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“If he contends, as sometimes he will contend, that he has defined all his terms and propositions, than either he is a performer of logical miracles or he is an ass; and as you know, logical miracles are impossible.”
(Keyser, 1922)

MASTER THESIS

THE EFFECT OF OWNERSHIP STRUCTURE ON STRATEGIC
DECISION-MAKING: HOW REAL ARE REAL OPTIONS?

**THE EFFECT OF OWNERSHIP STRUCTURE
ON STRATEGIC DECISION-MAKING:
HOW REAL ARE REAL OPTIONS?**

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PREFACE

As a student and employee I have always been interested in organizations that in one way or another do something 'new'. People's passion to create and build new things, products, organizations, new relations has increasingly interested and motivated me during the course of my studies. Hence, my choice regarding the topic of this research is a logic one. Having witnessed the rise and fall of the dotcom-hype from up-close, it strongly appeared to me how success and development in entrepreneurial venturing is unmistakably intertwined with personal characteristics such as risk attitude, entrepreneurial stamina, experience and commitment. It was during my internship in the early months of the year 2002, when I encountered repeated occasions in which social or relational aspects and the often accompanying perceptual bias played a decisive role in the strategizing processes of young firms. In this light I have heard both academics and practitioners claim that some of the 'old-economy' paradigms suddenly became irrelevant or non-applicable. Following, I sensed the need for a systematic and integrated tool to include these aspects into a synthesizing approach towards strategic decision-making. Having done so the past twelve months, I am indebted to a number of people. First of all I would like to thank my coach for her good advice, flexibility and support, especially during the last few months. Also I would like to thank my first co-reader for her rewarding critique; it has been gratefully used. I acknowledge Pim van Vliet of the Department of Finance of the Faculty of Economics and Bob Stumpel of Result Venture Knowledge International for their ideas and feedback on my research topic and proposal. Furthermore I am indebted to Heleen de Ryck of CCH, Ritsaert Dolle of eProjects and Charlotte Looij of NIB Capital for allowing me to benefit from their experience in the field of start-up financing. They have provided me with useful feedback with regard to my model and propositions. Special thanks go out to eProjects for providing me with the technical infrastructure to accommodate my research. Lastly, I am grateful to my friends who never (or rarely) complained in times when most of my spare time was devoted to the writing of this thesis, Aida for being there, my housemates, and of course, my family. This work would not have been accomplished without their support.

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SUMMARY

Real options allow decision-makers to reconsider investment opportunities as events unfold and uncertainty subsides. One aspect that is often neglected in the event of subsiding uncertainty is the effect that the capital aspect of a sequence of tactical investment projects may have on the internal objectives of the management. Hence, in adopting a synthesising approach, the general aim of this paper is to explore the possibility whether an approach that incorporates both real options and agency perspectives, will provide an improved understanding of the effect of ownership on options in a strategic decision-making process. By investigating potential rigidities and flexibilities of real options in an agency context, a new model should enable the systematic (re)consideration of relevant variables in the valuation process of a potential strategy.

Real option theory provides a sound basis for the discussion of decision-making behavior in start-up ventures. By observing the value of a firm as consistent of two aspects, the NPV of company assets and the value generated from active management, a framework is created in which a flexibility component can be treated to extent to a different academic field: agency theory. It has been described how only five parameters (derived from the Black Scholes formula) are needed to estimate the value of a financial call option. A closer look on the analogy of financial options with real options helps to determine to what extent real options are to be treated in a similar way and, more importantly, which differences between the two types of options and assumptions underlying the BS model should be reconsidered in specific situations or under certain conditions. Real options being a valuation tool that uses insights from both financial and strategic management, the sequential decision-making process, referred to as the option chain, distinguishes between incremental options and flexibility options. The former refers to simple decisions regarding the (dis)continuance of an investment-process; the latter refers to a radical switch in strategy that management may undertake. Furthermore, the flexibility component of project value is structured by the acknowledging of a number of different real options. When analyzing this project value, one is confronted by a range of variables that influence the estimation of expected value. The four moments of return distributions can help explain this estimation. The view of a start-up venture as consisting largely of growth options allows for an emphasis on the importance of strategic decision-making and therewith the process of real option valuation.

In theory the entrepreneur is wealth-constrained and therefore, in order to obtain funding for the venture and be able to move forward, he offers an investment opportunity (capital for equity in the start-up venture) to a competitive market of venture capitalists. As a result the ownership and control of a venture firm are (partially) divided and a potential agency problem occurs. It is assumed that both parties (entrepreneur and the venture capitalist) operate with bounded rationality and are by nature utility maximizers. The conflict arises when the goals of both entrepreneur and venture capitalist with regard to the project start to diverge, there is information asymmetry and the entrepreneur starts using corporate resources (time, assets) for private consumption. Another important reason for conflict could be a change in the entrepreneur's risk attitude. Assuming information asymmetry to be a condition for the agency problem, the problem can be resolved or reduced by monitoring the entrepreneur's behavior: the principal (venture capitalist) is faced with a trade-off between costs, incurred by monitoring behavior, and costs incurred by opportunistic behavior. In the real world however, even under conditions of extensive monitoring, the probability of success of the project is subject to personal perception. A divergence in the evolution of this perception, the posterior belief of success, is one of the main difficulties

underlying strategic and investment decision-making; opportunistic behavior like window-dressing influences perception. Like the division of equity between management and outside investors, the firm's leverage is an important 'generator' of agency costs. It has been argued that debt has similar effects as outside (preferred) equity on the entrepreneur's behavior and risk attitude. However, since it is difficult for young ventures to obtain big loans in early stages the firm's growth is most often accelerated by the staged infusion of risk-capital. This staging process is one of the most powerful tools outside investors hold to 'secure' their investment and control opportunistic behavior.

As the venture capitalist infuses capital into the project, the ownership structure changes, potentially causing agency conflict. In this context the definition of ownership has been broadened by including the allocation of specific the contractual agreements in the discussion. Venture capital contracting being a popular topic in recent scientific literature, earlier empirical research has been used to determine and extract conditions and boundaries of the subject of analysis of this thesis. Subsequently, the following has been assumed: before the venture capitalist has been offered a stake in the venture, there is no debt and all equity is held by the entrepreneur. Early stage financing rounds (before revenue is being generated) are recognized to be shorter in duration and smaller in size than later stage financing rounds (after revenue is being generated). The dominant mode of financing is convertible preferred equity, providing the venture capitalist with special rights such as a fixed rate of return. In later stages, the convertible preferred equity is partly replaced by common equity and debt, giving the lender the right to foreclose. In addition, the venture capitalist has a senior claim on the project value in case of liquidation. Furthermore, the venture capitalist has a large claim on voting rights and board rights but these are contingent on venture performance. It has been assumed that the project's performance or probability of success is negatively related to the venture capitalist's control and liquidation rights. So-called switches in control occur mostly in the early stages of the investment process. Lastly, if ventures have the potential to go public, financing is continued into later stages; if not, the investment is abandoned or sold in an early stage.

To structure the complex issue of relating a comprehensive body of potential conflict situations to its underlying cause, use has been made of an earlier classification. It has been assumed that when a functional, cognitive dispute transforms into an affective, dysfunctional conflict about the goals of the venture, an agency problem arises. Conflicts about short-term, long-term orientation, product/innovation and control might, however dependent on the qualitative state of the project and successive conditions, lead to adverse selection, moral hazard, hold-up and/or window-dressing. It has been proposed that the qualitative state of a project can be brought back to only two variables: 1) the (external) market conditions, and 2) the (internal) project quality. Assuming each variable can only be one of two states ('good' or 'bad') four different risk situations are distinguished. Expanding the model with a time-variable, posterior belief and the assumptions of this chapter, agency problems (caused by the affective goal conflict) can be posed accordingly: adverse selection occurs with start-up firms with a short or no track record. The entrepreneur holds all equity and has therefore sole access to private information. The venture capitalist must rely on the trustworthiness of the entrepreneur and the information he provides. In a high upside risk potential situation the entrepreneur has generally no incentives to overestimate prospects and chances on adverse selection are small. However, when there is diffusion about the venture's prospects or when downside risk potential is high, the entrepreneur is likely to accept a higher rate of return for the venture capitalist therewith causing potential adverse selection. The moral hazard problem is triggered by a difference in goal objectives by the entrepreneur and the venture capitalist. In general the staged

investment structure and the co-ownership should prevent the entrepreneur from behaving opportunistically, but under certain circumstances he might feel benefited by exercising personally beneficial strategies. In an upside potential situation goals are likely to be aligned, but if there is any goal conflict and it is of the affective type, it is not likely that the ownership structure (as in the broader sense of this thesis) will hinder the entrepreneur in striving to obtain his personal goals. On the other hand, when there is increased downside risk potential, the ownership structure may start to affect the entrepreneur's behavior causing a serious moral hazard at various stages of the investment process. This is increased by the venture capitalist's seniority with regard to liquidation value and control rights (in a downside potential situation). Furthermore, when not much is known about the intrinsic project quality and information asymmetry is high, especially in early stages, the entrepreneur might feel incentivized to window-dress results just before a periodic performance review by the venture capitalist. Having assumed that projects that do not have the potential to go public are abandoned or sold in a relative early stage, goals are not aligned when performance is not met: the entrepreneur starts behaving opportunistically by window-dressing results in order to achieve a follow-up investment-round. When downside risk is high and continuance is not perceived to be a reasonable option, the potential of window-dressing problems is overshadowed by moral hazard. Window-dressing in later stages is less common since information-asymmetry is reduced. The hold-up problem is particularly pronounced among new start-up ventures that face contract renegotiation. As the investment by the venture capitalist sinks into the project, the hold-up problem increases. In chapter five an attempt has been made to analyze how a deviation of interest and goal diversion may cause a difference in 'conceptual bridges' as perceived by the entrepreneur, who acts as agent, and the venture capitalist, who is the principal. Using assumptions and theoretical elements from previous chapters, strategic issues such as the continuance, exiting or deferment of follow-up investment have been related to the dynamics of a staged investment structure. It has been described how real option reasoning relates to the strategic alternatives at the outset but also during the investment process. Dependent on various contextual variables as well as the qualitative states from which the project progresses, each strategic option is valued at very discrete points in time. Here the interaction among options plays an important role. Projecting the assumptions of chapter 4 and the evolution of available options on the time-frame, a number of abstract scenarios have been sketched and portrayed in a decision-tree. Following, this renewed framework has been used to derive various combinations of variables that provide the conditions for potential agency conflicts. Accordingly, in paragraph 5.3 the impact of the entrepreneur-investor relationship and the accompanying asymmetric distribution of information on the valuation of potential strategies have been discussed. Several propositions, organized around three themes (learning, opportunistic behavior and risk attitude), suggest probable relations between real options in a specific context and the variables of the principal-agent relationship. A fictional example is used to illustrate the various propositions.

It is proposed that an asymmetric distribution of information and a potential goal diversion cause significant differences in the perceived conceptual bridges between strategic action and firm value. Hence, the discovery of negative information about the project or the reception of successive but contradicting signals has direct effect on the posterior belief of the outside-investor in the probability of success. Realizing that posterior belief is rapidly adjusted when uncertainty is high, the discrete learning moments of a staged investment structure causes the venture capitalist to attach disproportional weight to negative signals about the project quality. The entrepreneur on the other hand performs the opposite behavior. Providing that the entrepreneur is subject to the

so-called confirmation bias, it is suggested he perceives a lower value of deferral and exit strategies. This however being a fairly basic observation, it is proposed in addition how the unequal distribution of liquidation rights and put provisions negatively affects the option value of abandonment *for the entrepreneur*. Furthermore, since early abandonment by the venture capitalist possibly means the instant liquidation of potential growth and complete deterioration of salvage value that the entrepreneur might otherwise receive, the entrepreneur is under these conditions triggered to use the information asymmetry to his advantage. It is proposed how the intentional distortion of results positively affects the expected outcome and decreases the uncertainty level as perceived by the venture capitalist. Another factor that affects the perceptual bias is the changing risk attitude of stakeholders. The venture capitalist, essentially being risk-averse, protects his (calculated) risk by demanding high discount rates. However, should returns be disappointing, deferring decision-making is often the attractive low-risk strategy to follow. The entrepreneur on the other hand only benefits if project value exceeds a certain limit, causing it to be increasingly attractive to pursue high variance strategies: expansion and possibly even emergent strategy switches can be used to increase option value. It is argued how the venture capitalist's risk averse attitude causes him to increasingly focus on the expiration signal of deferral, while the risk preference by the entrepreneur signals opportunity with regard to potential option value. In addition, it has been described how many factors influence the managerial behavior of the entrepreneur. If option value is perceived low and a lack of flexibility limits the current managerial means to accommodate growth, opportunistic behavior is likely to occur. Considering that, if the NPV is extremely negative, no amount of optionality can possibly rescue the project, the agent is increasingly motivated to pursue personally beneficial activities, such as extracting resources for personal consumption or intentional risk-taking with very low probabilities of success. Hence, it is proposed in this paper how moral hazard and hold-up problems have a direct effect on the value of exit and continuance options. Perception and actual value are reconsidered in this context.

Chapter six serves to integrate the findings, assumptions and propositions of the preceding chapters into a synthesizing approach, ultimately leading to the construction of a new model. To do so, paragraph 6.2 briefly set out how classic option reasoning is expanded by the inclusion of the principal-agent relation into one model. Whereas financial option strategy assumes information on risk aversion and expected returns to be reflected by the stock price, it has been argued that in the real option market, not only variance, but other parameters are also subject to estimation and ambiguity. It has been shown how Black Scholes determinants are to be seen in a wider context. Not only do contextual variables such as conjuncture, country, contract type and competition have a direct effect on factors such as expected growth, current value, risk and interest rate, also do various variables, derived from the division of ownership, have a significant affect on real option value. Examples of these added variables are investment phase, monitoring activities, goal diversion, agency costs, risk attitude and information asymmetry. Paragraph 6.3 introduces the application of this expanded view on option value into a new model. A matrix consisting of four quadrants, each representing specific principal-agent characteristics as well as the allocation of specific contractual rights allows for the projection of one's posterior belief in the success of the venture on an 'agency' situation. A clear distinction has been made between exit, continuance and deferral strategies. Relating the preference for a continuance strategy to a posterior belief level close to one and the exit strategy to a level close to zero, enables an insight into the likely effects of an agency-conflict on the value of a strategic option. Various dotted lines represent the dynamic effect of the propositions formulated in chapter five on the strategy preference. Chapter 6.4 suggests direction for the inclusion of the model into the practice of

decision-makers. With a focus on the underperforming venture, a four phase program has been developed to systematically assess the project's health and integrate the agency issue in the determination of its probability to successfully turn around. Feedback from various decision-makers has been used to reflect on the model.

While chapter seven concludes, in chapter eight a brief reflection on the issues and approaches of this paper as well as some suggestions for future research has been described. It can be concluded that, while the body of this paper consists of the analysis of theories and previous empirical studies, the scientific contribution of this research lays in the construction and formulation of a synthesizing tool to systematically integrate the derived effect of a division of ownership in venture capital-backed firms on the strategic decision-making process. It has been found that not only does the model serve as a way to estimate a project's status-quo with regard to agency issues and strategy preference; also does the model serve to foresee the potential effect of a specific strategic choice. However, the relaxation of the underlying assumptions provides interesting suggestions for future extensions of this research. The most obvious follow-up would be the expansion and translation of the propositions into a set of empirically testable hypotheses. Other extensions such as a broadened categorization of institutional investors, the formulation of standard evolutions of posterior belief, syndicated investment structures, a reversed principal-agent relation and the addition of game-theoretic elements also reflect how fruitful the integration of agency and real option theory can be in terms of academic research. It is suggested that the methodological application of these elements into practice should follow.

1 INTRODUCTION

1.1 INTRODUCTION

The way the Internet bubble burst in April 2000 was as irrational as the hype that caused it to exist in the first place. While ‘old economy’ indices such as the Dow Jones and the AEX remained fairly constant, the technology stock index NASDAQ dropped 68% from 4800 to 1500 in less than 18 months. This leads to the expectation that not only did outside investors enormously overvalue Internet stock; also did they collectively lose their confidence in the growth potential of their investments and the viability of their business models when the continuous growth of the preceding years seemed to have reached its peak. But how could this have happened? While the new economy environment is characterised by enormous uncertainty as the business landscape is paced by technology innovation, start-up financing and investment valuation during the hype seems to have been based on a different paradigm. Myers first suggested in 1977 that the market value of a firm consists of the present value of its expected cash flows (NPV) *plus* the value of the firm’s growth opportunities, the so-called *real options*. Amram and Kulatilaka followed up on this in 1999 by stating that Internet era valuations are based on the perception of the ability to rapidly adapt to changing conditions and the costs of searching for a profitable business model in a highly competitive and uncertain world. ‘Most company investments in the volatile Internet world are options – business investments that create the opportunity to make decisions in the future, after events unfold. (...) Between now and maturity, the company’s value is driven by its ability to identify and execute the sequence of options.’ (Amram, A., Kulatilaka, N., 1999)

But how are these options valued? And more importantly in this context, *who* values these options? Uncertainty – hence potential variance – is key to the value of an option (Gunther McGrath, 1999). This implicates that a higher option value is accompanied by a greater uncertainty for the risk-bearer: the owner of the project. It is expected that a division of ownership influences the willingness to take risk and consequently, the valuation of strategic options. In accordance, the agency theory proposes how managers who are agents of shareholders, or managers that have a declining share of stock, cannot be relied on to (fully) act in shareholders’ interests because their objectives are different (Bethel, J., Liebeskind, J., 1993).

It is aimed at in this paper to explore the effect of a division of ownership on the valuation of strategic options during the investment process. Acknowledging that an examination of these issues implies the difficult task of integrating factors from a variety of scientific fields, it is important to define clear boundaries of the scope of this research. In this chapter first attention will go out to defining a detailed problem area. Formulating a number of research questions will provide direction for structuring the research process. Next, the objectives of research will be described, where after thesis-specific terminology is unambiguously defined. Paragraph 1.5 goes into the methodology that is used to obtain and structure information and paragraph 1.6 follows up on this by describing the structure of this paper.

1.2 PROBLEM DEFINITION

Now the question arises how this contributes towards understanding the irrationality that so characterises the rise and fall of the Internet hype of the late nineties and early 2000? It is expected that, in order to grasp the decision-

making process that preceded both events, it is necessary to create an understanding of the relation between the way these ventures were funded and the effect this has had on the valuation of strategic options. In addition it will be argued that the wealth-constrained entrepreneur, seeking capital to accommodate the expected growth of his venture, turns himself into a lessee under venture capital contract, therewith losing autonomy. Following, the relation between venture capitalist and entrepreneur can *under specific assumptions* be seen as a principal-agent relationship, observing the entrepreneur as agent and the venture capitalist as principal.

This poses the following scientific problem:

Extending real options in an agency context how is strategic decision-making in venture capital-backed firms affected by the ownership structure of these firms?

An essential feature of any venture project is the necessity to fund the project in order to learn more about the uncertain return of the project. The simultaneity of the financing decision and the acquisition of new information about the investment project are characteristic for ventures and more generally for the financing of innovation (Bergemann, D., Hege, U., 1998). Thus, the acquisition of information is an important aspect of the investment process. However, the division of ownership implies the information to be unevenly distributed among stockholders, causing a perceptual bias with regard to the success rate of potential strategies. Hence, to tackle the problem, it is important to first pay attention to the dynamic interaction of venture capital financing – and therewith the dynamic ownership structure – and the agency problem.

1. What is the agency problem in venture capital backed firms?
 - a. How does the ownership structure change during the investment process in venture capital backed firms?
 - b. How does this change in ownership structure affect the agency problem?

Having created an understanding of the relation between the agency problem and the investment process, a second area of attention can be addressed: the effect of the agency problem on real options. In order to investigate the areas in real option theory that require flexibility in an agency context, where none is presently assumed appropriate, a comprehension of the role of the agency issue in financial contracting is required. The projection of these findings on a theoretical analysis of real options is expected to reveal areas that require a (more) flexible approach.

2. How does this agency problem affect the real options in strategic decision-making?
 - c. Which options are considered ex-ante the financing contract?
 - d. Which determinants of the value of real options should be reconsidered in an agency context?

1.3 RESEARCH OBJECTIVES

1.3.1 General objective

The general aim of this research is to create insight into the derived effect of ownership structure on the strategic decision-making process. By investigating potential rigidities and flexibilities of real options in an agency context, a model will be developed to be able to systematically (re)consider the relevant variables in the valuation process of a potential strategy. The general purpose of this model is to contribute towards the body of theoretical tools to be able to systematically integrate the principal-agent relation in ex-ante investment decision-making.

1.3.2 Scientific contribution

Real options allow decision-makers to reconsider investment opportunities as events unfold and uncertainty subsides. One aspect that is often neglected in the event of subsiding uncertainty is the effect that the capital aspect of a sequence of tactical investment projects may have on the internal objectives of the management. Hence, in adopting a synthesising approach, this paper is meant to explore the possibility whether an approach that incorporates both real options and agency perspectives, will provide an improved understanding of the effect of ownership on options in a strategic decision-making process.

1.4 FOCUS, DEFINITIONS AND RESTRICTIONS

Venture Capital

Venture capital has become a major vehicle for the funding of entrepreneurial ventures and serves a particularly interesting purpose when examining the social aspects of financial contracting. Although many factors play a role in the decision-making process, the focus of this paper is on the agency problem, as derived from financial contracting in a venture capital environment. For this purpose no explicit distinction is made between venture capitalists that limit themselves to the funding of start-up ventures (American VC's) and venture capitalists that also fund mature projects (European VC's). However, since start-up ventures provide most fruitful conditions for agency conflict, the main focus is on (start-up) ventures with increased uncertainty, high R&D levels, and low (or negative) net present values.

Real Options

The existing body of literature on real options is extensive. Trigeorgis (1993) discussed (some of) the stages of development and evolution of the real options theory, while organising his presentation around several broad themes. In this thesis, his proposed classification (1993) is used to discuss and deepen the theory. When discussing real options as strategic options, the entrepreneurial venture –the investment project– is regarded object of analysis.

Strategic Decision-making

When I propose to examine the effect of ownership on strategic decision-making, real options are approached from a strategic point of view. Although real option theory has been developed and used as a quantitative

valuation method, the focus of this thesis will be on the thoughts behind real option theory: strategizing in uncertainty. As the investment process progresses and internal and external conditions change, deliberate strategies might become less relevant as alternative strategies might emerge. As such, strategic decision-making is referred to as the translation of a dynamic real option set into strategic options.

Ownership structure

Although the main focus of this paper is on the division of ownership between the inside-investor (entrepreneur) and outside-investor (venture capitalist), financial contracts are generally not bounded by all-equity financing. The interaction of entrepreneur and venture capitalist has resulted in the evolution of a unique set of financial contracts. And in no other kind of transaction does the implied link between value and financial structure appear so strong and direct as in the typical venture capital deal (Sahlman, 1993). For this reason I will not restrict the scope of my research to equity financing; when appropriate I will discuss the interactions between the agency issue and the general flexibility of venture capital contracting.

1.5 METHODOLOGY

1.5.1 Research methods

The body of this thesis will consist of a theoretical study and model development. By examining existing literature on real option theory, financial contracting and agency theory, the (non) existence of possible causalities is suggested. Formulated as propositions, these causalities will form the basis for the model. However, since potential causalities are merely assumptions at this stage, the discussion of unambiguous propositions with a number of sources (in the field) will precede the integration of these assumed causalities into a model. Furthermore, in order for the model to have practical relevance, feedback from potential users is used during the modelling process.

1.5.1.1 Literature study

Strategy, according to the real options approach, is viewed as ‘a process of organizational resource-investment choices, or options.’ (Bowman, Hurry, 1993) The agency problem has been described as the tendency of management to use company resources for private consumption (Jensen, 1976). This, in synthesis with the definition of strategy by Bowman & Hurry, leads to an interesting perspective. A review and analysis of the literature on these issues will lead to the extraction of relevant interactions. A creative approach towards the interaction between the different theories and earlier assumptions will thereafter provide material for the formulation of propositions that will form the basis for the development of a new model. For the discussion of research question one, relevant conclusions from previous research will be assumed appropriate in the context of this paper.

1.5.1.2 The key informant interview

After having reviewed and analysed the literature and an insight into the interaction of different theories has been created, a number of assumptions are formulated into unambiguous propositions. For these assumptions to contain practical value, a ‘reality check’ must be performed. For this purpose the key informant interview

technique will be used. Considering the qualitative nature of social science, it is believed that more practical value is found through semi-structured and open end-interview techniques, than can be found through the quantification (and therewith simplification) of these complex issues. Understanding and accepting the scientific and practical relevance of empirically proven hypotheses, it is aimed to contribute to the overall understanding of strategic decision-making by conducting a number of in-depth interviews with experienced people in the industry.

To obtain information from all relevant perspectives the informants are divided into three groups: 1) the outside-investor, 2) the owner/manager of a venture capital backed firm, and 3) independent professional observer (strategy consultant). The aim is to conduct interviews with at least one player in each group. To structure interviews and receive good and comparable answers from the different informant groups, an outline of the research objective, a list with propositions and an accompanying explanation will be send to each informant before the interview. During the interview suggestions are made about the expected needs for translation into a practical model.

1.6 THESIS STRUCTURE

This paper will consist of four sections. The first section discusses the research objective and approach (chapter 1), and lays a detailed theoretical foundation by discussing the real options theory (chapter 2) and the agency theory (chapter 3). The second section will serve to go deeper into the problem areas, as defined in the research questions. Chapter 4 will deal with the first research question, discussing the investment process in venture capital backed firms in relation to the accompanying agency problem. Previous research on financial contracting, ownership structure in venture capital-backed firms and potential agency issues will be used. Chapter 5 will use the discussion of the first research question as a starting-point to propose the effects of the agency conflict on real options, as set out in the second research question. This will conclude second 2. The third section (chapter 6) is used to integrate the findings and propositions from previous chapters into a practical model. By conducting semi-structured interviews with people in the industry, the propositions are tested and suggestions are made towards a new model. The purpose of this model is to contribute towards the body of theoretical tools to be able to systematically integrate the principal-agent relation in ex-ante investment decision-making. This will then conclude section three. The fourth and final section will round up. Chapter 7 will conclude and chapter 8 will describe a discussion of conducted research and ideas for future extensions.

2 THEORETICAL FRAMEWORK: REAL OPTIONS

2.1 INTRODUCTION

Real option theory is in many ways closely aligned to a number of scientific fields. Researchers in option theory, as an area in both financial economics and strategic management, study organizational investments – the former in terms of economic value, the latter in terms of action and performance. The intuition to ‘keep options open’ against the unforeseeable future has motivated the development and use of option contracts in order for individuals to retain the right to future investment choices without being obliged to invest. As such, these contracts give expression to a typical pattern of investor behavior (Bowman & Hurry, 1993). In fact, *strategy* is often seen as the ‘organizational process of sequential resource-investment choices’ (Mintzberg, 1978). And, as this perspective offers an economic logic for the behavioral process of incremental resource investments (Dixit, 1992) an interest in the interrelation between real option valuation, investment behavior and the different roles in the decision-making process is next.

This chapter will provide a theoretical foundation necessary for a discussion of these issues. In paragraph 2.2 a brief historical review of options literature will provide some insight into the development of this academic field as well as the need for ongoing extension. In paragraph 2.3 attentions will go out to the basic thoughts behind real option theory, its relation to corporate strategy, the analogy with financial options, and the determinants of option value. In order to structure the discussion of real options in a later stadium, a common classification of real options as they appear in business, efficiently portrayed by Trigeorgis (1993), will be described in paragraph 2.4. The managerial flexibility of real option theory is explained in the light of probability distributions of expected returns in paragraph 2.5, where an understanding of the four moments of a probability distribution will help to discuss the dynamics of option value in specific contexts later on. To conclude, paragraph 2.6 will touch upon the use of real growth options in start-up venturing, the object of analysis in this thesis.

2.2 A BRIEF HISTORICAL REVIEW OF CONCEPTUAL DEVELOPMENT

‘The real option revolution arose in part as a response to the dissatisfaction of corporate practitioners, strategists, and some academics with traditional capital budgeting techniques. Early critics recognized that standard discounted cash flow (DCF) criteria often undervalued investment opportunities, leading to myopic decisions, underinvestment and eventual loss of competitive position, because they either ignored or did not properly value important strategic considerations’ (Trigeorgis, 1993: 203). A new era began in 1977 when Myers first suggested that the market value of a firm consists of the present value of its expected cash flows *plus* the value of the firm’s growth opportunities, the so-called *real options*:

$$\begin{aligned} \text{Expanded (strategic) NPV} = & \text{static (passive) NPV of expected cash flows} + \\ & \text{Value of options from active management (flexibility)} \end{aligned} \quad (2.1)$$

Up until then, the calculation of a project's value consisted of the estimation of the expected pattern of cash flows, $\sum_{t=0}^T \frac{CF_t}{(1+i)^t}$, over a pre-specified life, discounted at a risk-adjusted discount rate, i , (derived from the prices of a twin security in the same risk class), i.e.,

$$NPV = \sum_{t=0}^T \frac{CF_t}{(1+i)^t} - I_0 \quad (2.2)$$

Accordingly, the net present value (NPV) is the above gross present value minus the present value of investment outlays, and represents the value creation for the shareholders from this project. The main shortcoming of this method is the implicit definition of each investment decision as a 'now or never' proposition; it does not take into account the value of a 'wait and see' strategy to make or alter decisions as the value of the project is gradually revealed (Smit, 1996). Hence, acknowledging that (i) many investment projects can be deferred, and (ii) investment is irreversible or 'sunk', Myers' answer to the traditional NPV method was to add a flexibility component to the project's value. He claimed that deferment of an irreversible investment decision, driven by uncertainty over its value, could create flexibility for management, or decision-makers. The implication of irreversibility motivates management to wait ascertain that the project is clearly lucrative, while keeping open the option to reconsider the planned investment decision (Smit, 1996). Examples of such irreversible investments (sunk costs) are expenditures in marketing or specialized plants. However, after publication of Myers' article it still nearly took a decade for the first practical application method of real options to be developed. In 1986 McDonald and Siegel came forward with a model that suggested that in an uncertain market, a firm should postpone an irreversible investment until the value of the investment exceeds the costs if the investment by the option value of waiting to invest.

This was the first time a direct analogy with a financial call option was shown – an option, in essence, gives its owner the *right*, but not the obligation, to take an action now or at some future point in time (Ross *et al.*, 1999). As such, financial options are rights to buy, sell, or exchange claims on traded securities, such as stocks and bonds. Based on this analogy, many researchers have been applying real options in a wide variety of cases and contexts since. First examples of practical applications are Paddock, Siegel & Smith (1987) in valuing offshore petroleum leases, Majd & Pindyck (1987) in valuing projects that require time to build, and Trigeorgis & Mason (1987) in examining the option to alter operating scale (i.e., expand or contract). In 1990, Myers & Majd analyzed the option to abandon a project analogous to an American put option, while, a few years later, Trigeorgis (1993a) for the first time focused on the nature of real option interactions. As the earlier literature focused on valuing individual options, Trigeorgis pointed out that the combined value of a collection of real options might differ from the sum of separate option values. More recently the element of competition and game theory has entered the discussion of real options; see, for example, Smit (1996) and Kulatilaka & Perotti (1997). Needless to say, this 'listing' is far from complete. However, since it reaches too far in the context of this thesis to elaborate and do right to every author, the interested reader is directed to the work of Trigeorgis (1993b) and Hull (1995) for a more comprehensive description of real option literature and contributions.

2.3 VALUING THE OPTION: SIMILARITIES AND DIFFERENCES OF THE OPTION ANALOGY

The analogy with financial options needs further attention. Broadly speaking, options are found in two types: financial options and real options. Not only can similarities between the two types help explain some of the factors that determine the value of a real option, also do differences in the option analogy shed light on the relative value of the method.

2.3.1 The American Call and the ability to defer investment

The most common type of option is a call option. A *call* option gives the holder the right, for a specified price within a given amount of time, to exercise the option to acquire the underlying asset; exercising the option however, is irreversible. In theory, if there are no opportunity costs, such as dividends, the holder will postpone the decision to exercise a call option until the expiration date.¹ When the value of the underlying asset is greater than the exercise price of the option, the call is said to be *in the money*. In this case, the holder will exercise the option; after all, he has the right to obtain stock for less than the market value. On the other hand, when the value of the underlying asset is less than the exercise price of the option, the call is *out of the money*. This time the holder will *walk away* and by doing that, make use of his right not to exercise the option; the option expires. When the market value of the underlying asset is exactly the exercise price, the option is said to be *at the money*.

