor could rely neither on previous start-up experience of the entrepreneur, nor previous venture investment experience with the entrepreneur. This leaves social status as a possible signal of legitimacy (Shane and Khurana 2003: 520). Podolny (2005: 18) has proposed that 'the greater market participants' uncertainty about the underlying quality of a producer and the producer's product, the more that market participants will rely on the producer's status to make inferences about quality'. If Podolny's hypothesis is correct, and if the investor's chosen measure of status does not reflect entrepreneurial capability, then the investor is likely to make sub-optimal investment decisions. On the other hand, investment in high status individuals may have a self-fulfilling, or 'Matthew' effect (Merton 1968; Podolny 1993; Podolny and Stuart 1995), in which status attracts resources which then increases the likelihood of success.

Hsu (2007) found that in a sample of early stage technology-based start-ups in the emerging Internet industry, teams with a doctorate degree holder were significantly more likely to get VC investment and receive higher valuations. Hsu interpreted this as a signaling effect. Signaling theories tend to be ‘difficult, if not impossible, to test empirically’ (Levy and Lazarovich-Porat 1995: 39) because of the difficulty of holding all other parameters constant. However, Gimmon (2006) conducted a study in which many of these parameters are held constant. His sample was 193 high-tech new ventures, a 20% random sample of ventures nurtured in the Israeli Technology Incubator Programme between 1991 and 2001³. This sample offered a good test of the hypothesis that in highly uncertain markets, market participants rely on status as signals of quality, for two reasons. First, the criteria of entry to the incubator system were that the participants were first-time entrepreneurs and that the technology was new and its commercialisation potential uncertain. Second, search for external funding was mandated as part of the incubation process, and the participants were required to leave the incubator after two years. Thus the socialisation process with investors was to a considerable extent equalised by the incubator system⁴.

Gimmon (2006) found that financial investors (both VCs and angels) were not significantly more or less likely to invest in ventures where the founders possessed certain forms of human capital that positively affected venture survival and growth⁵, such as being a technologist, bringing one’s own technology to the venture, and having transferred the technology to

³ For a comprehensive introduction to the Israeli technology incubator programme and high-tech VC in Israel, see Avnimelech, Schwartz and Bar-El (2007).

⁴ The study controlled for geographical location of the incubator.

⁵ The mean time span for the sample firms (including those that had died) from the time of entry to the incubator to the outcome measurement was seven years.

others. However, investors were significantly more likely to invest in ventures whose founders possessed high academic status, specifically a PhD degree or the title of Professor. Yet academic status had no effect on survival and growth during the period of study.

While selection on the basis of status symbols finds a plausible explanation in signaling theory for this particular sample⁶, what is less readily explainable is why investors did not select more explicitly on the founder's technological expertise, given the early commercialisation phase of these ventures. In this paper, we seek answers to this puzzling result. One possibility is that the investors may have assumed technological ability from academic status. Yet the technology on which a venture is founded may not necessarily have any connection with the founder's PhD thesis topic. To give an example, the results suggested that within the Israeli Technology Incubator system, an individual starting a high-tech business who had a PhD in economics but had not developed the technology on which it was based would find it easier to raise money than a Masters level engineer who had developed the technology and managed to licence it for another application. Another possibility is that technological capability had a low priority among the investors. Both of these possibilities pointed to sub-optimal decision-making, given the results of the quantitative study.

⁶ It is possible that status-based selection may have been made with a view to long term value, because status may confer advantages such as easier access to other high-status individuals and organizations (Podolny 1993; 1994; Podolny and Stuart 1995). However, this does not alter the main puzzle which is why would investors ignore easy to measure signals of specific technological capability. Furthermore, those with high academic status were slightly more likely to be immigrants, mainly from Russia (the correlation coefficient was 0.256, $p < .05$) and thus likely to have less local links to high status individuals and organizations, not more.

In addition to asking why might investors follow signals such as academic status while ignoring other, easily measured, factors that enhance survival and growth, we also wondered if this phenomenon was wider than the rather special situation of the Israeli Technology Incubator Programme. Given the practical implications of this issue for investors, we followed the logic of the quantitative → qualitative mixed methods research design (Morgan 1998) to see what investors from different backgrounds would think of the results, and what they made of our interpretations. In the next section, we explain how we did this.

Methodology

To explore reasons why investors might ignore cues of human capital, we opted for a qualitative methodology using data gathered from intensive semi-structured interviews with investors chosen on a replication logic, similar to the logic used in the multiple case method (Eisenhardt 1989; Yin 2003). This interview data is not as rich in overlapping or redundant data as a typical in-depth case study, grounded theory-based piece of research (Flyvbjerg 2006). This is because we were following the multi-method, quantitative → qualitative approach (Morgan 1998), in which the purpose of data collection in the qualitative phase was to gather investor's stated views on the earlier research, not to document their in-use criteria, as that had already been done in the quantitative study. We did however follow the general logic and protocol of multiple case designs (Yin 2003) in which replications are conducted under different experimental conditions to see whether the findings could still be duplicated. Accordingly, we sought maximum variation (Flyvberg 2006) along multiple investor characteristics between the cases, while holding the specific context of early stage technology venture investing constant. If early stage technology venture investors from a wide range of backgrounds accorded with our interpretation of the findings of the quantitative study, this

would increase the plausibility of the interpretation. On the other hand, if a wide variety of different explanations were offered, we would need to rethink the interpretation of the quantitative findings.

