



Calhoun: The NPS Institutional Archive
DSpace Repository

Faculty and Researchers

Faculty and Researchers' Publications

2009

**Prediction and control under uncertainty:
Outcomes in angel investing**

Wiltbank, Robert; Read, Stuart; Dew, Nicholas;
Sarasvathy, Saras D.

Journal of Business Venturing, Vol. 24 (2009) pp. 116133
<https://hdl.handle.net/10945/41247>

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

Prediction and control under uncertainty: Outcomes in angel investing

Robert Wiltbank^{a,*}, Stuart Read^{b,1}, Nicholas Dew^{c,2}, Saras D. Sarasvathy^{d,3}

^a Willamette University, Atkinson Graduate School of Management, Salem, OR 97301, United States

^b IMD, Chemin de Bellerive 23, P.O. Box 915, CH-1001 Lausanne, Switzerland

^c Naval Postgraduate School, 1 University Circle, Monterey, CA 93943, United States

^d University of Virginia, The Darden Graduate School of Business Administration, 100 Darden Boulevard, Charlottesville, VA 22903, United States

Received 1 September 2006; received in revised form 1 September 2007; accepted 1 November 2007

Abstract

Venture investing plays an important role in entrepreneurship not only because financial resources are important to new ventures, but also because early investors help shape the ventures' managerial and strategic destiny. In this study of 121 angel investors who had made 1038 new venture investments, we empirically investigate angel investors' differential use of predictive versus non-predictive control strategies. We show how the use of these strategies affects the outcomes of angel investors. Results show that angels who emphasize prediction make significantly larger venture investments, while those who emphasize non-predictive control experience a reduction in investment failures without a reduction in their number of successes.

© 2008 Elsevier Inc. All rights reserved.

Keywords: Angel investing; Decision-making; Prediction; Control; Effectuation; Uncertainty

1. Executive summary

The term “angel investor” typically describes a wealthy individual who acts as an informal venture capitalist, placing his or her own money directly into early stage new ventures. This paper takes two interesting steps forward in the study of angels by detailing angel investor outcomes and relating those outcomes to the strategic approach employed by each angel investor. Moreover, it accomplishes the latter in terms of new theoretical insights about entrepreneurial expertise that have not been subject to much rigorous empirical testing.

* Corresponding author. Tel.: +1 503 370 6955; fax: +1 503 370 3011.

E-mail addresses: Wiltbank@Willamette.edu (R. Wiltbank), Stuart.Read@imd.ch (S. Read), NDew@nps.edu (N. Dew), SarasvathyS@darden.virginia.edu (S.D. Sarasvathy).

¹ Tel.: +41 21 618 01 11; fax: +41 21 618 07 07.

² Tel.: +1 831 656 3622; fax: +1 831 656 3407.

³ Tel.: +1 434 982 2079; fax: +1 434 243 5020.

We characterize the strategic decision-making approaches of angels along two separate dimensions: strategies that emphasize prediction and strategies that emphasize non-predictive control (Wiltbank et al., 2006). We assume that human beings desire control over outcomes, i.e. that we seek systematic ways to reach favorable outcomes. Prediction can play a central role in this process: if we can predict the future we may be able to position ourselves to succeed. Predictive strategies include market research using formal tools such as surveys, detailed financial models leading to careful calculations of risk-adjusted expected return, etc., and are very familiar to virtually anyone involved in writing business plans. Using prediction to obtain control over future outcomes assumes a logic that suggests: To the extent you can predict the future you can control your outcomes.

However, high uncertainty may reduce the accuracy and usefulness of prediction, requiring alternative approaches to support our desires to have some control over achieving favorable outcomes (Knight, 1921). One such concept, the logic of non-predictive control, suggests that to the extent you can control the future you do not need to predict (Sarasvathy, 2001a). In highly uncertain situations, an emphasis on non-predictive control may present effective alternatives to prediction-based approaches.

But what does it mean to emphasize control in this fashion? An in-depth study of expert entrepreneurs sheds light on this question. Founders of large and enduring firms who had accumulated over 15 years of experience over multiple ventures in a variety of different industries used an internally consistent set of practical principles that together are named effectual logic (Sarasvathy, 2001a). Effectual logic inverts predictive rationality in several ways. Actors begin with who they are, what they know and whom they know, rather than with a predetermined vision or externally validated “opportunity.” They then imagine a series of viable and valuable courses of action that they can implement using only what they can afford to lose. This means that they do not evaluate opportunities based on expected return in order to determine venture goals. Nor do they stubbornly hold too closely to preconceived goals as a way to determine which stakeholders to pursue or which resource-owners to chase. Instead they work with any and all interested people – usually starting very close to home, inside their immediate social network – and work outward to expand the stakeholder network through a process of self-selection. In other words, those who commit something valuable to come on board help determine what the venture will do next; predetermined venture goals do not drive partner selection. Throughout the process, entrepreneurs and their stakeholders seek to go beyond predicting and adapting to the environments in which they operate — into transforming and re-shaping them, often in surprising new ways. People using this effectual logic are working on things within their control, working to expand the zone of things they can materially control, obviating the need to predict the future — at least in the early stages of building the new venture.

As a baseline for evaluating the role of prediction and control, we include critical variables from the existing venture capital and angel investing literature that might affect angel investor outcomes. We take into account the experience of the investors, the stage of the ventures at the time of investment, due diligence efforts, how they find ventures, and the extent of participation after an investment is made. This context ensures that our evaluation of prediction and control adds to our existing understanding of the phenomena.

We expect differences in the use of prediction and control by the angel investors in our sample to have important effects on how they select and direct the development of the ventures in which they invest. Size of angel investments will likely relate to their use of prediction and control, with control-based angel investors making smaller investments as they employ affordable loss strategies (H1), while those emphasizing prediction tend to make larger investments as they justify investment decisions based on predicted large and growing markets for the venture (H2). Additionally, we hypothesize that angel investors who emphasize control will experience fewer investment failures due to their cooperation with partners, use of affordable loss, and flexibility (H3). Angel investors who emphasize predictive approaches are likely to experience more failures given the difficulty of prediction in early stage ventures (H4), but they are also likely to experience more “homerun” returns when early predictions turn out to be correct (H5).

Our data cover 121 investors, who made 1038 new venture investments and had 414 exits from those investments. The bulk of the data relate to investments over the past 10 years (90% of the sample), with the oldest investment reported in 1985. The process, response rate, and descriptive statistics are comparable to earlier research on other angel investors (Mason and Harrison, 2002). Investors reported the IRR for each of their exits by category, i.e. between 1% and 25%, which allows for some margin of error in the details of IRR calculations, but still allows us to evaluate the distribution of each investor’s returns. Homerun exits are those where investments achieved greater than 100% IRR; 20% of all exits were in this category. Negative exits are the number of investments where the investor achieved a negative IRR; 64% of all exits were in this category.

Findings show that emphasizing control strategies is significantly related to experiencing fewer negative exits, and that investors who emphasize prediction make significantly larger investments, but do not experience more homeruns. We found that angel investors who performed more due diligence experienced significantly more homeruns, and significantly more negative exits (thus fewer moderate exits). Also, angel investors who participated more with their ventures, post-investment, experienced fewer negative exits. Surprisingly, we found that investors who concentrated on very early stage opportunities experienced fewer negative exits. These results raise important considerations about the use of prediction and control as decision tools in highly uncertain settings. Understanding the differential use of these strategic approaches may be relevant not only to angel investors but also to venture capitalists, corporate entrepreneurs, and managers making decisions in very uncertain situations.

2. Introduction

The term “angel investor” typically describes a wealthy individual who acts as an informal venture capitalist, placing his or her own money directly into early stage new ventures. In relation to formal venture capitalists in the United States, angels invest in approximately 20 times the number of new ventures. In the category of the youngest “seed-stage” investments in the U.S., angels invested over \$6 billion in 2004, compared to only \$346 million from venture capitalists (Sohl, 2005; Wiltbank, 2005). In addition to their financial role in new venture development, angels also play a significant role in the strategic decision-making of these ventures. Their influence stems both from the authority associated with formal participation on the firm’s board of directors as well as from their knowledge and expertise. Angels typically have substantial entrepreneurial experience of their own⁴ and act as a “sounding board” for the entrepreneur/s managing the venture day to day (Pfeffer, 1993; Van Osnabrugge, 1998; Amis and Stevenson, 2001).

