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PhD Thesis

Governance, contract structure and risk assessment in inter-firm relationships (IFRs) and venture capital investments

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INTRODUCTION

1.1 Introduction

In today's turbulent and competitive environment, innovation fostering and development is more and more realized outside the company boundaries. In recent years, the rate of formation of inter-firm relationships, especially in high-tech and R&D intensive industries, significantly increased (Dyer and Singh, 1998; Hagedoorn, 2002; Dyer et al., 2004); in other respects, the diffusion of external financial backers, such as Venture Capitalists (VCs), played a fundamental role in fostering innovation in modern society. The main reason is that even the largest companies are not able anymore to develop all the new knowledge and technology they need to compete within the company boundaries. All the more so, young and innovative start-ups are not able to enter and stay into the market without external financial and competences support.

As concerns to external technology sourcing, recently, Chesbrough (2003) coined the term 'open innovation' to indicate how big companies changed their traditional way of new business development by opening the firm's boundaries and combining external and internal technology development. Namely, it is a new definition of what in literature is historically addressed as inter-firm relations (IFRs); firms sign licensing agreements, alliances, joint venture or even merger and acquisitions with others firm in order to gain the access to new knowledge or technology.

As concerns to external financing of new high-tech start-ups, that are often too small to turn to equity markets and too risky to qualify for bank debt, they usually obtain financial capital through two different sources: Venture Capital (VC) financing or entering strategic deals with other firms (Pisano, 2006).

This thesis attempts to contribute both the issues anticipated above. On the one hand it discusses the dynamics of R&D inter-firm relationships, with the main aim of investigating how firms manage the risk embedded in the creation of such relationships through the choice of the most suitable governance form. On the other hand, it studies

the role of Venture Capital investors in fostering innovation and how VCs manage the risk in the investor-investee relation through the design of investment contracts.
This chapter gives an overview of both the topics addressed in this thesis and of the structure of the study. Specifically, section two briefly presents existing research and the gap identified in it. This gap is transformed into research objectives presented in section three. Finally, the following two sections introduce the methodology applied and the structure of the study that should give a quick overview of the content.

1.2 Theoretical background, motivations and research questions

Starting with the first topic object of the thesis, namely the governance and management of IFRs, I reviewed the most influential theoretical and empirical research on the topic and I noticed that basically researchers have tried to find reasonable explanations for two main issues. The former concerns the motivations for creating such relationships, how to choose the most suitable partner and, above all, how to formalize the relationship, namely what type of contract and governance form to choose in order to manage the relation. Whereas, the latter issue regards the performance evaluation of the relationship and the identification of those factors that may lead to the success (failure) of an alliance.
My attention has been particularly captured by the first research issue that is surely the one having received more contributions in the strategic management literature. Indeed, every day firms enter into strategic alliances, joint ventures and even undertake mergers or acquisitions for various reasons, and the formation of these relations is one of main research subjects in the field. I was especially attracted by the body of literature investigating the reasons that push firms to choose different governance modes in organizing their relationships, mainly because, despite the huge amount of existing literature, there are still many unclear aspects.
In particular looking at the drivers influencing the choice of the governance forms, researchers often limited themselves to analyze the problem from one or two theoretical point of views. The most adopted perspectives are: Transaction Cost Economics (TCE) (Williamson, 1979; 1985; 1991), Resource-Based View (RBV) (Kogut and Zender, 2002; Zollo et al., 2002), Property Right Theory (PRT) (Hart and Moore, 1990) and Real Options theory (RO) (Folta, 1998; Kogut, 1991). Instead, I believe that analyzing

the problem in the light of different perspectives at the same time could provide new and interesting insights. This was one of the motivations that prompted the first research work presented in this thesis (see chapter 4). Furthermore, I noted that several authors concentrate their studies on the motivation for selecting a specific governance from; surely, alliances received more attention than the other governance modes. Other scholars instead compare the choice between two or three governance modalities; mainly they investigate the choice between equity and non-equity alliances. Whereas, the aim of my research is to analyze all the spectrum of possibilities between pure market transactions and totally integration. For the aforementioned reasons, I developed a theoretical framework derived from the analysis of all the theories underling the formation of IFRs, that detect the main drivers that my influence the governance form choice and I link them to a particular governance mode.