The first method for pricing financial options was developed for an option that has no fixed expiration date (a perpetual option) and thus can be exercised at any moment (a so-called American option; see figure 2.1). As described, McDonald & Siegel were the first to link this with the (real) option to defer (i.e. option with ability to wait, wait-and-see option). In the real option case, the underlying asset is the value of the completed and operating project, V_t , while the exercise price is equivalent to the necessary investment outlay, I . The ability to defer a project with an uncertain value, V , creates valuable managerial flexibility.

Figure 2.1 Value of an American Call as a function of Stock price Source: Ross (1999: 556)

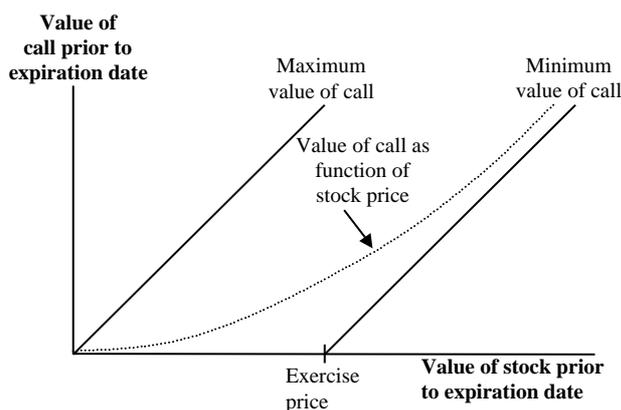
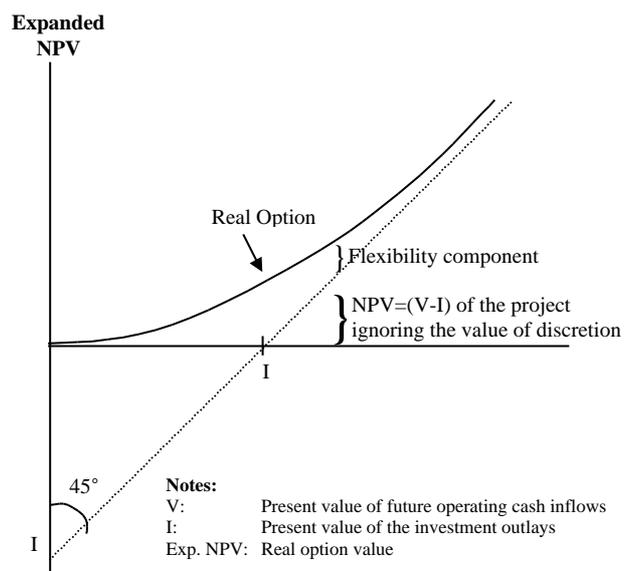


Figure 2.2 The Analogy of a Call Option with Ability to Wait Source: Smit (1996: 12)



¹ The type of option that may be exercised anytime up to the expiration date is known as an American option. A European option differs from an American option in that it can be exercised only on the expiration date.

The curve in figure 2.2 illustrates the value of the real option to defer investment. The curve is divided into two components: the static NPV of cash inflows and the flexibility component of the option to defer. In practice, this flexibility component can be explained by the positive strategic value with which investment projects with a negative net present value of their measurable cash inflows are often approved. For example, an R&D-project or entry into a new geographical area may yield no direct profits but still have an add-on value because of possible future investment opportunities.

Furthermore, two important assumptions can be read from the figure. Firstly, the added value of the option is greatest when $V=I$. This shows that value is directly correlated to uncertainty; any decrease or increase in expected value incorporates the difference between 0 and any positive value (if $V < I$ at expiration, the call is worthless). Secondly, the curve indicates that the call price, as a function of stock price, increases as the stock price increases. It is shown that the relationship is represented, not by a straight line, but by a convex curve. That is, the increase in the call price for a given change in the stock price is greater when the stock price is high than when the stock price is low (Ross, *et al.*, 1999). This can be explained as, that as the expected value of an investment project increasingly exceeds its investment outlays, the option becomes more expensive while the chance on *extra* return decreases.

2.3.2 The determinants of option value

Option valuation started with Bachelier (1900), and took definitive forms in accurate stock option valuation formulas (Black Scholes, 1973; Cox, Ross & Rubinstein, 1979). The best-known option pricing formula is that of Black and Scholes (1973). They derived a formula (2.3) for the simplest of all options: one that cannot be exercised prior to maturity and has a fixed expiration date (the so-called European option). Given that the price of stock will change over time, they show that a specific combination of stock and borrowing can duplicate the price of a call over an infinitesimal time horizon. In other words, their dynamic strategy allows one to value a financial call in the *real* world.²

$$C = N(d_1)P - N(d_2)PV(S) \quad (2.3)$$

$$d_1 = \frac{\log \frac{PV(S)}{P} + \frac{\sigma^2 t}{2}}{\sigma \sqrt{t}}$$

$$d_2 = d_1 - \sigma \sqrt{t}$$

P is the current *stock price*; S is the *exercise price* of the call at expiration date; $PV(S)$ is the present value of the stock discounted at the *annual risk-free rate of return* r_f ; t is *time to expiration date* and σ the *standard deviation*. $N(d)$ is a statistical component and represents the cumulative normal probability density function.

Although this formula is perceived to be one of the most complex formulas in finance, it basically involves only five parameters. This allows us to apply the basic definition to other situations than just financial options. When it was recognized that organizational resource investments are analogous to financial options, the next logical

step would only be to find a call option sufficiently similar to the investment opportunity, so the value of the option would tell us something about the value of the opportunity. Unfortunately, since most business opportunities are unique, the likelihood of finding a similar option is extremely low. Therefore, the only reliable way to find a similar option is to construct one. And to do so, a correspondence between the project's characteristics and the five variables that determine the value of a simple call option on a share of stock must be established (Luehrman, 1998).

The value of a real option can be understood as a function of the variables in table 2.1:

Table 2.1 Linking real option variables to the Black-Scholes model		
<i>Investment Opportunity</i>	<i>Financial Call Option</i>	<i>Variable</i>
Length of time the decision may be deferred	Time to expiration	t
Risky-ness of the project assets (project risk)	Variance of returns on stock	σ^2
Time value of money (interest rate)	Risk-free rate of return	i (=r _f)
Present value of a project's operating assets to be acquired	Stock price	V (=P)
Expenditure required to acquire the project assets	Exercise price	I (=S)

Source: Luehrman (1998:55)

The *length of time* that project outlays can be deferred makes a real growth option more valuable. The ability to defer the decision gives the decision-maker time to examine the course of future events and the chance to avoid costly errors if unfavorable developments occur. Even a project with a negative NPV can be a valuable 'out-of-the-money' growth option if the company can put off the investment decision for a while. Particularly when competitive pressure is low, management may postpone projects in new markets and decide to invest large irreversible outlays only when the project appears to be clearly profitable. A company might maintain such out-of-the-money options even if they require ongoing spending for engineering, product development, market research, and so on, provided there is a realistic chance that future events will make the project more valuable (Kester, 1984; Smit, 1996).

Paradoxically, *project risk* is a positive factor in the determination of a growth option's worth. Although high (systematic) risk results in a high required return by the capital market and a low market value of the project for immediate investment, high (total) risk has a positive influence on the value of a real option. In fact, if two investment opportunities have identical NPV's and can be deferred for the same amount of time, but uncertainty over the value of a projects' commercialization differs, a perceptive decision-maker would choose the riskier one. This is because of an asymmetry between potential upside gains and downside losses when an option matures. While large gains are possible when a project's NPV increases, losses can be cut by simply choosing not to exercise the growth option whenever the project's NPV is negative. This ability means that high risk increases the chance of eventually realizing a large gain without equally increasing the chance of incurring a large loss.

The *interest rate* (r) also influences the value of a real growth option. Generally, higher interest rates translate into higher discount rates and lower present values of future cash flows for any given project. But high interest

² It reaches too far for the purpose of this paper to go into further detail and explain the derivation of the Black Scholes formula. In this context, it is suffice to stress the application of the basic definition (and thoughts behind B&S) on other than financial options and therewith it's wider range of possibilities.

rates also influence the value of a real option if management believes that large investment outlays of the follow-up investment may be postponed. This can give certain kinds of projects – specifically those that create new options – a crucial competitive advantage in the capital budgeting process. A strategy that encompasses low immediate investments and large growth opportunities will therefore have higher value as interest rates increase.

The first direct difference between real and financial options lies in the underlying asset traded. Firms presumably create value by investing in projects for which the *present value of expected cash flows*, V , exceeds the *required investment outlay*, I . Therefore, the process of real asset valuation attempts to determine what a project would be worth if it were traded in the financial markets. Option valuation models are often based on arbitrage arguments that have an option equivalent. An equivalent portfolio strategy, consisting of a position in the underlying asset partly financed with a risk-free loan, is constructed so that in every future state it has the same pay-off as the option, and should have the same current value. In the real option case, the financial market valuation of the postponed project is determined by a project equivalent in the financial market with exactly the same risk characteristics. Of course, the existence of such a commodity is questionable. Still, under the assumption of completeness, with the discounted cash flow method the underlying value of the option (present value of operating CF's) is calculated as if it were traded, using its risk-required rate of return as the appropriate discount rate. Subsequently, the option pricing method can calculate the value of the option on the project. Whether the DCF and the OPM valuations are correct still rests in that the securities traded are sufficient for dynamic spanning of the underlying asset (Smit, 1996).

A second distinction between options in financial markets and options in real markets concerns the implication of future opportunities into the current value characteristics of a project. Most deferrable investment opportunities realize their benefits primarily through cash flows (simple options), while other projects realize benefits by including opportunities for further discretionary investment (compound options). In this approach, where a compound option implies an option on an option, a strategic investment is viewed as the first link in a sequence of investment opportunities that develop over a period of time. Given the company's strategy, management should question whether a particular option will bring the right investment opportunities in the right markets within a time frame suitable to their company's needs (Kester, 1984; Smit, 1996).

Another difference between the two option markets is the degree of exclusivity of the latter. A standard call option on common stock is 'proprietary', in that it gives the owner an exclusive right when to exercise the option. The value of a real option very often depends on the ability of the management to actually appropriate the benefits of the option. Competition can force a company to invest early, because postponing the follow-up project could result in project value erosion or profit preemption. 'Shared' options are thus less valuable 'collective' opportunities of an industry. Only if a company is in a sufficiently strong competitive position to ward off assaults and grab the lion's share of a projects value can a shared option be valuable (Kester, 1984; Smit, 1996).

2.3.2.1 Assumptions of the Black-Scholes model

As shown, there are a few factors in the value determination of a financial option that can be used to estimate the value of a real option. Nonetheless, the analogy is limited. It is often brought forward as the main attraction of the model: four out of five of the parameters in the model are observable; only variance of return must be

estimated. But as it seems, for the Black Scholes model to be correct, the assumptions are severe (Ross *et al.*, 1999):

1. There are no penalties for or restrictions on short selling.
2. Transaction costs and taxes are zero.
3. The option is European.
4. The stock pays no dividend.
5. The stock price is continuous; there are no jumps.
6. The market operates continuously.
7. The short-term interest rate is known and constant.
8. The stock price is log normally distributed.

Hence information on risk aversion and expected return on stock seems redundant since it is understood to be reflected by the stock price, which in financial markets can be known exact. In this paper it is argued that, in the real option market, not only variance, but also other parameters from the model are in fact subject to estimation and ambiguity. It is therefore that these assumptions will play an important role in the reevaluation of variables. Assumption 5 will be discussed in more detail in 2.6, whereas 2.5 will deal with the basics of assumption 8 for possible relaxation.

2.4 STRATEGY THROUGH THE OPTION LENS

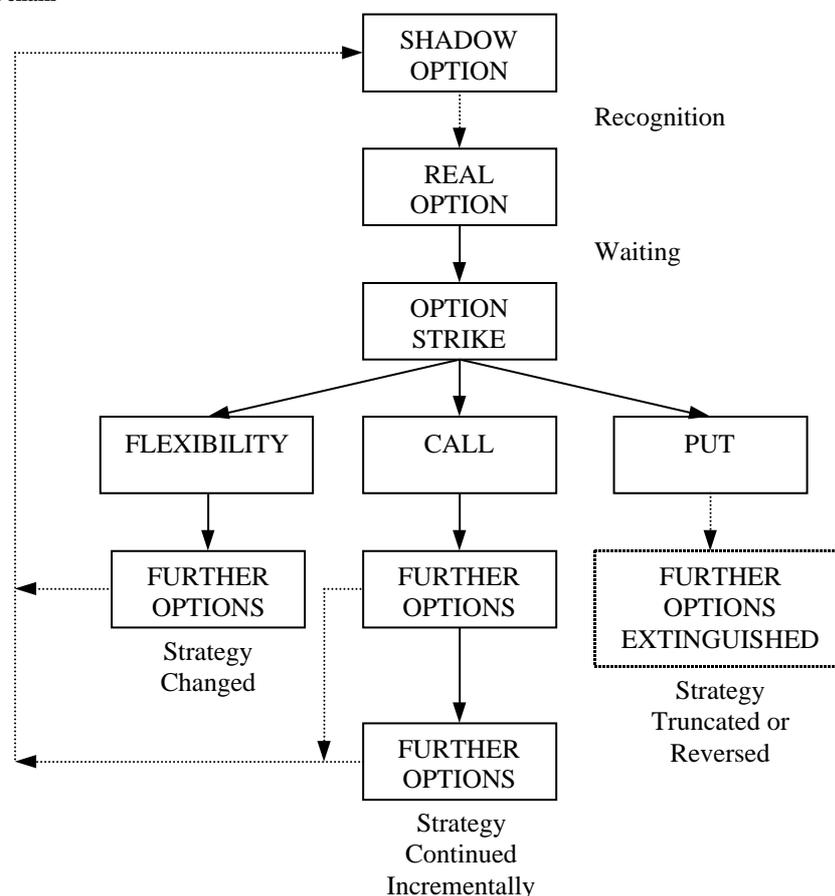
2.4.1 *The option chain*

‘The option lens provides a view of an organization’s resources – its capabilities and assets – as a bundle of options for future strategic choice. These options arise from the interplay of the organization’s existing investments, its knowledge and capacities, and its environmental opportunities.’ (Bowman & Hurry, 1993) They even go as far as stating that ‘strategies are produced by the sequential striking of the so-called *option chain*’.

Figure 2.4, the option chain as suggested by Bowman & Hurry (1993: 764), clearly illustrates a standard strategic decision-making process, dividing the real option into two broad categories: *incremental* options and *flexibility* options. As such, options form the choice mechanism that underlies strategy (Bowman & Hurry, 1993). In short, the chain must be explained as follows. Upon recognition of the *shadow* option – the option bundle contains several options awaiting recognition and opportunities for strategic choice come into being only when decision-makers recognize them – managers are motivated to ‘secure preferential access (i.e., to strengthen the linkage to the opportunity)’, to wait and see if the opportunity materializes. In practice, the conversion of the shadow option into a real option usually involves a small investment (e.g. seed capital provided by a venture capitalist), to develop the skills or resources necessary to exploit the opportunity later on. When the opportunity does materialize, and the organization is ready to exploit it, the (incremental) option is struck when a larger investment is made (e.g. follow-up investment). On the opposite site, if the opportunity fails to materialize, option-holders may choose to abandon the growth option and by doing that, strike a put option (e.g. discontinue investment).

The figure points out that incremental options take the form of simple calls and puts. Striking successive calls thus continues strategies, but they are reversed by striking puts (or by abandoning calls). Furthermore, the sale of a call option is equivalent to the creation of a put option (Bowman & Hurry, 1993). Flexibility options on the other hand, are exercised when strategic change occurs. Instead of simply continuing or discontinuing an investment stream, a ‘radical’ change in strategy calls for redefining the business model, therewith opening up the door to a whole new set of shadow options. A good example of a switch in strategy is the transition of ISP’s (Internet Service Provider) into application service providers. Whereas the ISP’s first only provided Internet access and hosting services, most of them now also offer a wide range of Internet services and applications (e.g. news, games, traffic/weather-information, matching-service). This view is supported by the Schumpeterian definition of the entrepreneur, who is capable of ‘breaking new ground’.³ These innovative activities lead to the discovery of an inter-temporal opportunity that cannot be said to actually exist before the innovation has been created, and this circumstance causes disruption and transformation of the pre-existing equilibrium situation (Volberda, 1997).

Figure 2.3 Option chain



An important note however is to recognize that the term ‘flexibility option’ (i.e. the option to switch), as used by Bowman & Hurry (1993), should not be compared to the flexibility component of the project value as used in formula 2.1: the value of options from active management. The former should merely be seen as one possible

³ Similarly, Ansoff (1998) distinguished between entrepreneurial behavior associated with the creation of new profit potential and competitive behavior associated with the exploitation of available profit potential (Volberda,

component of the latter. In this paper, the term ‘flexibility’ is generally meant as in the latter definition (2.1), unless otherwise is mentioned.

2.4.2 Managerial Flexibility

On the actual marketplace, which is characterized by change, uncertainty and competitive interactions, the realization of cash flows often differs from what management expected initially. As new information arrives and uncertainty about market conditions is gradually resolved, management is benefited by having valuable flexibility to alter its initial operating strategy in order to capitalize on favorable future opportunities or to react so as to mitigate losses (Van Vliet, 2000). This flexibility being the basic circumstance in real option theory, one common way to structure the body of real options is to distinguish between *operational* and *financial* flexibility. Table 2.2 illustrates the various options as they are recognized in the literature. Many of these options occur naturally; others may be planned and built in at some extra cost from the outset.

Table 2.2 Common real Options

Category	Description	Important in
Operational flexibility		
The option to defer (simple option)	Management holds a lease on (or the option to buy) valuable land or natural resources. It can wait to see if output prices justify constructing a building or plant, or developing a field.	All natural resource extraction industries, real estate development, farming, paper products.
Growth options (compound option)	An early investment (e.g., R&D, lease on undeveloped land or oil reserve or strategic acquisition) or a strategic investment is a prerequisite or a link in a chain of interrelated projects, opening up future growth opportunities (e.g., a new generation product or process, oil reserves, access to a new market, strengthening of core capabilities, strategic positioning investments).	
The option to abandon	If market conditions decline severely, management can abandon current operations permanently and realize on secondary markets the resale value of capital equipment and other assets.	Capital-intensive industries with tangible assets, such as airlines and railroads, financial services, and new product introductions in uncertain markets.
The option to alter operating scale	If market demand turns out to be more favorable than expected, management may increase capacity or accelerate resource utilization. Management may also extend production if the life of the product is longer than expected. Conversely, management may reduce the scale of operations.	Facilities planning and construction in cyclical industries; fashion apparel; commercial real estate.
The option to temporarily shut down	If operations are less favorable than expected, management may reduce the scale of operations. In an extreme case, management may halt and then start up again.	Natural resource industries such as mine operations.
The option to switch	If prices or demand changes, management may change the product mix of the facility (product flexibility). Alternatively, the same outputs can be produced by different production processes or inputs (process flexibility).	Output shifts: Any good sought in small batches or subject to volatile demand, e.g., consumer electronics; toys; specialty paper; machine parts; autos. Input shifts: All feedstock-dependent facilities (e.g., oil, electric power, chemicals, crop switching and sourcing).
Multiple interacting options	Real-life projects often involve a 'collection' of various options, both upward-potential enhancing calls and downward-protection put options present combination. Their combined option value may differ from the sum of separate option values, i.e. they interact. They may also interact with financial flexibility options.	Real-life projects in most industries discussed above.
Financial flexibility		
The option to default	If profits are less favorable than expected and the present value of the firm declines under bond payments the firm goes bankrupt. With this option	All levered firms, especially if there are no debt covenants.

	to default the liability of equity-holders is limited to the equity invested in the company.	
Staged financing	If the firm's performance is less favorable than expected, the venture capitalist has the option to exit early.	Start-up venture. Small firms operating in uncertain growing and emerging markets requiring sequential investments.

Source: Smit (1996), Trigeorgis (1993)

2.4.3 Option interaction

An important quality of an option chain is the interaction among successive options. As such, the value of an option is altered if followed by a subsequent option, because it would effectively be written on a higher underlying asset (equal to the gross project value plus the then expected value of the subsequent option). 'The degree of interaction and (non) additivity of option values – and the extent to which the underlying asset for a prior or subsequent option is altered – will be seen to depend on a) whether the options are of the same type (e.g. two puts or two calls) or are opposites (i.e., a put and a call), b) the separation of their exercise times (...), c) their relative degree of being 'in or out of the money', and d) their order or sequence. All these factors affect the degree of overlap between their exercise regions and the probability of their joint exercise (Trigeorgis, 1993b)'.

2.5 THE DISTRIBUTION OF EXPECTED VALUE

One of the assumptions of the Black Scholes model (see subparagraph 2.3.2.1) is that the stock price is lognormally distributed.⁴ It also is discussed that the incorporation of options into the project value enables management to increase upside potential while mitigating potential losses or downside risk. This has its direct effect on the distribution of expected return: it no longer is symmetric, or lognormally distributed. To understand the assumption and to be able to effectively discuss it in relation to managerial flexibility (and perceptual bias later on), in this section the basics of the moments of stock returns are touched upon.

2.5.1 Normal distribution

In financial analysis, a normal (i.e. symmetric) return distribution is sufficiently described by its expected return and standard deviation. The expected value of a distribution is referred to as the first moment of the distribution and is measured by the arithmetic mean of the returns. The variance, which equals the standard deviation squared, is called the second central moment about the mean. It measures the dispersion of the observations around the mean. Moreover, as the median (the middle value of the distribution) and the mode (the most common value of the distribution) are both equal to the mean, the normal distribution also has a standard degree of peakedness. However, although investment returns usually are assumed to be approximately normally distributed, this assumption is less likely to hold for short or very long horizons or in case of certain investment strategies.

2.5.2 Skewness

Skewness refers to the asymmetry of a distribution. A distribution that is positively skewed has a long tail on the right side of the distribution and its mean is typically greater than its median, which in turn is greater than its mode (see figure 2.5). Because the mean exceeds the median, most of the returns are below the mean, but they are of smaller magnitude than the few returns that are above the mean. In contrast, a distribution that is

negatively skewed has a long tail on the left side of the distribution, indicating that the few outcomes that are below the mean are more spread in terms of value than the larger number of outcomes above the mean (see figure 2.6). Hence the mean is typically lower than the median, which is lower than the mode.

Figure 2.4 Positively skewed distribution

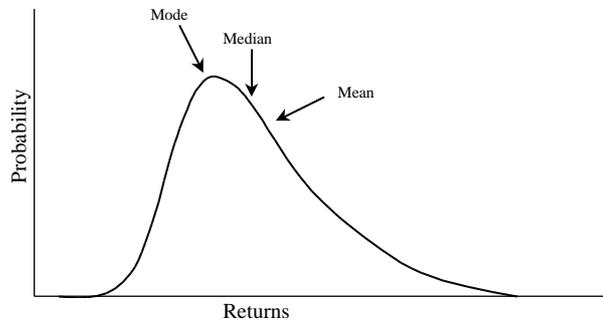
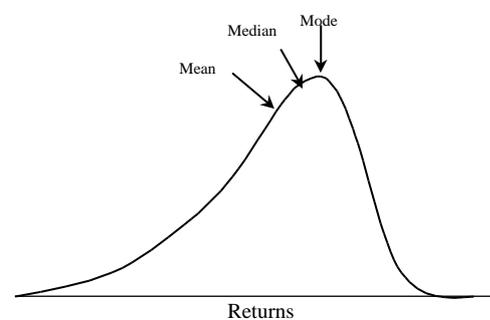


Figure 2.5 Negatively skewed distribution



In practice dynamic trading strategies and option strategies result in a skewed return distribution. For example, a protective put option on an asset with a symmetric distribution truncates the left tail of the distribution and thereby imparts positive skewness. On the other hand, writing covered calls prevents the writer of the options from participating in profits generated from increases above the exercise price. Thus, the right side of the return distribution observed by the writer of the options is truncated at the exercise price, which results in negative skewness (Kritzman, 1994).

2.5.3 Kurtosis

The fourth central moment is called *kurtosis*, which refers to the ‘peakedness’ of a distribution. A distribution that has wide tails and a tall narrow peak is called *leptokurtic*. Compared with a normal distribution a larger fraction of the returns are at the extremes than slightly above or below the mean of the distribution. Alternatively, a distribution that has thin tails and a relatively flat middle is called *platykurtic*. In this case, relative to a normal distribution, a larger fraction of the returns are clustered around the mean. Conditions that produce price jumps typically lead to leptokurtic return distributions (Kritzman, 1994).

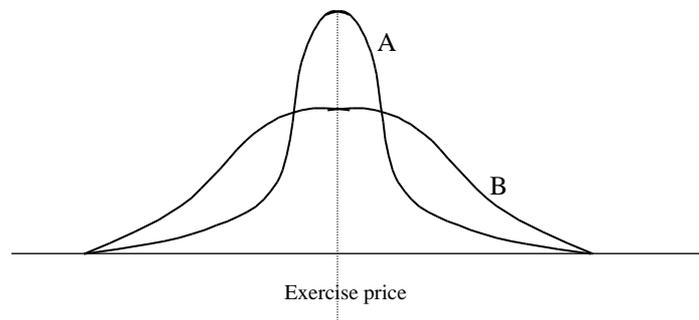
2.5.4 Option value and distribution moments

When considering (part of) a project’s value as a call option, certain aspects from the real option theory can be linked to the distribution moments. It is generally argued that, *ceteris paribus*, the higher the exercise price, and thus the less in the money is the option, the higher the expected return of the project must be, here referred to as the mean (Van Vliet, 2000). The risky-ness of the project, here referred to as the second moment or the standard deviation, holds a similar relationship to the exercise price of the project: the higher the investment outlay, the higher the standard deviation of the distribution of returns. To illustrate, figure 2.7 shows two normal distributions of stocks A and B. Stock B has a much higher standard deviation, or volatility, implying a higher probability of both abnormally higher or abnormally lower returns. To option holders, a return much above average on stock B is better than a return only moderately above average on stock A. While, in an out-of-the-

⁴ It is argued that the true lognormal distribution is well approximated by a normal distribution (Kritzman, 1994).

money situation at expiration date, a return much below average on stock B is no worse than a return only slightly below average on stock A.

Figure 2.6 Different volatility's



While the relation of the first two moments (mean and standard deviation) to the option value is obvious, the same can not be said of the third and fourth moment. Skewness and kurtosis show non-linear behavior in relation to the mean (Van Vliet, 2000). It is argued in this thesis that the skewness of a return distribution and in a lesser way kurtosis are subject to a number of external variables. Depending on these variables or circumstances the relative⁵ value of the higher distribution moments and hence the shape of the distribution is estimated together with the mean.

2.6 START-UP VENTURE GROWTH OPTIONS: THE JUMP MODEL

Investment in a start-up company is usually not undertaken so as to initiate immediate selling of a product or service, but to start a multistage process that may eventually reach that point. Even if a product or service has already been developed, often its market has not. As such, investment in a start-up venture can be seen to be similar to an investment in a compound real option (Trigeorgis, 1995). And in this notion, entrepreneurs are primarily seen as managers of growth options. Growth options come about as a result of new business ventures or as a result of a radically changing business environment. The typical start-up venture process proceeds in several stages, as portrayed in figure 2.7:

Figure 2.7 The Typical New Product Investment Time Line



Source: Trigeorgis, 1995: 224

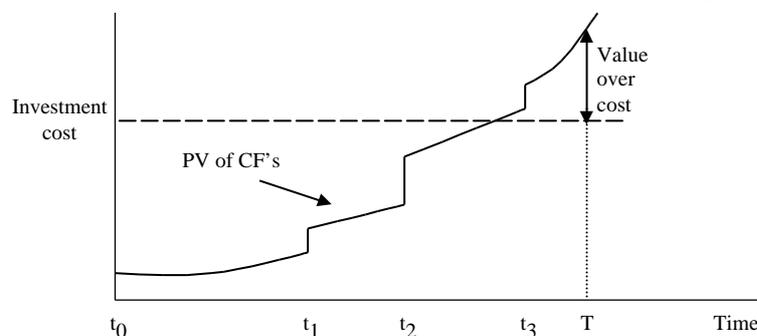
Willner (1987) argued that the real option approach as an alternative to the NPV rule is superior for valuing start-up firms in three regards. His first argument is that it is much easier to estimate the parameters that characterize the process of cash-flow estimation than estimating future cash flows that are to be received after investment takes place, the latter being something that NPV valuation depends on. Specifically, the option model requires

estimating: 1) the expected frequency of discovery, 2) the expected percentage of value increase per discovery, and 3) the expected value of the company at the time it expects to undertake full-scale operations.

The second advantage follows from the way cash-flow patterns are treated. Whereas the NPV methodology does not explicitly account for the non-symmetric cash-flow outcomes generated by the discretion managers exercise at the time of the manufacturing investment stage (i.e., the contingent nature of the underlying cash flows associated with real options), real option theory allows the many possible decision sequences in the process of start-up venturing to be considered at once. By using contingent cash-flow patterns and continuous probability distributions, managerial flexibility is integrated in the valuation process without compromising certain outcomes.

The third advantage of real options in start-up venture valuation is derived from a shortcoming in the risk treatment in NPV analysis. Because NPV methods base their discount rates on symmetric outcome distributions, their discount rates are generally too high for contingent cash flow discounting – a regular risk-adjusted discount rate is not appropriate (Trigeorgis & Mason, 1987; Willner, 1987). In the real option model the value of equity is assumed to steadily increase during the research process, until equity is available to the market. Occasionally, the equity value jumps up or down with new discoveries or due to competitive forces. It is proposed (Willner, 1987) to consider the cash-flow generation process in these young ventures as a *jump process* with an upward drift. Venture capitalists anticipate multiple-stage financing and reinvestment points during the start-up venture process, where each investment stage is seen as an option on the next financing round. Figure 2.8 illustrates a typical path of the present value of cash flows with net positive jumps. ‘The model is formulated as a (market-diversified) risk-neutral semi-moment, which regards the jumps in the cash-flow generation process as uncorrelated with the market portfolio held by the investor.’ (Trigeorgis, 1995: 225)

Figure 2.8 A typical Path of the Present Value of Investment Cash Flows with Net Positive Jumps⁶



Source: Trigeorgis (1995: 229)

Among other things, the figure shows the clear possibility of the expected present value of cash flows being below exercise value. Nonetheless, the new venture opportunity still has positive value because of the limited downside loss and unlimited upside potential gain. Venture capitalists are known to find this concept of

⁵ It is emphasized that for the purpose of this thesis the methodology allows the estimation of relative values, as opposed to a more quantitative empirical research.

⁶ The positive increases in the figure are due to new discoveries, but those increases are mitigated due to new competitive entrants (creating ‘net’ positive jumps). Between jumps the path is presumed to be smooth and exponential (Trigeorgis, 1995: 227).

asymmetric expected value very appealing. Furthermore, it can also be read from the figure that the increases in value are generally believed to be non-linear. This also can be seen as an effect of the discretionary right, with no obligation, to invest only if market developments are favorable. To clarify, an example by Willner (1987) is depicted in table 2.3.

Table 2.3 Examples of Start-up Venture Option Value for Varying Expected Cash-Flow Value

	<i>Case 1</i>	<i>Case 2</i>	<i>Case 3</i>
Expected cash flow value at t	2.0	3.0	4.0
Investment outlay I	3.0	3.0	3.0
NPV at t	-1.0	0	1.0
New venture option value	.10	1.13	2.86
Increase in option value	-	1.03	1.73

Assumptions: expected net jump level=1.05, expected number of jumps=3.0, rate of jump level decline =.3, risk-free rate=8 percent.