While their role is significant, far fewer studies investigate angel investing and performance as compared to work with formal VCs. This is particularly surprising for two reasons. First, angel investing provides a rather special opportunity to study investment decision-making under extreme uncertainty owing to the very early stage focus of angel investing. Second, from an empirical perspective angel investing is a substantially more important factor in early stage ventures than venture capital (c.f. the 16:1 investment ratio above).

In this paper, we exploit the intersection of these two research opportunities – namely, (a) the gap in our understanding of the phenomenon of angel investing given its importance to the entrepreneurial creation of new ventures, and (b) the unique setting that angel investing provides for furthering our understanding of strategizing under uncertainty – to explore the relationship between alternate strategies and venture investing performance. In particular, we develop a research instrument that operationalizes key elements of Wiltbank et al.’s (2006) exposition of non-predictive strategy, which we then apply to the development and testing of specific hypotheses about private equity investing.

Wiltbank et al.’s central argument consisted of positing strategies that emphasize prediction as separate and distinct from strategies that emphasize control. Broadly speaking, prediction refers to efforts that position the venture for success based on expectations/forecasts for the development of important market elements. This can include modeling event spaces, estimating probabilities and consequences, and forming sophisticated portfolio strategies with multiple options. Control, on the other hand, refers to efforts toward directly creating new market elements by transforming existing ones. This can include innovating new product forms and functions, influencing customer preferences, and creating market structures (i.e. channels, technical standards, common practices). In practice, entrepreneurs and their investors can and often do use both sets of strategies. However, as scholars have strongly argued in the past, it makes a real difference in terms of actual consequences, what the dominant driver of strategy formation is (Mintzberg and Waters, 1985; March, 2006; Shapira, 1995; Sarasvathy, 2001a; Wiltbank et al., 2006). Therefore, the research instrument used in this study is designed to *separately* measure one’s emphasis along these two distinct and theoretically important dimensions.

We hope to contribute to several key streams of thought in the fields of strategy making under uncertainty. Besides helping to fill a gap in our understanding of private equity related to angel investing and developing testable measures of Wiltbank et al.’s theoretical model, the results of the study build links to recent work involving effectuation and

⁴ The angel investors sampled in this paper had on average founded 3 ventures and worked as an entrepreneur outside their angel investing activities for nearly 15 years.

decision-making strategies. Current work in effectuation has been limited to showing the existence and use of effectual logic in expert decision-making as opposed to novices (Dew et al., 2007). This work moves into new territory constructing an empirical operationalization of effectual (i.e. non-predictive) control and testing its relationship to outcomes in a new setting. We discuss these contributions and their implications for practice and pedagogy in more detail at the end of the paper. For now, we begin with a discussion of relationships between prediction, control and angel investing in order to develop specific hypotheses, following which we describe the design, analysis and results of our empirical efforts.

3. Decision-making in uncertainty

Literature on decision-making under uncertainty has identified many techniques based on estimation and analysis to develop accurate predictions of the future and of the expected values of future outcomes (Raiffa, 1970). Scholarship in this area has also identified methods to deal with ambiguous situations when the probabilities are not or cannot be precisely known (Kogut and Kulatilaka, 2001; Schoemaker, 1993; Bergh and Lawless, 1998; Einhorn et al., 1986). In management scholarship, control over outcomes is commonly seen as a primary reason for investing in technologies of prediction. The field of strategic management, for example, grew from observations about how managers sought to control an organization in ways favorable to their organization and its owners (Ansoff, 1979; Chandler, 1962). The hope in this process is that control over outcomes can derive from predicting the organization's environment and positioning the organization to succeed in the predicted future state. Organizations regularly make predictions around the evolving strengths and weaknesses of competing firms, paths of market development, and factors affecting the supply of resources, among dozens of other factors.

However, prediction is not the only way to achieve control over outcomes. Drawing upon numerous variables in studies scattered over several decades, Goodie (2003: 598) defines control as follows:

...the characteristic of probability alterability. That is, if a participant could take steps to favorably alter the success rate in subsequent administrations of the task (not in the current administration), then the task is said to be characterized by control.

Thus, control may involve seeking favorable outcomes by altering probabilities in event spaces and by actions that construct entirely new event spaces. Knight (1921) conceptualized the emergence of new event spaces as a fundamental ingredient in decision-making under uncertainty. Knight identified three types of uncertainty — the first consisting of known distributions and unknown draws, the second consisting of unknown distributions and unknown draws, and the third consisting of non-existent distributions where the very instances are unclassifiable (subsequently known as true uncertainty). Knight's first two categories of uncertainty parallel classical and statistical probability (the domain of predictive decision technologies); the third type of uncertainty might instead be conceptualized as a product of purposeful human creative action (Buchanan and Vanberg, 1991; Lewontin, 1992; Joas, 1996) involving techniques of non-predictive control (Sarasvathy, 2001a). These ideas suggest that the appropriate decision technology depends on the nature of the decision problem the agent faces. For example, in environments characterized by high complexity and uncertainty, prediction becomes more difficult and decision makers may be better off pursuing favorable outcomes using decision technologies that minimize their dependence on prediction (March, 2006; Axelrod and Cohen, 1999). The "logic of non-predictive control" came from a study of expert entrepreneurs that found that they avoided the use of prediction in dealing with the uncertainties involved in building new ventures (Sarasvathy, 2001b).

Rather than focusing on prediction, these experts employed an internally consistent set of heuristic principles, collectively labeled effectual logic, which involve a more direct effort to control and influence how uncertainty is resolved. These principles make the concept of non-predictive control actionable: a means focus, affordable loss investing, pre-committed partners, and leveraging surprise (Sarasvathy, 2001a). In traditional decision-making theories, goals are the primary focus and the challenge lies in identifying and collecting the means needed to achieve those goals. In effectuation, the guiding focus is primarily on available means (who I am, whom I know, and what I know) rather than on pre-set goals. Attention then centers on creating and choosing among the possible effects that those means can create in the world. Spending money in these situations is hard to justify using predictions of future value and maximizing returns. Instead, the principle of affordable loss guides expenditures, where the desire is to keep expenses as low as possible as you create a market, ideally \$0. The market is then co-created with each

stakeholder investing only what he or she can afford to lose. By focusing on affordable loss, the decision maker keeps control over risk and must stay closely connected to market participants.

Working with others to co-create opportunities is an additional aspect of effectuation related to the logic of non-predictive control. Pre-committed partners play an essential role because they expand the means of the effort, and actually create a market specific to the opportunity that develops over time. From an effectual perspective, these partners self-select into the venture with commitments to create something, rather than being pursued as predetermined customers in a race against preconceived competitors (Sarasvathy and Dew, 2005). A practical example of an effectual choice might involve choosing to work with a customer because they will fund half of the capital expenditures, even though a different potential customer might be expected to provide a larger long-term opportunity, but will not commit to anything upfront. In all of these efforts, surprise is not only a regular part of the process, as it is in any situation of high uncertainty, but is also to be welcomed and creatively used as a resource in transforming the event space. This flexibility enables the decision maker to work with any and all partners who are willing to pre-commit, and to embrace strategies that are affordable rather than optimal. Options and strategies are likely to converge over time as the venture develops and uncertainty is resolved. The point of convergence, however, will likely be different from the end point reached through a more predictive approach.

3.1. Prediction versus control in angel investing

The uncertainty in angel investing makes it a useful setting for evaluating the impact of prediction and control decision strategies on angel investing performance. Owners of new ventures face substantial uncertainty surrounding technology, organizational design, target customers, customer preferences, marketing channels, competitive strategies, and employee recruitment (Boeker and Wiltbank, 2005; Thornhill and Amit, 2003; Shepherd et al., 2000; Baum et al., 2000). Angels are regularly the first source of outside equity into a new venture, and their approach to dealing with uncertainty can have a material impact on the direction of those ventures. Angel investors commonly invest their own money, typically \$25,000 to \$500,000, directly into an individual venture, while \$1 million is a small investment for a formal venture capital firm (Gompers and Lerner, 1999; Amis and Stevenson, 2001).