Prior to the interviews that contributed the data for this paper, we conducted a pilot in which two VCs and two angels were interviewed. The results of these pilot interviews were not included in the current study, but they helped us to form the question plan and to practice questioning investors. The replication logic then led us to choose six examples of early stage technology-based venture investors working under very different conditions.

We wanted to see if the phenomenon had wider application outside the Israeli Technological Incubator system, and so our basic selection grid has national context (US, UK, and Israel) as one dimension and type of early stage technology venture investor (VC or business angel) as the other. The three nations were chosen as they differ in size but all have relatively well-developed VC and business angel communities (Bygrave 2005). However, within this grid, we chose investors that differ from each other in many ways: by gender, experience, tendency to co-invest, industry preference, average amount invested, and whether the business model was equity-based capital gain or product income stream-based.

In all, ten investors were interviewed separately for one hour using the convenience sampling method outlined by Fried and Hisrich (1995) but within the grid of ‘three countries, two investor types’. We then selected six of these to maximise difference between investors without letting the sample size get so big that we would have to sacrifice richness for breadth in our reporting of results, as recommended by Elliott, Fischer, and Rennie (1999: 223) for qualitative studies that aim to uncover a general understanding of a phenomenon. The selection was also made to ensure a balanced sample (one investor of each type in each of

three nations). The final selection was made based on the characteristics of the investors, not on their answers to our questions. We did check to see if the findings would have been different had we reported on the full sample of interviews, by comparing data tables with all interviews to data tables with the smaller sample. No major differences were apparent.

Table 1 provides descriptive statistics on each investor. Appendix 1 lists the questions asked and the order in which they were asked. Respondents were told the study was on investment criteria in high tech ventures and were not sent information or papers on prior research in advance. We first used open-ended questions to elucidate their ‘espoused’ evaluation criteria generally, and then more specifically asked whether and how they assess the human capital of high tech venture founders in practice. Of course, we cannot know if they actually used these criteria in practice. The reason for asking for their criteria was so that we could confront them with the revealed, or ‘in-use’ criteria from the previous study after they had revealed their ‘espoused’ criteria, to stimulate discussion on the puzzling findings. We then presented the results of the quantitative study, variable by variable and asked the investors what they thought the reasons might be for these results. Finally, we presented some results of prior research (Shepherd 1999; Zacharakis and Shepherd 2001) on investor decision-making that underpinned our interpretation of the results, and sought their views. Shepherd (1999) had suggested a gap between espoused and in-use investment criteria and Zacharakis and Shepherd (2001) suggested that VCs rely on gut feeling rather than objective criteria. We put the latter two studies forward as possible explanations of the quantitative results, and asked for the investors’ views.

[Insert Table 1 about here]

The interviews were taped and transcribed. We then sought patterns in this textual data by looking for consistencies and inconsistencies in the explanations given by investors before and after the presentation of our results, by tabulating data and comparing responses across all respondents, as recommended by Myles and Huberman (1994) for cross-case analysis. The data in the tables are not intended to be interpreted as revealing associations between variables in a hypothesis-testing way. Rather, they are designed to reveal possible patterns in complex data from which explanations (theory) could be induced.

The methodology adopted here is different to previous methods used in this area, such as only asking VCs for their evaluation criteria, or simulation exercises that assume that VCs act alone in making decisions. In this study, patterns of actual investments made, reflecting true 'in-use' criteria (the findings of the quantitative study), were contrasted against espoused criteria which were previously revealed without prior knowledge of the quantitative study. Then, investors were asked to provide their own explanations for the findings of the quantitative study. Some of these findings conflict with their espoused criteria, reflecting the gap noted by Shepherd (1999). Others findings relate to decision variables that were not mentioned by the investors, perhaps reflecting the 'limited introspection' also noted by Shepherd (1999: 85). We hoped that this method of confronting 'espoused' with 'in-use criteria' would encourage deeper reflection than is normally observed in studies of investor decision-making (Zacharakis and Meyer 1998).

In the next section, we describe the espoused evaluation criteria of our interviewees, their explanations for the findings of the quantitative study, and their reaction to the findings of other research on investor decision-making, before discussing their implications for investors, entrepreneurs and further research in the final section.

Results

Espoused Evaluation Criteria

Table 2 shows the criteria that the interviewees stated they used to make investment decisions. They all mentioned one ‘most important’ criterion. Both US interviewees chose market potential as their number one criterion, whereas all of the other interviewees mentioned ‘the entrepreneur’ or ‘the management’ as their top criterion. Consistent with this, the US investors mentioned prior sales or significant client interest whereas the others did not. The US investors also mentioned directly or indirectly location as a criterion, whereas the other investors did not. Table 2 shows that there was no apparent difference between VCs and angels on what evaluation criteria were used.

[Insert table 2 about here]

Investors’ opinions on previous findings

Table 3 shows that while most investors agreed with the quantitative research findings once they were presented with them individually, there were some differences of opinion and some people agreed on the importance of criteria that they had not previously espoused. Only four out of six investors mentioned technological capability of the founder as an investment criterion in advance of the presentation of the findings. The US investors were not convinced about the importance of the founder being a technologist, with the VC adding the caveat that it was important for ‘super-high tech’. This may reflect the greater weight these US investors placed on the market rather than the initial management. As the US angel put it:

‘We’re looking to harvest investments not commercialise technologies, so we have to think about – OK the assumption is that this product will make it to the marketplace; now, will anybody buy it? Will somebody have the leadership to develop this firm?’