2.7 CONCLUSION

In conclusion it can be stated that the real option theory provides a sound basis for the discussion of decision-making behavior in start-up ventures. By observing the value of a firm as consistent of two aspects, the NPV of company assets and the value generated from active management, a framework is created in which a flexibility component can be treated to extent to a different academic field: agency theory. It has been described how only five parameters (derived from the Black Scholes formula) are needed to estimate the value of a financial call option. A closer look on the analogy of financial options with real options helps to determine to what extent real options are to be treated in a similar way and, more importantly, which differences between the two types of options and assumptions underlying the BS model should be reconsidered in specific situations or under certain conditions. Real options being a valuation tool that uses insights from both financial and strategic management, the sequential decision-making process, referred to as the option chain, distinguishes between incremental options and flexibility options. The former refers to simple decisions regarding the (dis)continuance of an investment-process; the latter refers to a radical switch in strategy that management may undertake. Furthermore, the flexibility component of project value is structured by the acknowledging of a number of different real options. When then analyzing this project value, one is confronted by a range of variables that influence the estimation of expected value. The four moments of return distributions can help explain this estimation. The view of a start-up venture as consisting largely of growth options allows for an emphasis on the importance of strategic decision-making and therewith the process of real option valuation.

3 THEORETICAL FRAMEWORK: AGENCY THEORY

3.1 INTRODUCTION

Like real option literature, agency theory has found its way into a wide variety of disciplines and applications. While for long economists have been treating the organization as a 'black box' in the theory of the firm, it is now widely accepted and most often required to add elements like 'social responsibility' and 'ownership structure'⁷ to the discussion of the firm. Because the idea of the black box is understood as a firm operated so as to meet the relevant marginal conditions with respect to inputs and outputs and thereby maximizing present value, this does not explain how conflicting objectives of the individual participants are brought into equilibrium so as to yield this result (Jensen & Meckling, 1976). Today the agency theory ideas on risk, outcome uncertainty, incentives, and information systems are recognized contributions to organizational thinking, particularly when coupled with complementary theoretical perspectives (Eisenhardt, 1989). Hence, in the light of this observation, this chapter is meant to provide a sufficient theoretical foundation of the agency theory, so a discussion of real option theory in this context can be performed. Paragraph 3.2 briefly touches upon the origins of agency theory, where after a more in-depth discussion of risk-aversion and related issues will follow in 3.3. Paragraph 3.4 will stress that information is a commodity that can be purchased and 3.5 will serve to discuss the relation between agency costs and the use of debt in venture-capital backed firms. It will be shown that debt and outside-equity have comparable effects on managerial behavior. A practical discussion of contracting problems and the staging of venture capital in venture-capital backed firms will be performed in 3.6. Paragraph 3.7 will conclude this chapter.

3.2 REVIEW OF CONCEPTUAL DEVELOPMENT IN GENERAL: ORIGINS OF AGENCY THEORY

During the 1960s and early 1970s, economists explored the risk-sharing problem that arises when cooperating parties have different attitudes towards risk. Jensen & Meckling (1976) and Ross (1973) broadened this risk-sharing perspective by noting the so-called agency problem that occurs when cooperating parties not only have different risk attitudes but also have different goals and division of labor. Specifically, an agency relationship is defined as a 'contract, in which one party (the principal) engages another person (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent' (Jensen & Meckling, 1976). Examples of principal-agent relationships are employer-employee-, buyer-supplier-, or client-lawyer-relationships. For the purpose of this thesis the relation between a venture capitalist and the 'founding father' of one of his portfolio companies is suggested to be a specific principal-agent relation. Whereas the owner-manager, a term introduced by Jensen (1976), and the outside investor both hold claims on the venture firm's equity, and as such would normally be recognized as co-owners and partners, their relation could, under specific assumptions, be seen as a principal-agent relationship, observing the entrepreneur as the agent and the venture capitalist as the principal.

⁷ In this thesis an important distinction is made between *ownership structure* and *capital structure*. Whereas the latter usually denotes the relative quantities of bonds, equity, warrants, trade credit, etc., representing the liabilities of a firm, this thesis focuses on another dimension (first recognized by Jensen & Meckling, 1976): the relative amount of ownership claims held by insiders (entrepreneur/management) and outsiders (investors with no direct role in the management of the firm).

These assumptions are the following:

- The entrepreneur/owner-manager of the start-up venture is wealth-constrained.
- The entrepreneur/owner-manager is in need of capital and so a demand for venture capital arises.
- In early stages debt-financing is uncommon (Gompers, 1995). The owner-manager accepts to give up part of his ownership, exchanging equity for work capital.
- The entrepreneur's equity stakes are junior to the preferred equity position of venture capital investors (Gompers, 1995).
- Entrepreneur loses autonomy, turning himself into a lessee. The 'entrepreneurial discretion' of owner/manager is reflected in the financing contract.

As the venture moves through various sequential stages of venture capital financing, the organizational form and risk taking changes with the ownership structure and the management. Although in this case the ownership of the firm is only partly transferred from the entrepreneur to the VC –instead of simply being delegated some responsibility in a principals firm –, the position of the initial owner (agent) now seems inferior to that of the investor (principal). Although this may seem unreasonable at first, a similar acceptance, known as *sharecropping*, has first been recognized and analyzed by Stiglitz in 1974. The attraction of this phenomenon lies in that equilibrium is met in balancing the concerns about risk sharing and providing the proper incentives⁸ to create output (Stiglitz, 2002). In practice the contract between the agent (the entrepreneur in this case) and the principal (the venture capitalist) could be thought of as a combination of a rental contract (the use of capital) *plus* an insurance contract (the VC has first rights on salvage value), while at the same time leaving room for proper incentives (the part owner-manager *does* benefit from profits).

In short, agency theory is concerned with resolving two problems. The first problem arises when the desires or goals of the agent and principal conflict. If both parties to the relationship are utility maximizers, there is good reason to believe that the agent will not always act in the best interest of the principal. When on top of that the principal cannot properly verify what the agent is doing, or how the agent is diverting the capital flow, the problem gets bigger.

The second problem is that risk sharing possibly implies a difference in risk attitudes; and different attitudes lead to differing preferences for certain actions or strategies. In the agency literature much attention is given to the application of the agency structure in a variety of settings, ranging from macro-level to micro-level issues. In most of these discussions the unit of analysis is on the contract governing the principal-agent relationship, focusing on the most efficient way to structure this contract with the use of incentives. Even though there are exceptions to this approach (e.g. Jensen & Meckling, 1976), the discussion of the agency issue in organizational theory is always based on the use of or discarding of assumptions about people (e.g. self interest, bounded rationality, risk aversion), organizations (e.g. goal conflict among members), and information (information can be purchased) (Eisenhardt, 1989).

⁸ The issues of incentives, monitoring and information asymmetry will be dealt with in further detail in the following of this chapter.

To simplify, the model assumes an arbitrary level of investment (which is already made), a constant scale of the firm and the manager's wage as fixed. The entrepreneur's tastes for non-pecuniary benefits are represented by a system of indifference curves, U_1 , U_2 and U_3 . The indifference curves will be convex as drawn as long as the entrepreneur's marginal rate of substitution between non-pecuniary benefits and wealth diminishes with increasing levels of the benefits. The model should be read as follows. When the entrepreneur has 100 percent of the equity in the firm, the value of the firm will be V^* where indifference curve U_2 is tangent to VF , the constraint-function in a 100 percent ownership situation; the level of non-pecuniary benefits consumed is F^* . Now suppose the entrepreneur sells a share of the firm, $1 - \alpha$, (where $0 < \alpha < 1$) to a venture capitalist and retains a share α himself; as a result the entrepreneur only bears α *100 percent of the costs of his non-pecuniary consumption. The new constraint function is represented by P_1 with slope $-\alpha$. If the VC paid $(1 - \alpha)V^*$ for his share and in this situation the entrepreneur is free to choose any level of private consumption of corporate resources he wishes, subject only to the loss in wealth he incurs as part owner, his welfare will be maximized by increasing his private consumption. While he was able to retain the same level of wealth and consumption he had before (point D), the entrepreneur's indifference curve will move up to U_1 representing a higher level of utility. His optimal level of wealth and consumption is now where P_1 is tangent to U_1 and, as the consumption level rises from F^* to F^0 , the value of the firm falls from V^* to V^0 by the amount of cost to the firm of the increased non-pecuniary expenditures. However, this is not realistic. Namely, the venture capitalist will know from experience that the entrepreneur will raise his private consumption and as a consequence, the VC will only pay $(1 - \alpha)$ times the value, given the induced change in behavior of the entrepreneur. As such, the entrepreneur's wealth in this new situation is maximized when P_2 is tangent to some indifference curve such as U_3 . The price for a claim $(1 - \alpha)$ on the firm that is satisfactory to both the buyer and the seller will require that this tangency occurs along VF . This implies that the decline in the total value of the firm ($V^* - V'$) is engendered by the agency relationship and is the measure of the 'agency costs'.

3.3.2 Risk attitude

Organizations have uncertain futures. The future of a firm is dependent on the interrelation of managerial behavior and environmental factors, such as economic state (e.g. growth, recession), governmental regulation, competition, technological innovation, adaptation rate, etc. One of the main contributions of agency theory is that uncertainty is not just viewed in terms of inability to preplan, but also in terms of risk/reward trade-offs. This implies that outcome uncertainty coupled with differences in willingness to accept risk should influence contracts between principal and agent.

It is often assumed that the agent is more risk averse than the principal, because agents are believed to be unable to diversify their employment. Principals on the other hand are generally believed to be capable of diversifying their investment, and are therefore risk neutral (Eisenhardt, 1989). If this is so, the principal should not worry about his investment: the agent will act in the interest of his principal. However, if this assumption is relaxed, we can explore the situation in which individuals vary widely in their risk attitudes. For example, if an agent becomes increasingly less risk averse (e.g. a wealthy agent), it becomes more attractive to pass risk to the agent using an outcome-based contract. It has been described how Jensen & Meckling (1976) argued that increasing the firm ownership of the managers decreases managerial opportunism. Conversely, as the agent becomes more

risk averse in certain situations, it is increasingly expensive to pass risk to the agent. Eisenhardt (1989) formulated this relation as follows: ‘the risk aversion of the agent is positively related to behavior-based contract and negatively related to outcome-based contracts. The risk aversion of the principal is in theory negatively related to behavior-based contracts and positively related to outcome-based contracts.’

When considering the specific principal-agent relation of a venture capitalist and the (partial) owner-manager (entrepreneur) of one of his portfolio-companies, an interesting point can be made. Although the entrepreneur initially ‘owns’ the project, he is assumed to have no wealth to develop his project and explore options, and so he seeks to obtain external funds from a competitive market of venture capitalists. And although the entrepreneur and the venture capitalist may initially have the same assessment about the likelihood of success, the VC will protect himself against high uncertainty (no proof regarding the project’s viability, no previous experience with the entrepreneur, etc.) by staging the investment process (see further in 3.6). This implies considerable risk-aversion by the VC, the principal. The entrepreneur on the other hand may have a different attitude towards risk, assuming that he has no wealth other than his shares in the project. If we consider for example a case in which the entrepreneur has sold equity as preferred stock (as will be shown later is often the case), salvage value will largely fall part to the venture capitalist in case of bankruptcy. If this is a reasonable prospective this will most likely have its effect on the entrepreneur’s willingness to take risk and save asset value. In fact, as his claim on dividend and company assets decreases he may even start to pursue unreasonably high-risk business opportunities, in search for non-pecuniary benefits or ‘extreme’ high outcomes. Scenario’s in which risk attitudes differ will be further explored in this thesis.

3.4 INFORMATION

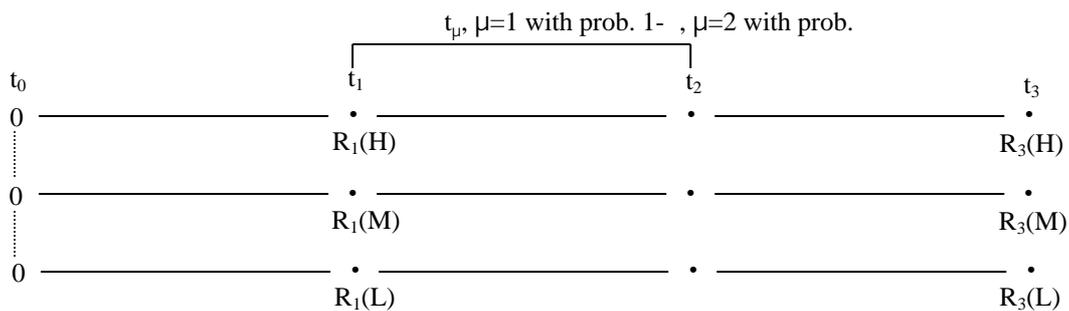
By definition the agent performs a service on behalf of the principal, and as such, has access to company resources and decision-making authority. Given the self-interest and bounded rationality (3.3.1) and the difference in risk-attitude (3.3.2) it is shown that it is generally impossible for the principal or the agent at zero cost to ensure that the agent will make optimal decisions from the principal’s point of view. The basic reason for this is that the principal can not determine appropriately what the agent is doing. The allocation of the funds to the project is unobservable to the principal, so a so-called *moral hazard* problem arises: the efficient application of the investment requires effort which is costly for the entrepreneur. By reducing the effort, the entrepreneur also reduces the probability of success and hence the efficiency of the employed capital. An equivalent situation is the one where the entrepreneur can ‘shirk’ and divert capital flow to private ends (Bergemann & Hege, 1998). Another common problem is *adverse selection*: a misrepresentation of ability by the agent. The argument here is that the entrepreneur may claim to have certain skills, abilities or prospects when he is hired and the investor is unable to completely verify this information (Eisenhardt, 1989). Hence, when the investor invents mechanisms to eliminate ‘bad’ projects from entering the competition for venture capital (e.g. by raising interest rates), the good ones may drop out of the race since they are not willing to give away large parts of their ‘good’ venture. Paradoxically, the investor’s strategy has the opposite effect it aimed for (Stiglitz, 2002).

3.4.1 Learning

An essential feature of any venture project is the necessity to fund the project in order to learn more about the uncertain future of the project. The simultaneity of the financing decision and the acquisition of information about the investment project are characteristic for ventures and more generally for the financing of innovation (Bergemann & Hege, 1998). It is suggested that the risk of the entrepreneur observing information about the project type before the venture capitalist may play a role in the contract type selection (and thus the ownership structure) as well as the project quality uncertainty itself (Trester, 1998).

To exemplify, consider a project (figure 3.2) with four periods $t_0 < t_1 < t_2 < t_3$, where all agents seek to maximize their wealth at t_3 . At t_0 the entrepreneur owns the project, which may be one of three types $S = L$ (low value), M (medium value) or H (high value). To move forward with the project the entrepreneur obtains funding I_0 at t_0 , of which fraction q will be used as fixed capital (e.g. plant) and the rest as operating capital; in the course of operations the project will also take on current liabilities d payable at t_2 . While the type of the project is not known to the entrepreneur or the venture capitalist at t_0 , the probabilities of the project being of each type ($P_L + P_M + P_H = 1$) are known at t_0 to both parties.

Figure 3.2 Funding under (a) symmetric information



Source: Trester (1998: 679)

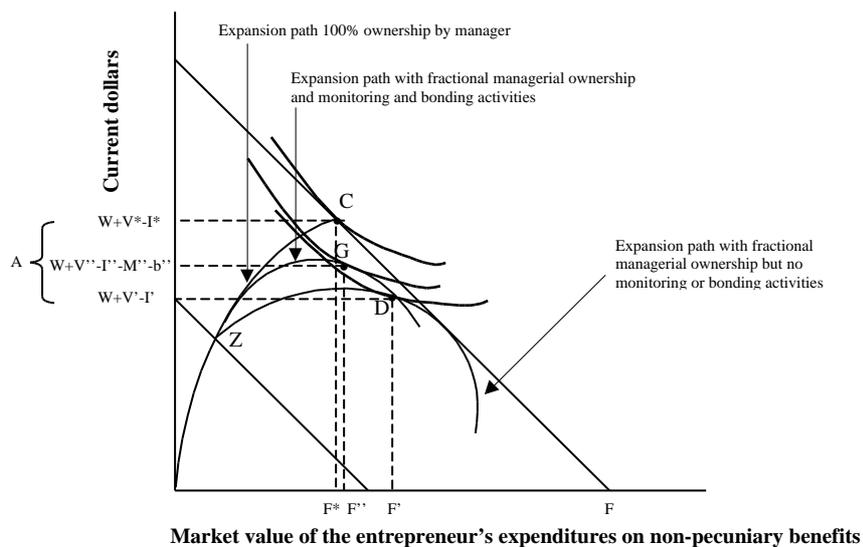
The first pay-out generated by the project is $R_1(S)$ where $R_1(H) = qI_0 + d$, $R_1(M) = qI_0 + d$, or qI_0 $R_1(L) < qI_0 + d$. However, while the entrepreneur observes the payoff and the S (!) at t_1 , the venture capitalist observes the payoff and the S (!) at t_μ where $\mu=1$ with probability $1-$ and $\mu=2$ with probability $.$. Thus there is a probability of a state of asymmetric information existing between the venture capitalist and the entrepreneur. The venture capitalist learns S at t_μ through a costless auditing process, while the entrepreneur learns S at t_1 . Therefore, if $\mu=2$ the entrepreneur learns S before the VC and has operating control of the project. The entrepreneur may choose to pay himself any amount equal to or less than $R_\mu(S)$ at t_1 , regardless of any contractual obligations at t_2 , and abandon the project. In practice this can be done by legally increasing the projects 'burn rate' of capital. And even if the entrepreneur decides to behave opportunistically at this point, the VC will still consider moving into a second round of financing at t_2 . Alternatively the entrepreneur may choose to stay with the project, to await the payoff at t_3 , which in case of a favorable state at t_1 , he now knows he will receive. On the other hand, if $\mu=1$ then the entrepreneur and the VC observe S simultaneously. In this case it is assumed that the VC has at his disposal the legal enforcement mechanism to assure compliance with any contractual obligations. The entrepreneur is thus unable to perform opportunistic behavior without the VC knowing. So if the entrepreneur behaves

according to contract and expectations at t_1 , the VC may invest I_2 in case of a favorable state or foreclose on debt in an unfavorable state (Trester, 1998).

3.4.2 Monitoring

The foregoing discussion of the agency theory has been held under the assumption of no monitoring and thus information asymmetry. However, in case of unobservable behavior (due to moral hazard or adverse selection), the investor has the option to monitor his agent. He can discover the agent's behavior by investing in information systems such as budgeting systems, reporting procedures, boards of directors, consulting professionals or additional layers of management. Such investments reveal behavior and are assumed to transform the asymmetric information situation into one with complete information. Eisenhardt (1989) formulated this as follows: information systems are positively related to behavior-based contracts and negatively related to outcome-based contracts. If venture capitalists could costlessly monitor the project, they would monitor and infuse cash continuously. But of course in practice, if VC's need to 'kick the tires' of the venture, read reports and take time away from other activities, these costs are substantial (Gompers, 1995). It is therefore only periodically that VC's can check up on their investments.

Figure 3.3 Value of the firm under opportunistic behavior and monitoring



In reference to figure 3.1 where the entrepreneur's non-pecuniary benefits and agency costs were depicted against firm value, figure 3.3 shows an extension of this model (also Jensen & Meckling, 1976), where the firm's growth paths with the (agency) costs of monitoring and bonding activities are included. In the figure the expansion path OZC represents the equilibrium combinations of firm value and non-pecuniary benefits consumed by the entrepreneur, if he would have enough personal wealth to finance the sequential levels of investment up to I^* . Point C denotes the optimal level of investment (in a 100% equity ownership-situation); additional investment beyond this point reduces net firm value. OZD is the alternative expansion path in which outside equity is used to help finance the growth of the project. Distance A in the figure measures the gross agency costs as described before in 3.3.1. In this case point D denotes the optimal investment level when the entrepreneur owns fraction θ of equity. Now observe the same investment path, except under the assumption of monitoring, OZG. As becomes clear, the optimal investment level, point G, represents a equilibrium with a

higher firm value and lower non-pecuniary consumption. Of course this reduction in opportunistic behavior varies as monitoring and bonding costs will differ from firm to firm depending on such things as the inherent complexity, geographical dispersion of operations and the attractiveness of perquisites available (Jensen & Meckling, 1976). In conclusion, the agency-relationship is non-optimal, wasteful and inefficient. In response, monitoring managerial behavior by the principal can reduce the effects of opportunism but is costly at the same time. Paradoxically, principals face a trade-off between *reducing* agency costs (residual loss as a result of opportunistic behavior) through monitoring performance and *incurring* agency costs by monitoring the agent.

3.4.3 The perception of probability of success

Where the probabilities of the project being of each type were known to both parties in t_0 in figure 3.2, it will here be argued that the probability of success of a project is subject to personal perception. It will be shown that, as the flow of investment sinks into the project, the entrepreneur and the venture capitalist update their assessment of the prospects of the project. Bergemann & Hege (1998) describe this learning process as the 'evolution of posterior belief of eventual success'. They emphasize that 'while there is no initial asymmetry in the information between venture capitalist and entrepreneur, the asymmetry may arise as the project receives funding. If entrepreneur and investor have different assessments over how the funds have been employed, then in turn they will have different posterior probabilities over the likelihood of success.' Hence instead of the actual probabilities, which were previously assumed to be known, it is the *perception* of these probabilities that is the basis of the decision-making process. To create an image of how a specific posterior belief, α_{t+1} ,⁹ might evolve, figure 3.4 will display the evolution of the posterior belief of the participants in the success of a 'bad' project (i.e. conditional on no success).¹⁰ The progression is given by Bayes' rule (3.1), as a function of the prior belief, α_t , and the capital flow $c(p_t)$; p_t is the probability of success, where $0 < p < 1$:

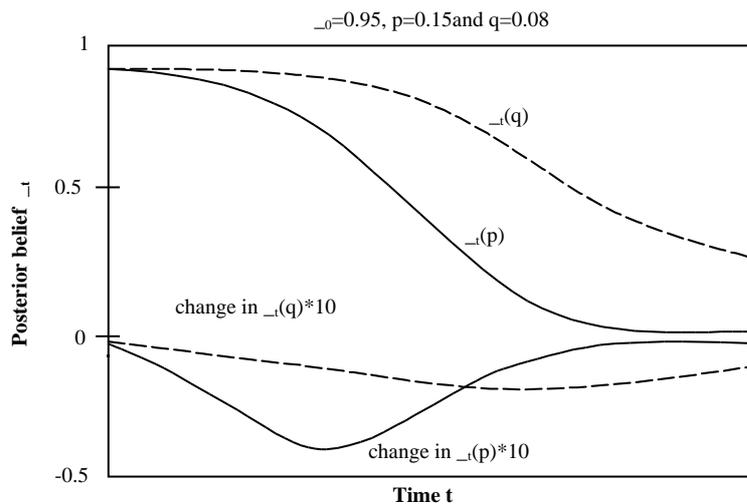
$$\alpha_{t+1} = \frac{\alpha_t (1 - p_t)}{\alpha_t (1 - p_t) + 1 - \alpha_t} \quad (3.1)$$

Figure 3.4 shows that the posterior belief decreases over time when success has not been realized. The decline in the posterior belief is stronger for larger investments, as the participants tend to be more pessimistic about the likelihood of success. The straight line in the figure, as opposed to the dotted line, represents that a higher investment level accelerates the rate at which the posteriors change over time. Furthermore, if the participants have very precise beliefs about the probability of the project (i.e. if α_t is very close to 0 or 1), the posterior belief changes only slowly. When, on the other hand, there are very diffuse beliefs about the success rate of the project (i.e. α_t is close to $\frac{1}{2}$) the posterior belief changes most rapidly (Bergemann & Hege, 1998). This can be understood as follows.

⁹ Note how α is here used to symbolize *posterior belief*, whereas it was used earlier to describe fraction of equity.

¹⁰ It must be emphasized that this figure only displays the combined beliefs of investor and entrepreneur. Depending on the level of information asymmetry, the rate of new discovery and the number of investment stages, the posterior beliefs of both parties evolve separate from each other. This paper will pay attention to this difference in perception of reality.

Figure 3.4 Volume of financing and the evolution of posterior belief



Source: Bergemann & Hege (1998: 709)

The ideal situation for a decision-maker is when there is no doubt about what is and what is not the right decision, at least in his perception. If he finds himself in doubt about the nature of the project ('good' or 'bad'), he will search for signals and defer his decision until he finds one. If for example his perception lingers around \hat{p} and he does a negative discovery (e.g. disappointing returns, opportunistic behavior by the agent) he automatically adjusts his perception in a negative way (towards 0). Conversely, if the decision-maker does a positive discovery (e.g. good returns, growing demand), he automatically adjusts his perception in a positive way (towards 1).

However, this does not necessarily mean that his perception of probability also approximates the true probability. For example, in some situations the entrepreneur might feel benefited by influencing the VC's perception of reality through *window-dressing*¹¹ short term results. The discrepancy between perception and reality here is thus caused by purpose of the entrepreneur. If the venture capitalist then does find out the true state of the project (and this state has not changed) he automatically adjusts his perception at that point; chances are even that he may overcompensate his former misjudgment or deception by valuing the project even lower than its true value. Nevertheless it's argued that, as sequential discoveries give off the same signals (either positive or negative), it becomes more likely that the adjustment of perception is moving in the right direction. Moreover, as the investment process progresses over time, it will also be increasingly the case that posterior belief approximates the actual probability.

The model in figure 3.4 depicts the combined posterior belief with a fixed probability ($p=0.15$) and a constant investment policy. These assumptions need relaxation. Not only is the arrival of good and bad news a complex process, also do investment flows influence the probability by which success is generated. A 'bad' project may therefore turn out to be a 'good' project and vice versa. This is an important observation that will be used in this

¹¹ 'Window-dressing' is a terminology that is often used for describing the act of manipulating short-term results to make the state of a project look more attractive than it actually is. In general, poor performance can't be hidden over a longer period of time.

thesis. Furthermore, projects are frequently divided into various stages which are defined by the completion of certain intermediate results. In these circumstances continued financing may be conditional on the successful completion of earlier stages. As such, if the entrepreneur believes in the potential and eventual success of the project and he realizes that the realization of this success depends on continued financing, his incentives to perform opportunistically are reduced. On the other hand, if he has lost all hope on a positive turn of events, he will not care about future financing rounds and focus on short-term benefits. This also is an important observation for the discussion in this paper.

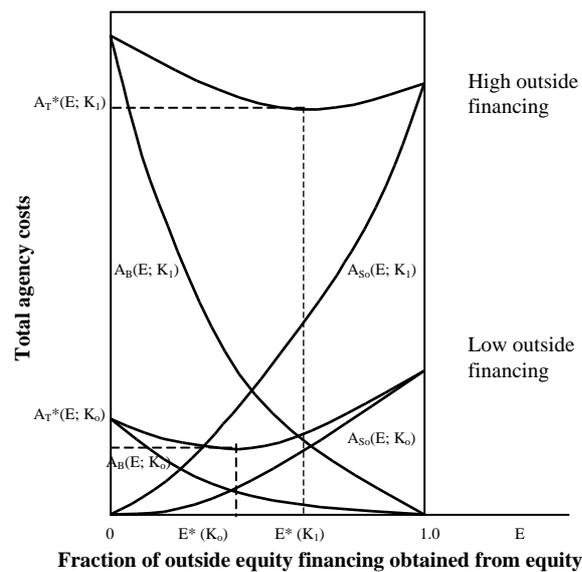
3.5 LEVERAGE

If asymmetric information and agency costs do not exist, the structure of financing is irrelevant. Entrepreneurs would pursue shareholder value maximizing strategies and decide whether to continue the project based on their information; venture capitalists would provide them with all the money they need (Gompers, 1995). In the real world however assumptions are relaxed and equity is leveraged. In this thesis the focus is on the effects of the separation of ownership and control derived from the division of equity. It has been mentioned earlier in this chapter that the ratio inside-equity/outside-equity is an interesting and proven dimension to the classic definition of capital structure, largely referring to debt equity ratio's and the division of liabilities. Besides that agency-literature pays a fair amount of attention to the role of agency costs in determining leverage. This paragraph will discuss the issue of debt in the context of agency relationships in venture-capital backed projects.

It has been described by Rajan and Zingales (1995) how there's a negative relationship between a firm's market-to-book ratio's and the firm's leverage. The higher the option-element (see chapter 2) in market-value determination, the less use is made of debt. The main reason for this is that banks are generally limited by regulations to fund high-risk projects. Banks are often not allowed to accept shares in the investment as collateral, so high tangible asset value, an absolute scarcity in start-up ventures, is often a prerequisite for the issuing of debt. In addition, banks do not have the necessary skills to evaluate projects with few collateralizable assets and significant ex ante uncertainty. Even if banks were to make loans to high-risk projects, required interest payments would be extraordinarily high, creating severe liquidity problems that would limit a firm's growth and exacerbate risk-shifting problems (Gompers, 1995). However, research does point out that as the liquidation value of assets (higher value, higher tangibility, lower firm-specificity) increases as the investment process progresses, the firm is more leveraged (Williamson, 1988) having its impact on the agency issue.

While the incentive to issue debt is constrained by the high risk of new ventures, this same risk is one of the main reasons why leveraging could be attractive to the entrepreneur. Myers (1977; see chapter 2) described this as that as firms largely depend upon investment in future growth options, the entrepreneur can undertake investment strategies that are particularly detrimental to bondholders. To illustrate consider the relationship between agency costs and the debt/equity ratio for two fixed levels of investment, K , where $K_1 > K_0$, as depicted in figure 3.5.

Figure 3.5 Agency costs functions for two levels of outside financing



The figure depicts four functions for the ratio of outside equity to total outside financing, where $E = S_o / (B + S_o)$. S_o is the amount of equity held by outsiders (venture capitalist) and B is the amount of debt issued to the project. It is shown that, in case of no outside equity ($E=0$), the managers incentive to exploit outside equity, S_o , is logically at a minimum. At the same time, the agency costs associated with debt, $A_B(E)$, are composed of the value reductions in the firm and monitoring costs caused by the entrepreneur's incentive to reallocate wealth from the bondholders to himself. They are at a maximum where all outside funds are obtained from debt ($E=0$). When the amount of debt declines (and E increases) his incentive to reallocate wealth from the bondholders to himself falls. However, as E increases, agency costs are assumed to increase substantially as a result of decreasing share of equity held by the entrepreneur. The curve $A_T(K_0)$ represents the sum of both functions; it shows the minimum total agency costs at point $E^*(K_0)$ where there is combination of debt and equity at investment level K_0 . The same functions, except for investment level K_1 , show a minimum level of agency costs at point $E^*(K_1)$, a point more to the right on the horizontal axis, relative to $E^*(K_0)$. This implies that the agency costs of debt rise relative to the agency costs associated with equity as the amount of outside financing increases (Jensen & Meckling, 1976).

It is assumed in this paper that debt and preferred equity have similar effects on the behavior of the entrepreneur. As the investment process progresses and the amount of funding increases, more debt is used. It must be noted that the entrepreneur's equity stakes are almost always junior to the preferred equity position of venture capital investors. The seniority of the venture capitalists' stake makes the entrepreneur's payoff analogous to leveraged equity.

3.6 STAGED CAPITAL INFUSION

One of the most potent control mechanisms in venture financing is the staging of capital infusion (Gompers, 1995). During the screening process of a potential investment venture capitalists review business plans and design contracts that are to minimize potential agency costs ex-ante. Due to asymmetric information it is

considered extremely important to structure the investment process in stages so information can be gathered and the progress can be monitored, while the option to periodically abandon the investment process is maintained (Gompers, 1995). As such the role of staged capital infusion can be seen as analogous to that of debt in highly leveraged transactions. The continuance of the venture is in principle dependent on the successful completion of an investment round. As is the case with debt, the entrepreneur's stake in the project is similar to a call option: only if a pre-specified target is met on a certain point in time, the project is continued. In all other cases the project is, at least in theory, abandoned by the investor.

It is found that the shorter the duration of an individual round of financing, the more frequently the venture capitalist monitors the progress and the greater the need to gather information. Besides the duration of the round, the size of each investment, the total financing provided and the numbers of financing rounds are important measures of the staging structure. Chapter 4 will go into further detail describing the effects of staged financing.