Given that angels invest earlier in new ventures and are often themselves successful ex-entrepreneurs, they are likely to have experience in using non-predictive control strategies as entrepreneurs (c.f. footnote 1; Dew et al., 2007). Their differences in the use of prediction and control can impact both the *selection* of entrepreneurs and ventures in which to invest, as well as the *content* of their advice and execution of those ventures over time as they deal with uncertainty. For example, in the selection of new ventures, angels may separate them into those that appear capable of shaping niche markets (whose prospects for fast growth are less clear), and those that attempt to compete in large fast-growing markets (without the ability to control key elements of that market). When angel investors emphasize opportunities of the first type, it suggests that a focus on control is an important aspect of how they deal with uncertainty, while a preference for the second type of opportunity suggests a focus on prediction.

As argued by Sarasvathy (2001a) the principles of effectuation are rooted within this logic of non-predictive control. The individual effectual principles such as means-driven decisions and affordable loss cohere with each other in the new venture's attempts to control how key market elements develop over time. In particular, through making affordable rather than optimal expenditures, control approaches tend to minimize potential losses per stakeholder, and encourage the entrepreneurs leading the venture to reach positive cash flow more quickly rather than investing "to plan." The effectual commitment to means rather than goals suggests that a control-based angel investor evaluates a venture in light of its current means and capabilities; thus, the actual market size need only be sufficient to reach the minimum required return of the investors. A priori estimates of huge markets with a potential for blockbuster returns are not necessary to justify investment.

Differences in the strategic orientation of angel investors ought to be manifest in the way in which they invest. One way we expect to see these differences is in relation to the magnitude of the investments an angel investor will make. Angel investors emphasizing control invest with failure in mind, using the effectual principle of affordable loss rather than expected values (based on predictions) as the basis for making investment decisions. Affordable loss focuses on getting to market quickly and cheaply based on the means at hand. These investors tend to over-weight the benefits of low upfront investments relative to potential inefficiencies this may create later in the development of the venture. Even while investment may increase over time, the overall size of investment will likely be lower for control-based investors.

Hypothesis 1. *Angel investors with a greater emphasis on control will make smaller venture investments than angel investors with a low emphasis on control.*

Decision makers emphasizing prediction tend to work toward larger high-growth markets where the *necessary* potential exists for the venture to capture some share of the forecasted markets. Prediction-based angel investors encourage a venture to gather the necessary resources to position it for leadership within that predicted market, usually based on investments in market research and careful planning aimed at maximizing expected return. This predictive information informs the selection of goals for positioning, which in turn guides the accumulation of means necessary to execute those goals.

As a result, a predictive emphasis is likely to lead to bigger bets on forecasts for market potential and profits. Additionally, research suggests that investors may be more prone to escalation of commitment when those predicted payoffs are large (Ryan, 1995). The combination of increasing the magnitude of investments and increasing the likelihood of escalation of commitment means that investors focused on prediction are likely to make systematically larger investments than investors that do not emphasize prediction.

Hypothesis 2. *Angel investors with a greater emphasis on prediction will make larger venture investments than angel investors with a low emphasis on prediction.*

For the implications of prediction and control on performance, two definitions are useful to start with. We define “investment failure” as an exit (including the closure of the venture) where the angel investor experiences a negative return on investment. “Investment homeruns” are exits where the investor receives an IRR on their invested capital of over 100%. By looking at the end points of the outcome distribution, failure and homerun, we are able to evaluate the differential effects of prediction and control on these separate positive or negative events, rather than simply aggregating the detailed information together in an overall “performance” type measure.

As argued in our discussions of effectuation earlier, we expect investors who emphasize control to make smaller investments, encourage the venture to reach breakeven more quickly, and emphasize the use of partners for resources and direction in guiding the venture forward. Angel investors emphasizing control seem likely, therefore, to reduce the occurrence of investment failures.

These investors focus on using current means effectively, versus leveraging the venture to acquire new means in pursuit of their initial goals. In doing so, the investors ensure that the venture is in a less precarious position when negative surprises occur, and remain flexible to positive surprises because they are not over-committed to their initial goals. Focusing on existing means and smaller capital investments through affordable loss forces the venture to work with other stakeholders to create something that both parties value early in the process. At this early stage adjusting goals to cooperate with partners is most feasible. The guidance provided by partners and customers and the flexibility to pursue changing goals can enable the venture to refine its value proposition and competitive position in ways that were unpredictable at the point the angel initially invested and that are directly connected to their actual market. Additional resources flow to the venture, and more players become interested in the survival of the venture.

The combination of starting with means and co-creating goals with committed stakeholders enables control-based decision makers to shape the business to address real rather than predicted opportunities. Simultaneously, focusing on small investments that reach positive cash flow avoids ‘betting’ the venture on predictions of the future. While using this control-based approach may underutilize predictions that could have turned out to be correct, it also minimizes the risk of catastrophic failure of a venture built on predictions that turn out to be wrong. Hence,

Hypothesis 3. *Angel investors with a greater emphasis on control will experience fewer investment failures relative to angel investors with a low emphasis on control.*

We expect a different impact on outcomes for angel investors emphasizing prediction as they deal with the uncertainty they face. The pitfalls of predictive strategies in uncertain situations have been argued in a variety of work (Wiltbank et al., 2006; Denrell and March, 2001; Mintzberg and Waters, 1985). In the angel investing context, forecasting early stage venture outcomes is particularly challenging given multiple sources of uncertainty (Anderson and Tushman, 2001). Investors focused on positioning their ventures toward specific forecasts increase their dependence on accurate predictions of a variety of unpredictable variables, such as preferred channels, competitive offerings, cost curves, customer adoption rates, and so on. As predictive investors make investments justified by their predictions, overheads and expenses consume resources and lock the venture into existing plans. When surprises occur, those early investments raise the bar of survival for the venture. While there may be some advantages to this approach (as we will discuss in the lead-up to Hypothesis 5), we expect that angel investors who select and develop

ventures based in a predictive logic will experience more investment failures as those predictions often turn out to be significantly off target.

Hypothesis 4. *Angel investors with a greater emphasis on prediction will experience more investment failures relative to angel investors with a low emphasis on prediction.*

While we expect investment failure to be more frequent for angel investors emphasizing prediction in such an uncertain setting, these same investors may experience extreme success in those rare cases when their predictive strategies turn out to be correct. If the venture is strategically positioned around correct predictions, it may have advantages such as the ability to preemptively acquire complementary resources at favorable prices (i.e. skilled employees, key locations and customer relationships). Additionally, investments in capacity and overhead can generate cost advantages in production. The venture can also more carefully position to create optimal exit opportunities for the angel investors, such as being positioned as an attractive acquisition target for larger firms or for an initial public offering early on in the development of the industry. These factors may greatly enhance the possibilities for predictive-based angel investors to earn very large returns, to “hit a homerun.”

Hypothesis 5. *Angel investors with a greater emphasis on prediction will experience more homeruns relative to angel investors with a low emphasis on prediction.*

The effect of emphasizing control on angel investors’ magnitude of success is less clear. On the one hand, control efforts may limit their ability to achieve homeruns because they may tend to underinvest in opportunities by focusing on current means, risk reduction, and cooperation. Their next steps are anchored around what can be done to influence the future of the venture, rather than exclusively on what should be done to maximize predicted returns. On the other hand, emphasizing control may increase the incidence of homeruns by creating new market elements, which, when successful, can result in market leadership positions rather than incremental opportunities in existing market spaces. Some research suggests that market leadership and the creation of high levels of market value are connected (Tellis and Golder, 2002; Collins and Porras, 1994). On balance, there is not a definitive relationship between control and homeruns that can support a clear hypothesis.

In total, when investors follow prediction-based strategies, their investment performance in the given venture depends heavily on the accuracy of their predictions. However, when investors follow control-based strategies, their investment grows only as a function of survival, and they may underinvest in any given opportunity. When an investor brings on a variety of committed partners that co-create a market with the new venture, rather than leveraging financial muscle and predictive insight, it plays a key role in the outcomes. This suggests that a control oriented investor may miss “homeruns” — i.e. ventures in markets with explosive growth and high rates of return that require larger amounts of financing very fast. However, the control-based process keeps the bar for survival significantly lower, where an external shock or limited options for exit from the investment do not necessarily lead to investment failure.