The US angel pointed out that possibly the lack of discrimination on this feature might be a result of the due diligence process, where assessment of the potential in the technology is separate from the assessment of management.

[Insert Table 3 about here]

Both Israeli investors disagreed with the quantitative research findings that founder’s tacit knowledge of technology was important, although the other investors tended to agree, even though only two of them (the US VC and UK angel) had mentioned it previously as an espoused criterion. The Israeli VC commented:

‘Tacit knowledge may be important in the short range, but not in the long range, moreover not for exit... Tacit knowledge is ‘nice to have’ but it does not relate to the founder’s execution capabilities which are more important.’

The Israeli angel stated that it may help but was not crucial, since founders can further develop other inventors’ work.

Investors tended to take issue with the quantitative research findings that academic credentials attracted financial investment, and their explanations of the findings conflicted. Some suggested that having a PhD might make a difference, especially if it was in a relevant domain, and professors might have value in R&D.

Whether the founder had transferred the technology to a third party was not mentioned specifically by the investors as a criterion, although the US investors did have prior sales as

an investment criterion and this could be seen as a type of sale. After being presented with the finding that this variable predicted survival and growth but not investment, investors tended to argue that this would be a bonus: ‘If a business has a licence, that’s great’ (UKAng).

Similarly with early sales and number of patents, only two investors (sales) and one investor (patents) mentioned these as espoused criteria without prompting, but in discussion of the findings of the quantitative study they all agreed that these were positive features.

Investors offered a range of other human capital features they looked for in the entrepreneur⁷. Both US investors mentioned the issue of succession and stated they explicitly looked for people who would be willing to recognise when it was time to step aside. As the US angel put it:

‘We are not particularly skilled at coming up with a good appraisal of their willingness to build a leadership team and step aside at the right time. If an entrepreneur smells the fact that coachability⁸ is important, they can hide that for a long time, surely until after they get the money. I think technology skills, especially for a PhD or someone are much more transparent. I mean, gosh you’ve written 20 papers let’s see if we can call around and see what we can find out about you.’

[Inset Table 4 about here]

⁷ The investors were also presented with findings on gender, age and origin/minority status, none of which significantly affected survival/early growth or investment. Most investors did not espouse these as criteria, although one had a preference for younger entrepreneurs, the Israeli investor practised affirmative action with female entrepreneurs and the two UK investors favoured immigrants.

⁸ A euphemism for acceptance of one’s management limitations and the need to step aside at a time that is best for the venture.

The pattern of responses in Table 4 suggests that the Israeli and UK investors were more likely to look for team players, but this may stem from similar concerns over the ability of the founder entrepreneur to grow a professional management team. As the UK angel said:

‘The big cause of failure has usually been personality issues, something with the team that started to crumble and fall apart. I think it’s because the entrepreneur tends to ride roughshod over others’.

The attempted solution in Israel and the UK, though, appeared to be to try to ensure the entrepreneur could grow a team, rather than the US investors’ approach which appeared to be to accept that the initial entrepreneur will probably have to be replaced and therefore look for a founder who was willing to accept this. Investor compatibility was also a general theme across the three countries and both types of investor. Some investors linked this to the subjective aspect of investment decision-making, and several noted that this took a long time to assess and was a ‘deal killer’.

Table 5 shows that, when presented with propositions drawn from three pieces of research: the Gimmon (2006), Shepherd (1999) and Shepherd and Zacharakis (2001) studies (corresponding to questions 1, 2, 3 of Section 4, Appendix 1), the investors were divided on the proposition from the first study but tended to agree with the propositions from the latter two studies.

[Insert Table 5 about here]

Investors were divided on the first proposition that investors often misjudge founders’ human capital, with three disagreeing with the proposition that investors often misjudge founders’ human capital, specifically the technological expertise of founders of high-tech ventures, one

agreeing, and two saying yes and no. Here is a selection of opinions that illustrate the diversity of opinions:

‘It’s a bit tricky. You just meet them a few times and get a bit of a feeling about their attitudes but you can’t really know how they are going to behave when their back is against the wall. You have got to take some of that on trust. That’s probably the trickiest thing actually is assessing the individual’.

(UKAng)

‘I think it’s easy. Studying the financials, that’s just made up. Studying the entrepreneur, there’s a lot of data to go on. I look for what they’ve done in the past, what other people say about them and I look a lot at how they deal with me as a potential investor as a potential board member. I have a little bit of a bias in that direction as I [have] a doctorate in psychology. How they try to sell me, work with me, how they respond, do they get defensive – all those kinds of things to me are just more data’. (USVC)

‘I think that by far and away the toughest piece of due diligence is trying to appraise the quality of the team and that hasn’t much changed much over time; it is a very time-consuming, difficult analysis. I think the more experience an entrepreneur has in starting and running companies the easier the due diligence is because there are more other investors you can go to and talk about. So I would say more experienced, serial entrepreneurs are easier to judge than the new ones’. (USAng)

‘Sometimes judgements are wrong since human beings are unpredictable. Also the founders may be fine but do not fit with their environment, for example there may be a lack of compatibility with their investors. In any case, the evaluation process may indeed be faulty because of unprofessional evaluators.’ (IsraVC)