3.7 CONCLUSION

In theory the entrepreneur is wealth-constrained and therefore, in order to obtain funding for the venture and be able to move forward, he offers an investment opportunity (capital for equity in the start-up venture) to a competitive market of venture capitalists. As a result the ownership and control of a venture firm are (partially) divided and a potential agency problem occurs. It is assumed that both parties (entrepreneur and the venture capitalist) operate with bounded rationality and are by nature utility maximizers. The conflict arises when the goals of both entrepreneur and venture capitalist with regard to the project start to diverge, the entrepreneur starts using corporate resources (time, assets) for private consumption and there is information asymmetry. Another important reason for conflict could be a change in the entrepreneur's risk attitude. Assuming information asymmetry a condition for the agency problem, the problem can be resolved or at least reduced by monitoring the entrepreneur's behavior: the principal is faced with a trade-off between costs, incurred by monitoring behavior, and costs incurred by opportunistic behavior. In the real world however, even under conditions of extensive monitoring, the probability of success of the project is subject to personal perception. A divergence in the evolution of this perception, the posterior belief of success, is one of the main reasons underlying strategic and investment decision-making; acts like window-dressing influence perception. Like the division of equity between management and outside investors, the firm's leverage is an important 'generator' of agency costs. It has been argued that debt has similar effects as outside (preferred) equity on the entrepreneur's behavior and risk attitude. However, since it is difficult for young ventures to obtain big loans in early stages the firm's growth is most often powered by the staged infusion of risk capital. This staging process is one of the most powerful tools outside investors hold to 'secure' their investment and control opportunistic behavior.

4 VENTURE CAPITAL CONTRACTING AND COMMON CONFLICTS

4.1 INTRODUCTION

This chapter aims to provide an answer to the first main research question of this thesis: what is the agency problem in venture capital-backed firms? This question has been split up into two components; the first one dealing with the changes in ownership structure of the firm during the investment process, the second addressing the effects of these changes on the actual agency problem. In paragraph 4.2 evidence from earlier research is used to create an understanding of the dynamic investment process in which the sequencing of investment rounds characterizes change. Attention will go out to the way entrepreneurial firms are financed with venture capital. It is explored which types of contracts are most commonly used as well as other contractual arrangements that might influence decision-making behavior. Paragraph 4.3 will follow up on this by discussing and categorizing conflict-areas between a venture capitalist and entrepreneur that may lead to an agency conflict. In paragraph 4.4 the effects of the gradual change in ownership and the accompanying conflict situations on the features of the principal-agent relationship are discussed. By placing specific features of this principal-agent relation in a context in which external factors and intrinsic values of the project are combined, a broader insight into the interrelation of ownership structure and the agency conflict is achieved. The component of time will be added to this context, expanding the discussion over yet another dimension. Paragraph 4.5 will conclude.

4.2 OWNERSHIP AND VENTURE CAPITAL CONTRACTING

The first research question addresses the problem of how a change in ownership structure affects the agency problem. It is argued here that, for one to understand the effects of (partial) outside-ownership on the strategic decision-making process, other aspects of the contract between entrepreneur and (institutional) investor must be taken into consideration. There are many contract forms and therefore ownership, as in the context of this thesis, relates strongly to the right to make decisions. In general, decision-making power in venture capital backed firms is determined in two ways:

- 1) Through the issuance of stock
- 2) By embedding the allocation of specific legal rights in the investment contract.

On the choice of methodology

Much has been written on theories behind venture capital contracting, but detailed empirical evidence on contract types and characteristics has only recently found its way into the body of investment-literature. For the purpose of this thesis, use will be made of the recent empirical research by Gompers (1995), Trester (1998), Kaplan & Strömberg (2000), Cumming (2001) and Grimmelt (2001). The different studies are compared to come to an insight of the most commonly used contract types and control mechanisms. The formulation of the findings into assumptions will provide a practical basis for further discussion.

4.2.1 Previous research on venture capital contracting

4.2.1.1 Gompers (1995)

Gompers examined the structure of staged venture capital investments of 794 venture capital-backed firms in a context of agency and monitoring costs. He utilized a dataset from the Venture Economics database, with information on the total amount of funding, the duration and size of each investment round, the sort of financing (e.g. seed, start-up, etc.) and the way of exit. Since no other information on contractual arrangements than general annual information on venture capital commitments was available, this implies that the scope of his research is limited. Gompers provides evidence for the prediction from agency theory that venture capitalists concentrate investments in early stage companies and (high technology) industries where informational asymmetries are significant and monitoring is valuable. He shows that firms that go public receive more total financing and a greater number of rounds than other firms (that go bankrupt or are acquired). Furthermore, he finds that early stage firms receive significantly less money per round, but increases in asset tangibility (or decreases in asset specificity) increase financing duration and reduce monitoring intensity. Inversely, as the role of future investment opportunities (high growth option-value, high market-to-book ratio) increases or R&D intensities are higher, duration declines.

Of his entire sample 22.5% of the firms went public, 23.8% merged or was acquired and 15.6% was liquidated or went bankrupt. Firms that go public receive more financing rounds than those that remain private, while firms that are acquired or go bankrupt do not receive more rounds on average than those that remain private. This is explained as follows: if venture capitalists receive favorable information about the firm and it has the potential to go public, the venture capitalist continues to fund the project. If the project is viable but has little potential to go public, the venture capitalist quickly searches for a corporate buyer. Firms that have little potential are liquidated.

4.2.1.2 Trester (1998)

As it seems Trester has been first to perform an empirical study on the evolution of contract types and the relative amounts used throughout the life of the firm. Unable to reveal detailed information on a deal by deal basis, Trester performed a survey among eight venture capital firms of which all had done in excess of 100 deals and compares the use of three types of contracts: (a) debt, (b) common equity, and (c) preferred equity. He distinguishes between deals in early stages (defined as firms with no current customers) and later stages (defined as firms with current customers). The contract types are defined as follows: under a debt contract the venture capitalist loans the entrepreneur a specific amount and receives a fixed payment if there is no default. An important aspect of this type of financing is the venture capitalist's right to foreclose if he has reason to believe continuance would deteriorate scrap value. Foreclosure by the venture capitalist means he forces the project into bankruptcy and takes whatever assets are available less the current liabilities, which are assumed to be senior to all contracts between the venture capitalist and the entrepreneur.

The second contract type, the common equity contract, has no precise meaning. It is applied when the venture capitalist invests a certain amount in the project and in exchange he receives a fraction of equity. Common stock has no special preference either in dividends or in case of bankruptcy. In a simple model it is assumed that if the

venture capitalist and the entrepreneur each own half of the common stock, the firm is jointly controlled and thus both parties must agree on pay-out decisions.

The third contract type, the preferred equity contract, is often argued to be debt in disguise. In exchange for their investment in preferred stock, preferred shareholders receive a stated dividend, and in the case of liquidation preferred shareholders only get a stated value. Furthermore, as opposed to a debt contract, unpaid preferred dividends can not be seen as debts and therefore preferred equity holders do not hold the right of foreclosure¹². However, while in the event of default the venture capitalist may not foreclose, the entrepreneur may not take any payment for himself unless the amount due to the venture capitalist is paid in full.

Trester's research results reveal a clear pattern in the evolution of the firm. Table 4.1 demonstrates that preferred equity represents the dominant mode of contracting in both early and later stages, while the use of common equity and debt is significantly less. However, in later stage financing there appears to be an increase in the use of debt and common equity. As the investment process progresses and the firm moves into a revenue generating phase, preferred equity financing is partly replaced by debt (10.1%) and common equity (3.9%). As more information on the success probability is available to the outside investor, it becomes increasingly attractive to make use of other types of contracts. Whereas the choice of equity type before issuance was more or less to the outside-investor, the entrepreneur has increased bargaining power in later stages, as the probability of success increases and the probability of information asymmetry subsides.

In conclusion, the choice of contract type is driven by the high probability of information asymmetry and a relative high degree of uncertainty about the probability of success. The extensive use of preferred equity represents the method in which monitoring difficulties are dealt with in an incentive-compatible manner.

Table 4.1 All deals – The evolution of the use of financing types

	Early stage	Later stage
% preferred equity ¹³	96.4	87.8
% common equity	2.0	3.9
% debt	2.1	10.1

Source: Trester (1998: 690, 692)

4.2.1.3 Kaplan & Strömberg (2000)

In addition to previous research the subject of analysis in Kaplan & Strömberg (2000) is the type of financing *plus* the dynamic allocation of contractual rights throughout the life of the portfolio company. As such Kaplan & Strömberg studied the contractual agreements of 120 investment rounds by fourteen American venture capital firms between 1987 and 1999. In congruence with Trester (1998) it is shown that in the vast majority of the investment rounds (94.5%) convertible preferred stock is the most commonly used type of security.¹⁴ Furthermore they show and explicitly measure that venture capitalists separately allocate cash flow rights, voting rights, board rights, liquidation rights, and other control rights. While venture capital financing allows for

¹² Other features of debt, like the possibility to deduct interest when determining taxable corporate income, are here left out of the argument.

¹³ It is worth noting that 88.8% of the preferred equity deals were financed with convertible preferred stock (convertible into common stock).

different types of securities, these types are similar in that they allow for different allocations of legal rights. For example, different types of common stock exist, providing the venture capitalist's share of common stock with other rights than the entrepreneur's share of common stock. Hence the focus is on the allocation of different rights rather than on the use of a particular security. It appears that control rights, voting rights, cash flow rights and future financings are often contingent on observable measures of financial and non-financial performance, especially in early stages.

A. Cash flow rights

Cash flow rights refer to the fraction of equity value of the project the venture capitalist (or entrepreneur) has a claim to. It is argued that the actual measuring of the fraction of equity is not trivial since the relative value of these rights is much more dependent on the state the project is in. An average entrepreneurial claim on cash flow rights of 30% (see table 4.2) indicates two things: 1) a relative large share by the entrepreneur is desirable; 2) the entrepreneur is willing to give up a large share of ownership in exchange for outside-financing. Moreover, another important observation can be made from the state-contingency classification in table 4.2. Maximum VC ownership occurs when management does not meet performance milestones; minimum VC ownership occurs when management meets all performance and vesting milestones. It is shown that, when performance is good in early stages, the average venture capitalist claim on equity appears to be 11.9% lower than when performance is bad. In later stages this difference is 5.4%.

B. Voting rights

In venture capital-backed firms most strategic decisions are based on majority rule. Voting rights represent the percentage of votes one has to affect corporate decisions. Table 4.3 shows that the percentage of voting rights held by the venture capitalist increases significantly in early stages when management does not meet the performance criteria (percentage increases from 65.8 to 86.9). In later stages this increase is 10.3% (from 48.7% to 59%). A switch in control indicates the percentage of instances in which voting control can switch based on subsequent performance.

C. Board rights

Like voting rights, board representation has an significant impact on the rights to control strategic decisions. On average the board of a venture capital backed firm holds 6.1 members, of which in less than 30% of the cases majority is held by the venture capitalist and in 12% by the entrepreneur; in all other cases by neither one of them. Interesting is that while the venture capitalist generally has voting control, board control is much less common. State-contingent board control provisions (VC gets control in adverse state) occur in roughly 15% of the cases.

¹⁴ Unlike Trester (1998), Kaplan & Strömberg (2000) provide no specific information on the evolution of the use of the various types of securities throughout the life of the portfolio company.

D. Liquidation rights

Assuming that venture capitalists finance with (convertible) preferred stock, it is clear they have a senior claim on the project value in case of liquidation. Moreover, table 4.5 indicates that this senior claim in 98% of the cases is equal or larger than the original outlays. The increase over time in the rightful liquidation value can be explained by adding the unpaid cumulative preferred dividends to the nominal investment. Furthermore, in 84% of all financing deals the presence of redemption and put provisions strengthens the venture capitalists liquidation rights. Very similar to a debt claim, these provisions give the holder the right to demand the redemption of the claim against liquidation (or fair market-) value.

Table 4.2 All deals - Average state-contingent percentage of ownership

	Management meets all performance milestones (min. VC own. contingency)		Management does not meet all performance milestones (max. VC own. Contingency)		Difference Min. and Max. VC ownership (good performance vs. bad performance)	
	Early stages	Later stages	Early stages	Later stages	Early stages	Later stages
VC%	53.0	44.2	64.9	49.6	-11.9	-5.4
Entrepreneur %	28.8	32.0	19.5	27.8	9.3	4.2
Others %	18.2	23.8	15.5	22.6	2.6	1.2

Source: Kaplan & Strömberg (2000:52)z

Table 4.3 All deals – Average state-contingent percentage of voting rights

	Management meets all performance milestones (min. vote contingency)		Management does not meet all performance milestones (max. vote contingency)		Switch in control	
	Early stages	Later stages	Early stages	Later stages	Early stages	Later stages
% VC control	65.8	48.7	86.9	59.0		
% Entrepreneur control	14.5	28.2	3.9	17.1	20.8	14.5
% Neither control	19.7	23.1	9.2	23.9		

Source: Kaplan & Strömberg (2000: 53)

Table 4.4 All deals – Average state-contingent percentage of board rights

	Normal board		Adverse state board		Adverse state board provisions	
	Early stages	Later stages	Early stages	Later stages	Early stages	Later stages
% VC majority	28.0	24.5	36.0	36.4		
% Entrepreneur majority	6.7	16.4	5.3	15.4	14.7	16.4
% Neither board majority	65.3	59.1	58.7	48.2		

Source: Kaplan & Strömberg (2000: 54)

Table 4.5 All deals – Average state-contingent percentage of liquidation rights

	Fraction of total		Redemption and put provisions	
	Early stages	Later stages	Early stages	Later stages
VC liquidation rights < I	2.8	1.0		
VC liquidation rights = I	26.4	21.4	80.3	88.1
VC liquidation rights > I	70.8	77.7		

Source: Kaplan & Strömberg (2000: 56)

In conclusion, it can be said that the venture capitalist's cash flow, voting and board rights decline over time while the entrepreneur's rights increase. Furthermore, the allocation of cash-flow and voting rights in the early contracts are much more sensitive to performance than those in later stages. If the company performs poorly, the venture capitalist obtains full control. As company performance improves, the entrepreneur retains/ obtains more control rights. If the company performs very well, the venture capitalist retains his cash flow rights, but relinquishes most of the control and liquidation rights. The entrepreneur's cash flow rights also increase with firm performance.

4.2.1.4 *Cumming (2001)*

Cumming conducted a research among 208 US venture capital investments in Canadian entrepreneurial firms and indicates that for investment in foreign securities, in contrast to domestic investment, a wider variety of financing forms is used (i.e. common equity, (straight) preferred stock, (convertible) debt, or a combination of these instruments). He suggests different tax laws, restrictive covenants, different market characteristics and complicated exit-options as likely explanations for this difference. Moreover, he argues that the optimal contract type depends much more on the details of the specific agency problem and the type of transaction; and as such, convertible preferred stock is not always the dominant form. However, given the mix of possible explanations, care must be taken when drawing conclusions on the relation between agency problem and choice of security.

4.2.1.5 *Grimmelt (2001)*

Grimmelt (2001) performed a study on the deal structuring of 122 contractual agreements in the Dutch venture capital market, a study quite similar to the US-based study by Kaplan & Strömberg. Both studies point out that there is a direct relation between the ability to increase risk and contract type. It seems that preferred convertibles are also the most common contract type in the Dutch market. During early stages 71% of the ventures are financed with preferred convertible stock; during later stages this share is 67%. Other findings by K&S, concerning the cash flow and control rights allocation, are evaluated against the light of the Dutch market. While both studies recognize a significant relation between performance and cash flow rights, Grimmelt, unlike K&S, has found no overwhelming evidence that the allocation of control rights in the Dutch market is directly related to the size of the agency problem. A possible explanation is the difference in which countries allow for investors to remove the entrepreneur. When easier to replace the leading entrepreneur, investors have a stronger incentive to hold the power/control right to do so.

4.2.2 *Assumptions*

The first research question, defined as "how does the ownership structure change during the investment process in venture capital backed firms?", can be seen to consist of two factors: time & ownership. So to provide a clear answer to this question, clear definitions must be made explicit.

First of all, a clear definition of the time-varying investment process must be made. The five research papers all use a variant of the same classification: early stages versus later stages. As such, Gompers classifies 'seed', 'start-up' and 'early stage' as all early stages and 'expansion', 'second', 'third' and 'bridge' financing as later stages. Trester distinct early stages as the financing phases, where there are no current customers, whereas later

stages are typified as the phases *with* current customers. Kaplan and Strömberg consider a financing to be early stage if the company is pre-revenue at the time of financing, and later stage if revenue is being generated. Cumming uses a slightly more detailed staging structure. While ‘start-up’ and ‘expansion’ roughly refer to the no-revenue respectively revenue phases, he adds the ‘buy-out’ phase and the ‘turn-around’ phase. Grimmelt conforms to the general classification of early versus later stages without specifying its exact meanings.

Considering the importance of the time-variable with regard to the subject of analysis in this thesis, no such simplification of the stage structure will be used. When in the following is referred to early or later stages, this is merely done to roughly indicate a point in time. Thus, while using the advantages of this split into two phases, the nuances of an indiscrete continuum and dynamic economic scenarios (as in Cumming, 2001) are preserved. From now on the following is assumed:

A. Timing

- Assumption 1: Time is assumed continuous with a 100% ownership by the entrepreneur at the beginning of the investment process, and the exit of the venture capitalist at the end of the investment process.
- Assumption 2: Early stage firms receive significantly less money per round, but increases in asset tangibility or decreases in asset specificity increase financing duration.
- Assumption 3: The continuance of the venture is dependent on the successful completion of an investment round.
- Assumption 4: Projects that go public receive more total financing and a greater number of rounds than firms that go bankrupt, are acquired or remain private.

Second of all, the definition of ownership is broadened. Whereas it was mentioned earlier that ownership usually refers to the holding of equity stakes in a company, it appears that this definition is relevant only as it affects pure cash-flow rights. Other variables, embedded in the investment contract, influence the decision-making process just as well and must therefore be taken into account. Although the previously discussed researches show a slight nuance in the conclusions regarding the use of the various types of securities, from now on the following is assumed:

B. Ownership

- Assumption 5: Before venture capitalists are offered a stake in the project, all equity is held by the entrepreneur.
- Assumption 6: The dominant mode of venture capital contracting in both early and later stages is preferred equity and convertible preferred equity in particular.
- Assumption 7: There is no debt in early stages.
- Assumption 8: In later stage financing, (convertible) preferred equity financing is partly replaced by debt and common equity financing.
- Assumption 9: The probability of success is negatively related to the venture capitalist’s claim on equity.
- Assumption 10: If investment is continued into later stages, the venture capitalist’s claim on equity decreases.

With regard to rights, other than cash flow rights, embedded in the contract, the following is assumed:

C. Other contractual arrangements

Assumption 11: The project's performance or probability of success is negatively related to the venture capitalist's control and liquidation rights.

Assumption 12: In early stages, the venture capitalist has largest claim on voting rights. If the entrepreneur meets performance measures, the venture capitalist loses majority. If not, the venture capitalist holds majority.

Assumption 13: Neither the venture capitalist nor the entrepreneur holds the exclusive majority of board rights.

Assumption 14: Venture capitalists have a senior claim on the project value in case of liquidation over the claim of the entrepreneur.

Assumption 15: While the majority of control and liquidation rights are state-contingent and most often held by the venture capitalist, day-to-day management and control is in the hands of the entrepreneur. He makes most of the operational decisions.

Assumption 16: State-contingent voting control switches occur more often in early stages than in later stages.

4.3 OWNERSHIP STRUCTURE AND THE AGENCY PROBLEM

In paragraph 4.3 the second component of the first main research question is discussed: 'How does this change in ownership affect the agency problem?' Consistent with the theoretical framework and the assumptions of the previous paragraph the effects of this gradual change in ownership, organizational form and contracting on the features of the principal-agent relation are discussed. Paragraph 4.3.1 discusses potential conflict areas that might trigger agency problems to exist. Paragraph places specific features of this principal-agent relation into a context in which external factors and intrinsic values of the project are combined; through this a broader insight into the interrelation between ownership structure and the agency conflict is achieved¹⁵.

4.3.1 *Agency problems and the nature of conflict*

For the agency problem to be used as a contextual variable, it is necessary to determine the nature of this problem. It is suggested here that the existence of conflict is a pre-condition for agency problems to arise. Conflicts affect venture performance and therewith the creation of agency problems. While standard agency problems have been discussed, its implications with regard to practice must still be made explicit. It is expected that this will create an insight into the interrelation of the conflict on one hand and the particular stage and state of the project on the other. This however is complex.

Merely listing a number of conflict situations is assumed inefficient for two reasons: (1) every situation is different; (2) not one listing of examples can ever do complete coverage. For this reason use will be made of the recent work of Higashide and Birley (2002). They performed a study in the UK, examining the nature of conflict that may arise between the venture capitalist and the entrepreneur in the process of strategic decision-making and

¹⁵ For the sake of completeness it is emphasized that the principal-agent relation here refers to the situation in which the entrepreneur is agent and the venture capitalist is principal. A situation in which these roles are reversed is thinkable when the venture capitalist must answer to the entrepreneur's expectations with regard to the non-financial input (e.g. consultancy, distribution channels) of the venture capitalist. This however, is here left out of consideration.

its effect on venture performance *as perceived by the venture capitalist*. They suggest a classification of the various conflicts that is here used to effectively structure the otherwise limited discussion on conflict situations. In this thesis there will be a particular focus on those conflicts that affect or cause agency problems to exist.

They distinguish two possible ways in which these conflicts may arise (Higashide and Birley, 2002):

- as the goals of the entrepreneur and the venture capitalist begin to diverge and/or
- as the policies adopted by the investee company are unacceptable to the investor.

In order to stay with the object of analysis of this thesis, the strategic decision-making process, the first way in which conflicts may arise, diverging goals, is here most relevant. Higashide and Birley describe four sub-dimensions of goal conflicts: short- and long-term orientation, product/innovation and control/incentives; and three sub-dimensions of the policy conflict: strategic advice, networking help and inter-personal/personnel help. It is assumed here that the sub-dimensions of the goal conflict may potentially lead to an agency problem, while the sub-dimensions of a policy conflict may not. Goal conflicts have a much greater impact on the venture performance than policy conflict. Furthermore, goal conflicts work independently of policy conflicts; while on the other hand, goal conflicts appear to be a necessary condition for policy conflicts (Higashide and Birley, 2002). Consequently, policy conflicts are from now on left out of consideration.

Furthermore a distinction is made between cognitive and affective conflicts, where ‘cognitive’ refers the ‘functional, task-oriented conflict which stands for judgmental differences about how best to achieve common objectives’; and ‘affective’ stands for ‘the dysfunctional and emotional conflict which arises from incompatibilities or disputes among decision participants.’ (Higashide and Birley, 2002) In practice, it is found that both types often emerge and exist together. For example, while entrepreneur and venture capitalist engage in cognitive conflict, they potentially trigger an affective conflict. Results show that there is a negative relationship between the affective conflict and performance (Higashide and Birley, 2002). It will be shown that where a cognitive conflict leads to affective conflict, agency problems may arise. Consistent with the previous, this negatively affects venture performance (through increased agency costs) and should therefore be dealt with in appropriate manner by the venture capitalist (see chapter 6).

To illustrate the significance of the mentioned sub-dimensions and specific conflict issues, tables 4.1 and 4.2 show results from the regression analysis by Higashide and Birley (2002). The data have been modified, so as to be presented in this form; values below 0.7 have been left out.

Table 4.6 Goal cognitive conflict

Item	Factor 1	Factor 2	Factor 3	Factor 4
	Short term orientation	Long term orientation	Product/innovation	Control/incentives
Profit next year	0.81825			
Sales growth rate	0.77084			
Exit/harvest timing and method		0.75918		
CEO/team rewards				0.70860
CEO/team decision authority				0.79918
CEO/ team personal development				0.81224
Cash flow	0.72680			

New product development	0.84449
Innovation/R&D	0.85197
Market penetration	0.70242

Table 4.7 Goal affective conflict

Item	Factors 1 (& 2)	Factor 3	Factor 4
	Profitability orientation	Product/innovation	Control/incentives
Long term profitability	0.76860		
Market share	0.78423		
Exit/harvest timing/method	0.71152		
CEO team rewards			0.79383
CEO team decision authority			0.83703
CEO/team personal development			0.83164
New product development		0.87684	
Innovation/R&D		0.84595	

As seen, most of the regression results correspond with the findings from earlier paragraphs. A major area for both functional (cognitive) and, resulting, emotional (affective) dispute between entrepreneur and venture capitalist is profitability orientation (both short-term and long-term financial prospects).

Conflict area 1: Short-term orientation

It is commonly acknowledged that the wealth-constrained, capital-seeking entrepreneur will almost always (purposely or not) exaggerate the venture's prospects prior to the first investment in trying to persuade venture capital parties to invest. The venture capitalist being aware of such possible behavior, he will make effort/costs by extensively screening the entrepreneur's precedents, intentions and business plan before embarking on the investment process. However, since this screening process is rather extensive and difficult, there is the always lurking danger of accepting doubtful projects (on account of asymmetric information). Also, since institutional investors leverage the business risk of their initial investments by demanding (exceptionally) high interest rates on their investments, projects with truly 'good' prospects will leave the market: the so-called *adverse selection* problem.

As a result it is likely that first results will be less than expected or proclaimed during negotiation. Thus, conflict arises when the venture capitalist is discontent with the achievements of the management. Further, one important and often constructive task of the venture capitalist is pushing the entrepreneurial team by playing devil's advocate. As shown in the tables above, conflicts arise about short-term financial prospects (next year's profit and sales growth rate). The entrepreneur on his part will put disappointing results into perspective by blaming it on limited available cash flow means, unreasonable time-frames/deadlines or external factors such as a declining market demand. Should the conflict turn into an affective conflict, agency costs arise. Should the entrepreneur start behaving opportunistically, there is a moral hazard problem. And, if cash flow is seen as (one of) the cause(s) of disappointing results, the entrepreneur may disguise this by window-dressing results. Paragraph 4.3.2 will discuss in further detail the conditions under which these specific agency costs are prevalent.

Conflict area 2: Long-term orientation

The venture capitalist sets out in the investment process to achieve the highest possible rate of return. As such, the ultimate goal of the venture capitalist is to eventually offer the venture to the public market: the so-called IPO (initial public offering). The entrepreneur on the other hand, may have started his venture for different reasons, such as personal fulfillment, independence, freedom. However, although this divergence of initial goals does not necessarily lead to bad management or conflicts on short-term issues, it does play a role on the long term horizon. The tables 4.1 and 4.2 show a significant conflict area where the ways and timing of exit are concerned.

Venture capitalists are concerned that entrepreneurs with private information and large private benefits will not want to liquidate a project even if they have information that the project has a negative net present value for shareholders (Gompers, 1995: 1486). Entrepreneurs on the other hand are worried that the venture capitalist wants to harvest a venture's profits rather than to reinvest in future developments in order to distribute to limited partners, especially when the venture is financially viable but too small to go public (Sahlman, 1990, Higashide and Birley 2002). It has been argued earlier that, if venture capitalists receive favorable information about the firm and it has the potential to go public, the venture capitalist continues to fund the project (assumption 4). If the project is viable but has little potential to go public, the venture capitalist quickly searches for a corporate buyer. Firms that have little potential are liquidated, especially since the venture capitalist has first rights to the salvage value (assumption 14).

In contrast to goal conflicts with a short-term orientation, where the functional element of such conflicts is clearly present, long-term orientated conflicts almost unavoidably lead to the affective, dysfunctional type of dispute that deteriorates performance. As such, conflicts between entrepreneur and venture capitalist about the ways and timing of exit entail agency costs of 'hold-up' and 'moral hazard'. Paragraph 4.3.2 describes the *conditio sine qua non*.

Conflict area 3: product/innovation

A third area that provides reason for conflict is: new product development, R&D and innovation. Like with long-term orientation and exit-options, functional disputes about the core business easily lead to an affective conflict. Moreover, these types of disputes have the strongest impact on venture performance in both a positive and a negative way, and seem to work independently of the other types of conflict (Higashide and Birley, 2002). Discussions between entrepreneur and venture capitalist about the product, the direction the project is going in, or new innovative features can be stimulating and lead to better results. If these functional discussions however result in the clash of very different ideas/opinions that can not easily be overcome, a situation arises that provides good ground for agency problems to arise.

For the same reason entrepreneurs might not strive for a rapid IPO, venture capitalists are concerned that entrepreneurs might invest in strategies, research, or projects that have high personal returns but low expected monetary pay-offs to shareholders. For example, entrepreneurs have more discretion to invest in personally beneficial strategies at shareholders' expense in industries where firm value is largely dependent upon future

growth opportunities. This way a moral hazard problem is very prevalent and costly. Situations in which the entrepreneur is triggered to strive for these types of strategies are discussed in the next paragraph.

Conflict area 4: control/incentives

In general, decision-making on one party's specialized field is likely to be more routine and may involve less debate for the party possessing the higher ability or expertise. As such, venture capitalists are usually unwilling to be involved in the day-to-day management but regard financial management as one of their most important roles. Decisions about strategic choice may however include a great deal of debate. It has been argued earlier (assumptions 12 and 14) that most of the voting and liquidation rights are held by the venture capitalist, while the entrepreneur, who once was sole owner, has now lost most of his 'official' saying-power. Furthermore, it has been argued that the venture capitalist's involvement increases as a reaction to bad performance (assumption 11), implying that the goal conflict on decision authority is directly affected by venture performance.

An interesting note is that, while this conflict is triggered by bad performance, no significant evidence is found that this cognitive conflict causes affective conflict on its turn. However, Higashide and Birley (2002) do show a clear inter-dependence among the four conflict areas, so the relevance of control and incentives in this context remains clear. Conflicts about control triggers affective conflict on other sub-dimensions!

4.3.2 Project/market quality: an extra dimension

In 4.3.1 four sub-dimensions of the potential goal conflict between entrepreneur and venture capitalist have been discussed. While the cognitive type of conflict is functional and therewith beneficial to venture performance, it may also lead to an affective conflict, negatively influencing performance. In the latter scenario, as mentioned in the previous paragraph, agency problems arise. In addition, it will here be argued that the way in which these problems arise, is very much dependent on the situation the project is in. Suggestions will be made with regard to the inter-relation of different qualitative states and the agency problem.

How should these qualitative states be defined? In the research model a correlation between ownership structure and the agency problem has been assumed. While in this chapter the definition of ownership has already been broadened once by including the contractual arrangement of specific rights under the same denominator, the scope of analysis is once again expanded by including the combined value of both external (the state of the economy) and internal factors (the intrinsic project quality) to the formula. To do so the following simple model is designed:

Figure 4.1 Four qualitative states

	Good project	Bad project
Favorable economy	(+,+) 4.	(+,-) 1.
Unfavorable economy	(-,+) 3.	(-,-) 2.

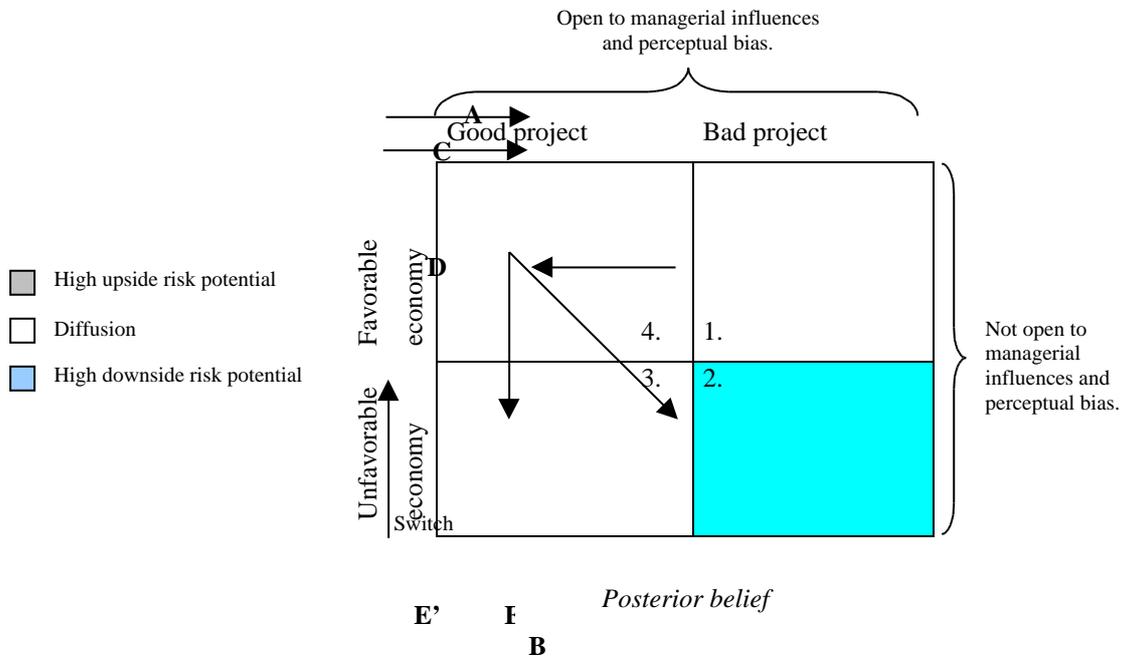
The intrinsic project quality and the external economic state have each been brought back to a two-state model: the project is either ‘good’ or ‘bad’ and the economy is either ‘favorable’ or ‘unfavorable’. And where the economic state is assumed to be seen as an unambiguous and unmistakable fact that can (at least in this model) *not* be influenced by management, the project state on the other hand is no less a fact but *can* in fact be influenced by management.