4. Methods

4.1. Data and sample

Over the two years of this study, the authors made countless phone calls and attended 12 conferences to develop relationships with directors of angel groups, and through their efforts have created a private nationwide sample of 600 angel investors. The data in this study cover the activities of 121 angel investors reporting on 1038 new venture investments and 414 exits from those investments. The bulk of these data relate to investments over the past 10 years (90% of the sample), with the oldest investment reported in 1985.

The process of study followed well-established protocols for survey research (Dillman, 2000). Initially, discussion and learning formed the survey, which was then fine-tuned through feedback from pilot testing and then used in large-scale data collection across the United States. Initial surveys were developed and discussed with angel investors from a local investment group, ensuring that the questions and method of response allowed them to report their experiences accurately. Data collection was then scaled up and expanded geographically.

The majority of the sample (75%) was reached in cooperation with 12 angel investor groups in 9 different U.S. states. The states represent areas where groups were committed to participating, and areas where angel investing is active. California represented 20% of the sample, followed by Georgia and Washington at 10% each. Contact was

made through the endorsement and involvement of group directors, who handled communication with members, keeping contact information strictly private. Initially, an e-mail invitation to participate in the study was passed from the director to the members, followed by a hardcopy of the invitation and survey approximately 2 weeks later, and then followed by an e-mail from the director asking for additional participation about 2 weeks after that. Participation was voluntary, and the information was gathered from the perspective of the individual, not the group, focusing on individual angel investors' history of new venture investing. Their responses were sent directly from the respondents to us, such that no members of the group, including the director, could see private details of the angel investors.

The remainder of the sample (25%) was reached through a survey to 150 members of an online investment network named NVST, a national forum connecting investors and entrepreneurs. These 150 members are active and accredited private equity investors. We contacted these individuals through the NVST network 4 times. The separate sources help reduce selection biases, and there are no significant differences between the different sources of respondents on any of the variables, except that non-group affiliated investors found more of their deals through personal sources ($p=0.05$).

The number of respondents to the survey from both sources was 136, giving an overall response rate of 23%. Fifteen of these responses were incomplete, taking the sample size of the models and results to 121 angel investors. While a higher percentage is of course desirable, this is on par with prior work investigating venture capital investors (Gifford, 1997; Sapienza and Gupta, 1994; Ruhnka et al., 1992), and strong when compared with venture capital studies regarding valuation and financial performance data where response rates can drop below 5% (Hellmann and Puri, 2002).

One of the concerns going into the study was self-selection bias, i.e. that investors might only respond if they had been successful overall, and/or only report their positive returns. To check for this possible bias we compared our sample on several measures with other samples used in venture investing and found it to be consistent. Investors report the majority of their investments as losses (64% of their investments) while 20% of investments were very successful. The remaining 16% fall into smaller positive returns. This is in line with existing performance data from venture capital investing and suggests significantly *more* failure than found in a sample of UK angel investors (Mason and Harrison, 2002; Murray, 1999). Additionally, the stage and age emphases are comparable to case-study work with angel investors: 73% of the investments were made at the seed and startup stage and 75% of the ventures were less than 2 years old (Prowse, 1998). Finally, the angels in our sample reported the portion of deals found through personal friends (51% of their investments) and the average dollar size of their investments (\$210K/deal). These were comparable to earlier case-study/interview work done with angel investors (Amis and Stevenson, 2001; Freear et al., 1995).

Two additional points speak to the representativeness of the sample. First, angel investing tends to be highly local and personal, and our sample reflects this variation, having been gathered across different states. Second, in follow-up conversations with many of the directors of these groups, the data described above falls within their experience and knowledge of member practices with the group.

4.1.1. Instrument

To measure the dimensions of prediction and control, we created a multi-item survey, built around an entrepreneurial scenario, in a fashion similar to Baum and Wally (2003) and Fredrickson and Mitchell (1984). We were specifically interested in the way angel investors used prediction and control in their development of new ventures, rather than in their overall investment portfolio strategies or other financing specific concepts; thus the instrument is designed from that perspective.

The scenario briefly describes a venture idea based on an innovative computer program and then presents a set of questions characterizing what the subject would do next to develop that opportunity. This is followed by 7 questions, with 2 response items per question. Respondents rated their agreement or disagreement with each item on a 7-point Likert scale. The scenario and items are detailed in Appendix A. Below is an example of a question and the items to which it is connected.

If you were to look at predictions for where potential markets are heading you would:

- A. Use them to create forecasts of what your business might accomplish over time.
- B. Discount them as they do not incorporate the impact of your innovation.

These items were the result of 4 iterations of the instrument that had been pre-tested with 200 entrepreneurs and angel investors. Special attention was paid to make each item a viable and attractive response to the question. Confirmatory factor analysis showed that the set of responses worked together statistically, and exploratory factor analysis showed that the control items did not load with the prediction items, suggesting that they effectively cover independent concepts. The set of prediction items resulted in Cronbach's Alpha score of 0.68, outlining prediction with the following approach to developing the opportunity:

Study expert predictions of where the market is “heading” as you assemble information.
 Develop a marketing approach by researching the competitors' approaches.
 Manage product development by comparing your progress against the development of competitors.
 Use predictions to create forecasts of what your business might accomplish over time.
 Base strategy on relevant forecasts and analyses.
 Form updated predictions of likely outcomes for the business as you learn of the expectations of others.

The control items resulted in Cronbach's Alpha of 0.70 from these items:

Talk with people you know to enlist their support in making this opportunity a reality.
 Imagine possible courses of action based on your prior experience to develop a marketing approach.
 You move forward because your expertise allows you to influence the uncertainty of this situation.
 You move forward through uncertainty because your actions can create a future you value.
 Manage product development by creating new solutions on your own terms; competitors have to keep up.
 Discount predictions of potential markets as they do not incorporate the impact of your innovation.
 Base strategy on what you are capable of, given the means available to you.
 Imagine ways your venture will change aspects of the situation others are forecasting for the industry.

The dimensions of prediction and control were measured separately, allowing angel investors to respond with any mix of the two approaches. Each investor could rate their predictive and control-based emphasis independently. Empirically, they are negatively correlated with each other, suggesting a moderate tendency toward one dominant approach over the other. The scores for these measures were calculated as the sum of a respondent's responses (1 through 7) for each item divided by the total possible score (42 for the 6 prediction items, and 56 for the 8 control items).

4.2. Dependent variables

Investment Size is simply the total dollars the investor invested, divided by the number of ventures into which that money was invested. This measure is based on all investments, not just on exited investments.

We measured outcome in terms of internal rates of return as a categorical variable. Having investors report the IRR in categories allows for a margin of error in the details of IRR calculation, but still allows us to evaluate the distribution of an investor's returns. This is in line with the method used in the only other study reporting outcomes for individual angel investors by [Mason and Harrison \(2002\)](#). The categories run from complete loss, to partial loss, to 0–24% IRR, 25 to 49% IRR, 50 to 99% IRR, and then over 100% IRR. The majority of the exits occurred at the extreme: either total losses or major successes. As a result our models are focused on these areas.

Ideally, every investor would report the amount and date of their cash outflows and inflows for each new venture in which they invest. We could then calculate internal rates of return in great detail. However, several issues make measuring investor performance more challenging. First, not all angel investors formally track their cash inflows and outflows, and second, investments and exits can occur over a large number of years. As a result, gathering detailed investment outlay and income data on the 1038 deals in this sample simply was not possible. Additionally, many of the investments reported by our sample were still active. While 1038 investments were made by 121 investors, 76 of them had experienced exits, with a total of 414 exits thus far. We include only assessments of investments actually exited, since conversations with experts in the field as well as media reports suggest those outcomes are more accurate (as a rule they are more conservative) than estimates of value for ongoing ventures ([Grimes, 2002](#)).

Homerun the number of investment *exits* where the investor achieved a greater than 100% internal rate of return; 20% of all exits were in this category.