Thus, the research presented in chapter 4 regarding the drivers influencing the choice of the governance form try to answer to the following research questions:

- *Why sometimes are contract-based alliances preferred to joint ventures or mergers and acquisitions? What are the drivers, if any, influencing the choice of the governance form of inter-firm relationships?*

Moreover, a second and in-depth literature analysis, led me to see the problem of the governance choice from another point of view. Thus, I started investigating which are the main causes determining a high perception of the partners relational and performance risk in IFRs. Thus, in chapter 5, I develop a new theoretical framework linking the perception of the above mentioned relational and performance risk to the governance forms. I provide reasons for which the extent of factors increasing relational risk perception leads firms to choose more hierarchical governance modes, whereas high perception of performance risk leads to more market oriented transactions. Finally, I show how the extent of both relational and performance risk perception is more related to hybrids governance forms.

With this research I try to answer to the following research questions:

- *Does the perception of a high relational risk in the IFRs lead companies to choose more structured and integrated governance forms (i.e. equity alliances, M&A)? Does the perception of a high performance risk in the IFRs lead*

companies to choose more market-oriented governance forms (i.e. licensing agreements, non-equity alliances)? How the presence of both factors influence this choice?

Both the frameworks on the decision of the governance of IFRs presented in chapters 4 and 5 have been empirically tested through two different datasets consisting of firms from the same industry, the bio-pharmaceutical one. This particular industry has been selected as research field, as it is one of the industries that are experiencing the highest number of inter-firm relationships; indeed, alliances between pharmaceutical and biotech firms are very frequent. Moreover, as I'll explain in detail in chapter 2, I'm particularly interested in inter-firm relationships involving an external technology sourcing, and again this industry is an ideal test-bed. Finally, the first dataset comes from primary data collected through a survey conducted within the Italian bio-pharmaceutical industry, thus it examines relationships signed in a specific country; whereas, the second one, is a secondary dataset examining IFRs signed worldwide.

As concern as the second object of this thesis, namely the investigation of venture capital investments contracts, the review of the main contributions of both theoretical and empirical research have shown that instead, this research stream is still poorly investigated. In particular, my point of view in analysing the issue was to investigate the main risk factors the investor faces during the entrepreneurial investment, namely agency problems such as adverse selection and moral hazard, and in which way, namely through which kind of contract rights and covenants, he manages these agency conflicts. Financial contracting literature stream is the main theoretical approach used in studying the issue and it has examined how typical principal-agent scenarios can be adapted to the relationship between VC and entrepreneur, that is characterized by an extraordinary high potential for agency conflicts resulting from information asymmetries between the two parties. Theoretical research tried for years to develop models of optimality between different securities combinations and financial instruments; these models have found only partially empirical support.

In particular, the motivation of my research comes from the observation that no research has focused on how the use of different mitigatory mechanisms, both contractual and pre-contractual, is associated to the perceived degree of agency conflicts. It is also not clear how pre-investment screening activities, such as syndication, are better used

alongside or as a substitute to the design of contractual rights and post investment activities. Thus, the literature review on the topic that is presented in chapter 3, was the starting point for the theoretical framework developed in chapter 6. Indeed, I firstly study from a theoretical point of view how Venture Capitalists use pre-investment screening mechanisms and contractual rights and covenants to mitigate agency conflicts (characterised by adverse selection and moral hazard problems) in the investor-investee relation with entrepreneurial companies.

Thus, the research presented in chapter 6 try to contribute to the VC contracting literature by answering the following questions:

- *How better selection of ventures through the use of pre-investment screening mechanisms, such as syndication, relates to the subsequent design of financial contracts provisions such as use of higher ranking equity financial instruments, cash flow and control rights in financial contracts? Does superior screening result in the use of covenant rights as complements or substitutes to the screening results?*

Furthermore, a tested the developed hypotheses through a hand collected dataset of worldwide VC investments in order to find empirical confirmations on the above-mentioned issues.

1.3 Methodology

The main aspects of each research are the *theory* and the *empiricism*. The interaction between these two elements is the core process for the production of knowledge. This process is also followed in this study. First, a solid *theory* is created. Without a solid theoretical understanding of how to answer to the research questions the study would lack to solve the problem statement. On the other hand, if the theory is created just on a stand-alone basis, it would lack to support the real world. Here is where the *empiricism* comes into play. It tries to draw on conclusions based on what is observable and actual data. The empiricism side in this thesis is based on the selection of data, as well as tests on predetermined hypotheses.

As regards as the selection of the data in the research works presented in this thesis, I use two main types of data: original data and secondary data. Original data, also known as primary data, are data collected at source. Secondary data is data which already-exists, such as books, documents, journals and databases.