Important is to recognize that although this model appears rather static, it is in fact very dynamic! Namely, it depends on the venture capitalist’s and the entrepreneur’s perception of how and to what extent the qualitative state is being recognized. As such, it is very possible that information asymmetry and limited rationality make a venture capitalist perceive a ‘good’ project to be ‘bad’ and vice versa. Consider for example the case of an up-market, in which the venture capitalist may behave in a manner that’s appropriate with the situation of quadrant 1 (of figure 4.1) while in fact, he should have responded to situational characteristics of quadrant 4 (or vice versa). Each quadrant/situation calls for specific means, strategies and behavior. This is a very important notion.

4.3.2.1 Posterior belief

If the venture capitalist and entrepreneur have very precise beliefs about the probability of success of the project (i.e. if t is very close to 0 or 1), the posterior belief changes only slowly, staying within the boundaries of a qualitative state. When, on the other hand, there are very diffuse beliefs about the success rate of the project (i.e. t is close to $\frac{1}{2}$) the posterior belief changes most rapidly (see also paragraph 3.4.3), shifting qualitative states (in perception). These changes become visible through movements over the horizontal axis in the model.

Figure 4.2 Posterior beliefs in a dynamic context



Where figure 4.1 shows a 2-state model, figure 4.2 graphs the four qualitative states against the indiscrete variable t of posterior belief. The economy is assumed to be observed in its true form, so a negative discovery

(under the condition of a favorable economy) about a project with uncertain prospects causes a shift in perception from quadrant 4 to 1 (situation A); under the condition of an unfavorable economy a similar shift occurs (from quadrant 3 to 2) except this time the perceiver is likely to use a greater adjustment (towards 0) on account of the disappointing market (situation B). On the other hand, when a negative discovery is done about a project with very hopeful prospects (in an up-market), one's perception of the probability of success (or posterior belief) is adjusted, but not necessarily shifted to another quadrant in the model; posterior belief lingers around 0,5 (situation C). Positive discoveries about a 'bad' project have of course a similar but reverse effect (situation D). Successive discoveries of the same type (negative or positive) therefore lead perception to approximate actuality. Thus, as the investment process progresses over time, it will be increasingly the case that posterior belief approximates the actual probability.

While perception is explained to be a dynamic factor, markets are of course also very dynamic. Two dynamics are distinguished causing shifts over the vertical axis.

Firstly, market conditions change on account of 'normal' economic supply and demand conjuncture. While a project may be 'good' under favorable market conditions, demand may decline, suddenly turning the venture into a project with 'uncertain' (E) or even 'bad' (E') prospects in a bear market. For example, this is what happened with many of the New Economy ventures.

The second market dynamic is not so much one that is external but one that is 'created' by the project's management: a switch in the project's product/market combination (PMC). If, for example, a project is faced with disappointing results, fierce competition or otherwise declining demand, management may decide to create a new or penetrate a different market where demand is high and conditions are good (see F in figure 4.2)

Resuming the above, the state of the economy, or rather the state of the market, is subject to change but not to perception (state can be observed by anyone at all time). The state of the project is subject to change (on account of PMC-switches or managerial behavior) and is subject to perception (state can not be observed by anyone at all time). Assuming all projects are located in quadrant 4 at the point of initial funding, changes in qualitative states (or movements to all other quadrants) remain theoretically possible throughout the investment process.

In conclusion a distinction can be made between three types of situations:

- a) the combination of an investment in a bad project under unfavorable market conditions results in a *high downside risk potential situation*;
- b) the combined probabilities of an investment in a good project under favorable economic conditions lead to a *high upside risk potential situation*, and
- c) the combined probabilities of a bad project in a favorable market or a good project in an unfavorable market can be referred to as *diffusion* or *uncertainty*. The former is referred to as negatively diffused (bad project), the latter is referred to as positively diffused (good project).

4.4 TIME

In addition to posterior belief and the qualitative state of project and market, time plays an obvious role in determining the potential occurrence of agency problems. Assumption 1 of this thesis already defined time as

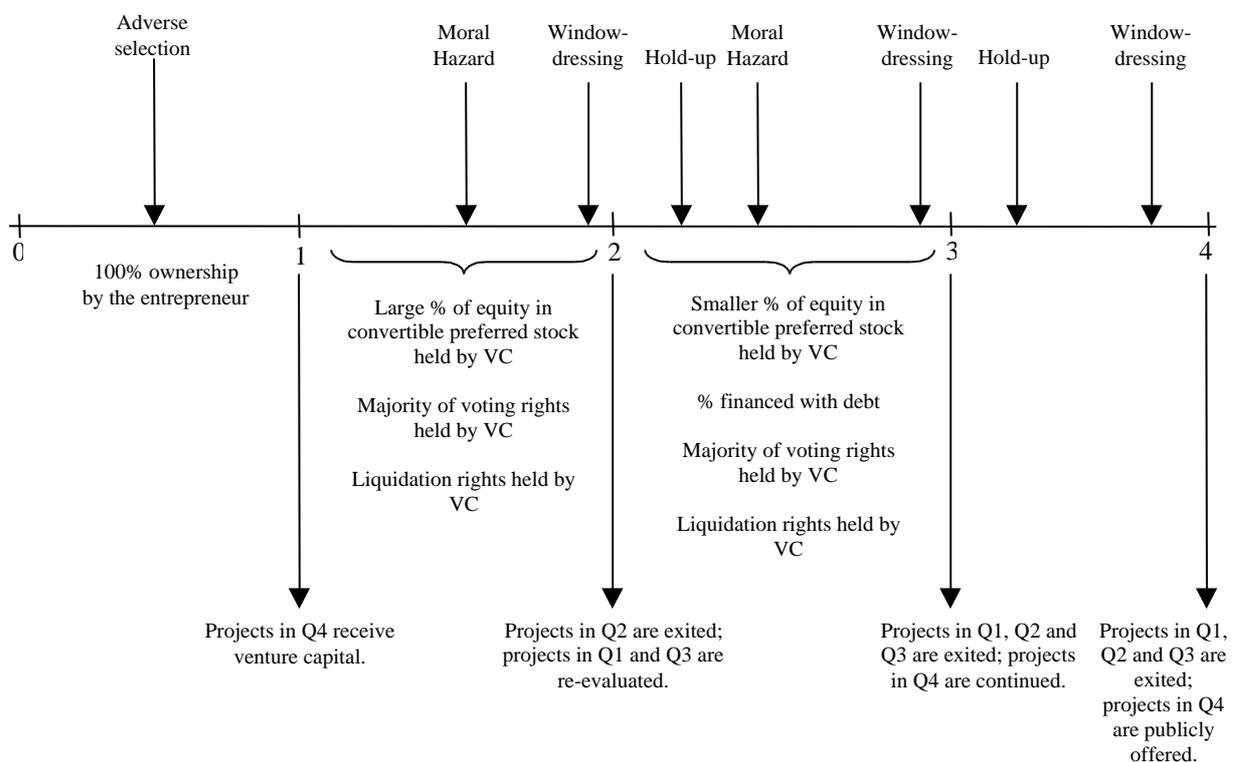
continuous with a 100% ownership by the entrepreneur at the beginning of the investment process and the exit of the venture capitalist at the end of this process. Table 4.3 adds a few more milestones to variable T (time).

Table 4.8 Time¹⁶

T	Milestones
0	There is no outside investment and the entrepreneur is the sole owner.
1	The initial outside capital infusion by the venture capitalist takes place and therewith an option on future investment is taken. A 'good' perception of the project state is considered a condition for initial investment.
2	At T=2 the venture capitalist evaluates his investment and decides whether or not to continue his investment by infusing second round capital at this point. All investments that are considered to be in quadrant 2 at this point are exited by sale or abandoned. Investment in Q4 are continued; investments in Q1 and Q3 are re-evaluated.
3	If continued at T=2, the venture capitalist again evaluates his investment at T=3 and decides to exit at this point or continue by infusing capital and prepare for the initial public offering. All projects in Q1, Q2 and Q3 are exited by sale or abandonment; projects in Q4 are continued and prepared for IPO.
4	If continued at T=3, the venture is offered to the public market at T=4. If not in Q4 at T=4, the venture is privately sold.

Accordingly, figure 4.3 displays the agency problems against a time-frame in which the sequential stages, qualitative states and ownership dynamics are included.

Figure 4.3 Time-frame



Adverse selection: this problem is obviously most pronounced for start-up firms with a short track record, high-tech firms, and new investments (as opposed to follow-up investments). In this situation the entrepreneur holds

¹⁶ These milestones are used to define a simplified model in which t1 and t2 refer to early stage financing and t3 and t4 to later stage financing.

all equity and control rights but is willing to exchange part of his ownership on account of being wealth-constrained. The entrepreneur has more information on project quality than the venture capitalist, potentially causing the venture capitalist to fund a 'bad' project (Cumming, 2001).

Moral hazard: the moral hazard problem may occur at various points throughout the investment process, but after initial investment has been made. When ownership is partly transferred to the outside investor, the inside owner and the outside owner may differ in their strategy preference or choice of behavior (with regard to creating maximum shareholder value). In general, the investment process is organized in stages to reduce potential opportunistic behavior by the entrepreneur, and if the project is 'good' and prospects are favorable, the entrepreneur should not have incentives to behave opportunistically and thereby negatively affecting venture performance. However, under less favorable circumstances, the entrepreneur might feel benefited by extracting resources for private consumption or exercising personally beneficial strategies. If the entrepreneur discovers, after having received first round financing, that the true state of the project is 'bad' while perceived as 'good' by the venture capitalist, he might come to the conclusion that reaching the set targets is suddenly very difficult. If prospects are very bad and most likely not to meet targets (even when window-dressing results) he may foresee a premature abandonment by the venture capitalist. Knowing that the venture capitalist holds first rights to salvage value, the entrepreneur starts behaving opportunistically by exercising risky strategies or extracting resources from the venture before it is being liquidated. This is in accordance with the venture capitalist demanding a higher claim on cash flow and control rights under unfavorable conditions. In principle, moral hazard costs increase with the firm's growth options, i.e. moral hazard costs are greater for younger firms (Sahlman, 1990; Gompers and Lerner, 1999; Cumming, 1999). Moral hazard is significant among early stage firms. As moral hazard costs increase, total investment duration may be reduced because monitoring is costly (Gompers, 1995). However, in a scenario in which the project has progressed into later stages, and in which information distribution remains asymmetric (high upside potential), a moral hazard problem might arise if downside potential suddenly increases.

Window-dressing: this type of agency problem is clearly most common around the time of staged performance reviews. Information-asymmetry and a belief by the entrepreneur in the (eventual) success of the project are conditional, meaning the entrepreneur perceives the project to be in Q1, Q3 or Q4 and especially in early stages. Where the staged investment structure is in theory motivational to increase performance, it could also be perceived as detrimental to fast growth. Early stage financings are always relative small amounts, possibly causing conflict about cash flow issues and short-term goals (see table 4.2). If these are believed by the entrepreneur to hinder the growth rate or performance improvement, window-dressing results in order to receive additional financing may seem attractive. In principle, window-dressing problems are seen under the conditions of information asymmetry and underperformance. While during early stages information asymmetry and uncertainty about performance is highest, later stage window-dressing is often seen when attracting additional outside-investors (syndication) or prior to an IPO.

Hold-up: after ownership has been divided by initial investment, the outside investor has made costs that are now sunk into the project. This causes abandonment by the venture capitalist to be a costly exit, when it is not

certain that abandonment is beneficial to venture value. The hold-up problem is therefore particularly pronounced among new start-up ventures that face contract renegotiation and in which the capital outlay is significant, i.e. later stage investment. The hold-up problem is potentially mitigated by syndicating investment (Rajan, 1992).

4.5 CONCLUSION

In order to explore the agency problem of venture capital-backed firms, the issues of changing ownership and accompanying agency problems have been discussed in this chapter.

As the venture capitalist infuses capital into the project, the ownership structure changes, potentially causing agency problems. In this context the definition of ownership has been broadened by including the allocation of specific legal rights in the contractual agreement to the discussion. Venture capital contracting being a popular topic in recent scientific literature, earlier empirical research has been used to determine and extract conditions and boundaries of the subject of analysis of this thesis. Subsequently, the following has been assumed: before the venture capitalist has been offered a stake in the venture, there is no debt and all equity is held by the entrepreneur. Early stage financing rounds (before revenue is being generated) are recognized to be shorter in duration and smaller in size than later stage financing rounds (after revenue is being generated). The dominant mode of financing is convertible preferred equity, providing the venture capitalist with special rights such as a fixed rate of return. In later stages, the convertible preferred equity is partly replaced by common equity and debt, giving the lender the right to foreclose. In addition, the venture capitalist has a senior claim on the project value in case of liquidation. Furthermore, the venture capitalist has a large claim on voting rights and board rights but these are contingent on venture performance. It has been assumed that the project's performance or probability of success is negatively related to the venture capitalist's control and liquidation rights. So-called switches in control occur mostly in the early stages of the investment process. Lastly, if ventures have the potential to go public, financing is continued into late stages; if not so, the investment is abandoned or sold in an earlier stage.

To structure the complex issue of relating a comprehensive body of potential conflict situations to its underlying cause, use has been made of earlier empirical research. It has been assumed that when a functional, cognitive dispute transforms into an affective, dysfunctional conflict about the goals of the venture, an agency problem arises. Conflicts about short-term, long-term orientation, product/innovation and control might, however dependant on the qualitative state of the project and successive conditions, lead to adverse selection, moral hazard, hold-up and/or window-dressing.

It has been argued that the qualitative state of a project depends on two variables: 1) the (external) market conditions, 2) the (internal) project quality. Assuming each variable can only be one of two states, four different risk situations are distinguished. Expanding the model with a time-variable, posterior belief and the assumptions of this chapter, agency problems (caused by the affective goal conflict) can be placed accordingly.

Adverse selection occurs with start-up firms with a short or no track record. The entrepreneur holds all equity and has therefore sole access to private information. The venture capitalist must rely on the trustworthiness of the entrepreneur and the information he provides. In a high upside risk potential situation the entrepreneur has generally no incentives to overestimate prospects and chances on adverse selection are small. However, when

there is diffusion about the venture's prospects or when downside risk potential is high, the entrepreneur is likely to accept a higher rate of return for the venture capitalist therewith causing potential adverse selection.

The moral hazard problem is triggered by a difference in goal objectives by the entrepreneur and the venture capitalist. In general the staged investment structure and the co-ownership should prevent the entrepreneur from behaving opportunistically, but under certain circumstances he might feel benefited by exercising personally beneficial strategies. In an upside potential situation goals are likely to be aligned, but if there is any goal conflict and it is of the affective type, it is not likely that the ownership structure (as in the broader sense of this thesis) will hinder the entrepreneur's personal goals. On the other hand, when there is increased downside risk potential, the ownership structure may start to affect the entrepreneur's behavior causing a serious moral hazard at various stages of the investment process. This is increased by the venture capitalist's seniority with regard to liquidation value and control rights (in a downside potential situation).

Especially in early stages, when not much is known about the intrinsic project quality and information asymmetry is high, the entrepreneur might feel incentives to window-dress results just before a periodic performance review by the venture capitalist. Having assumed that projects that do not have the potential to go public are abandoned or sold in a relative early stage, goals are not aligned when performance is not met: the entrepreneur starts behaving opportunistically by window-dressing results in order to achieve a follow-up investment. When downside risk is high and continuance is not perceived to be a reasonable option, the potential of window-dressing problems is overshadowed by moral hazard. Window-dressing in later stages is less common since information-asymmetry is reduced.

The hold-up problem is particularly pronounced among new start-up ventures that face contract renegotiation. As the investment by the venture capitalist sinks into the project, the hold-up problem increases. Especially in situations where there is diffusion about the venture's prospects, the hold-up problem is substantial.

5 REAL OPTIONS IN AN AGENCY CONTEXT

5.1 INTRODUCTION

It has been described in chapter 4 how the goals of decision-makers may diverge as the venture's prospects are uncertain and strategic decisions must be made. In chapter five this discussion is broadened by exploring the second main research question: "how does the agency problem affect real options in strategic decision-making?" In order to do so, this chapter has been divided into three sections. In paragraph 5.2 a real options view on the strategic decision-making process in start-up venturing will provide the basis for discussion. By taking a closer look on the timeframe in chapter four (figure 4.3), it will be explored how strategic options unfold and/or subside as the process of resource investment choices sequences. Strategic choices are related to real options. Paragraph 5.3 follows up on this by placing the real options in an agency context. The analysis is expanded with contextual dynamics that have been identified and modeled earlier (see chapter four). An attempt will be made to estimate the consequences of the agency conflict on the subjective process of option valuation. It is aimed at to show how a perceptual bias, caused by the division of ownership, may affect the value of the option. The determinants underlying the value of an option are reconsidered in this perspective. It is shown how, under specific conditions, perceptual bias leads to overestimation and/or deterioration of perceived option value, therewith leading to unintended negative consequences. In order to do so, several propositions will be formulated. Paragraph 5.4 will conclude this chapter.

5.2 REAL OPTIONS AND DECISION POINTS: STRATEGIZING WITH REAL OPTIONS

In this paragraph the first sub-question of the second research question of this paper (RQ 2c) is discussed: 'Which options are considered *ex-ante* the financing contract?' It is emphasized that the focus of this paragraph is on the options as considered *ex-ante* the initial contracting, implying there's flexibility for reconsideration in the next paragraphs. However, instead of simply commenting on the content of the standard venture capital contract, something that has been dealt with in detail in the previous chapter, the real option paradigm is used to expand the discussion on strategic decision-making in venture capital-backed firms.

Earlier, in the theoretical framework of this paper, strategy has been described as 'the pattern of resource deployment in the organizational process of sequential choice'. Resource investments and unfolding strategy choices are here part of the same phenomenon. It has been explained how opportunities come into being only when decision-makers recognize them. In accordance, it has been shown how the complete set of possible strategic choices is named the 'option bundle', in which shadow options (potential strategic choices awaiting recognition) and real (recognized) options are combined. As strategic choices are made and resources are deployed, decision-makers are faced with new situations and new contexts in which new (potential) opportunities arise and previous options (real or shadow) possibly subside.

5.2.1 The option set

In figure 4.3 a common development pattern of an entrepreneurial venture that is (partly) financed with venture capital is modeled. The life-span of the venture, under venture capitalist hood, has been divided into four distinct points in time. Each point represents a moment of choice in which the venture capitalist reconsiders his

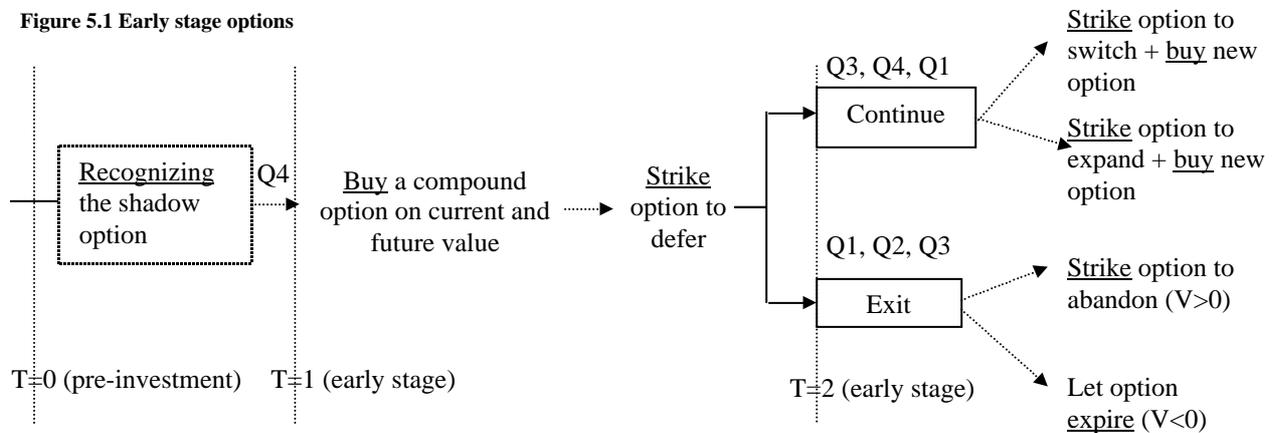
investment. As he takes into account factors such as recent (un)achieved milestones, market circumstances and, accumulating, growth potential, the real option set is valued¹⁷.

The investment process starts off at t_1 when the venture capitalist provides initial funding. Through the options lens, the period prior to t_1 can be divided into two parts. The first part is the period in which the entrepreneur was sole owner and manager and in which the opportunity had still to be recognized as a potential investment to the venture capitalist: the opportunity is still a shadow option. The second part prior to t_1 is the period between the moment in which the venture capitalist recognized the shadow option as a serious opportunity and the moment he actually infuses capital; only by infusing capital he transforms the opportunity into a real option (set). More specifically, by investing the venture capitalist has bought a compound growth option on the (future) value of the firm. In accordance with the option-analogy, the compound option is seen as an investment opportunity that is a call option on a portfolio consisting of the gross project value plus other real call and put options. Moreover, it is generally understood that the more volatile the opportunity, the more is gained and the less is risked losing by holding the option. In other words, the value of a real option is positively associated with risk. In expectance of events to unfold and uncertainty to decrease, the value of the option set changes and strategic follow-up choices must be made. At each decision point, either unambiguously laid down in the investment contract or triggered by conditions, the investor must make a trade-off between the implications of potential follow-up strategies. Recall Trigeorgis (1993b) from chapter 2 of this paper: ‘the value of a prior option would be altered if followed by a subsequent option because it would effectively be written on a higher underlying asset, V' (equal to the gross project value, V , plus the then expected value of the subsequent option). Specifically, in terms of sign, if the first option is a put, its value would be lower (giving a negative interaction) and if a call, higher (positive interaction), relative to its value as a separate option. Trigeorgis (1993b) described that as ‘there is a high positive marginal probability that the put option will be exercised at time t_1 or that the call option may later be independently exercised at time t_2 , the conditional probability of exercising the latter call option, given a prior exercise of the first put, is nevertheless small – smaller than the marginal probability of exercising the latter option alone.’ Extending this even further, it has been argued by some that options provide strategic positioning. Given initial uncertainty, followed by the reduction of uncertainty by learning, ‘an option chain unfolds as a series of interwoven small and large investments. Because real options reflect the organizations own sense making, they position the firm uniquely (compared to competitors with different sense making). Options thus actually form the inimitable resources that give an organization its sustained performance and competitive advantage (Bowman, E., Hurry, D., 1993).’

¹⁷ The ‘option set’ refers to the combination of a number of options available to a decision-maker, but it depends on the structure of the organization how this option set is treated. If the structure allows one single option (from the set) to be struck independently, keeping the other options intact, the ‘set’ approximates a ‘portfolio of options’. When, on the other hand, the set of options is seen as one option that confers several choices (e.g. expansion, contraction, divestiture or switching), of which the best alternative can be chosen to strike the option, the set should be seen as an ‘option on a portfolio of options’. Since in this paper options are looked at from a firm-level perspective, the first (portfolio) definition is most appropriate. However, in case of divestiture (or abandonment) other options are automatically ruled out, implying the use of the latter definition (an option on a portfolio or ‘compound option’).

Relating to the model, at t_1 the investor has access to series of potential strategies of which the outcome is uncertain and subject to internal and external conditions. Figure 5.1 pictures this sequential decision-making process during the early stages of the model. The process is approached from the outside-investors point of view and should be analyzed as follows.

Figure 5.1 Early stage options



After initial capital has been infused, the now acquired financial flexibility allows for the undertaking of actions by the entrepreneurial team to advance the growth rate. The venture is still in its early stage of evolution, meaning the duration of financing rounds are still relatively long and amounts are relatively small (Gompers, 1995). Perceiving the project quality and market conditions to be 'good' (Q4), the compound option on future value is taken and the investor now defers any decision-making until information about probabilities arrives. In accordance with the option analogy, the investor's 'wait-and-see strategy' can be valued as an American call option on the project, with an exercise price equal to the necessary investment outlays. This implies that, if there were no competition or other external time pressure, it would be optimal for the venture capitalist to hold the call until its expiration date (e.g. laid down in the investment contract) so as much perceived environmental uncertainty as possible would have subsided. This strategy would guard him against unnecessary downside risk taking. However, assuming the project operates in a competitive environment where time pressure is a daily issue, managers and investors alike are often triggered to strike the option before reaching its pre-determined expiration date.¹⁸ In relation to this observation, Bowman & Hurry (1993) distinguish two types of striking signals. They argue that one signal indicates the arrival of the opportunity, a moment that implies a possible end to the 'wait-and-see' period: an immediate strike is a profitable option but the incentive to wait still exists (a later decision might possibly be better). An example would be a young income-producing project. The second signal, the so-called expiration signal, indicates the imminent closure of the opportunity: waiting beyond this point may mean wasting (or expiring) the option. To exemplify, a project with decreasing volatility may possibly be worth more when struck (e.g. sold) immediately than when hold on to for a longer period. As such, competition is often a reason that advances the optimal time for striking. Thus, the first signal 'suggests' a practical termination date, the second signal 'enforces' it. In relation to figure 5.1, the optimal 'wait-and-see' period during the early stages of the investment process is modeled to end at t_2 ; whether both, just one or even none of the striking signals

¹⁸ Smit (1996), among others, has devoted much attention to relating the real option paradigm to the interactive play of competitive forces. As such, an interesting extension of this paper would be the inclusion of game theoretic elements.

have been received, is dependent on the situation. It is assumed that at t_2 a relative amount of learning has taken place, for the investor as well as the entrepreneur, and an insight into the development of external and internal conditions (and the combination of) has been created. Important is to stress that, although certain information has arrived, the internal quality remains subject to perception.

In general, the investor may now decide on one of two basic strategies: 1) he *continues* investing by striking the compound option and buying another compound option, therewith obtaining and maintaining access to immediate and future value, or 2) he *abandons* his investment by not infusing follow-up capital and striking his option to abandon, acquiring access to his share of salvage value.

Upon deciding that an exit-strategy is not (yet) to be executed, the investor can choose between various alternatives. First of all there is the option to expand, valued analogous to the American call to acquire an additional part of the project by paying an extra outlay as the exercise price (Trigeorgis, 1993b). Obviously this is the most favorable alternative, since follow-up investment only occurs under the condition of perceived high upside risk (see assumptions 3 and 4). However, when there is considerable positive diffusion regarding the probability of success (Q3) the investor might consider continuing investment and wait for events to unfold.

Another option to continue investing is switching use. Providing that the outside-investor perceives the intrinsic project quality to be good, but not to effectively meet (potential) market demand (Q3), a switch in market choice or use of the project's resources may be preferable. As such, the option to switch is valued analogous to a portfolio of an American put on the current project and an American call on the alternative project, with an exercise price equal to the value in its best alternative use (Copeland, 2001). Although this alternative is included in the model in figure 5.1, it is important to stress the conditions *sine qua non* such a switch might occur in the early stages of the investment process. In general, venture capitalists seek to maximize their wealth by taking large risks *regarding the probabilities* of success (instead of expected outcome (red.)) (March & Shapira, 1987). Staged investment-structure limits the potential downside losses, which makes high variability very attractive and even conditional. When a certain product-market combination fails to provide sufficient potential for high growth, in other words if there's lack of volatility, a choice must be made. Hence, if the alternative use of resources leads to increased variability, switching can be considered a realistic option. However, if expectations are that the project will be viable but a significant increase in variability is not expected, the outside-investor will be increasingly tempted to divest and look for a corporate buyer; (potential) resale value is often decisive.

However, there is a third alternative to exiting the investment process: the option to contract. Valued as an American put option on part of the project, with an exercise price equal to the potential cost savings, this downsize strategy is executed in situations where performance of (a part of) operations is disappointing (Trigeorgis, 1993b). This option is however less applicable in the described venture capital-backed project scenario. Underlying the model in this paper lays the implicit assumption that start-up ventures are small and consist of only one core operating unit; reducing the scale of operations is therefore assumed to be practically not possible. For this reason this alternative is left out of the model.

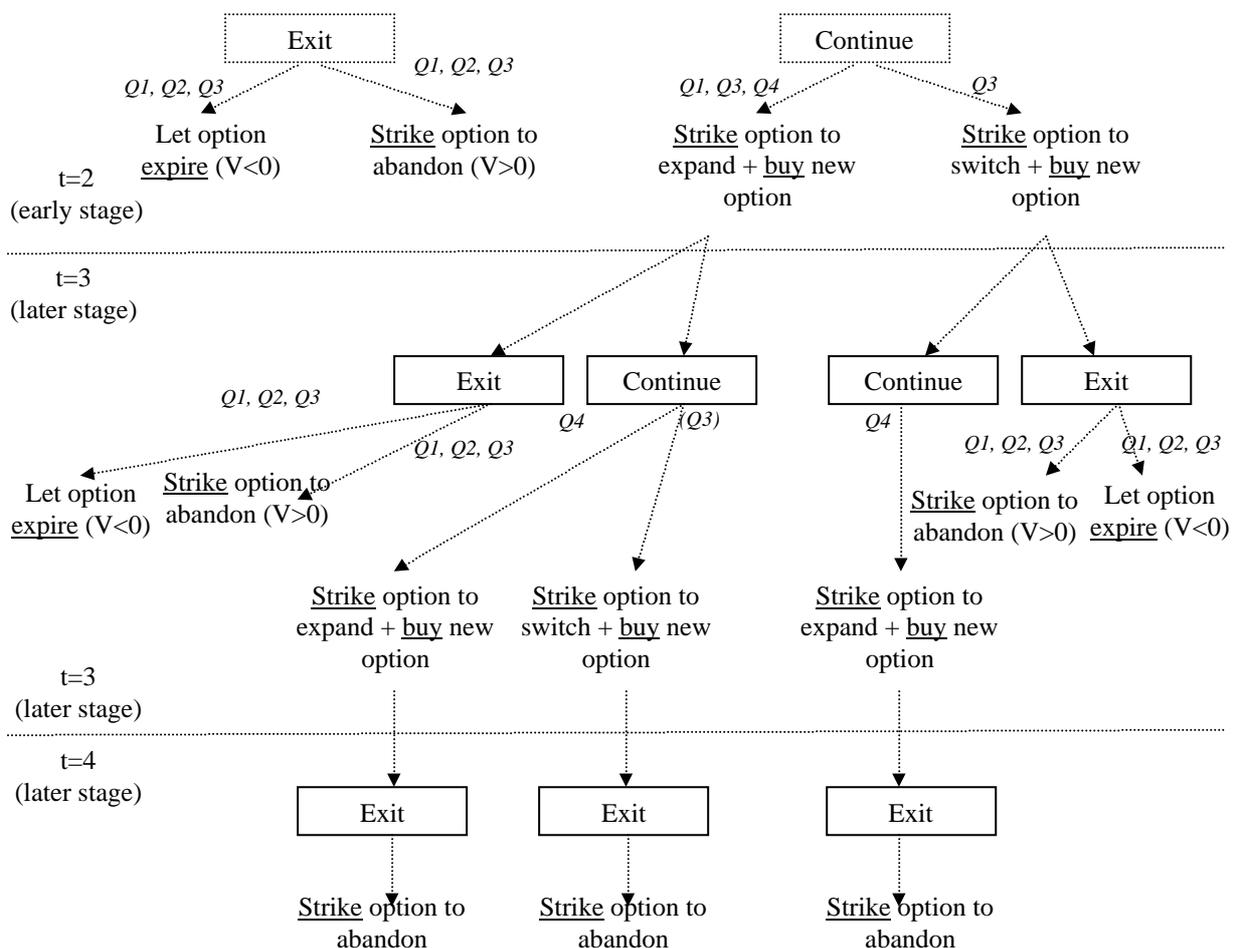
Opposite to continuing the investment process is the obvious alternative: the exit-strategy. As mentioned before, venture capitalists take large risks regarding the probability of success: projects with low variance and no real switching opportunities are divested (Q2). Consistent with the option analogy there are two possibilities.