Negative IRR the number of investment *exits* where the investor achieved a negative internal rate of return; 64% of all exits were in this category.

4.2.1. Control variables

We evaluate the effects of the concepts of prediction and control in our models against a baseline model of factors already identified as significant in existing research on new venture investing as a whole. To do this, we created a baseline of factors known to be important from research with formal venture capitalists. This baseline model accounts specifically for the context in which this study takes place – i.e., angel investing – and provides a strong control for evaluating the added value of the ideas developed in this paper. The baseline model includes:

Total venture investments the *total number of investments* an investor has made, and represents a control for overall activity to standardize the number of exits in each category.

Investment experience measured as the *number of years* over which the respondent has been investing in new ventures.

Entrepreneurial experience measured as the *number of years* over which the respondent worked as an entrepreneur.

Seed stage captures the extent to which the respondent concentrates his or her investments in early stages of new venture development. It is measured as *the number of a respondent's investments made in seed-stage opportunities* rather than the other stages of development. Seed, startup, early growth, late growth, and buyouts are standard stage categories in new venture investing, and are an important decision factor for venture investors (Jain, 2001; Gupta and Sapienza, 1992).

Due diligence captures the extent to which the investor emphasizes upfront research into the venture (Fried and Hisrich, 1994). Due diligence is measured by the *total number of hours the investor spends investigating* the entrepreneur's references, the venture's legal position (for example, with regard to patents or pending legal action) and the venture's market prospects, etc.

Deals through personal relationships measured as the respondents' report of their number of investments that came from various sources. We measure the *number of investments where the investor had a personal relationship with the entrepreneur*, either as friends, having previously worked together, or the entrepreneur was referred to the investor through a friend. These personal relationships compare to more professional/pragmatic sources where the entrepreneur was referred to the investor through professional contacts, or the deal resulted from the investor's participation with an investment group (Amis and Stevenson, 2001; Kelly and Hay, 2000).

Prior investors in a new venture provide additional support and insight into the potential of the venture (Lerner, 1994). Investors vary in the extent to which they go in on their own or with other investors involved. This is measured as the *number of a respondent's investments in which there were other investors prior to that investment*.

Table 1
Inventory of model variables

| Variable | Definition |
|----------------------------|---|
| Venture investments | Total number of angel investments that an investor has made |
| Investing experience | Total number of years over which an angel investor has been operating |
| Entrepreneurial experience | Number of years that an investor worked as an entrepreneur outside his/her investing experience |
| Seed stage | Investor's deals done in ventures at the seed stage of development |
| Due diligence | Total number of hours an investor spends conducting due diligence prior to making an investment |
| Personal relationships | Number of an investor's deals that were found from personal relationships |
| Prior investors | Number of investments in which there were investors prior to the angel investor's involvement |
| Participation | Number of hours per week spent with ventures in which the investor has already invested |
| Prediction | Their emphasis on predictive efforts in response to the venture development scenario |
| Control | Their emphasis on control efforts in response to the venture development scenario |
| Exits with negative IRR | Number of investor's investments that exited at less than 0% IRR |
| Exits with over 100% IRR | Number of investor's investments that exited at a return of >100% IRR |
| Investment size | Mean dollar amount of an angel investor's investments in new ventures |

Table 2
Correlations and descriptive statistics^a

| Variable | Mean | s.d. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------------------------------|-------|-------|---------|---------|-------|---------|---------|---------|---------|-------|---------|---------|---------|-------|
| 1. Venture Investments | 7.70 | 5.24 | | | | | | | | | | | | |
| 2. Investing experience (years) | 9.39 | 7.05 | 0.28 * | | | | | | | | | | | |
| 3. Entrepreneurial experience (years) | 12.72 | 9.69 | 0.22 | 0.47 ** | | | | | | | | | | |
| 4. Seed stage | 2.25 | 2.53 | 0.65 ** | 0.26 * | 0.18 | | | | | | | | | |
| 5. Due diligence (hours) | 49.50 | 52.90 | 0.13 | 0.11 | 0.04 | 0.36 ** | | | | | | | | |
| 6. Personal relationships | 3.59 | 3.79 | 0.64 ** | 0.45 ** | 0.15 | 0.55 ** | 0.09 | | | | | | | |
| 7. Prior investors | 4.86 | 4.35 | 0.74 ** | 0.16 | 0.08 | 0.43 ** | 0.02 | 0.32 ** | | | | | | |
| 8. Participation (hours) | 4.55 | 7.57 | 0.22 | -0.14 | -0.21 | 0.22 | 0.48 ** | -0.01 | 0.22 | | | | | |
| 9. Prediction | 0.78 | 0.13 | -0.17 | 0.02 | -0.05 | -0.04 | 0.07 | -0.05 | -0.12 | 0.12 | | | | |
| 10. Control | 0.74 | 0.14 | -0.09 | -0.04 | 0.05 | -0.13 | -0.10 | 0.01 | -0.07 | -0.09 | -0.27 * | | | |
| 11. Exits with negative IRR | 2.39 | 1.45 | 0.59 ** | 0.26 * | 0.07 | 0.24 * | 0.11 | 0.33 ** | 0.45 ** | -0.04 | -0.01 | -0.28 * | | |
| 12. Exits with over 100% IRR | 0.83 | 2.07 | 0.58 ** | 0.36 ** | 0.18 | 0.33 ** | 0.24 * | 0.37 ** | 0.37 ** | 0.04 | -0.04 | -0.16 | 0.56 ** | |
| 13. Investment size | 210K | 227K | -0.08 | 0.21 * | -0.05 | -0.03 | 0.14 | 0.03 | 0.00 | 0.21 | 0.19 | 0.08 | 0.10 | -0.05 |

Two-tailed tests.

^a $n=121$.

* $p<0.05$.

** $p<0.01$.

Table 3
Regression analysis of investment size

| | 1 | | 2 | |
|----------------------------|----------------|------|-------------|------|
| | Baseline model | | Whole model | |
| Constant | | 0.58 | | 0.03 |
| Venture investments | 0.55 *** | 0.00 | 0.59 *** | 0.00 |
| Investor experience | 0.20 * | 0.08 | 0.19 * | 0.0 |
| Entrepreneurial experience | −0.25 ** | 0.02 | −0.26 ** | 0.02 |
| Seed stage | −0.29 ** | 0.02 | −0.29 ** | 0.02 |
| Due diligence | 0.29 *** | 0.00 | 0.29 * | 0.00 |
| Prediction | | | 0.18 ** | 0.04 |
| Control | | | 0.15 | 0.16 |
| Adjusted R^2 | 0.23 | | 0.27 * | |
| ΔR^2 | | | 0.04 * | 0.06 |
| N | 97 | | 97 | |

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

Participation, post-investment enables investors to potentially add value to a venture beyond just their cash infusion (Gompers and Lerner, 2001; Boeker and Wiltbank, 2005). This is measured as the *number of hours they spend each week with ventures in which they've invested*.

5. Results

Tables 1 and 2 show definitions, descriptive statistics, and correlations for the measures. Table 3 details the analysis of investment size. Regression models in Table 4 show the standardized coefficients and significance levels for the baseline model along with the effects for prediction on control of angel investment outcomes.

The measures used in the models are predominantly sums of the number of investments made in various categories. As a result, more active investors will as a rule have higher responses for each of the measures. To standardize these sums, the total number of an investor's investments is included in the models as a control.