As far as primary data, I participated in a work team composed by colleagues of the DICGIM department of the University of Palermo, with which I conducted a survey within the Italian biotechnology and pharmaceutical companies associated to Farmindustria, that is the main Italian Association of Pharmaceutical and Biotechnology companies. The survey was conducted through the use of a questionnaire. It is the most common method to collect primary data and it is a most useful method when large numbers of people are to be reached in different geographical regions (Sekaran, 2003). These data is presented and used in chapter 4.

Also the dataset presented in chapter 6, on Venture Capital financing contracts, consists of hand-collected data, primary data, that were collected in the scope of a broader research project titled, "Governance and Contractual Structures in the European Venture Capital Industry". The project received funding from the German Research Foundation and the data collection was carried out by several researchers at the European Business School (EBS); then, through a collaboration with Professor Kamuriwo at Cass Business School during my staying there, I had the possibility to access this dataset with the main aim of investigating the issue presented in chapter 6 of this thesis.

As concern as secondary data, they can be obtained from various sources (Hussey and Hussey, 1997) and they are one of the cheapest and easiest means of access to companies' information. In this thesis I use secondary data in the research presented in chapter 5 on the risk assessment as rational for the governance mode choice in IFRs. This data were collected by using the BioWorld Industry Snapshot database, in particular the Biotech & Pharma Collaboration section. This data source was used for identifying worldwide inter-firm relationships among biotech and pharmaceutical companies during the period January 2007 to December 2010. I selected the BioWorld database because it is a new and reliable source of records specific for the biotechnology industry.

Finally, as regards as the methods that enable to make tests and determine relations they are found in the statistical theory. Specifically, a *multinomial logit regression model* was developed for each of the empirical analysis presented in this thesis.

1.5 Thesis outline

This study is organized into seven chapters. In here, I briefly report contents of the following chapters.

Chapter 2 gives an overview of the theoretical background and of the existing literature on the governance of inter-firm relationships. In particular, it clarifies what researchers mean with inter-firm relationships and which are the governance modalities within the market-hierarchy continuum considered in this thesis. Then, it examines the main theoretical approaches underling IFRs literature. Finally, Chapter 2 briefly presents existing research literature on the drivers influencing the choice of the governance form of IFRs and the research context of this study, namely the biopharmaceutical industry.

Chapter 3 introduces the theoretical background and literature review on venture capital contracting. First, it presents some definitions of the venture capital industry and of its characteristics. In particular, the focus is on the agency conflicts existing in the relationship between the venture capital investor (the principal that provides funds to a venture) and the entrepreneur (the agent with a venture that needs financing). Finally, Chapter 3 offers a detailed review of the most relevant literature on pre-contractual mechanisms and contractual rights and covenants used to reduce these agency conflicts.

Chapter 4 presents the first theoretical framework of this thesis and its empirical test. By reviewing the relevant literature and the theoretical approaches underlying the choice of the governance of IFRs in the biopharmaceutical industry, I locate some drivers that might influence this choice and I develop a set of hypotheses. Such theoretical framework is then empirically tested through data collected from a survey in the Italian context. Empirical results provide interesting insights on how shaping bio-pharmaceutical deals. Then, discussion, conclusion, managerial implications and limitations are presented.

Chapter 5 presents the second theoretical framework on the choice of the governance of IFRs. It differs from the one presented in chapter 4, because it is based on the analysis of risk factors perceived by companies when they start a new relationship. In here, I detect factors influencing the perception of a relational risk and those determining the

perception of a performance risk. Then, I provide reasons for which the extent of these factors lead firms to controversial decisions on the governance of their relations; namely, relational risk factors push toward more hierarchical governance modes, whereas performance risk factors push toward more market oriented transactions. Finally, the set of hypotheses is empirically tested through the analysis of a sample of IFRs signed worldwide in the period 2007-2010 between pharma and biotech companies. The results strongly support the theoretical framework; thus, discussion, conclusion and managerial implications and limitations are presented.

Chapter 6 concerns the research on venture capital contract design. In here, I first develop a set of hypotheses linking the perceived degree of agency conflicts existing in the relation between the venture capitalist and the entrepreneur with the use of pre-investment activities and contractual rights and covenants. In particular, I investigate how the use of syndication, the choice of equity financial instruments, the staging of the investment and the VC board rights are employed by the venture capitalists in order to manage adverse selection and moral hazard problems. The developed hypotheses are then empirically tested through the analysis of a sample of venture capital investments covering both European and US entrepreneurial firms. The empirical analysis shows very interesting results, supporting the hypotheses. Then, discussion, conclusion and managerial implications and limitations are presented.