On the other hand, the investors tended to agree with the propositions of the other two studies that a gap existed between espoused and in-use evaluation criteria and that investors suffered from availability bias. The Israeli angel suggested that the gap may arise because of a tendency for investors to ‘follow the herd’ rather than adhere to their espoused criteria. The UK VC thought that much more could be done to improve this side of investment decision-making:

‘[The] traditional approach, P&L based - that’s the one they [VCs] talk to. When you get them in private conversation, it’s more about private judgment; it’s more about gut feeling about the

personalities. I think that's a problem because while the mathematical approaches have been refined and developed, the other bits haven't, but they play an equally if not more important part in the judgement process. So because people are not talking about them, not open about them, they are not being developed. There's probably a lot that could be contributed from academia as to how those subjective decisions are made, but nobody's willing to talk about those subjective decisions'. (UKVCap)

In summary, several possible explanations were provided by investors for the results of the quantitative study:

1. Investors seek exits rather than early survival and growth, and the former has precedence in assessment, thus technological expertise may not be comprehensively assessed given time constraints but assumed from high level signals such as academic status;
2. Investors rely on both gut feeling and rational criteria;
3. Investors are subject to their own biases and heuristics; they recognize these as inevitable constraints and not necessarily only negative constraints;
4. Founders send signals which misrepresent their effective human capital resources and thus mislead investors.

Overall, the investors' comments suggest that while investors recognise that they do rely on gut feeling alongside more objective criteria, and don't always make decisions in the way they say they do, most of them think that they do a fairly good job of assessing founders on average, and also a 'better than average' job. In summary, the interviewees substantiated the two theoretical explanations provided by the literature for suboptimal judgment of human capital as reviewed above, but did not all accept our proposition that investors often misjudge human capital, and that this explains the puzzling results of the quantitative study.

Improving assessment of human capital

All except one investor felt that the process of assessing founders' human capital could be improved. The one dissenter (who had a PhD in psychology) felt that the problem lay with some individual investors, not with available processes. There was little agreement over possible solutions. Suggestions included involving headhunters and HR experts in the process, as they were found to be more objective, sharing of experiences among investors, courses or seminars and spending more time with the entrepreneurs.

Discussion

The research question we sought to answer was: why might investors in early stage high tech ventures founded by first-time entrepreneurs follow signals such as academic status that have no effect on early survival and growth while ignoring other, easily measured, factors that enhance survival and growth, and is this phenomenon wider than the rather special situation of the Israeli Technology incubator system? We found clear differences of opinion between the investors we interviewed on the importance of technology-related human capital variables. These are the variables that showed the least association between in-use evaluation criteria of investors and venture early survival and growth in the quantitative study, a finding that led to the current follow-on qualitative study. However, investors tended to agree that they differed in their espoused and in-use investment criteria and that they suffered from availability bias.

The investors resolved the conflict between their views and the study results in a number of ways: by arguing that exit value rather than survivability was the main criterion of assessment, by focusing on management rather than technological capabilities of the founder,

and by arguing that the biases and heuristics employed in decision-making were not necessarily sub-optimal. In the next subsection, we reflect on their views and integrate them with theory to form our answer to the research question. Then we caveat the discussion by outlining the limitations of our study, and finally we make recommendations for practitioners and for further research.

Explaining the Original Puzzling Result

Combining our qualitative follow-on study findings with the literature review, we propose the following explanation for the puzzling findings of the original quantitative study. First, we combine the two alternative theoretical explanations we reviewed earlier: ‘biases and heuristics’ (Shepherd 1999; Zacharakis and Shepherd 2001) and ‘signaling’ (Podolny 2005; Hsu 2007). We see these two theories as views of the same phenomenon but from different sides of the investment relationship (see Figure 1). Entrepreneurs transmit a variety of cues⁹ to future performance, some consciously as signals and some unconsciously. They do not necessarily know which cues or signals are most relevant, either to future performance or to investors. Investors select some cues and some signals through a filter of biases and heuristics, and seek further information on some cues and signals in a due diligence process.

[Insert Figure 1 about here]

⁹ We follow animal ecology nomenclature (Maynard Smith and Harper 2003) in which cues are features that can be used by a receptor as a guide to future action, irrespective of whether this is intended by the transmitter, while signals are cues that are intended to or have evolved to transmit a certain quality.

In an uncertain market for VC such as that available in the Israeli technology incubators, or in any emerging industry, where normal cues such as entrepreneurship experience or prior contact with investors are absent, investors rely on signals. Investors make decisions on relatively few criteria (Zacharakis and Meyer 1998). Since capital gain is their principal goal, they focus on factors that affect this (such as the market and whether they can find management for the firm to make it dominate the market) and devote less effort in due diligence on factors that might affect survival, such as founder's technology-specific expertise. In the case of the Israeli Technology Incubator entrepreneurs, academic status may have been interpreted by investors as a signal of technological ability and/or a signal of high quality scientific networks and high status generally. While the latter may or may not be an indicator of future value, academic status does not closely measure the specific tacit knowledge that may be needed to get the technology working in a commercial setting early in a venture's life (Murray 1999; 2004; Gimmon, 2006). Time pressure and limited attention magnifies the impact of this highly visible signal, crowding out the more accurate but less visible cues of specific technological ability.