Table 4
Regression analyses of investment approach on investor outcomes

| | Negative exits | | | | Homerun exits | | | |
|----------------------------|----------------|------|-------------|------|----------------|------|-------------|------|
| | Baseline model | | Whole model | | Baseline model | | Whole model | |
| Constant | −0.42 | 0.65 | 4.22 | 0.12 | −0.99 | 0.04 | 0.47 | 0.74 |
| Venture investments | 0.36 *** | 0.00 | 0.33 *** | 0.00 | 0.16 *** | 0.00 | 0.15 *** | 0.00 |
| Investor experience | 0.03 | 0.51 | −0.02 | 0.68 | 0.03 | 0.29 | −0.02 | 0.33 |
| Entrepreneurial experience | −0.05 * | 0.10 | −0.03 | 0.30 | −0.01 | 0.52 | −0.01 | 0.70 |
| Seed stage | −0.22 | 0.14 | −0.32 ** | 0.04 | −0.06 | 0.40 | −0.09 | 0.25 |
| Due diligence | 0.41 | 0.13 | 0.46 * | 0.08 | 0.27 * | 0.06 | 0.28 * | 0.06 |
| Personal relationships | −0.07 | 0.43 | −0.01 | 0.96 | −0.02 | 0.62 | −0.01 | 0.91 |
| Prior investors | −0.01 | 0.93 | −0.00 | 0.96 | −0.03 | 0.49 | −0.03 | 0.49 |
| Participation | −1.24 ** | 0.04 | −1.07 * | 0.06 | −0.41 | 0.17 | −0.36 | 0.23 |
| Prediction | | | −1.73 | 0.37 | | | −0.76 | 0.45 |
| Control | | | −4.78 ** | 0.04 | | | −1.25 | 0.31 |
| Adjusted R^2 | 0.37 | | 0.43 | | 0.33 | | 0.31 | |
| ΔR^2 | | | 0.06 ** | 0.02 | | | −0.02 | 0.47 |
| N | 70 | | 70 | | 70 | | 70 | |

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

5.1. Investment size

Table 3 shows effects of emphasizing prediction and control on size of angel investments. Model 1 shows a set of baseline factors that were found to be significant factors in investment size. The number of investments is significantly related to making larger angel investments ($p=0.00$), an indicator of some survival bias. Investor experience is moderately related to making larger angel investments ($p=0.08$), while the years of experience as an entrepreneur was negatively related ($p=0.03$). An emphasis on earlier stage investments was negatively related ($p=0.09$) to investment size, as one would expect, as deal sizes tend to be smaller when ventures are younger and less developed. Due diligence was significantly and positively related to investment size, where more due diligence is performed when more money is being put into the company. Personal relationships, prior investors, and participation (elements of the baseline model in Table 4) were omitted as they were not significantly related to investment size.

Model 2 shows the addition of the prediction and control variables to the model, which significantly increases the explanatory power of the model ($p=0.06$). Hypothesis 1 argued that investors with a greater emphasis on control will make smaller investments than investors with a low emphasis on control, based on their use of affordable loss decision-making and commitment to means more than to current goals. Hypothesis 2 expected that investors who emphasize prediction would make larger investments than investors with a low emphasis on prediction, leading to larger losses when they fail. We find that investors who emphasize prediction demonstrate a tendency to make significantly ($p=0.02$) larger angel investments, in support of H2. An emphasis on control, however, is unrelated to investment size, leaving H1 unsupported. Ad hoc analysis shows that angel investors, who are above the sample mean in their emphasis on prediction, make angel investments that are twice as large as investors who are below the sample mean on our measure of prediction.

5.2. Investors outcomes

Table 4 shows regression analysis relating a baseline model and then prediction and control to the outcomes experienced by these angel investors. Model 1 shows the effects for activity, experience (both investing and entrepreneurial) and a broad set of variables that have been shown to be important in existing research on new venture investing. In this baseline model, only due diligence has a significant effect ($p=0.06$) on exits over 100% IRR, increasing the extent to which an investor experiences major successes. Angel investors that make more of their investments in the seed stage, rather than at startup and later stages, actually experienced significantly fewer negative exits ($p=0.04$), which is somewhat surprising as the earlier stage of investing is normally considered to be at the greatest risk of failure.

In the Whole model, we show the results of relating prediction and control to the investor outcomes. Hypothesis 3 argued that angel investors with a greater control emphasis will experience fewer investment failures. This hypothesis is supported in Table 4, where a control emphasis is significantly ($p=0.04$) and negatively related to negative exits.

Hypothesis 4 related an investor's emphasis on prediction to experiencing more failures, and, in Hypothesis 5, to experiencing more "homeruns." Because of the challenges to prediction in early stage new ventures, an emphasis on prediction was expected to result in more frequent failures, but when predictions are on target, the venture should be well positioned for very successful exits rather than small successes. In Table 4, a prediction emphasis is not significantly related to exited outcomes in either direction, leaving Hypotheses 4 and 5 unsupported.

As shown in Table 4, prediction and control significantly ($p=0.02$) increased adjusted R^2 for the model of negative exits, from 0.37 to 0.43 adjusted R^2 . This was primarily due to the addition of the measure of control. The homerun model was not impacted by the addition of prediction or control, and the variable which explains the most variance around homeruns is simply the number of investments, providing some evidence of an experience effect on homeruns in angel investing.

The robustness of these findings was tested in a number of ways, primarily through tests for collinearity and confirming the findings in split samples. None of the tolerance statistics were smaller than 0.5, where 0.2 is the general threshold for concern, and the relationships of the variables to the dependent variables were stable through stepwise regressions. Additionally, the results of the models are stable across sub-samples of the overall sample. We ran models that included only investors who had made 3 or more exits and then only investors who had 7 years or more of experience to ensure that the effects weren't simply resulting from the extreme ends of the distribution of investors, and also split the sample in two by even and odd number records to rule out spurious relationships.

6. Discussion

Through this research, we have begun to understand the differential use of prediction and control strategies by angel investors to deal with the uncertainty involved in selecting and developing new ventures. The primary results suggest that angel investors who emphasize control experience fewer investment failures without experiencing fewer homeruns. The direct relationship of prediction to outcomes was not supported in this study. While there could be several explanations for this result, one theoretically intriguing possibility is that the uncertainty in angel investing may undermine the effectiveness of predictive approaches.

But why is an emphasis on control at all related to favorable outcomes? Under Knightian uncertainty, why not simply use some kind of ad hoc decision-making (Winter, 2004) or intuition (Mitchell et al., 2005)? While people do use these strategies, perhaps in tandem with control-based strategies, evidence from psychology in support of a desire for control is quite strong (Goodie, 2003; March and Shapira, 1987; Shapira, 1995). Given the human penchant for seeking control, and the entrepreneurial expertise of angel investors, it appears that the occurrence of failure can be directly impacted by the approach of venture leaders, in this case angel investors.

Our results also contribute to one ongoing debate in the literature about the efficacy of using real options in the new-venture setting. While McGrath (1999, McGrath et al., 2004) has argued in favor of this approach, Adner and Levinthal (2004) have critiqued it, suggesting that:

A prominent characteristic of strategically interesting settings is that, having made an initial investment, firms can actively engage in follow-on activities that can influence outcomes and identify new possible actions and goals. While in established real options theory there is recognition that the option to make or forego follow-on investments is a source of value and that prior stage-setting investments may be a precondition for the exercise of these options, there is an assumption that the nature and quality of options are independent of the firms' interim activities. The implicit imagery is of a firm "buying a ticket" to engage in some pre-specified opportunity set, thus ignoring the potential for the firm to mold and enhance initiatives, learn about new opportunities, and discover new possible initiatives not conceived of at the time of the initial investment (Adner and Levinthal, 2004:120).

The results of our study offer some support for this critique. Effectual logic is about molding and enhancing initiatives, formulating new goals and creating new opportunities, rather than positioning oneself within environments largely outside one's control or taking opportunities as exogenously given. The results of this study provide empirical evidence in support of the arguments in the theory of effectuation, specifically, that efforts anchored on existing means, using the principles of affordable loss, pre-committed partnerships, and leveraging surprise, can provide useful benefits under uncertainty.

In addition to support for and against particular theoretical streams of interest to scholars, the results of the current study have some practical implications. First, they question the usefulness and value of current emphases on predictive approaches in entrepreneurship courses that are built around formal business plans and standard analytical techniques. Instead, both potential entrepreneurs and those in the pre-angel phase may benefit from a focus on non-predictive control strategies such as affordable loss and means-based opportunity creation. Second, venture capitalists and corporate venturing managers may want to reconsider some of their predictive strategies and complement or modify them with specific consideration of control-based approaches. Given the structure and process of their decision-making apparatus, this may require them to experiment with "effectual cells" within which they incubate new ventures and bring to bear a more predictive approach at key inflexion points as the new market begins to coalesce around a new venture.