First there is the option to permanently abandon the project ‘during construction’. Considering the uncertain prospects of most start-up companies this is an option that is very common. Since this option has value only after a significant investment is made and resale value has been created, it is sometimes valued analogous to a compound call option on the project with exercise price equal to the costs of investment installments. Striking this compound option excludes the exercising of all or at least most of the sequential options at the same time (Trigeorgis, 1993b). Another way of observing the option to abandon is as an American put option with exercise price equal to the cumulative value of subsequent cost savings (Copeland, 2001). Either way, the option is struck by defaulting on subsequent pre-planned investment cost "installments" if a coming installment outlay exceeds the expected value from continuing the project.

The second possibility to exit the investment process is the least preferable. Namely, when the current value (on the resale market) minus liabilities is not positive, the venture capitalist, and especially the entrepreneur (assumption 6), receive nothing in case of bankruptcy. If in this situation there is absolutely no chance on recovery and significant growth potential, the initial compound option is left expired and losses are taken.

Proceeding with the model, figure 5.2 shows how reasoning with real options can illustrate the available choices during the later stages of the financing process. Arriving at t3, the investor/decision-maker finds himself in a different situation from t2. By now a considerable amount of relevant events are assumed to have unfolded and significant investments have been made. Hence, most projects that are ‘bad’ (Q1, Q2) are filtered out, leaving mainly the ‘good’ projects (Q3, Q4) in the race.

Figure 5.2 Later stage options



As can be read from the expanded decision-tree, the venture capitalist will in the later stages be reluctant towards continuing investing in a project that has little potential to go public. Point t3 is therefore modeled as the decision point at which the investor divests from all projects that do not have high risk potential or the possibility to obtain this status on a short-term horizon. Executing strategies accordingly, those projects that arrive at t4 are either prepared for IPO or sale on the private market. It must be noticed that, while it has been assumed earlier that projects in Q3 at t3 are usually pushed out of the portfolio, the possibility to switch use during these later stages of the investment process remains open as a potential opportunity (Trester, 1998).

The next paragraph discusses this into further detail.

5.3 *Real options in an agency context*

Having touched upon the implications of real option reasoning on the modeling of the investment process, a framework has been created in which the behavioral side of option investment can be investigated. The objective of this paragraph is to discuss the impact of the entrepreneur-investor relationship and the accompanying asymmetric distribution of information on the valuing of potential strategies. In order to do so, the model is used to generate a number of propositions around several relevant themes that have been identified and assumed in the previous. These themes are: learning (information), opportunistic behavior and risk attitude. Staying within the boundaries of this research, there will be a special focus on the principle-agent relation and its effect on option value. As such this paragraph aims to provide an answer to research question 2d of this paper ‘which determinants of the value of real options should be reconsidered in an agency context?’ The relationship and its impact are approached from both the venture capitalist and the entrepreneur’s point of view.

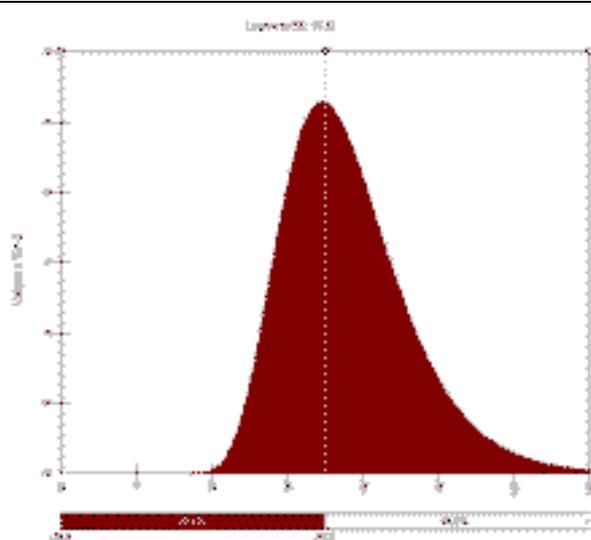
In order to visually clarify implications of information asymmetry and agency problems on real option valuation, some propositions will be graphically portrayed using numerical examples of a fictional high technology called project X using venture capital to accommodate its expected growth. Figure 5.3 briefly introduces this example. It is emphasized that this example is designed to more effectively explain the propositions of this paper, and not (yet) to test their practical relevance. As such the objective is to provide a theoretical ground for future empirical testing.

5.3.1 *Information*

‘The option bundle strengthens the conceptual bridge between strategic action and the value of the firm. The option value component often contributes well over half the firm’s total assets (Bowman & Hurry, 1993).’ While the asset value is not subject to perception, the option component of value is. It is discussed here how a deviation of interest may under the condition of information asymmetry lead to different ‘conceptual bridges’ between value and strategic action. In other words, dependent on the level of interest deviation and (short-term) prospects, the learning or discovering of information about the project quality is a very powerful happening that directly influences decision-making. Given the principal-agent relationship, the entrepreneur is concerned with daily management and operational decision-making, and the venture capitalist (or outside investor), not being part of daily management but having control over postulated capital, has almost exclusive access to deciding over long-term strategies and, maybe even more important, short-term continuance. Against this light the role of information is obvious. The venture capitalist is very much dependent on discrete signals indicating the status of his investment.

Figure 5.3 Project X's lognormal distribution of expected return

Project X is a high technology start-up aiming to use a large amount of venture funding to realize the growth potential that is expected by the entrepreneurial team. As capital is infused into the project, events start to unfold and the relationship of the entrepreneur (agent) and the venture capitalist (principal) is developed. As time progresses, both deliberate strategies and emerging strategies are weighted and valued as they become relevant in the continuously changing context. [In order to prevent from losing sight on the generic thought, the dynamics as they are presented in the following are not accompanied by a detailed case-specific description of background facts. For the purpose of this example, the details of this fictional case are limited to the variables that are essentially needed to graph the probability distributions. To graph the distributions below, use has been made of Palisade's Risk Analysis software, called *Riskview 4.5*. It is stressed that this program does not require data to graph its lognormal distributions. As such, the detailed numerics below have been constructed merely using the mean, standard deviation, exercise price and distribution type. The choice of each of these variables has been based on industry ratio and logic.] The following numerics are used: the initial investment needed is 50; the mean value of the rate of return at t1 is 12%; the volatility (standard deviation) at t1 is 30%; the net present value of X is minus 20, yielding a present value of 30. The entrepreneurial team and the outside-investor operate in the time-frame of figure 4.3 under the condition of the four qualitative states of figure 4.2. Q4 and Q2 are assumed to be the least volatile, carrying a volatility of (at least) 30% respectively 20% (at the most); this is in compliance with the 'managerial flexibility matrix' by Copeland et al. (2000). Q1 is assumed to be more volatile (>50%) since management has access to means that influence outcome volatility level. Q3 is less open to managerial means, since project is intrinsically good; however, outcome is uncertain and emergent strategies are possible (>40%). Outcome levels are obviously more situation-specific. Lastly, valuation is based on the funds supplied, not on the individual project value.



Mean	56
Mode	49,209
Median	53,638
Std. Dev	16,8
Variance	282,24
Skewness	0,927
Kurtosis	4,5659
Left X	-20
Left P	0,00%
Right X	

		50
	Right P	40,54%
	Diff. X	70
	Diff. P	40,54%

As mentioned earlier (chapter 3) the simultaneity of the financing decision and the acquisition of information is very typical. Hence, the venture capitalist's perception of project quality is more subject to discrete learning moments than the entrepreneur's perception. The perception and, more specifically, the adjustment of perception is very much related to the qualitative state of the project as perceived prior to the moment of learning new information. Examining this perceptual bias therefore demands a dynamic approach.

5.3.2 Learning

As assumed, the perception of the project's probability of success of both entrepreneur and venture capitalist is good at the start. After all, if the venture would not be perceived to be in a high upside potential situation during the early stages of the process the entrepreneur would not search for capital and the venture capitalist would not provide it. Awaiting events to unfold during the first stage of the investment process, the book-to-market ratio is considered high as well as the asymmetric distribution of information between inside and outside shareholders. This leads to the expectation that the outside-investor's perception is easily and rapidly adjusted upon receiving information that contradicts earlier prospects. The entrepreneur (or inside shareholder) on the other hand has been receiving information on a more continuous basis as operating manager, and has therefore had more time to adjust (or strengthen) his perception about the venture's probability of success.

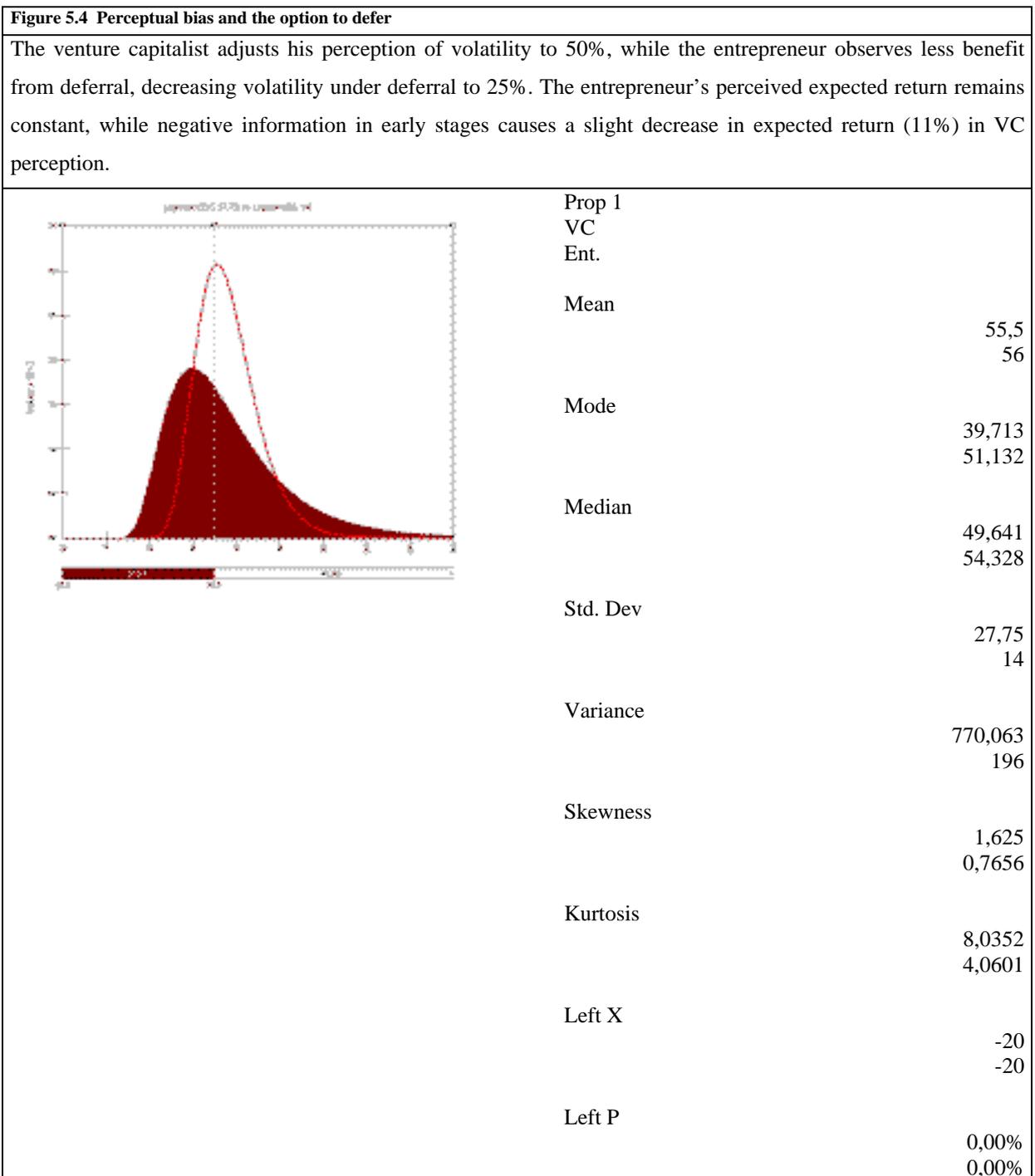
Sit. (1): High information asymmetry, Early Stages, Deferral

Consider the scenario in figure 5.1 where the venture capitalist has just infused his first round of capital into the project and now for the first time receives negative information about the projects internal quality. As a result his perception about the probability of success is quickly adjusted from 'high upside potential' (Q4) towards the 'negatively diffused' region (Q1). In accordance with Bayes' rule and the evolution of posterior belief as in figure 3.4, his perception now lingers around the upper bound of the 0,5 region¹⁹. This implies an important increase in the potential variance of expected returns. However, although still early in the process, the average return expected by the venture capitalist is adjusted to the downside, meaning that deferment of making a follow-up decision gets increasingly attractive to the venture capitalist. The entrepreneur on the other hand, having adjusted his belief in a more continuous mode, feels a lesser urge to await new events. Moreover, the entrepreneur-owner is assumed to have a much clear(er) and more positive vision about the future prospects of his project. This is in compliance with the 'confirmation bias', as proposed by Gunther-McGrath (1999) that

¹⁹ As described in chapter 3, a higher investment level accelerates the rate at which the posterior changes over time. Also, since this is the first discrete point in time at which the VC receives new information, relatively less weight is attached than when information is repetitive.

causes entrepreneurs to systematically reject information that might indicate that their current assumptions are incorrect. The project is *his* project and ‘when making decisions, individuals may see information as less vivid, plausible, visible, or available, whereas they readily accept information with positive connotations (Gunther-McGrath, 1999)’.

Proposition 1: During early stages, the learning of negative information about the project quality is positively related to the value of the option to defer as perceived by the venture capitalist and negatively related to the value of the option to defer as perceived by the entrepreneur.



Right X	50
	50
Right P	50,61%
	36,80%
Diff. X	70
	70
Diff. P	50,61%
	36,80%

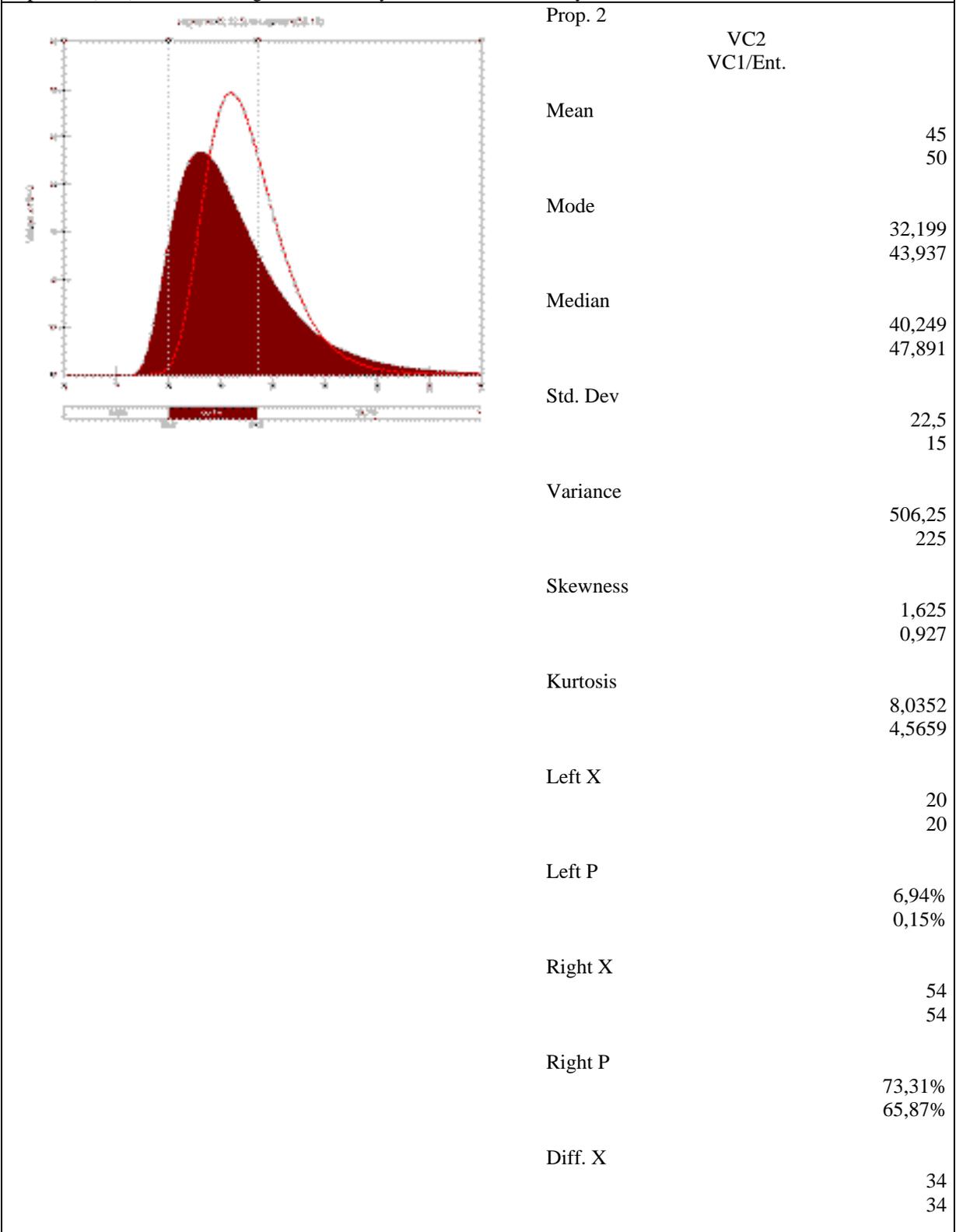
Sit. (2): High information asymmetry, Early Stages, Exit-strategy

Now consider this same scenario except this time with regard to a potential exit strategy. Again negative information about the project quality is received, and the perceived values of potential strategies are adjusted. Looking at figure 5.1, roughly two scenarios are distinguished: 1) the project is abandoned and all assets are sold on the secondary market for salvage value, or 2) the project is abandoned and all options are left expired. Upon receiving negative information about the project and considering an exit-strategy, the venture capitalist and the entrepreneur perceive two very different distributions of expected value. The exit-strategy entails a put option of which the values of its determinants are dispersed. Firstly, the perception of the probability of success is adjusted rapidly (from Q4 towards Q1), significantly increasing the volatility of expected outcome. However, the entrepreneur only starts to benefit from abandonment when the value (on the secondary market) exceeds the venture capitalist's share of salvage value. Kaplan & Strömberg (2000) prove that in early stages the VC holds over 70% of liquidation rights, claiming a share that's *larger* than the venture capitalist original outlay. Furthermore, he holds an average claim of 80,3% of redemption and put provisions. This demands salvage value (exercise value) to be even higher for the entrepreneur to benefit. The unattractiveness of this requirement is reflected by Higashide & Birley (2002) as mentioned in chapter 4, stating that exit-timing is one of the main causes of VC/entrepreneur conflict. Disappointing results decrease (future) salvage value, therewith decreasing the entrepreneur's claim on part of this value. It has been described earlier how some authors see the option to abandon as a call option with exercise price equal to the costs of investment installments. This of course is a more attractive way for the entrepreneur to approach value of an exit-strategy. However, it changes nothing on the outcome. Therefore, based on exit value, the entrepreneur is assumed to not directly benefit from early exiting by the venture capitalist. Figure 5.4 displays this difference in expected value distributions.

Proposition 2: During early stages, the learning of negative information about the project quality is positively related to the perceived value of the option to abandon by the venture capitalist and negatively related to the perceived value of the option to abandon by the entrepreneur.

Figure 5.5 Perceptual bias and the option to abandon

Here the value of the abandonment option of project X is displayed in a lognormal distribution of outcome. The salvage value of the project (after investment) is assumed to be 20. The VC perceives an increased volatility of 50%, with a decreased average return (45); his abandonment option is worth 6,94%. The entrepreneur on the other hand perceives a less volatile environment (only 30%), with an expected outcome level of 50. He however only benefits from abandonment when salvage value exceeds the initial inlay (plus dividend) by the venture capitalist (>50). As such a negative discovery reduces his chances by more than 7%.



Diff. P	66,37%
	65,72%

Sit. (3) High information asymmetry, Early Stages, Continuance-strategy, Window-dressing

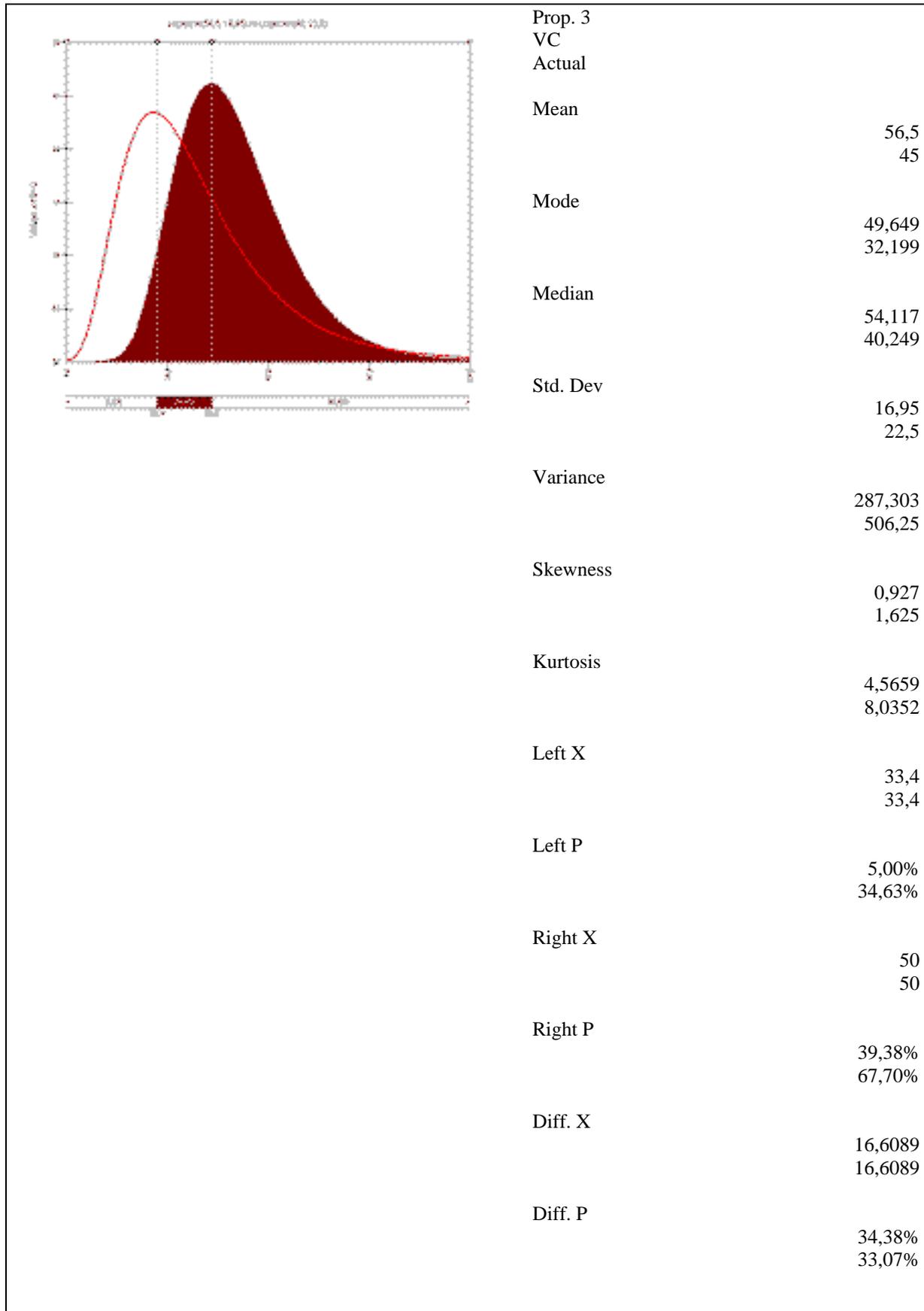
Prior to a discrete learning moment that has a negative impact on the venture capitalist's perception of success, it is the entrepreneur's immediate concern to prevent the investor from overdrawing conclusions and pulling out from the process. The entrepreneur, having access to managerial means to influence venture performance, knows market conditions are favorable (Q4, Q1) and therefore needs time and follow-up capital to grow and improve. Knowing negative impact may deteriorate his chances on receiving the necessary time and follow-up financing, he feels triggered to window-dress short-term results. Having sole access to direct information, blurring true results creates a more favorable picture to outside-investors. Previous research (Meyer, 1997; Cable & Shane, 1997) points out that, entrepreneurs purposely distort original meanings or values of measures for self-serving and unethical manipulative purposes. They intentionally misinform investors and other stakeholders. Besides this very intentional behavior, Gunther-McGrath (1999) proposes another, less intentional element that causes this type of behavior. She argues that a more realistic adjustment of perception is bounded by the entrepreneurial tendency (called 'anti-failure bias') to make information associated with potential failure less vivid, plausible, visible or available and factors associated with success the opposite. In terms of real option determinants, this is explained as follows: in early stages, in a negatively diffused position, the entrepreneur perceives increased volatility, but at the same time experiences a slightly decreased expected value. The exercise price of continuance (expansion) is assumed to remain constant (in this context). The venture capitalist on the other hand perceives a maintained (or more favorable) expected value of outcome and a less increased variance on account of the window-dressing practices by the entrepreneur.

Proposition 3a: During early stages, the entrepreneur's anti-failure bias and resulting window-dressing behavior is positively related to the venture capitalist's perceived value of the option to expand.

Proposition 3b: During early stages, the entrepreneur's anti-failure bias and resulting window-dressing behavior is negatively related to the venture capitalist's perceived value of the option to abandon.

Figure 5.6 Window-dressing and the option to expand

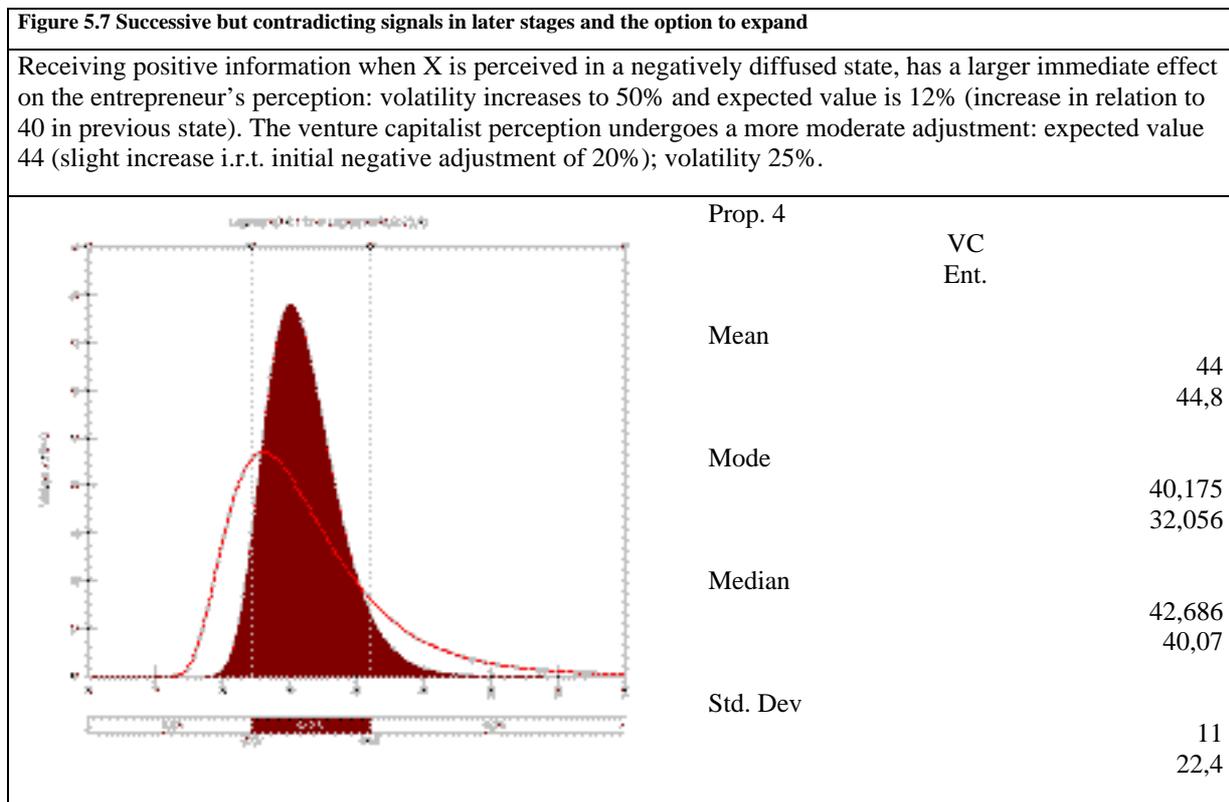
Here the perceived value of continuance is influenced by window-dressing activities by the entrepreneur. While the actual probability (without manipulation) displays relative large weight to a negative NPV (-5), the expected outcome perceived by the VC is significantly higher (13%). Although the actual probability is more volatile (50%) its decreased expected outcome (45) reduces the real option value.



Sit. (4) Learning positive information about the project, Later Stages, Continuance-strategy

When defining the four qualitative states in chapter 4, it has been described that the internal project quality is open to managerial influences. Opposite to receiving negative information, it is of course well possible that management improves (or turns around) an underperforming project. Now consider a venture capitalist who receives successive but contradicting signals about the internal quality of a project that is in the later stages of its investment process. Suppose he previously adjusted his perception about the likelihood of success on account of a negative discovery, and is now faced with a positive signal contradicting earlier information. Where the evolution of posterior belief (chapter 3) suggests a less rapid adjustment pace as investment levels increase (and the process progresses), it is here proposed how the entrepreneur’s posterior belief is more subject to rapid adjustments on account of positive discoveries than the posterior belief of the venture capitalist. The same anti-failure bias, that caused the entrepreneur to distort results in situation 3, now affects his posterior belief after a positive discovery. The opposite can be said for the venture capitalist. While, in essence, the investor and entrepreneur are both benefited by a positive turn of events, the venture capitalist is generally assumed to be less rapidly convinced, especially when learning contradicting information. This results in two different perceived probabilities of expected outcome. The entrepreneur, who manages improvement and (therewith) creates opportunity, is likely to overestimate his success and the firm’s option-value. Earlier research (Gimeno et al., 1997) even proposed a correlation between the overestimation of success and lower performance. This is interpreted as that those who are intrinsically motivated are willing to accept lower performance (Gunther-McGrath, 1999).

Proposition 4: The value of the option to expand after receiving successive but contradicting information is perceived higher by the entrepreneur than by the venture capitalist.



Variance	121 501,76
Skewness	0,7656 1,625
Kurtosis	4,0601 8,0352
Left X	28,5 28,5
Left P	5,00% 23,47%
Right X	64 64
Right P	95,00% 83,92%
Diff. X	35,5286 35,5286
Diff. P	90,00% 60,45%

5.3.3 Risk attitude: deferral versus continuance

Sit (5): Learning negative information about the market, Difference in risk attitude, Deferral

So far there has been a focus on the perceptual adjustment after receiving new information about the project quality. Following next, is an exploration of the effect of learning new information about the qualitative state of the market. As assumed in chapter 4, the market quality can openly be observed, and is as such not subject to managerial influences and perceptual bias. In this specific situation (sit. 5) the project quality is considered good, but market conditions are unfavorable: a positively diffused situation (Q3). It is argued here how risk attitude plays an important role in deciding over the best strategy.

The idea behind the staged investment structure is to create the opportunity to wait for events and market demand to develop. So for the venture capitalist the obvious choice of strategy would be to wait for market conditions to improve. The venture capitalist's attitude towards risk in essence is to avoid uncalculated risk and to protect their risk-taking with high discount rates. Thus, if expected return decreases, they tend to defer investment until uncertainty about market developments subsides and the expiration signal arrives.

The entrepreneur on the other hand is driven by a more intrinsic motivation, causing him to attach different weight to, for example, time to expiration and risk. Although the entrepreneur perceives the same qualitative state of the market, his anti-failure bias encourages him to focus increasingly on the opportunity signal of expansion. Whereas the venture capitalist waits for the expiration signal of his deferral strategy to arrive, the entrepreneur is focused on a less risk-averse strategy, namely to proceed with investment in order to preempt investors and effectively position in expectance of high growth. This type of behavior is encouraged by his tendency to overestimate upside potential and undervalue downside risk, as described earlier. Moreover, a threat that is often overlooked by the entrepreneurial team is that emerging markets attract many new entrants that make the exact same evaluation, causing yet another increase in the probability of failure for any given entrant (Gunther-McGrath, 1999).