Limitations

Both the original quantitative study and this follow-on study have limitations. First, the findings apply at most to first time founders of high technology ventures, not to all ventures seeking VC. Second, the original study measured venture performance in terms of survival and growth, whereas investors are focused on long term exit value. Third, it was based on a random sample of early stage high technology ventures with a unique experience – the Israeli Technology Incubator Programme. These ventures could not be said to be representative of all new high technology ventures in Israel (Avnimelech, Schwartz and Bar-El 2007) or

elsewhere. Given the recent findings of Hsu (2007), however, they may have wider application than just the Israeli Incubator Programme, and could apply to first time founders in any emerging market. Also, survival and growth is necessary for long term value creation, and that therefore factors that enhance survival and growth are worth considering in addition to factors that enhance long term value.

The limitations of this follow-up study include the small number of interviews that cannot be said to be representative in a statistical sense, and the nature of the data gathered: one-time interviews rather than in-depth observation of decision-making. We acknowledge these limitations and address them in our recommendations for further research. In relation to representativeness, in the first study the intention was to control for many non-human capital factors so that the effect of technological capability could be detected. In the qualitative study, our intention was to maximise variance, not seek representativeness, so that the views of the widest possible range of early stage high technology investors could be compared. Thus these limitations were part of the research design so that particular associations could be revealed or explained. In the next stage of research, we propose addressing these limitations, as outlined in the final subsection below.

Possible Implications for Investors

The results of this study suggest that, in emerging industries, investors give technology commercialisation capability lower priority over longer term issues of market potential and harvest in the limited due diligence time available. They do not appear to assess the specific technological capability of the founder in much detail, or if they do, it is on the basis of academic status. If one views early-stage high technology venture investment as akin to

taking an option on an uncertain future income stream (McGrath and MacMillan 2000) then it seems sensible to select on the basis of early stage survivability *as well as* long term value creation, particularly in the case of new technologies where commercialisation routines are not codified and still emerging and tacit (Murray 1999, 2004). By selecting on both dimensions, investors can reduce the proportion of investments that fail to launch, thereby increasing the proportion of cash available to support venture growth among the most promising to survive the launch stage.

Prospective investors in high technology ventures led by a first-time founder could benefit therefore by examining both the general and specific technological human capital of the founder in order to improve their decision-making. They could do this by digging a little deeper than academic titles and seek to understand the extent to which the founder has both general technological expertise and tacit knowledge of the specific technology underlying the business. The quantitative study suggested that simple heuristics such as ‘did the founder bring their own technology to the venture’, ‘are they a technologist by occupation’ and ‘have they transferred the technology to others’ would be more effective than ‘has the founder got an academic title’ in relation to survival and growth. We recognise that it is possible that academic status may confer other benefits to the venture (although this has not been tested), and therefore we are not suggesting that investors drop this as a criterion, but supplement it with other cues of technological capability.

Further research

Further research could continue this iterative process of understanding what matters in investment decision-making in new high tech ventures led by first-time founders in regard to

various aspects of founders' human capital, and address some limitations of this study. First, the sample of ventures could be revisited to track performance over the long term. In addition to measuring survival and growth, it would be important to measure venture value. The follow-up quantitative study could identify whether academic status positively affects value, as suggested by status theory. One way of assessing value for those ventures that had not yet exited would be to task a panel of expert valuers to estimate the value of the survivors of the cohort based on a standard set of indicators. Another avenue would be to take a portfolio approach by comparing performance of investee firms in investors' portfolios with objective measures of their founders' human capital. A third approach could be to study the extent to which experienced investors use different decision criteria from 'virgin' investors (Mason and Harrison 1993) or non-investors. A fourth option would be to interview simultaneously investors and entrepreneurs of the same new ventures in regard to the investment decision criteria of both parties, given that the entrepreneurs are their own first investor. These studies might lead to additional simple evaluation aids for investors' decision making processes.

Our replication interview design revealed some apparent patterns in relative importance of the entrepreneur and the market that, while not significant in any statistical sense, are interesting in the light of recent cross-national research on venture capitalists' investment criteria (Zacharakis et al. 2007). Specifically, while all investors listed broadly similar criteria, consistent with earlier cross-national literature (Knight 1994), and both US investors identified the market as the most important investment criterion, consistent with the quantitative finding of Zacharakis, McMullen, and Shepherd, all four UK and Israeli investors identified the entrepreneur as their most important investment criterion. This seems to run counter to Zacharakis, McMullen and Shepherd's hypothesis, based on institutional theory, that VCs in rules-based market economies rely on market information to a greater extent

while VCs in transitional economies weight human capital factors more heavily, since both the UK and Israel are rules-based market economies, coming 6th and 37th, respectively, out of 157 countries rated by the Index of Economic Freedom¹⁰.

Interestingly, many of the early US-based studies on espoused criteria emphasised the entrepreneur (e.g. Wells 1972; Poindexter 1976; Tyebjee and Bruno 1984; Macmillan, Siegel, and Subbanarasimha 1985; Macmillan, Siemann, and Subbanarasimha 1987), reflecting General Doriot's famous remark in a 1963 TIME magazine interview¹¹ 'a grade-A man with a grade-B idea is better than a grade-B man with a grade-A idea' and similar comments by Arthur Rock quoted in the literature review above. Rock himself (1987: 67) noted with apparent regret a shift in high tech investing from looking for the best people to looking for 'the largest untapped market or the highest projected returns or the cleverest business strategy'. Later studies and commentaries on the US VC industry (e.g. Hall and Hofer 1993; Zacharakis and Meyer 1998; Zider 1998; Zacharakis et al. 2007) have emphasised market aspects, although recent US-based studies of business angel criteria do not show the same shift (May and O'Halloran 2003; Sudek 2007).