Chapter 7 presents the main theoretical, empirical and managerial contributions of the studies discussed in this thesis. Finally, it outlines the limitations of the studies and suggests further research development.

Chapter 2

UNDERSTANDING INTER-FIRM RELATIONSHIPS: THEORETICAL BACKGROUND AND LITERATURE REVIEW ON THE GOVERNANCE OF IFRs

2.1 Introduction

Inter-firm relationships (IFRs) have received an enormous attention in the strategic management literature (Das and Teng, 2000); in the literature, some authors refer to these collaborations using the term "alliances", others use "strategic alliances" or "inter-firm alliances". With the term IFRs, in this thesis, I refer to any type of arrangement that one finds in between standard market transactions of unrelated companies and integration by means of mergers and acquisitions. In particular, the focus of this work is on *strategic technology partnering*, namely those collaborations between two independent firms, formalized through a proper agreement, where joint technology development or technology sharing is at least part of the collaborative effort. Of course, in R&D intensive industries, the intensity and the number of alliances is much greater than in other contexts (Freeman, 1991; Hagedoorn, 2002).

This chapter presents a review of a part of the 'IFRs literature', or as it is more often labelled, of the 'alliance literature' with a particular focus at R&D alliances. In general, the 'IFRs literature' is roughly divided between: a) those papers who analyze inter-organizational relationships and networks as a class of phenomenon such as Gulati (1995) and Oliver (1990); b) those papers who try to detect variables associated with alliance success, failure, and stability (Doz, 1996; Parkhe, 1993b; McCutchen et al., 2008); c) and those papers that focus on the choice of a specific kind of IFRs, such as strategic alliances, compared to alternative governance mechanisms (Kogut, 1988; Powell, 1990; Das and Teng, 2001a).

Thus, in accordance with the focus of this thesis, the literature review here presented mainly concerns this last literature strand, namely the analysis of those papers that examine factors that influence managers choice between different governance forms of

an inter-firm relationships; thus, I mainly review the following theories: Transaction Cost Economics (TCE) (Williamson, 1979; 1985; 1991), Resource-based View (RBV) (Kogut and Zender, 2002; Zollo et al., 2002), Property Right Theory (PRT) (Hart and Moore, 1990) and Real Options theory (RO) (Folta, 1998; Kogut, 1991).

The reminder of the chapter is organized as follow: in section 2.2 I present the most adopted definitions of inter-firm relationships; then in section 2.3 I analyze the market-hierarchy continuum of governance forms highlighting the ones that are object of this thesis; section 2.4 is a review of the theories underling IFRs; section 2.5 contains the literature review of drivers influencing the choice of the governance form of IFRs; in section 2.6 I introduce the research context, namely I explain why I choose the biopharmaceutical industry as the test-bed of my research and finally section 2.7 discusses conclusions.

2.2 Defining inter-firm relationships

Firms usually enter into strategic alliances, joint ventures, equity investment, or M&A for the purpose of strengthening their ability to compete. They choose one or more of these alternatives depending on their strategic purposes, market environment, products, and technological capabilities (Doz and Hamel, 1998).

Collaboration between firms is an old phenomenon, companies have entered into alliances for centuries; however, the increasing diffusion of such collaborations occurred from later eighties (Draulans et al., 2003). Consequently, the rapid growth of the number of alliances in the 1980's and 1990's is reflected by the prosperity of the literature and by the different views and definitions of what an alliance/partnership is. There are many definitions of strategic alliances, or more generally of inter-firm relationships, in literature; some of the most influential are chronologically presented below.

> According to Forrest (Forrest, 1989) "strategic alliances are those collaborations between firms and other organizations, both short-term and long-term, which can involve either partial or contractual ownership, and are developed for strategic reasons".

> Parkhe (Parkhe, 1993a) defines strategic alliances as "relatively enduring inter-firm cooperative arrangements, involving flows and linkages that use resources and/or governance structures from autonomous organizations, for the joint accomplishment of individual goals linked to the corporate mission of each sponsoring firm".

> Yoshino and Rangan (1995) and Mocker (1997) defined strategic alliances as "inter-firm relationships that two or more independent firms use on a continuing basis to contribute to one or more key strategic goals. The firms share the benefits of their teamwork while remaining independent".
>
> According to Contractor and Ra (Contractor and Ra, 2000) an alliance is "any cooperative or joint action between two companies on contractual and/or equity joint venture basis".
> Das and Teng (Das and Teng, 2000) define strategic alliances as "voluntary cooperative inter-firm agreements aimed at achieving competitive advantage for the partners".