The notion of "effectual cells" within more predictive organizations suggests an important avenue for future research into control-based decision-making. The current study has spotlighted the intriguing possibility that angel investors can limit their downside failures through a control-based approach, a risk-reducing move, without inherently capping their potential returns from homerun exits (Bowman, 1980; Ruefli et al., 1999). This suggests the possibility of exploring decision strategies that affect success and failure distinctly rather than in the amalgamated category "performance." In turn, this suggests research into topics such as the performance consequences of matching managers with particular talent in control-based strategies to different types of opportunities than managers with particular talent in prediction-based approaches, or investigating how the probability of hitting homeruns can be improved independent of the size of investments made.

This study also has implications for the practice of angel investing. The relationships between prediction, control and outcomes reported in this study suggest reconsidering the application of formal venture capital and traditional finance practices as the ‘best practice’ model to which angel investors should aspire. This perspective relates directly to common dilemmas faced by angel investors. For example, should an angel investor be more diversified or hold more capital in reserve (dry powder)? Is an angel investor better off investing in deals that are pursuing a small piece of a fast-growing market, or in deals where the market seems smaller but the firm potentially has some influence over the evolution of elements of the market? It is not clear that using best practices from research with formal venture capital investors is the obvious choice for angel investor success. It may be effective for angel investors to more deliberately bring their entrepreneurial expertise to bear on the challenges they face in angel investing.

Another finding of this study is that emphasizing prediction is significantly related to angel investors making larger investments. This is important in the consideration of decision formality at existing large companies in which prediction plays a large role. While some managers regard the use of prediction in these decisions to be useful, others question its validity, as prediction is simply not possible at the time new venture investment decisions are typically made. It is important to recognize that the use of prediction has a significant impact on the way investments are pursued. In this study, a more predictive approach involved a more extensive use of capital. Other effects may be discovered in future research. For this reason, the use of predictive approaches to decision-making about new venture investments ought to explicitly consider the effects that emphasizing prediction may have on *how* each opportunity is pursued, in addition to the impact it has on *which* opportunity is pursued.

Studying angel investors has also helped connect effectuation to a new decision-making arena beyond entrepreneurs and has empirically demonstrated relationships of control strategies to failure rates and investments size. Much of the existing work on effectuation relates to the existence of the use of effectuation. This paper goes a step further, showing how the use of an effectual process actually affects both behavior and outcomes of decision makers in uncertainty.

Two further empirical aspects of this study are also worth noting. First, this large sample of angel investor data offers an interesting glimpse into the returns of angel investors, their investment practices, and the types of investments they make. Angel investing is an important area for the field of entrepreneurship. As mentioned at the beginning of this paper, many more entrepreneurs deal with angel investors than with formal VCs, yet this is a relatively understudied area because the collection of data is uniquely challenging. The data in this study should be useful to future developments in the collection of more angel investor data.

Additionally, the development of an empirical method for working with ideas from the theory of effectuation on a relatively large scale provides a useful platform on which to explore ongoing questions. How does the use of prediction and control shift as new ventures develop, either over time or size or number of customers, etc? Do venture investors have a preference for investing in opportunities where the entrepreneurs share their approach to using prediction and control? What are the effects of emphasizing control in less uncertain situations? Future studies along these lines may benefit from the scenario design and items employed here.

6.1. Limitations

Despite the robustness of the results reported here, as with any study, there are tradeoffs inherent in design choices and the approach to empirical analysis. While most items in this design are not psychometric measures, they are still subject to retrospective and self-selection issues that are often involved in survey methods. We attempt to minimize and control for those effects, but collecting more data in an ongoing fashion is ultimately required to overcome this limitation.

More significantly, data in this study were gathered at the level of the angel investor, rather than the new venture. While this greatly facilitates the collection of data from angel investors, it only assumes and does not directly examine the coherence between the investor and venture in the emphasis on prediction and control, and the consistent use of prediction and control by the investor across ventures. Future research might look directly at the decisions of angel investors and new ventures over time in relation to prediction and control in order to help overcome this limitation.

Finally, as mentioned earlier, measurement of the financial performance of new venture investments poses special challenges. In this study, we used categories of IRR in an attempt to take both the timing of investments as well as cash in and outflows into account. To the extent future researchers are able to acquire data on the actual timing of cash inflows and outflows, the measurement of rates of return could be made more precise.

6.2. Conclusion

We set out to exploit the intersection of two research opportunities — namely, (a) the gap in our understanding of the phenomenon of angel investing given its importance to the entrepreneurial creation of new ventures, and (b) the unique setting that angel investing provides for further understanding of strategy under uncertainty. We developed a research instrument that operationalized key elements of effectual – i.e. non-predictive control – logic and tested specific hypotheses relating the use of these strategies to angel investment behavior and performance. The study helps push empirical investigations of effectuation beyond demonstrating its existence in the entrepreneurial setting into the behavior and outcome implications of the logic of non-predictive control. In doing so, the study makes a contribution to constructing a Knightian theory of the entrepreneurial firm.

Appendix A. Scenario instrument. Wearable computing business situation

Please use your imagination, put yourself in the context of the scenario, and answer each question as if you were CEO:

During your 12-year tenure as an engineer at a major computer manufacturer, you work on your own time to invent a computer device that recognizes and responds to eye movements. You imagine it might make a great alternative to the computer mouse. You can make it rest on the user's head much like headphones and set it up so that point-and-click navigation is accomplished with even the most minor head and eye movements. You are convinced that there is a huge potential for change in the way things are currently done. But when you attempt to interest your current company in licensing the idea from you, they are uninterested. There are no firms currently offering anything close to this, and you possess all the technical skills to create the product effectively and efficiently. You quit your job to further develop this idea.

| | | | | | | | |
|---|-------------|---|-------|---|---|---|--|
| 1. As you assemble information on this business, you would: | | | | | | | |
| Disagree | Indifferent | | Agree | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Talk with people you know to enlist their support in making this become a reality. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Study expert predictions of where the market is "heading". |
| 2. As you develop a marketing approach for this product you will: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Research the competitors' approaches. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Imagine possible courses of action based on your prior experience. |
| 3. When you think about the uncertainty of a market for this idea, you move forward anyway because: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Your expertise allows you to influence that uncertainty. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Your actions can create a future you value. |
| 4. As you manage product development, you will be driven by: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Comparing your progress against the development of competitors. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Creating new solutions on your own terms, any competitors will have to keep up. |
| 5. If you were to look at predictions for where potential markets are heading you would: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Use them to create forecasts of what your business might accomplish over time. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Discount them as they do not incorporate the impact of your innovation. |
| 6. In situations like this, it is important to base strategy on: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Relevant forecasts and analyses. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | What you are capable of, given the means available to you. |
| 7. As you learn about the expectations other people have for this industry, you: | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Imagine ways your venture will change aspects of the situation they are forecasting. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | Form updated predictions of likely outcomes for the business. |

References

- Adner, R., Levinthal, D.A., 2004. Real options and real tradeoffs. *Academy of Management Review* 29 (1), 120–126.
- Amis, D., Stevenson, H., 2001. *Winning Angels: The Seven Fundamentals of Early Stage Investing*. Pearson Educational, Harlow.
- Anderson, P., Tushman, M.L., 2001. Organizational environments and industry exit: the effects of uncertainty, munificence and complexity. *Industrial and Corporate Change* 10 (3), 675–711.
- Ansoff, H.I., 1979. *Strategic Management*. Macmillan, London.
- Axelrod, R. & Cohen, M.D. 1999. *Harnessing complexity. organizational implications of a scientific frontier*. New York: Free Press/Simon & Schuster.
- Baum, J.R., Wally, S., 2003. Strategic decision speed and firm performance. *Strategic Management Journal* 24 (11), 1107–1129.