Thus, the discovery of negative information about the market is negatively related to the expected value of the project. However, this decrease is subject to perception. Furthermore, the volatility that is associated with an increase in uncertainty is valued differently by the two stakeholders. In other words, the venture capitalist considers the opportunity signal with regard to a put strategy (opportunity because VC has longer breath, deferring is beneficial when being risk-averse), while the entrepreneur considers the expiration signal with regard to expansion and a call strategy (expiration signal because of the entrepreneur's increased risk-preference; deferred installment will deteriorate opportunities and probability of success). Whereas the venture capitalist experiences an increased downside risk potential, the entrepreneur attaches less weight to this downside and highlights the importance of upside potential.

Proposition 5: During early stages, the learning of negative information about the market is positively related to the value of the option to defer as perceived by the venture capitalist and negatively related to the value of the option to defer as perceived by the entrepreneur.

Sit (6): Negative information about market, Later Stages, Switch

Consider the same situation as in 5. During the early stage it is discovered that the project is intrinsically good but demand is disappointing on account of conjuncture. Besides deferring or expanding by infusing follow-up capital, management has access to the flexibility option to switch use of assets. Dependent on the situation, there are behavioral aspects that affect the probability of success of such a switch in strategy. Should a different product-market combination be possible or should the assets be suitable for alternative employment, the effective execution of an emergent strategy is subject to the level of entrepreneurial commitment. Table 4.1 shows that one of the main causes behind affective goal conflicts between venture capitalist and the entrepreneurial team is disagreement about long-term strategy and methods. This is underlined by Kaplan & Strömberg (2000) who point out that, especially when performance is not met, the vast majority of voting rights are in hands of the venture capitalist. This easily provides the opportunity to push through a strategic decision such as switching use. Reason behind the conflict is that the entrepreneur is initiator and owner of the original idea: he started out with a very deliberate strategy, which so far has proven to be good (Q3), and as such might be hesitant to rebuild his entire business model. In terms of determinants, low commitment of the executive board ultimately has a negative effect on the exercise value of the assets in its best alternative use. The likelihood of success of an

emergent strategy is for obvious reasons positively related to the effort put into managing the switch and the potential that is as such created.

Proposition 6: During early stages, the value of the option to switch is positively related to the willingness of the entrepreneur to support this emergent strategy switch.

5.3.4 *Opportunistic behaviour*

Sit. (7, 8, 9): Learning negative information about the project, Later Stages, Moral Hazard

T3 in figure 5.2 is the second discrete point in time information is received. Having arrived in the later stages of the investment process it is extremely relevant from which perceived qualitative state the project has progressed. In terms of sign, if the option struck at t2 was a put (e.g. switch) and during t3 another negative signal about project or market quality is received, the value is much lower than when, for example, two successive calls (e.g. defer & expansion) are struck. This is translated into the value of posterior belief: adjustment of perception from 1 to $\frac{1}{2}$ has far less weight attached, than the strengthening of a certain perception by receiving two identical successive signals, either close to 1 or close to 0. Receiving negative information about the project quality, previously perceived in a diffused state (Q1 or Q3), therefore leads the venture capitalist's posterior belief to be rapidly adjusted towards the 0 boundary. Against this light it is unlikely that expected value is below a level above which the entrepreneur receives part of salvage value (according to Kaplan & Strömberg (2000), chances of VC claiming more than his initial investments are increased with over 7 percent), leaving little motivation for the entrepreneur to pursue maximization of stock value. Furthermore, since the project has progressed into later stages, chances are that use has been made of debt as financing type, providing the issuer with the right to foreclose and the entrepreneur with another incentive to behave opportunistically (Trester, 1998). Possible follow-up actions should be observed in this perspective.

Looking at the later stage options of figure 5.2, roughly three²⁰ scenarios with a high probability of agency conflict are distinguished:

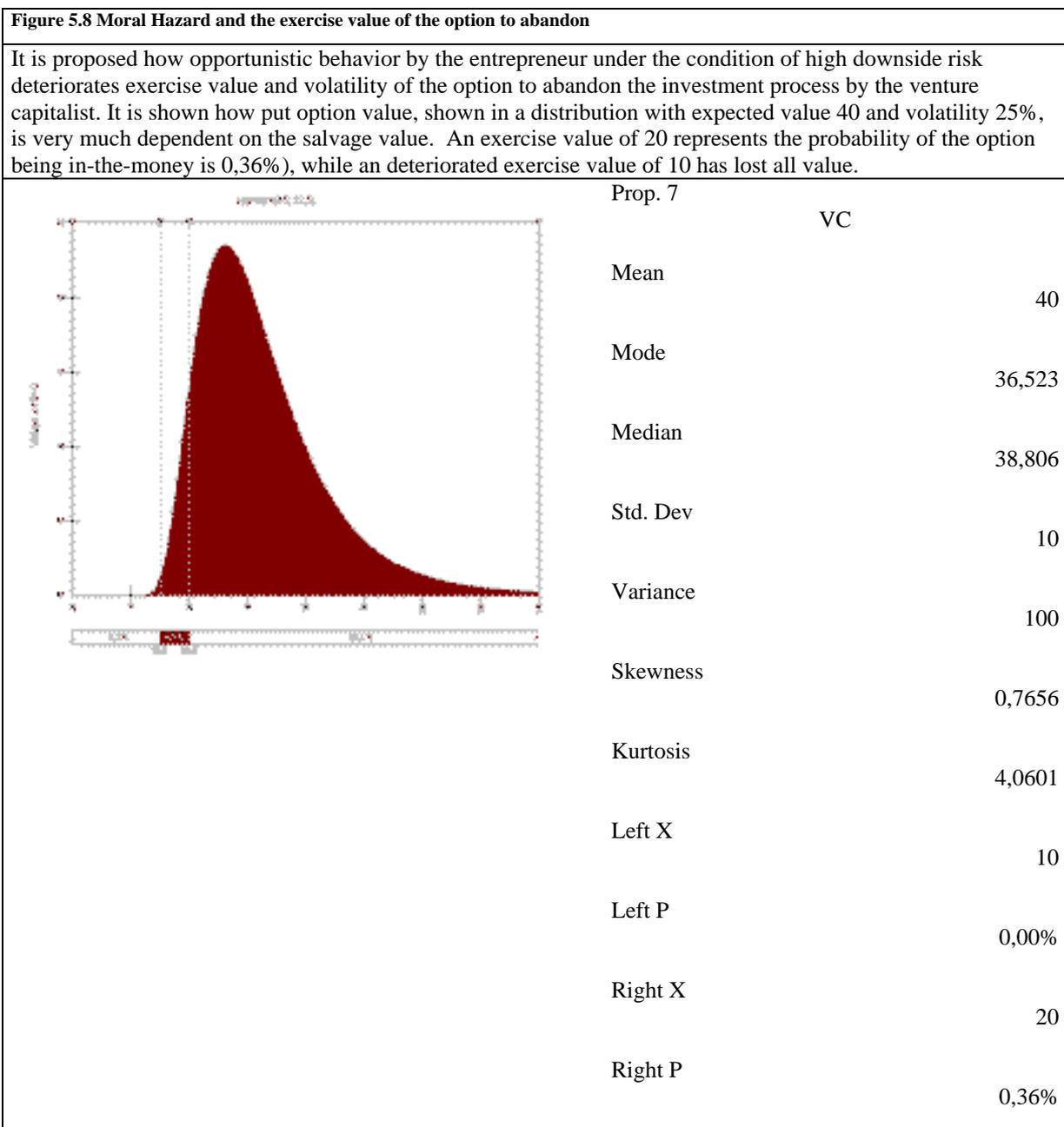
- 7) Q4 \rightarrow Q1, Q3 (expand at t2) \rightarrow Q1, Q2, Q3 (exit)
- 8) Q4 \rightarrow Q3 (expand at t2) \rightarrow Q3 (continue: switch)
- 9) Q4 \rightarrow Q4, Q3 (switch at t2) \rightarrow Q1, Q3 (continue: expand)

In each of these scenarios, the continuance of the project is at risk. Having evolved into later stages, the success of the venture is still not secured. At this point, a point where significant investments have been made, the venture capitalist's ongoing objective is to make a clear distinction between projects that have the potential to go public and those that haven't; the latter are divested. As set out, in a situation where repetitive and negative signals are received, the agent feels a strong incentive to behave opportunistically. In case of abandonment he

²⁰ The remaining scenarios (Q4 \rightarrow ... \rightarrow Q2 (abandon) or Q4 (expand)) are less relevant in this context, since it is assumed that projects at the extreme ends of the probability scale (close to 0 or 1) have obvious outcomes and are less subject to perceptual bias. Depending on the probability these projects are assumed to be unambiguously exited or continued.

receives little or nothing, and even more, debt-providers hold the right to foreclose him. With this in mind the entrepreneur is triggered to extract resources from the firm, deteriorating its value on the second-hand market. Also, once the entrepreneurial team has lost confidence in a positive turn of events and as a result loses commitment, upside risk is significantly reduces. This causes the deferring of decision-making by the venture capitalist to be increasingly less attractive: the longer he waits; the less worth is his investment. This means that, during later stages, downside risk is negatively related to exercise price and therewith value of the option to abandon the project. Call options are practically worthless, while put options still being valuable lose value as abandonment is postponed.

Proposition 7: The size of the moral hazard problem is negatively related to the value of the option to abandon.



Diff. X	10
Diff. P	0,36%

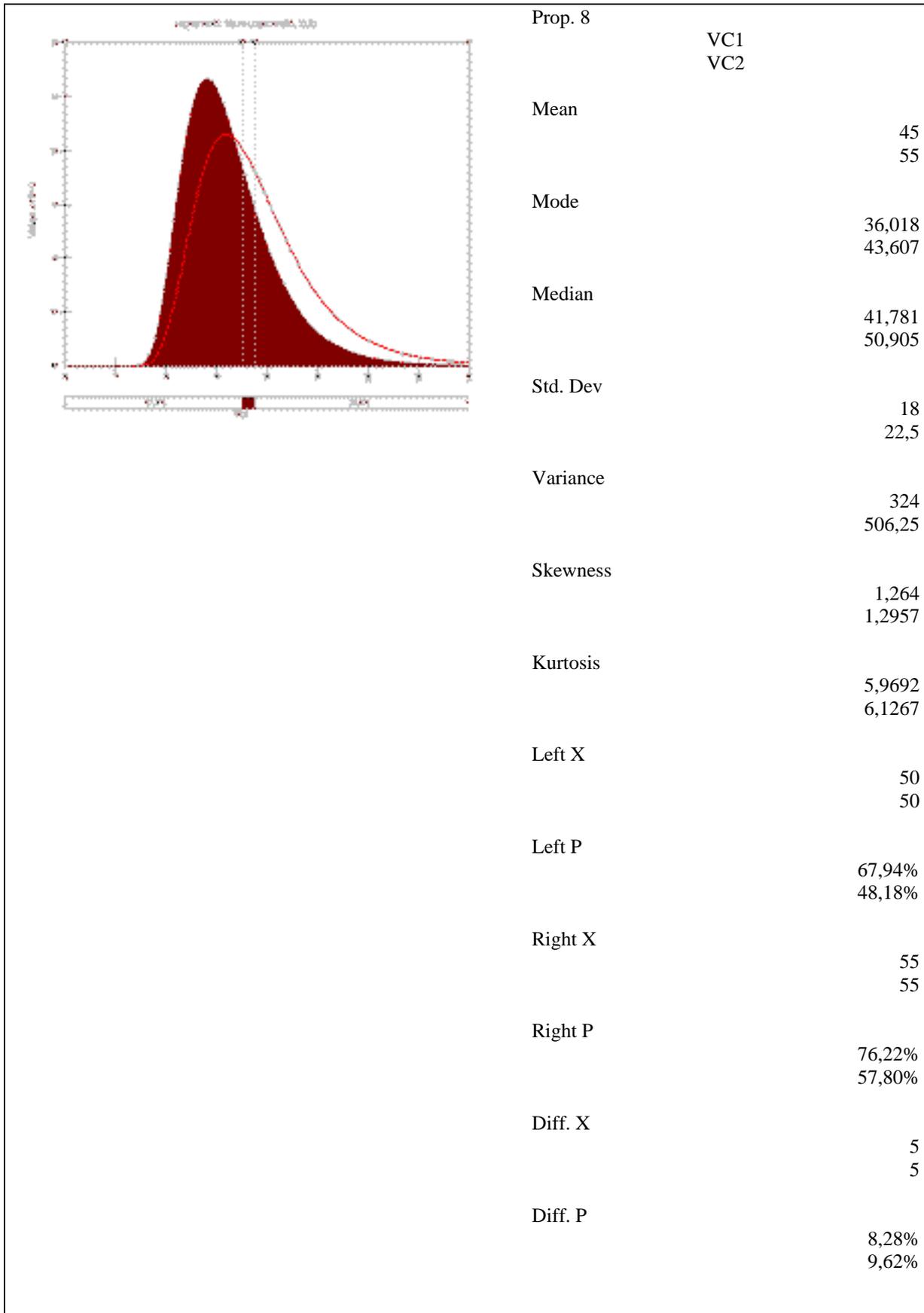
However, referring to proposition 6, during later stages the option to switch use is held open. Although in principle projects with doubtful returns during the later stages of the investment process are exited, the venture capitalist has infused a considerable large amount of capital into the project that he risks losing in case of abandonment. Partly dependent on the level of asset specificity and asset tangibility, a significant part of the infused capital has ‘sunk’ into the firm: abandoning would mean losing it, implying the entrepreneur now holds a different kind of power. Knowing that the venture capitalist won’t pull out as easily as during early stages, he (the entrepreneur) now operates in an environment in which there’s expanded bandwidth for negotiation. In other words, the agent has increased power to push through personally beneficial strategies. In fact, it has been argued by others (Trester, 1998) that in such states and under the threat of foreclosure, the venture capitalist would prefer to make another investment than receive nothing, and the entrepreneur would rather continue with the project than extract resources for personal consumption.

Looking at scenario 2, a project that has been re-financed at t2, and now lingers at Q3 at t3, the goals of entrepreneur and venture capitalist diverge. While all projects in Q3 would normally be abandoned by the venture capitalist, the entrepreneur, who realizes the hold-up problem faced by the investor, may exert his power and promote the potential option value under the condition of an emergent strategy-switch or follow-up investment.

Proposition 8: Ex-post opportunistic behavior by the entrepreneur (hold-up) is positively related to the venture capitalist’s perceived value of the option to switch use and the option to expand.

Figure 5.9 Hold-up and the value of continuance

In later stages, when significant costs have sunk into project X, the entrepreneur holds increased bargaining power. While in a positively diffused state the average volatility is 40%, it is argued how hold-up positively influences the venture capitalist’s decision to continue his investment. The entrepreneur’s incentive to properly manage is increased, potentially causing an increase in volatility. In this light, the expected outcome is increased by 22%, perceiving a positive NPV.



5.4 CONCLUSION

In this chapter an attempt has been made to analyze how a deviation of interest and goal diversion may cause a difference in ‘conceptual bridges’ as perceived by the entrepreneur, who acts as agent, and the venture capitalist, who is the principal. Using assumptions and theoretical elements from previous chapters, strategic issues such as the continuance, exiting or deferment of follow-up investment have been related to the dynamics of a staged investment structure. It has been described how real option reasoning relates to the strategic alternatives at the outset but also during the investment process. Dependent on various contextual variables as well as the qualitative states from which the project progresses, each strategic option is valued at very discrete points in time. Here the interaction among options plays an important role. Projecting the assumptions from chapter 4 and the evolution of available options on the time-frame, a number of abstract scenarios have been sketched and portrayed in a decision-tree. Following, this renewed framework has been used to derive various combinations of variables that provide the conditions for potential agency conflicts. Accordingly, in paragraph 5.3 the impact of the entrepreneur-investor relationship and the accompanying asymmetric distribution of information on the valuing of potential strategies has been discussed. Several propositions, organized around three themes (learning, opportunistic behavior and risk attitude), suggest probable relations between real options in a specific context and the variables of the principal-agent relationship. A fictional example is used to illustrate various propositions.

It is proposed that an asymmetric distribution of information and a potential goal diversion cause significant differences in the perceived conceptual bridges between strategic action and firm value. Hence, the discovery of negative information about the project or the reception of successive but contradicting signals has direct effect on the posterior belief of the outside-investor in the probability of success. Realizing that posterior belief is rapidly adjusted when uncertainty is high, the discrete learning moments of a staged investment structure causes the venture capitalist to attach disproportional weight to negative signals about the project quality. The entrepreneur on the other hand performs the opposite behavior. Providing that the entrepreneur is subject to the so-called confirmation bias, it is suggested he perceives a lower value of deferral and exit strategies. This however being a fairly basic observation, it is proposed in addition how the unequal distribution of liquidation rights and put provisions negatively affects the option value of abandonment *for the entrepreneur*. Furthermore, since early abandonment by the venture capitalist possibly means the instant liquidation of potential growth and complete deterioration of salvage value that the entrepreneur might otherwise receive, the entrepreneur is under these conditions triggered to use the information asymmetry to his advantage. It is proposed how the intentional distortion of results positively affects the expected outcome and decreases the uncertainty level as perceived by the venture capitalist. Another factor that affects the perceptual bias is the changing risk attitude of stakeholders. The venture capitalist, essentially being risk-averse, protects his (calculated) risk by demanding high discount rates. However, should return be disappointing, deferring decision-making is often the attractive low-risk strategy to follow. The entrepreneur on the other hand only benefits if project value exceeds a certain limit, causing it to be increasingly attractive to pursue high variance strategies: expansion and possibly even emergent strategy switches can be used to increase option value. It is argued how the venture capitalist’s risk averse attitude causes him to increasingly focus on the expiration signal of deferral, while the risk preference by the entrepreneur signals opportunity with regard to potential option value. In addition, it has been described how many factors influence the managerial behavior of the entrepreneur. If option value is perceived low and a lack

of flexibility limits the current managerial means to accommodate growth, opportunistic behavior is likely to occur. Considering that, if the NPV is extremely negative, no amount of optionality can possibly rescue the project, the agent is increasingly motivated to pursue personally beneficial activities, such extracting resources for personal consumption or intentional risk-taking with very low probabilities of success. As such, it is proposed in this paper how moral hazard and hold-up problems have a direct effect on the value of exit and continuance options. Perception and actual value are reconsidered in this context.

6 TOWARDS A NEW MODEL

6.1 INTRODUCTION

Having analyzed how real options can be related to the division of ownership in venture capital-backed firms, the key challenge is now to develop a synthesizing and practical method to systematically integrate the suggested causalities into future decision-making processes. Paragraph 6.2 will discuss the implications of the findings and assumptions of the previous chapters on real option reasoning. It will be suggested which variables should be seen as determinants of option value and how this affects the paradigm. In paragraph 6.3 a model will be constructed with which the probability of success can be better estimated while acknowledging the complex interdependency of variables. The objective of this model is to prevent from disregarding the potential misuse of managerial discretion into a more systematic assessment of corporate flexibility. Following, paragraph 6.4 will be used to describe and suggest the integration of this new insight into a systematic and synthesizing approach towards valuing potential strategies. As such, a four stage program, the Corporate Recovery Program, will be developed to quickly and systematically assess the probability of success of a portfolio company while incorporating both real options and agency perspectives.

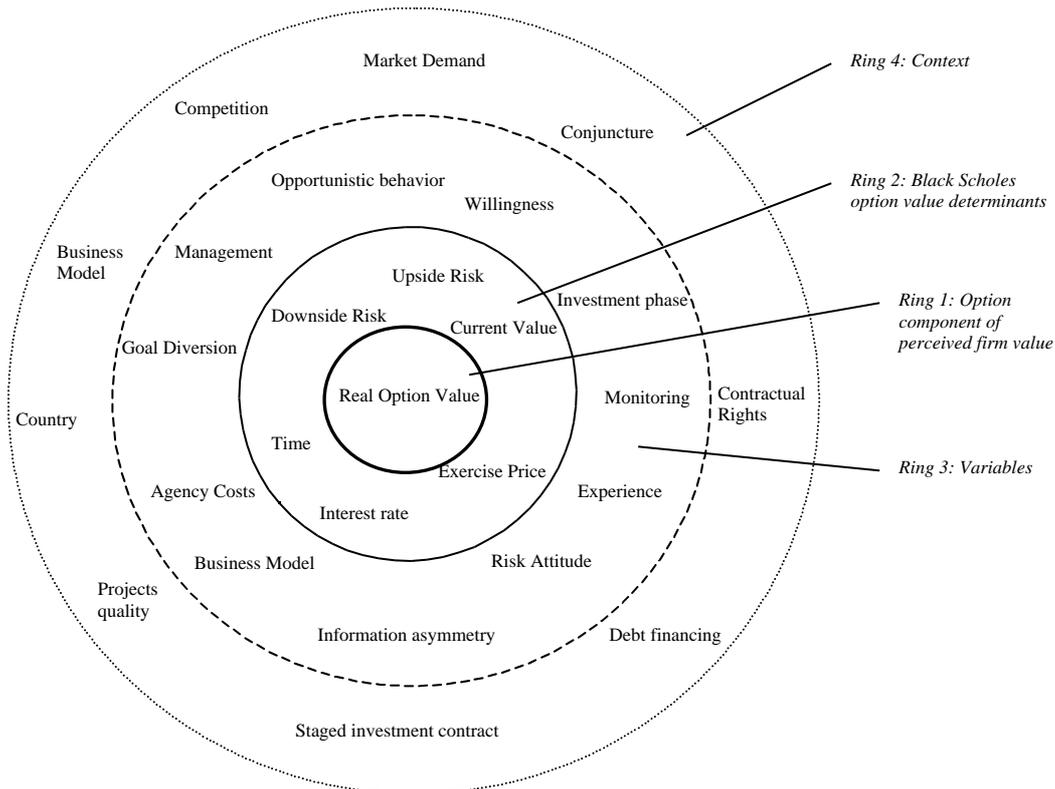
6.2 EXPANDING THE PARADIGM

This paper started out by explaining the real option paradigm as derived from financial option theory. Black & Scholes (see paragraph 2.3.2) effectively constructed a formula with which the value of a financial option can be derived from the five specific variables, represented by the second ring in figure 6.1. While in financial option theory these determinants apart from variance can be unambiguously determined, the assumptions underlying the Black Scholes formula (described in paragraph 2.3.2.1) should be reconsidered in a real option perspective. For example, while BS assumes a European option and continuous stock price evolution, real options are generally American and the staged investment structure is inherent to stock price jumps. Furthermore, aspects such as dividend and changing interest rates are important variables affecting real option value that are neglected or assumed not-present in financial option theory. Besides these flexibilities in the underlying assumptions a more structural difference in both approaches has been discussed in chapter 2. It has been mentioned that in the real option case, the financial market valuation of the postponed project is determined by a project equivalent in the financial market with exactly the same risk characteristics. Of course, the existence of such a commodity is questionable (Smit, 1996). A second distinction between options in financial markets and options in real markets concerns the implication of future opportunities into the current value characteristics of a project. In this approach, where a compound option implies an option on an option, a strategic investment is viewed as the first link in a sequence of investment opportunities that develop over a period of time. Another difference between the two option markets is the degree of exclusivity of the latter. A standard call option on common stock is 'proprietary', in that it gives the owner an exclusive right when to exercise the option. In this respect, the value of a real option very often depends on the ability of the management to actually appropriate the benefits of the option.

Figure 6.1 shows how the determinants are related to real option value and how these are to be seen in a wider context. Contextual variables such as conjuncture, country, contract type and competition have of course a direct effect on factors such as expected growth, current value, risk and interest rate. However, this paper is devoted to exploring a different set of variables: aspects derived from the division of ownership that affect real option value.

Ring 3 in the figure below shows how by means of an extra layer a number of variables have been added to the paradigm. The figure is constructed in a way to demonstrate how contextual variables (ring 4) influence the (added) variables (ring 3), that on their turn affect the basic determinants of option value. While information on risk aversion and expected return on stock seems redundant since it is understood to be reflected by the stock price, which in financial markets can be known exact, in this paper it is argued that, in the real option market, not only variance, but also other parameters from the model are in fact subject to estimation and ambiguity.

Figure 6.1 Expanding the paradigm



6.3 CONSTRUCTING THE MODEL

The following model is designed along two dimensions. The first dimension is time: the progression of the investment process through the various stages. Acknowledging that the number and duration of investment stages differ per project, the contrast between early and later stages in the investment process is stressed. For this purpose, the classification of investment rounds used for the model is one that is often used in the literature (e.g. Gompers, 1995; Trester, 1998). Seed, startup, early and first stage financing will be characterized as *early* stage, while expansion, second, third, and bridge financing will be characterized as *later* stage. However, since the use of this discrete classification risks oversimplifying the complex issue of a dynamic agency context, attention must go out to the non-linearity that characterizes the way in which financing decisions are made. While the discrete classification is used to bring out the contrast between early and later stage financing, this approach is flexed in a context of logical progression. Hence time, denoted as t , is indiscrete (continuous) and measured from the moment of initial investment to the moment of exiting the venture (by sale, abandonment or IPO). In practice, this means that decisions can be made during each of both phases.

The second dimension is the posterior belief in the success of the project. Assuming that the actual probability of success, denoted by p_t where $p_t \in [0,1]$, can not be known, it is the *perception* of the actual probability that plays a role in the decision-making process. Bergemann and Hege (1998), see figure 3.4, described this perception of the probability of success as the posterior belief in success, denoted by \hat{p}_t . They define posterior belief, conditional on *no* success, as a function of the initial belief \hat{p}_0 . In this paper, there will be no particular emphasis on the condition of no success, as expressed in formula (3.1). The perceived probability is considered a function of many internal and external variables, where $\hat{p}_t \in [0,1]$. In compliance with figure 4.2 (posterior belief in a dynamic context), the project is believed to be 'good' if the posterior belief approaches 1 and 'bad' when it approaches 0. Correspondingly, a perceived probability above $\frac{1}{2}$, $\hat{p}_t \in (\frac{1}{2}, 1]$, is characterized as an upside potential situation, whereas a perceived probability below $\frac{1}{2}$, $\hat{p}_t \in [0, \frac{1}{2})$ is characterized as a downside potential situation. A posterior belief close to $\frac{1}{2}$ implicates uncertainty about future growth opportunities, similar to the 'positive and/or negative diffused situation' of figure 4.2. As can be read from figure 6.2, this dimension is deepened by emphasizing that the perceived probability of success is closely related to the value of specific strategic options. As such, a probability that approaches 1 is related to potential expansion strategy, whereas the 0 probability of success implies a strong preference for abandonment. Whereas uncertainty is the highest, around $\frac{1}{2}$, deferral is in this model assumed most appropriate.

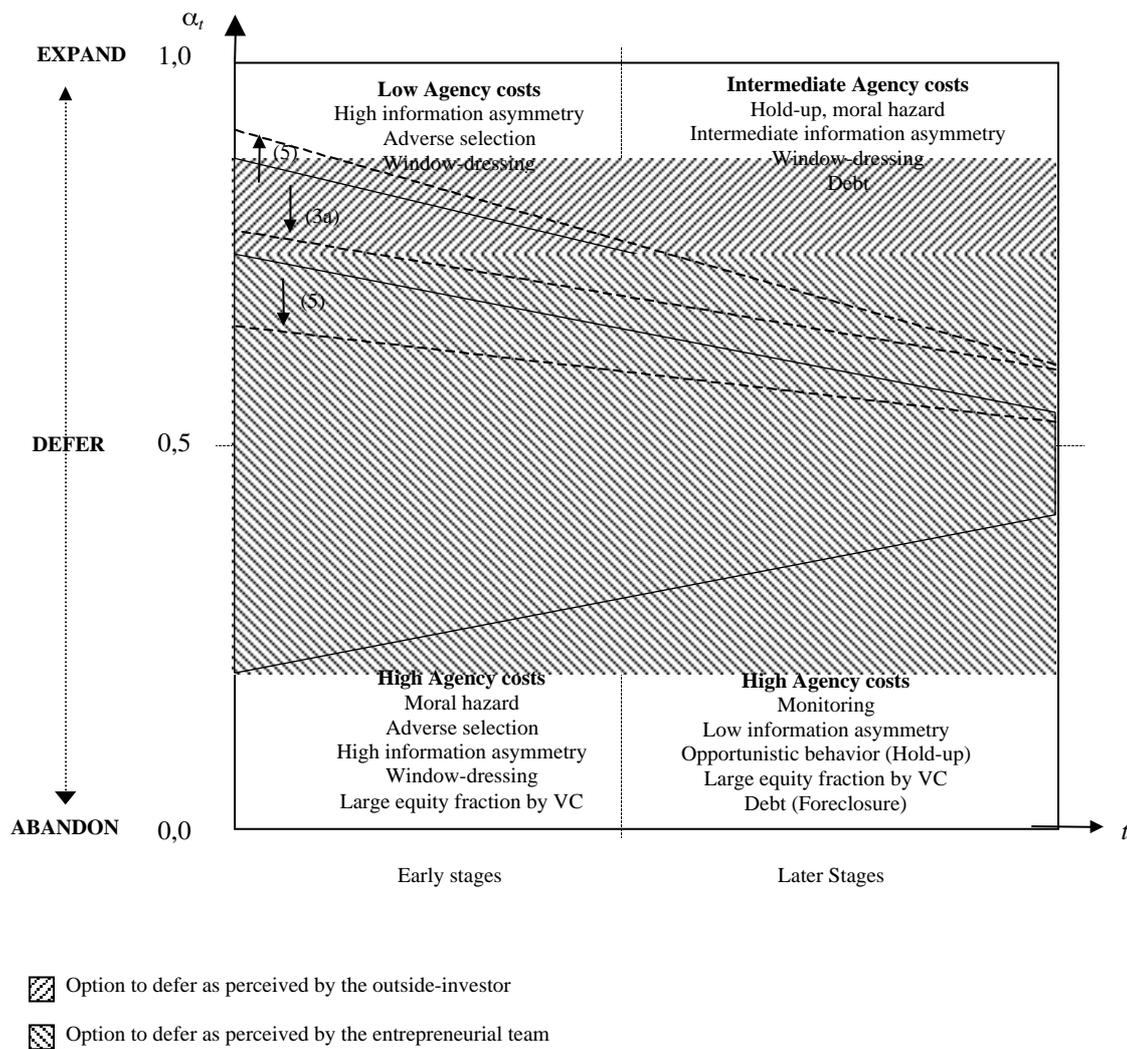
When looking at figure 6.2 each of the two dimensions t and \hat{p}_t represents a continuum while together they distinguish four quadrants. Each quadrant denotes different values of time and perceived probability, creating the opportunity to project potential strategies (or real options) and the evolution of posterior belief on the matrix. This provides decision-makers with the ability to use the model to visualize the agency context in which they are forced to operate under certain strategies.

Quadrant 1, not to be confused with Q1 in figure 4.1, represents the later stages of the investment process in which upside potential is most prominent. The posterior belief in the success of the project is larger than 0.5 while of course perceptions close to 1 weigh the heaviest. Since in this quadrant projected outcome is reasonable or good, there are relatively little or intermediate monitoring practices, leaving room for information asymmetry and thus the potential for opportunistic behavior. Window-dressing practices by the entrepreneur are expected when results are (partially) disappointing, given the good conditions. Especially when aiming for an initial public offering, window-dressing often occurs. In addition, and in compliance with proposition 8, sunken capital might cause the venture capitalist to face the hold-up problem. Under the condition of increased uncertainty (e.g. $\hat{p}_t \in (0,6-0,7)$) the entrepreneur could still benefit by renegotiating more appropriate terms given the higher risks (i.e. offering a greater share of equity or a higher interest rate).

In contrast, quadrant 2 represents the later stage scenario under the condition of high downside risk. Providing that follow-up capital has been infused, and the hold-up problem has arisen, agency costs related to monitoring practices increase on account of disappointing projections. In accordance with figure 5.2 (decision tree) most 'bad' projects have already been abandoned and those that remain face to be rapidly exited. Although the staged investment structure provides for renegotiating contract terms such as interest rate and equity-shares and prices,

this is of course only viable if the entrepreneur still believes it is worthwhile to pursue. Should continuance look only beneficial under the condition of switching strategy, the success under management of the entrepreneur is closely related to his willingness to back such an emergent strategy. Furthermore, leveraging with debt is a much used instrument in later stages to increase financial flexibility. Since this creates the opportunity for venture capitalists to default on debt payments deriving from limited liability, venture capitalist value is increased and an incentive is created for the entrepreneur to try to behave opportunistically. Hence, a disbelief in a potential upturn by the entrepreneur causes the threat of deteriorating salvage value.