We also observed that the US investors stressed the need for the entrepreneur to be willing to step aside once the business was growing to allow more experienced management to take it to the next level. Investors did not look forward to having to do this, and this feature weighed heavily in their decision-making. But they recognised that this might be necessary if the market potential was to be exploited fully and the value of the venture maximised. The Israeli

¹⁰ <http://www.heritage.org/index/> accessed 16 October 2007

¹¹ <http://www.time.com/time/magazine/article/0,9171,896620,00.html>

VC explicitly recognised these country differences in interview and suggested more research and data on venture capital is needed outside of the US:

‘In Israel more than in the US it is [more] difficult to judge the quality of the entrepreneur, since the population of potential founders is too small and the history of start-ups is too short.’

As Zacharakis, McMullen, and Shepherd (2007: 693) point out, ‘the US venture capital industry is the largest and oldest’. A meta-analysis of the literature on investor decision-making might reveal whether entrepreneur and market as criteria have shifted in relative importance in the US as its VC industry has matured. While fewer studies have been conducted in other countries, we speculate that VC industries elsewhere, being smaller and younger, and with smaller pools of experienced venture management talent with VC experience to draw on, may still adhere to the entrepreneur-based model of investment.

Another possibility is that US VCs are more focused on returns than risk, while VCs in other countries like the UK and Israel may be more focused on risk than return. This is suggested by the results of regression analysis on US VC investment criteria by Tyebjee and Bruno (1984), who found that Market Attractiveness was a determinant of expected return, while Management Capabilities was a determinant of risk, and a comparative analysis of investment criteria of VCs from US, Canada, Europe and Asia-Pacific by Knight (1994), who found that US VCs rated market growth and returns higher as investment criteria than non-US VCs. Knight (1994: 31) also found that Canadian VCs were becoming more demanding over time. These alternative hypotheses of differences in relative weighting given to investment criteria in different countries might be worth investigating in a systematic fashion with large samples of investors drawn from a selection of rules-based economies whose VC industries vary in age.

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Figure 1. Conceptual model explaining suboptimal investment decision-making in uncertain markets for venture capital

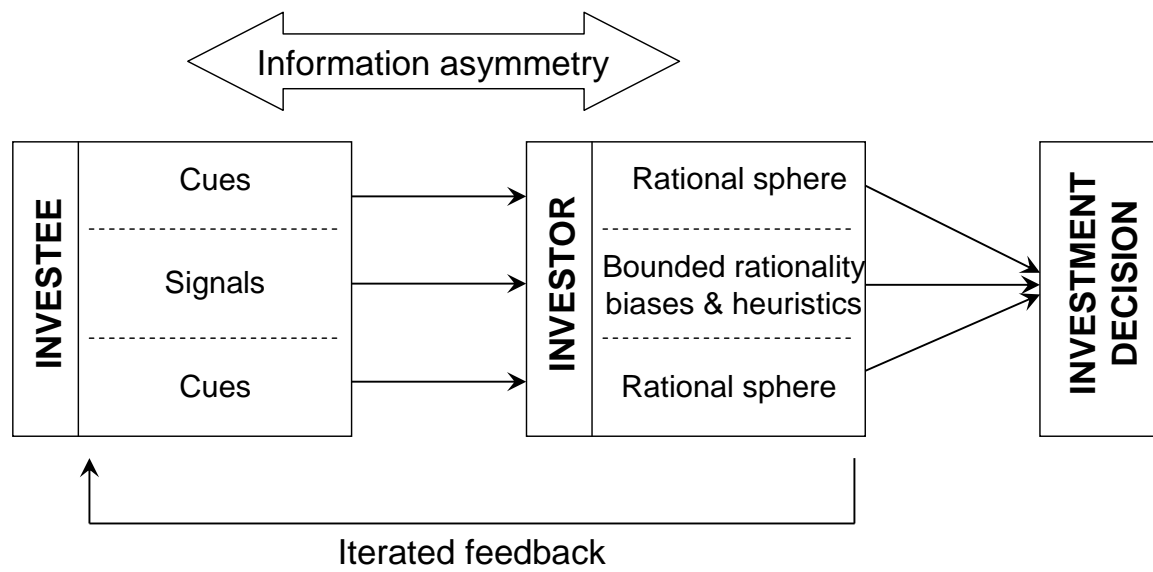


Table 1. Investor characteristics

Respondent Code	US-VC1	US-Ang1	Isra-VC1	Isra-Ang1	UK-VC1	UK-Ang1
Respondent gender	M	M	F	M	M	M
Stage of invested ventures	Seed, early stage	Seed + follow-on rounds	Seed+ Early stage	Seed	Startup, early stage, mature	Seed
Coinvestment	Yes	Yes: active in angel syndicate	Yes	No	Yes: lead investor	No: lone, first investor
Industry sector	Mostly tech equity	Any (including hi tech)	IT	DSP + life science equity	Bioscience	Hi tech equity
Type of investment					Product income streams	
Years in investments	5	26	10	5	10	12
No. of proposal reviewed	1000	2000	1000	dozens	350	600
No. investments made	4	32 cos., 60-75 investments	dozens	5	20	20
Average amount of investment	\$1million	Slightly more than \$25k ^a	\$5million	\$Tens of thousands	£1-2million	£20k-£25k