- Baum, J.A.C., Calabrese, T., Silverman, B.S., 2000. Don't go it alone: alliance network composition and startups' performance in Canadian biotechnology. *Strategic Management Journal* 21 (3), 267–294.
- Bergh, D.D., Lawless, M.W., 1998. Portfolio restructuring and limits to hierarchical governance: the effects of environmental uncertainty and diversification strategy. *Organization Science* 9 (1), 87–102.
- Boeker, W., Wiltbank, R., 2005. New venture evolution and managerial capabilities. *Organization Science* 16 (2), 123–133.
- Bowman, E., 1980. Risk/return paradox for strategic management. *Sloan Management Review* 21, 17–31.
- Buchanan, J.M., Vanberg, V.J., 1991. The market as a creative process. *Economics and Philosophy* 7 (2), 167–186.
- Collins, J.C., Porras, J.I., 1994. *Built to Last: Successful Habits of Visionary Companies*. HarperBusiness, New York.
- Chandler, A.D., 1962. *Strategy and Structure: Chapters in the History of the Industrial Enterprise*. M.I.T. Press, Cambridge.
- Denrell, J., March, J.G., 2001. Adaptation as information restriction: the hot stove effect. *Organization Science* 12, 523–538.
- Dew, N., Read, S., Sarasvathy, S.D., Wiltbank, R., 2007. Logical frames in entrepreneurial decision making: differences between experts and novices. Working paper.
- Dillman, D., 2000. *Mail and Internet Surveys: The Tailored Design Method*. Wiley, New York.
- Einhorn, H.J., Hillel, J., Hogarth, R.M., 1986. Decision making under ambiguity. *Journal of Business* 59, 225–250.
- Fredrickson, J.W., Mitchell, T.R., 1984. Strategic decision processes: comprehensiveness and performance in an industry with an unstable environment. *Academy of Management Journal* 27 (2), 399–423.
- Freear, J., Sohl, J.E., Wetzel, W.E., 1995. Angels: personal investors in the venture capital market. *Entrepreneurship and Regional Development* 7, 85–94.
- Fried, V., Hisrich, R., 1994. Toward a model of venture capital investment decision making. *Financial Management* 23 (3), 28–37.
- Gifford, S., 1997. Limited attention and the role of the venture capitalist. *Journal of Business Venturing* 12, 459–482.
- Gompers, P., Lerner, J., 1999. *The Venture Capital Cycle*. MIT Press, Cambridge, MA.
- Gompers, P., Lerner, J., 2001. *The Money of Invention: How Venture Capital Creates New Wealth*. Harvard Business School Press, Boston.
- Goodie, A.S., 2003. The effects of control on betting: paradoxical betting on items of high confidence with low value. *Journal of Experimental Psychology* 29 (4), 598–610.
- Grimes, A., 2002. Little VC Secret: Value Lies In the Eye of the Beholder. *Wall Street Journal*. Electronic ed., New York.
- Gupta, A.K., Sapienza, H.J., 1992. Determinants of venture capital firms' preferences regarding the industry diversity and geographic scope of their investments. *Journal of Business Venturing* 7, 347–362.
- Hellmann, T., Puri, M., 2002. On the fundamental role of venture capital. *Economic Review - Federal Reserve Bank of Atlanta* 87 (4), 19–22.
- Jain, B.A., 2001. Predictors of performance of venture capitalist-backed organizations. *Journal of Business Research* 52, 223–233.
- Joas, H., 1996. *The Creativity of Action*. The University of Chicago Press, Chicago. (J. Gaines & P. Keast, Trans.).
- Kelly, P., Hay, Michael H., 2000. 'Deal Makers': reputation attracts quality. *Venture Capital* 2 (3), 183–202.
- Knight, F.H., 1921. *Risk, Uncertainty and Profit*. Houghton Mifflin, New York.
- Kogut, B., Kulatilaka, N., 2001. Capabilities as real options. *Organization Science* 12 (6), 744–758.
- Lerner, J., 1994. Venture capitalists and the decision to go public. *Journal of Financial Economics* 35, 293–316.
- Lewontin, R.C., 1992. *Biology as Ideology: The Doctrine of DNA*. HarperPerennial.
- March, J.G., 2006. Rationality, foolishness and adaptive intelligence. *Strategic Management Journal* 27, 201–214.
- March, J.G., Shapira, Z., 1987. Managerial perspectives on risk and risk taking. *Management Science* 33 (11), 1404–1418.
- Mason, C.M., Harrison, R.T., 2002. Is it worth it? The rates of return from informal venture capital investments. *Journal of Business Venturing* 17, 211–236.
- McGrath, R.G., 1999. Falling forward: real options reasoning and entrepreneurial failure. *Academy of Management Review* 24 (1), 13–30.
- McGrath, R.G., Ferrier, W.J., Mendelow, A., 2004. Real options as engines of choice and heterogeneity. *Academy of Management Review* 29 (1), 86–101.
- Mintzberg, H., Waters, J.A., 1985. Of strategies, deliberate and emergent. *Strategic Management Journal* 6 (3), 257–272.
- Mitchell, J.R., Friga, P.N., Mitchell, R.K., 2005. Untangling the intuition mess: intuition as a construct in entrepreneurship research. *Entrepreneurship Theory and Practice* 29 (6), 653–670.
- Murray, G., 1999. Seed capital funds and the effect of scale economies. *Venture Capital: International Journal of Entrepreneurial Finance* 1, 351–384.
- Pfeffer, J., 1993. Barriers to the advance of organizational science: paradigm development as a dependent variable. *Academy of Management Review*, 18, 599–620.
- Prowse, S., 1998. Angel investors and the market for angel investments. *Journal of Banking and Finance* 22, 785–792.
- Raiffa, H., 1970. *Decision analysis: introductory lectures on choices under uncertainty*. Reading, Mass. Addison-Wesley.
- Ruefli, T., Collins, J., LaCugna, J., 1999. Risk measurement in strategic management research: Auld lang syne? *Strategic Management Journal* 20, 167–194.
- Ruhnka, J.C., Feldman, H.D., Dean, T.J., 1992. The "living dead" phenomenon in venture capital investments. *Journal of Business Venturing* 7, 137–155.
- Ryan, P.M., 1995. Why some venture capitalists escalate and others don't in the same investment. *Best Paper Proceedings. Academy of Management Journal*, pp. 337–345.
- Sapienza, H.J., Gupta, A.K., 1994. Impact of agency risks and task uncertainty on venture capital. *Academy of Management Journal* 37 (6), 1618–1628.
- Sarasvathy, S.D., 2001a. Causation and effectuation: toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review* 26, 243–263.
- Sarasvathy, S.D., 2001b. Effectual reasoning in entrepreneurial decision making: existence and bounds. *Best paper proceedings, Academy of Management 2001*. Washington DC.
- Sarasvathy, S.D., Dew, N., 2005. New market creation through transformation. *Journal of Evolutionary Economics* 15, 533–565.
- Schoemaker, P.J.H., 1993. Multiple scenario development: conceptual and behavioral foundation. *Strategic Management Journal* 14 (3), 193–213.
- Shapira, Z., 1995. *Risk Taking: A Managerial Perspective*. Sage, Thousand Oaks, CA.

- Shepherd, D.A., Douglas, E.J., Shanley, M., 2000. New venture survival-ignorance, external shocks, and risk reduction strategies. *Journal of Business Venturing* 15 (5), 393–410.
- Sohl, J., 2005. The Angel Investor Market in 2004. University of New Hampshire, Centre for Venture Research. <http://www.unh.edu/news/docs/cvr2004.pdf>.
- Tellis, G.J., Golder, P.N., 2002. *Will & Vision: How Latecomers Grow to Dominate Markets*. McGraw-Hill, New York.
- Thornhill, S., Amit, R., 2003. Learning about failure: bankruptcy, firm age, and the resource-based view. *Organization Science* 14 (5), 497–509.
- Van Osnabrugge, M., 1998. Comparison of Business Angels and Venture Capitalists: Financiers of Entrepreneurial Firms. *Venture Capital Report*, Oxford.
- Wiltbank, R., 2005. Investment practices and outcomes of informal venture investors. *Venture Capital: International Journal of Entrepreneurial Finance* 7 (4).
- Wiltbank, R., Dew, N., Read, S., Sarasvathy, S.D., 2006. What to do next? The case for non-predictive strategy. *Strategic Management Journal* 27 (6).
- Winter, S., 2004. Understanding dynamic capabilities. *Strategic Management Journal* 24 (10), 991–996.