Figure 6.2 Principal-agent relations in ex-ante investment decision-making



Following, quadrant 3 represents the situation during the early stages of the financing process, when downside potential is high. Having started out while perceptions of expected outcome were favorable (see figure 4.2, both internal and external quality are assumed 'good'), placement in quadrant 3 of figure 6.2 implies a rapid negative adjustment of posterior belief, possibly on account of the adverse selection problem. Since the amount of infused capital is still fairly small during these early stages, there are little monitoring activities and information asymmetry is high. As discussed, these are fruitful conditions for a moral hazard problem. Although during these stages no debt is used, the venture capitalist generally holds a large share of preferred equity in the project,

meaning that in case of abandonment he has first rights to salvage value. The type of behavior performed by the entrepreneur all depends on his belief in the success and prospects of the venture. Propositions 1 and 2 stating that the entrepreneur's perception of the probability of success during early stages is generally higher than the venture capitalist's, window-dressing behavior and the pursuit of high risk strategies is likely to occur. As a result agency costs are generally very high.

Quadrant 4 represents the situations during the early stages under high upside risk. Like in quadrant 3, the venture capitalist holds rights to a large share of equity in the project. There is no debt and information asymmetry is high. Since in early stages uncertainty is high, the adverse selection problem might still be present. Although there are generally little incentives for the entrepreneur to extract resources for personal consumption, or pursue relatively high risk strategies, window-dressing and moral hazard problems might potentially occur depending on interim results and the accompanying perception of the entrepreneur. For example, high expected returns might incentivize the entrepreneur to consume more luxuriously.

Besides the four quadrants, another interesting characteristic of figure 6.2 are the shaded 'triangular'-shaped areas. Each area displays a set of combinations of investment phase and perceived probability of success in which deferral is seen as the preferred strategy. Clearly, the area with the upward diagonal represents the venture capitalist's perception and the area with the downward diagonal represents the entrepreneur's perception. When taking a close look at the figure, several things can be read from the shape of both areas.

First of all the triangular shape points out that as the investment process progresses deferring decision-making gets decreasingly attractive. Logically, since during early stages uncertainty is high and experience is little, much can be learned from a wait-and-see strategy. As information is received and the amount of capital infused increases (remember: 'the simultaneity of the financing decision and the acquisition of new information about the investment project is characteristic for ventures and more generally for the financing of innovation' (Bergemann, D., Hege, U., 1998)), strategic choices must be made and actions must be taken. When upside potential is high, growth is accommodated by additional capital; when downside risk is high, further deferral might be detrimental to the project value, motivating the venture capitalist to abandon his investment.

A second aspect is the overlap, and more importantly, the gap in perceived option value between the entrepreneur and the venture capitalist. The figure shows that, at the outset, the entrepreneur attaches less value to the option to defer in the up-state while in the down-state he prefers deferring over abandoning. The outside-investor on the other hand, attaches great value to deferral during early stages, but prefers abandoning over deferral when it becomes clear that downside potential is high and the project is 'bad'. This is in accordance with propositions 1, 2 and 5. Further, the entrepreneur tends to be more decisive than the outside-investor when uncertainty is high during later stages, than when downside risk is high during later stages. This is in accordance with proposition 4 and explains the shape of the deferral-areas in the later phase. Whereas the venture capitalist accepts very little uncertainty during the later stages and prefers abandoning over re-investing, the entrepreneur is expected to prefer deferral and continuance over abandonment, even when prospects are unfavorable or greatly uncertain.

A third characteristic that can be read from the figure are the dotted lines, denoting a possible expansion or contraction of the deferral-areas. These dotted lines represent the way perception is adjusted when additional information is received. It is emphasized that this is an essential feature of the model: perception, hence value, is dynamic and subject to specific situational characteristics. The upper dotted line shows a broadening of the venture capitalist's perceived value of a deferral strategy, while the third dotted line (from above) shows a decrease in value of this strategy as perceived by the entrepreneur. These dotted lines represent the effect of proposition 5. Proposition 1 has a similar effect while proposition 2 has the opposite effect. The second dotted line (from above) shows the adjustment as formulated in proposition 3a.

It should be noted that the proposed relation of 3b is not represented by a literal expansion of the deferral area. Since window-dressing causes the project value to be perceived as higher, this does not necessarily have a direct effect on the value of deferral in a downside potential situation. Furthermore, it is mentioned that these areas are subject to situational characteristics and personal attitudes. It is nevertheless expected that these areas give a fair display of the effects of perceptual bias.

6.3.1 *Projecting a portfolio company*

Having described the basic elements of the model and relating these to the propositions of chapter 5, it must still be explained how this model can be used and how this model contributes towards a better understanding of the interaction between the agency conflict and real option reasoning.

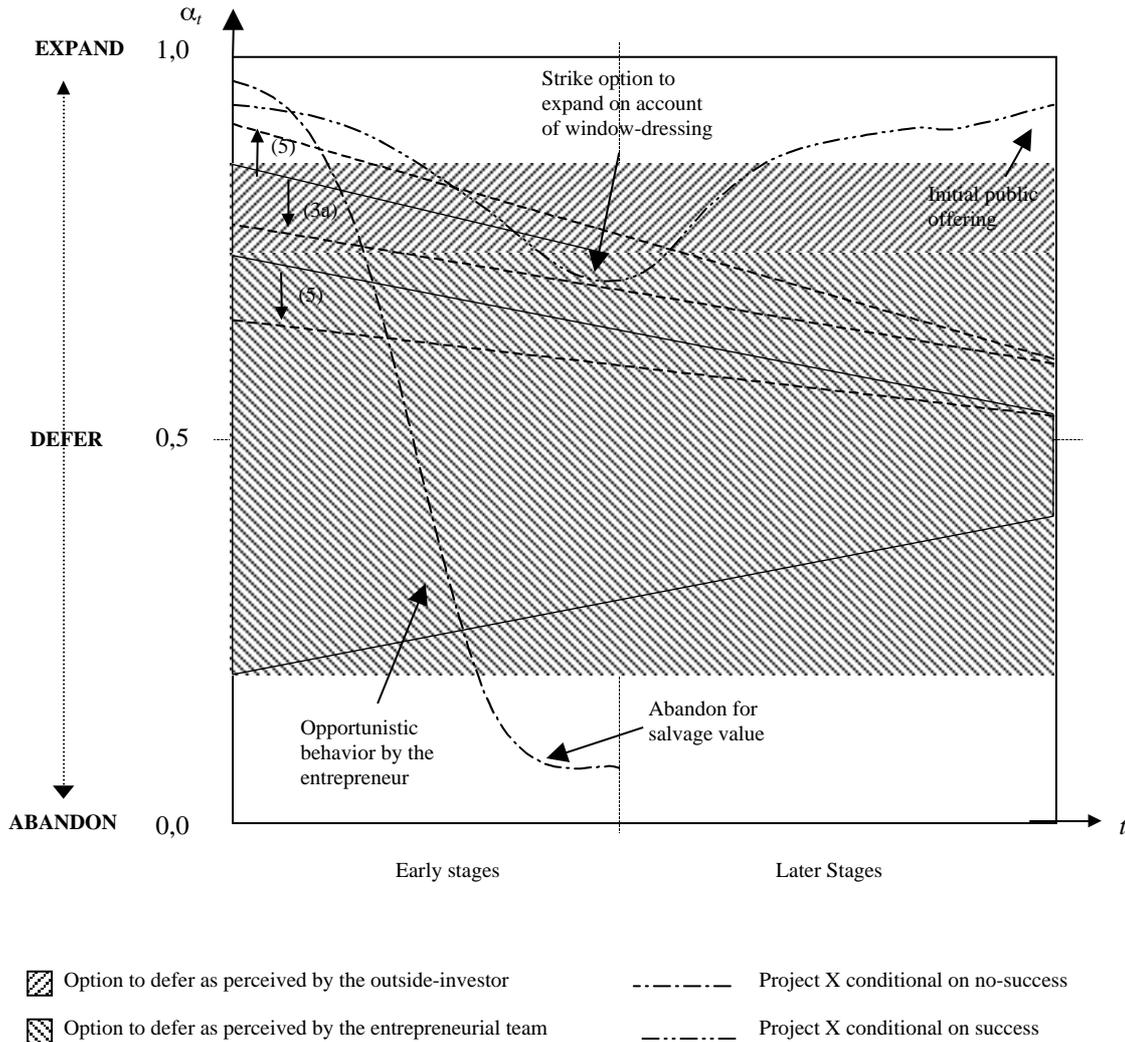
One of the main purposes of this model is to be able to project one's perceived probability of success of a portfolio company on the agency matrix. By doing so repeatedly, every time after events unfold and information is received, the evolution of posterior belief is graphed against various 'strategic areas' that require special attention. Following, the advantages of this model are:

- Insight is created into the evolution of posterior belief. This is very important since it has been stated that the interaction between subsequent options greatly affects their value and therewith future decision-making.
- Derived from the insight into the evolution of posterior belief, one other advantage is to be able to better foresee potential conflict areas. Plotting posterior belief on the matrix automatically reveals potential agency conflicts.
- By being able to better and more systematically foresee potential conflict areas (see also propositions 6, 7 & 8), decision-makers (outside-investors in this case) can respond accordingly. Re-evaluating strategic options, management motivation, monitoring practices and financial contracting are among the popular tools.

To exemplify, see figure 6.3 in which two possible outcomes of project X have been plotted; one displays the evolution of the venture capitalist's posterior belief in the project conditional on no-success, the other conditional on success. The dotted line, conditional on success, shows how window-dressing might cause the venture capitalist to expand, while he otherwise would have deferred his decision. While in this example the venture capitalist's perception is graphed, the information asymmetry should enable a second graph, the entrepreneurial view, to be drawn. In practice, the estimation of the entrepreneur's as well as the venture capitalist's posterior belief (in terms of value) will prove to be highly subjective. However, as the exact plotting

is difficult, this is clearly not the purpose of this model. Roughly estimating posterior belief, providing this subjection, should reveal useful information.

Figure 6.3 Projecting a Portfolio Company



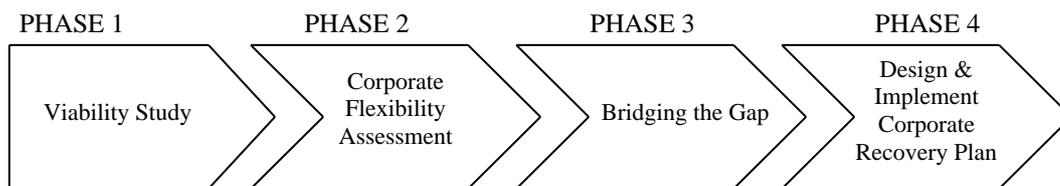
6.4 CORPORATE RECOVERY PROGRAM

Where the information and suggestions of the preceding paragraphs sketch a new approach towards valuing strategies, this paragraph serves to elaborate on the inclusion of the model in the practice of venture capital deal-making. Valuable feedback²¹ from a number of experienced players in the venture capital environment will be used to translate the theoretical foundation, as laid above, into a clear and practical program. Besides feedback on the model and underlying assumptions, substantial use is made of information that has been gathered in the context of a six-month internship with a strategy consulting firm operating in the venture capital environment. As agency conflicts are derived from goal diversion, underachievement is seen as an important condition. Hence, the program that is here introduced serves to structure the strategic decision-making process in under-achieving portfolio companies: the *Corporate Recovery Program*. It is stressed that the following description is meant to provide rough direction for practical inclusion. It would be an interesting future extension to conduct a more in-depth analysis in order to work out the recovery program into further detail.

6.4.1 Four phases

The program consists of four distinctive phases (see figure 6.4). Each phase contributes towards a quick and systematic estimation of the project's probability of success, its potential and the means needed to 'recover' the company. During the first phase the viability of the business model is discussed. The second phase is designed to do a quick assessment of the project's internal flexibility to accommodate the changes needed for recovery. In the third phase the findings from the flexibility assessment are translated into essential means to 'bridge the gaps'.

Figure 6.4 Corporate Recovery Program



Phase 1 How viable is the product-market combination?

a. Viable after change of business model?

Can a change to the model accelerate profitability? Can it be achieved within the same company, by the same people, with existing resources? To what extent are changes to the original idea (or business model) acceptable?

b. Viable after restructuring?

While the idea is good, the company lacks performance. A thorough analysis of operations and forecasts must be made. Meetings with potential partners/clients must be arranged.

c. Viable after adjustment?

While the business model is good, and revenues are generated, there is little proof-of-concept. A reality-check ('due diligence') will reveal the need for improvement.

Phase 2 Is the organization flexible enough to change?

The organizational flexibility is the company's ability to adapt to change. Should the product/market viability study reveal a need for change, an assessment of the organization's internal ability to handle change is required. In this phase there will be a focus on the assets that facilitate and withstand change/adaptability: entrepreneurial stamina (willingness), financial status quo, technology, people and structural rigidity.

a) An investment in a company is also an investment in an entrepreneur. It is the entrepreneur who spends many hours a day realizing an ambition. Therefore the entrepreneur's stamina is crucial to the success of the company. Answers to the following and other, more specific questions, should provide an assessment of the management and the role they will play going forwards. It should also provide a better insight into probability of success under entrepreneurial management and potential agency costs.

²¹ Three interviews have been conducted: one with the founder of a young Internet start-up, one with an independent consultant with experience in the field of start-up strategies and one with a "Strategic Advisory"

- Will you remain committed to the company, even if we decide upon another strategy/direction?
- Is/are the entrepreneur(s) the right person(s) to drive the recovery program and lead the company in to the future?
- Is/are the entrepreneur(s) willing to step back in favor of someone else if this is what's needed to recover the company?

b) In the end, return on investment is what counts. Besides the intangible assets, the company's financial status-quo is analyzed. The outcome of this analysis forms the basis for the determination of the capital requirement and capital structure. Several techniques are used:

- Benchmark the current financial situation against industry standards;
- Measure the financial forecast with industry standards and potential case scenario's;
- Value the current financial assets in relation to potential case scenarios.

Phase 3 What is required to turn the organization into a profitable venture?

Having determined if the company is fit for recovery and having identified the areas that require further attention, this phase provides an insight of the costs associated with the potential turn-around strategies. The viability study and corporate flexibility analysis already provided general ideas regarding the recovery process. In order to make the optimal decision and give the proper follow-up decision:

- Multiple (conservative, realistic and optimistic) scenarios are sketched.
- Multiple strategies are translated into the sorts of investment required.
- Re-estimation of financial forecast with regard to potential strategies and scenario's; financial implications are made explicit.
- Capital requirements and structure is determined.
- Potential strategies and expected rise in probability is plotted in the Agency Matrix.

Phase 4 Design & Implement Recovery Plan

The long-term strategy being the basis for all decisions, the Corporate Recovery Program focuses on the translation of lasting profitability into *short-term* goals and milestones and the delivery of an *immediate* action plan. As such, the Recovery Plan is a business and action plan. Based on the assessment, the business model is revised and the corrective actions are implemented. Possible features are:

- New strategy, which can be anything from: a new product/market combination (PMC), a new marketing strategy, a new sales strategy, new corporate governance structure, new management, to financial input. In short: a revised and sharpened business model.
- Re-evaluating strategic options, management motivation, monitoring practices and financial contracting. Considering the implications of possible follow-up decisions with regard to agency issues.
- Definition of milestones.

Executive at NIB Capital. For a detailed description of each interview please contact the author.

- A clear, realistic and efficient time-frame.

6.5 CONCLUSION

Chapter six served to integrate the findings, assumptions and propositions of the preceding chapters into a synthesizing approach, ultimately leading to the construction of a new model. To do so, paragraph 6.2 briefly set out how classic option reasoning is expanded by the inclusion of the principal-agent relation into one model. Whereas financial option strategy assumes information on risk aversion and expected returns to be reflected by the stock price, it has been argued that in the real option market, not only variance, but other parameters are also subject to estimation and ambiguity. It has been shown how Black Scholes determinants are to be seen in a wider context. Not only do contextual variables such as conjuncture, country, contract type and competition have a direct effect on factors such as expected growth, current value, risk and interest rate, also do various factors, derived from the division of ownership, have a significant affect on real option value. Paragraph 6.3 introduces the application of this expanded view on option value into a new model. A matrix consisting of four quadrants, each representing specific principal-agent characteristics as well as the allocation of specific contractual rights allows for the projection of one's posterior belief in the success of the venture on an 'agency' situation. A clear distinction has been made between exit, continuance and deferral strategies. Relating the preference for a continuance strategy to a posterior belief level close to one and the exit strategy to a level close to zero, enables an insight into the likely effects of an agency-conflict on the value of a strategic option. Various dotted lines represent the effect of the propositions formulated in chapter five. Chapter 6.4 suggests direction for the inclusion of the model into the practice of decision-makers. With a focus on the underperforming venture, a four phase program has been developed to systematically assess the project's health and integrate the agency issue in the determination of its probability to successfully turn around. Feedback from various decision-makers has been used to reflect on the model.

7 CONCLUSION

This paper started out by mentioning the irrationality with which the technology hype of the late nineteen nineties and early 2000 rose and fell. Following it has been assumed that the exploration of internal financial and managerial complexities should provide an interesting and partial explanatory argument for the irrationality that so characterized this era. This led to posing the following research problem: extending real options in an agency context how is strategic decision-making in venture capital-backed firms affected by the ownership structure of these firms? The slightly cynical addition ‘how real are real options?’ emphasizes the relativity of quantitative valuation methods in a context of decision-making under perceptual bias. In order to find an answer to this question, the general approach of this paper has been to examine the theoretical interaction of two scientific fields.

First of all the analysis of real option theory provided the understanding that, although only five parameters are necessary to estimate the value of a financial call option and of these only variance is subject to perception, the value of a real option is much more subject to personal perception and should as such be evaluated and reconsidered under the conditions of each specific situation. The flexibility component of project value is structured by acknowledging a number of different real options. When analyzing this project value, one is confronted by a range of variables that influence the estimation of expected value.

Second of all, the analysis of agency theory revealed how a potential agency conflict might arise as the outside capital is infused into the project, the ownership is partially transferred and the entrepreneur loses part of his autonomy, turning himself into a lessee. In this perspective, entrepreneur can be considered ‘agent’ and the outside-investor ‘principal’: the entrepreneurial discretion of the owner/manager is reflected in the financing contract. The relevance of this perspective is found in the effect that is often neglected in the event of subsiding uncertainty that the capital aspect of a sequence of tactical investment projects may have on the internal objectives of the management. The principal is faced with a trade-off between costs incurred by opportunistic behavior of the agent or costs incurred by monitoring the agent’s behavior.

Based on the analysis of various comparable empirical studies on the subject of structuring venture capital contracts, it can be concluded that these contracts provide enough incentives and conditions for the entrepreneur to behave opportunistically. The following is found: early stage financing rounds (before revenue is being generated) are recognized to be shorter in duration and smaller in size than later stage financing rounds (after revenue is being generated). The dominant mode of financing is convertible preferred equity, providing the venture capitalist with special rights such as a fixed rate of return. In later stages, the convertible preferred equity is partly replaced by common equity and debt, giving the lender the right to foreclose. In addition, the venture capitalist has a senior claim on the project value in case of liquidation. Furthermore, the venture capitalist has a large claim on voting rights and board rights but these are contingent on venture performance. The project’s performance or probability of success is negatively related to the venture capitalist’s control and liquidation rights. So-called switches in control occur mostly in the early stages of the investment process. And lastly, if ventures have the potential to go public, financing is continued into later stages; if not, the investment is abandoned or sold in an early stage.

Besides substantial research on venture contracting, the analysis of empirical evidence on common conflicts in the process of venture capital financing revealed the popular topics for argument. It can be concluded that when

a functional, cognitive dispute transforms into an affective, dysfunctional conflict about the goals of the venture, an agency problem arises. Conflicts about short-term, long-term orientation, product/innovation and control might, however dependent on the qualitative state of the project and successive conditions, lead to adverse selection, moral hazard, hold-up and/or window-dressing. Furthermore, these conflicts provide information on the timing and cause of the agency problems, enabling insight into the possible relation between conflict type, strategy preference and perceptual bias. Summarizing, the following can be concluded: adverse selection occurs with start-up firms with a short or no track record. Because it is the entrepreneur who holds all equity and therefore has sole access to private information, the venture capitalist must rely on the trustworthiness of the entrepreneur and the information he provides. In a high upside risk potential situation the entrepreneur has generally little incentives to overestimate prospects. Hence, chances on adverse selection are small. However, when there is diffusion about the venture's prospects or when downside risk potential is high, the entrepreneur is likely to accept a higher rate of return for the venture capitalist therewith causing potential adverse selection.

The moral hazard problem is triggered by a difference in goal objectives by the entrepreneur and the venture capitalist. In general the staged investment structure and the co-ownership should prevent the entrepreneur from behaving opportunistically, but under certain circumstances he might feel benefited by exercising personally beneficial strategies. In an upside potential situation goals are likely to be aligned, but if there is any goal conflict and it is of the affective type, it is not likely that the ownership structure (as in the broader sense of this thesis) will hinder the entrepreneur in striving to obtain his personal goals. On the other hand, when there is increased downside risk potential, the ownership structure may start to affect the entrepreneur's behavior causing a serious moral hazard at various stages of the investment process. This is increased by the venture capitalist's seniority with regard to liquidation value and control rights (in a downside potential situation).

Furthermore, when not much is known about the intrinsic project quality and information asymmetry is high, especially in early stages, the entrepreneur might feel incentivized to window-dress results just before a periodic performance review by the venture capitalist. Assuming that projects that do not have the potential to go public are abandoned or sold in a relatively early stage, goals are not aligned when performance is not met: the entrepreneur starts behaving opportunistically by window-dressing results in order to achieve a follow-up investment-round. When downside risk is high and continuance is not perceived to be a reasonable option, the potential of window-dressing problems is overshadowed by moral hazard. Window-dressing in later stages is less common since information-asymmetry is reduced.

The hold-up problem is particularly pronounced among new start-up ventures that face contract renegotiation. As the investment by the venture capitalist sinks into the project, the hold-up problem increases.

Following, strategic dilemmas such as the continuance, exiting or deferment of (follow-up) investment have been related to the dynamics of a staged investment structure. It has not only been shown how real option reasoning relates to the strategic alternatives at the outset but also during the investment process. Concluding, the value of each strategic option is dependent on various contextual variables as well as the qualitative states from which the project progresses. Here the interaction among options plays an important role. It has been proposed that an asymmetric distribution of information and a potential goal diversion cause significant differences in the perceived conceptual bridges between strategic action and firm value. Hence, the discovery of negative information about the project or the reception of successive but contradicting signals has direct effect on the posterior belief of the outside-investor in the probability of success. Realizing that posterior belief is rapidly

adjusted when uncertainty is high, the discrete learning moments of a staged investment structure causes the venture capitalist to attach disproportional weight to negative signals about the project quality. The entrepreneur on the other hand possibly performs an opposite type of behavior. Providing that the entrepreneur is subject to the so-called confirmation bias, it has been suggested he has a lower preference of deferral and exit strategies. In addition it is explained how the unequal distribution of liquidation rights and put provisions negatively affects the option value of abandonment *for the entrepreneur*. Furthermore, since early abandonment by the venture capitalist possibly means the instant liquidation of potential growth and complete deterioration of salvage value that the entrepreneur might otherwise receive, the entrepreneur is under these conditions triggered to use the information asymmetry to his advantage. Hence, the intentional distortion of results positively affects the expected outcome and decreases the uncertainty level as perceived by the venture capitalist. Another factor that affects the perceptual bias is the changing risk attitude of stakeholders. The venture capitalist, essentially being risk-averse, protects his (calculated) risk by demanding high discount rates. However, should returns be disappointing, deferring decision-making often seems the attractive low-risk strategy to follow. The entrepreneur on the other hand only benefits if project value exceeds a certain limit, causing it to be increasingly attractive to pursue high variance strategies: expansion and possibly even emergent strategy switches can be used to increase option value. Resuming, the venture capitalist's risk aversion causes him to increasingly focus on the expiration signal of the deferral option, while the risk preference of the entrepreneur causes him to focus on the opportunity signal with regard to option value. It is said that many factors influence the managerial behavior of the entrepreneur. If option value is perceived low and a lack of flexibility limits the current managerial means to accommodate growth, opportunistic behavior is likely to occur. Considering that if the NPV is extremely negative, no amount of optionality can possibly rescue the project, the agent is increasingly motivated to pursue personally beneficial activities, such as extracting resources for personal consumption or intentional risk-taking with very low probabilities of success.

Summarizing, it can be concluded that agency conflicts such as moral hazard, adverse selection, window-dressing and hold-up have a direct effect on the value of exit and continuance options. Perception and actual value are aspects that play an important role that should continuously be evaluated in this context. Whereas financial option strategy assumes information on risk aversion and expected returns to be reflected by the stock price, it has been argued that in the real option market, not only variance, but other parameters are also subject to estimation and ambiguity. Black Scholes determinants are to be seen in a wider context, in which not only contextual variables such as conjuncture, country and competition have a direct effect on expected value, current value, time, risk and interest rate, also do variables that are derived from the division of ownership have a significant effect on real option value. Examples of these added variables are investment phase, monitoring activities, goal diversion, agency costs, risk attitude, entrepreneurial stamina and information asymmetry. The systematic integration of these influences in the strategic decision-making process of venture capital-backed firms should lead to an increased understanding and better estimation of the effects of strategic choices and follow-up investment. There is no doubt that a combined understanding of perceptual biases, people's bounded rationality and utility maximization, the risks of an asymmetry distribution of information and surely common logic can explain part of the dream (or nightmare) that manifested the historic rise and fall of the dotcom hype. Nonetheless, the fact remains that the real option component of project value is more real than ever, that people remain bounded rational and that no amount of good advice is ever expected to weigh up to that.

8 DISCUSSION & FUTURE EXTENSIONS

8.1 INTRODUCTION

This research set out to create insight into the derived effect of the dynamic ownership structure of venture-capital-backed firms on the strategic decision-making processes of these firms. This final chapter serves to present a reflection on the issues and approaches of this paper. The scientific relevance and practical application will be discussed, as well suggestions for future research.

8.2 DISCUSSION

In chapters two and three a comprehensive theoretical foundation has been laid to enable the investigation of potential rigidities and flexibilities of real options in an agency context and to explore the possibility whether an approach that incorporates both real options and agency perspectives will provide a better understanding of the effect of ownership on the interplay between real options and strategic decision-making. Having analyzed a number of different but comparable studies on venture capital contracting in chapter four, assumptions have been made to proceed with the exploration of the research problem and to formulate propositions in chapter 5 that have been used to construct the model in chapter six.

While the model has been initially designed for deductive purposes - to create insight into the status-quo and dynamic effect of agency conflict on strategy preference of investor and entrepreneur - the model also has an inductive purpose. As such, this paper has provided settings for a successful method to estimate probable agency conflicts when deciding upon follow-action. Once a decision-maker is able to project his relative perception on the matrix, he can roughly estimate the effects of a potential strategic choice. When explicitly realizing and acknowledging that the variables in figure 6.1 directly relate to the size of a specific strategy-preference, choices which would otherwise be obvious are now reconsidered in this context. Thus, it is claimed that potential consequences of a principal-agent relationship that would normally be merely implicitly included in the decision-making process, can now be explicitly integrated and weighted so potential opportunistic behavior can be avoided or appropriately reacted upon.

One aspect that has only briefly been touched upon in paragraph 6.4 is the practical application of the model in business practice. Although it is claimed that the model contributes to the theory as a theoretical tool that integrates the principal-agent relation in ex-ante investment decision-making, it must still be proven how this model serves its purpose in practice. During several in-depth interviews with players with different but distinctive roles in business practice several possible inclusions of the matrix in a systematic decision-making process have been suggested and discussed. The purpose of these interviews is to gain a wider variety of perspectives and to be better able to value its practical relevance and define future enhancements. Paragraph 7.3 will describe these into further detail. It is emphasized that the key informant interviews do not serve as empirical evidence and are not meant to do so.

8.3 SUGGESTIONS FOR FUTURE EXTENSION

Inherent in the exploration of an interaction of two scientific fields has been the need to limit the scope of research by assumptions and simplifications. However, this automatically creates interesting perspectives for future extensions of this research.

Firstly, an obvious follow-up of this thesis would be the empirical testing of the proposed relations (between variables and option determinants). The translation and expansion of the propositions into a complete set of empirically testable hypotheses should attach a different but added value to the suggested causalities of this paper.

Secondly, an extra dimension to the empirical testing of mentioned causalities would be the division of venture capitalist organizations into distinct groups. While in this paper venture capital organizations have been considered to solely invest in start-up ventures, no functional distinction has been made between the way agency issues are dealt with by venture capitalist organizations that are well equipped and more experienced in dealing with these issues and venture capitalist organizations that are less experienced and less equipped. As such, an interesting extension would be the mapping of structural differences in management approach, monitoring practices and overall strategic goals between various types of institutional investment firms. It would be interesting to test the expectation that a successful division of institutional investors based on these themes also implies a structural difference between these firms in the dynamics of the agency conflict. In addition, it could be explored to what extent the shape of the 'bandwidths' of the various strategic areas (i.e. deferral, abandonment, expansion) are dependent on the type of institutional investor and the type of investment.

Thirdly, it would be interesting to explore a possible addition to the model by trying to determine a set of standard evolutions of posterior belief in dynamic contexts. While figure 4.2 and figure 6.3 suggest the effect of internal and external dynamics on possible adaptations in the evolution of posterior belief, the graphing of a limited number of more general evolution types could possibly serve as an interesting tool for the strategic decision-making process. In addition, it can be examined whether the evolution of posterior belief and the accompanying perceptual bias could be more precisely determined based on exact parameters. Paragraph 7.2 already mentioned the inductive use of the model. While in the current design it is well possible to determine a project's status-quo with regard to the significance of the agency-issue, and potential effects can be roughly estimated, a more precise way to determine one's perception of the probability of success could serve to more effectively estimate possible friction. Further, the definition of parameters and possibly the construction of a standard questionnaire could provide exact determination of the bias.

Fourthly, while this paper assumes only one single outside-investor, this assumption could possibly be relaxed in future research. Since syndicated venture investments are common in venture capital deal-contracting, the effects of syndication on risk attitude, project acceptance and agency conflicts could be further explored. Another assumption of this paper is the definition of the principal-agent relationship, in which the entrepreneur is seen as agent and the venture capitalist as principal. A reversed role-pattern might exist when the entrepreneur relies on the outside-investor for non-financial input, such as consultancy or matchmaking. This approach, in which the investor is agent and the entrepreneur principal, should provide an interesting perspective of the model.

Finally, one prominent aspect of today's real option theory is the inclusion of game-theoretic elements to the valuation and decision-making process. Although it has been chosen not to include these elements in the scope of this research, the relation between internal structure or governance and the management's response-behavior to competition and external threats could however provide very interesting subjects for future research. As such, the integration of principal-agent relationships in game-theoretic decision-making tools should provide fruitful material for an extensive research program.

8.4 CONCLUSION

This chapter described a brief reflection on the issues and approaches of this paper as well as some suggestions for future research. It can be concluded that, while the body of this paper consists of the analysis of theories and previous empirical studies, the scientific contribution of this research lays in the construction and formulation of a synthesizing tool to systematically integrate the derived effect of a division of ownership in venture capital-backed firms on the strategic decision-making process. It has been found that not only serves the model as a way to estimate a project's status-quo with regard to agency issues and strategy preference, also does the model serve to foresee the potential effect of a specific strategic choice. However, the relaxation of the underlying assumptions provides interesting suggestions for future extensions of this research. The most obvious follow-up would be the expansion and translation of the propositions into a set of empirically testable hypothesis, but other extensions such as a broadened categorization of institutional investors, the formulation of standard evolutions of posterior belief, syndicated investment structures, a reversed principal-agent relation and the addition of game-theoretic elements also reflect how fruitful the integration of agency and real option theory is in terms of academic research. A methodological application of these elements in practice should follow.

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