^arespondent mentioned some much bigger investments that would skew the average

Table 2. Major investment criteria

Investor Code	US-VC1	US-Ang1	Isra-VC1	Isra-Ang1	UK-VC1	UK-Ang1
Industry sector	(+)		(+)	+	(+)	(+)
Market potential	+++	+++	+	+	+	+
The entrepreneur/the management	+	+	+++	+++	+++	+++
Competitive advantage		+	+	+		
Innovative idea	+			(+)		+++
Execution feasibility		+	+			
\$ required (not too high)		+		+		
Protected IP				+		
Sales or significant client interest	+	+				
Location	(+)	+				

+ this factor was mentioned

(+) this factor was mentioned implicitly rather than explicitly

+++ this factor was stated to be the most important

Table 3. Interviewee comments on quantitative study findings

Respondent Code	Significant effect in original study on ^a :		Investment criterion for investor? ^{a,b}					
	survival/growth	investment	US-VC	US-Ang	Isra-VC	Isra-Ang	UK-VC	UK-Ang
Founder was technologist	1	0	B1 for super high tech for startup only A1/0 (army effect?)	B0 A0 'Interesting statistic but not very compelling'	B1 A1 technological background is important	B1 A1	B1 A1 'but with an eye to getting it to a product'	B0 A1
Managerial Experience	1	1	B1 A1	B1 A1	B1 A1	B1 A1	B1 A1	B1 A1
Tacit knowledge	1	0	B1 A1/0 (arguments for and against)	B0 A0 'may be insignificant in final analysis'	B0 A0 in depth understanding is not necessary	B0 A0 may help but not crucial	B0 A0 market more important	B1 A1 'VCs more interested in market traction'
Academic credentials (Dr. / Prof.)	0	1	B1 if related to the field and is balanced by abilities A0 'May be different in the US'	B0 A0	B0 A0	B1 A0	B0 A0 'for some it does seem to be a tick in the box'	B0 (PhDs) A0 B1 (Profs maybe) A0
Technology transferred to third party	1	0	B0 A1 'it's external validation'	B0 A1/0 'neutral'	B0 A1 'makes sense, not come across it'	B0 A1 'may affect funding'	B0 A1 'that would be a big plus for us'	B0 A1 'Licenses are great news'
Attained early sales	1	1	B1 A1 'proof and validity, improves ability to do due diligence'	B1 A1	B0 A1 fully agree	B0 A1 fully agree	B1 A1 shows customer focus	B0 A1 'something I look for, if possible'
No. of Patent applications	1	1	B0 A1 'indicator of protection and network'	B0 A1 'hints at platform technology'	B0 A1 'Important but not vital, some VCs regard patents highly'	B1 A1 'less important criterion'	B0 A1 'indicates company is innovative, it's a strong point'	B0 A1 'you do have to be very conscious of it now'

^a 1 = yes; 0 = no

^b B = Before being presented with results of quantitative study; A = After being presented with results of quantitative study

Table 4. Other investment criteria mentioned by interviewees following presentation of quantitative findings

Respondent Code	US-VC	US-Ang	Isra-VC	Isra-Ang	UK-VC	UK-Ang
Other: leadership Other: Business orientation		A leader; integrity	Ability to write business plan R&D management	Integrity Business orientation	Cares about product and customer	Focus, strategy global awareness
Other: commitment		Both feet in; passion, commitment	maturity	Fully dedicated & investing own capital	Passion; enthusiasm	Global ambition
Other: investor compatibility	Someone I'd like to work with		Compatibility with the VC	Compatibility with investors	Do we like the people	Good personality
Other: Team player			Team rather than a single	Team work		Team player
Other: fortitude	Can handle adversity			Long runner Work under pressure	stamina	driven
Other: recognises own weaknesses	Will take advice; willingness to step aside	Coachability	Ready to be replaced one day			
Other: communicator	Communicator, seller					
Other: Entrepreneurial skills	Entrepreneurship generally				Track record in entrepreneurship	

Table 5: Investors' views on research findings^a

Investor Code	US-VC	US-Ang	Isra-VC	Isra-Ang	UK-VC	UK-Ang
Investors misjudge founder's Human Capital (Gimmon)	0	0	Mainly 1 (but over 50% success in judging human capital in this VC firm)	1 & 0 (over 50% success)	1	0
In-use vs. espoused criteria (Shepherd)	1 'but not sure where the gap is'	No comment	1	1	1	1
Investors availability bias (Zacharakis and Shepherd)	1 & 0 'success breeds success'	1 'sounds like life to me'	1	1	1	1
Possible to improve evaluation?	0 'problem is some people not process'	1 Put head-hunter on the due diligence team.	1 Use HR experts	1 'Don't rely on gut feelings'	1 'Create a structure to allow investors to talk about it.'	1 'Probably there are metrics that could be used'

^a Code: 1: Agree 0: Disagree

Appendix 1

Subject: Investment Criteria in High-tech New Ventures

Section 1: Interviewee's Experience:

1. Name and date of interview: _____
2. Firm Name:
3. Sort: VC / Angel/ Advisor
4. Sort: Seed / Early stage / mezzanine
5. Industry sector: _____
6. Years in investments:
7. Number of proposals reviewed:
8. Number of investments made:
9. Average amount per investments:

Section 2: Evaluation Criteria

- 1a: What, in your opinion, ultimately determines your funding decisions as an investor (specify VC or angel)? In other words, what criteria do you use in making your funding decisions?
- 1b: Do you think your view would be a typical view in your industry? (If no: What in your opinion typically determines funding decisions by VCs/angels in this country?)
- 2a: How easy or difficult is it for VCs/angels to judge the quality of the entrepreneur as part of the funding decision? Why?
- 2b: How accurate do you think VCs/angels are in evaluating entrepreneurs as part of the funding decisions? Why?
- 3a: What do you look for in evaluating the entrepreneur in high-tech ventures? (Assume there is one clear leader, who is a first-time entrepreneur.)
- 3b: Do you rely on third party independent data, and in what form?
- 3c: Are there any criteria you used in the past that you no longer use, or criteria you use now that you haven't used in the past? What are these, and why have you changed your criteria?
- 3d: How typical would this be of evaluation by VCs/angels generally?
- 3e: Do you know of other specific criteria that other VCs/angels use that are different to the ones you use?
- 3f: If the entrepreneur had a PhD, would that make any difference to your funding decision?
- 3g: If the entrepreneur was a professor, would that make any difference?
- 3h: Do you think the entrepreneur needs to have an in-depth understanding (tacit knowledge) of the how the technology works in practice or can he delegate this to others?
- 3i: Have you known VCs/angels to say they make investment decisions in one particular way but actually use other methods? If yes: can you give me some examples?
- 3j: To what extent do you always apply your investment criteria in your actual investment decisions? If not always: can you give me some examples?

Section 3: Findings from our research on the founder's human capital and Investors' attraction to founder's human capital

We investigated a sample of 193 high-technology start-ups in Israel, based on a homogeneous cohort of the Israeli Technology Incubators Programme (ITIP). Findings show that if a venture founder was a technologist by background, or has previous P&L responsibility (for example, as a CEO, from being self-employed, or being a project manager) or developed the technology that the business is based on, the probability of venture survival is increased. Having early sales, patents applied for, multiple fund rounds or transferring technology to other businesses also positively affect venture survival.

We also explored whether the human capital factors that affect the performance of new high-tech ventures are also those that attract financial investors. Findings show that financial investors appear to be attracted by certain founder-based human ceremonial resources, such as academic titles, which have no effect on venture survivability, while ignoring certain founder-based instrumental resources, like the founder being a technologist, and the founder bringing their own technology to the venture, which enhance survivability.

I would now like to go through each of these findings in turn, and ask you what you think of them, and if you can think of an explanation for our findings. At the end, I'll tell you what researchers have suggested might be the reasons for our findings.

1. Industry-related experience

If the founder is a technologist by background, this has a positive effect on new venture survival – accepted.

If the founder is a technologist by background, this attracts financial investors - not supported

2. Managerial experience

Founder's prior P&L responsibility has positive effect on new venture survivability – marginally accepted.

Founder's prior P&L responsibility attracts financial investors – accepted.

3. Tacit knowledge

If the founder brings their own original technology to the venture, this has a positive effect on venture survivability – accepted.

If the founder brings their own original technology to the venture, this attracts financial investors - not supported

4. Academic credentials

Founder's academic titles do not affect venture survivability – accepted.

Founder's academic titles attract financial investors – accepted.

5. Gender

Founder's gender does not affect venture survivability – accepted.

Founder's gender has effect while women attract financial investors less than men - not supported.

6. Immigration status

Founder's immigration status has no effect on venture survivability - accepted.

Immigrant founders attract financial investors less than non-immigrants - not supported.

7. Age

Founder's age does not affect venture survival – accepted.

Founder's age has no effect on attracting financial investors - accepted.

Findings on organizing activities and investor's attraction to organizing activities:

8. Technology transfer to other party – positively affects venture survival, but it was not found to affect venture funding.

9. Attaining early sales – positively affects both venture survival and venture funding.

10. Number of fund raising rounds – positively affects venture survival.

11. Number of Patent applications – positively affects both venture survival and venture funding.

12. Findings on geographical location of the incubator where the venture was nurtured: was not found to have a significant impact on venture survival but was found to have a marginally significant effect on venture funding in favour of centrally located ventures.

Section 4: Evaluation bias

1. Do you agree or disagree with the proposition that VCs/angels often misjudge founders' human capital, specifically the technological expertise of founders of high-tech ventures? Why?

2. VCs' in-use criteria vs. espouse criteria: Shepherd's (1999) research on investors' evaluation processes suggests that there is a gap between evaluation policies VCs *use* in their actual decisions and the intended criteria they *espouse* as reported by them. What do you think of this view?

3. VCs rely on 'gut feelings': Zacharakis and Shepherd (2001) studied the phenomenon of VCs' heuristics and biases. They found evidence of an 'availability bias' in VCs' decision-making while VCs rely on how well the current decision matches past successful or failed investments. VCs, they argue, are overconfident in their prediction of either very high or very low likelihood of venture success. This high level of overconfidence in success or failure predictions may encourage the VC to make wrong funding decisions. What do you think of this view?

4. How do you think the accuracy of investors' evaluation of founders' human capital might be improved?