Interesting for the purpose of this thesis is also the definition provided by Hagedoorn (2002) for R&D partnerships, that is the specific type of collaborations I'm interested in.

> Hagedoorn (2002) refer to R&D partnerships as the specific set of different modes of inter-firm collaboration where two or more firms, that remain independent economic agents and organizations, share some of their R&D activities.

As the reader can note from the previous definitions, one common view of what an alliance is does not exist. Moreover, a number of taxonomies of different modes of inter-firm relationships were introduced in both the economics and business and management literature.

However, as concerns to the definition of 'alliance', it is possible to recognize several common key points that define a strategic alliance. Firstly, most of the definitions use the words *cooperative inter-firm agreements;* namely, the word 'cooperative' implies there must be resource sharing among all the partners, and 'agreements' implies that firms sign a formal contract that must regulate the relationship. Secondly, several authors point out that alliances must be *strategic*, i.e. they must have a significant impact on corporate future position and competitiveness. Finally, alliances can involve *equity* investments, determining a partial ownership of a part in the other firm.

The reader should note that some confusion about the terminology used in literature to refer to strategic alliances does exist.

The main point is that some authors, with a more inclusive view, use the terms 'alliance', 'strategic alliance', 'inter-firm relationship', 'strategic partnerships' or 'strategic network' as synonymous (Borys and Jemison, 1989; Lei and Slocum, 1991; Forrest, 1992; Murray and Mahon, 1993; Stafford, 1994). Instead, other researchers

adopt a more restricted view, as they make a distinction between 'strategic alliances' and other cooperative arrangements (Devlin and Bleackley, 1988; Yoshino and Rangan, 1995). According these authors strategic alliances are only those deals in which the parent firms are tied to each other in a long-term interdependence, with shared control, and continued contributions by the parents. Following these narrowed view seems that only a few kinds of cooperative arrangements would qualify as strategic alliances, that is joint ventures, equity investment, joint R&D, and joint marketing.

For the main purpose of this study I believe that it is not fundamental makes this distinction between restricted and inclusive view. Therefore, in this study, like others authors in the field, I use the term 'strategic alliance' as a common term to encompass all the previous inter-firm relationships (Harrigan, 1986; Ohmae, 1989; Parkhe, 1991). More generally, I use the term 'inter-firm relationship' to refer to a broad range of collaborations including bilateral licensing agreements, outsourcing agreements, bilateral contract-based alliances, equity investments, joint ventures, and mergers and acquisitions (M&A) and so on.

Finally, I encompass also Merger and Acquisition (M&A) as a distinct alternative between strategic alliances and other inter-firm relationships (Barney, 2002). M&A is considered a "make" solution because of is a governance form that internalises the assets or the activities to be accomplished during the inter-firm relationship.

The definition of 'alliance' or 'inter-firm relationship' is also strictly linked to the numerous taxonomies present in literature that try to classify all the different governance modes of these partnerships by using different criteria.

In the next paragraph I briefly analyze some of these classifications and I give a definition of the governance modes discussed in this thesis.

2.3 The market-hierarchy continuum: analysis of different governance forms.

As explained in the previous section, existing research shows that alliances can take a variety of forms those represent different approaches that partner firms adopt to control their dependence on the alliance, different legal forms which enable firms to control the resources allocation, and different distribution of benefits among the partners. Prior research has described differences in alliance governance structure as being similar to the differences between markets and hierarchies (Gulati, 1998).

However, along the market-hierarchy continuum (Williamson, 1995), several classifications of the alliances governance modes do exist. Traditionally, researchers have retained the distinction between equity and non-equity alliances (Gulati, 1995; Lambe and Spekman, 1997; Hagedoorn and Duyster, 2002; Dunne et al., 2009 Vamhaverbeke et al., 2002). Equity relationships include both minority equity investments and joint venture agreements, whereas non-equity alliances are all the contractual agreements that do not involve an equity investment. Following Gulati (1998) they consider a non-equity alliance as the closer governance form to a market transaction, whereas equity alliances resemble more to hierarchical forms of governance. On the other hand, other researchers have searched for more sophisticated classifications, adding for example licensing agreements as a separate organizational form and distinguishing between minority equity alliances and joint ventures (Gulati and Singh, 1998; Santoro and McGill, 2005.

From my point of view one of the clearest and most comprehensive taxonomy is the one by Das and Teng (2001), since they attempt to explain all the complexity and variations of alliance structure beyond the equity-non equity dichotomy. They propose a framework of four kinds of alliances: unilateral contract-based alliances, bilateral contract-based alliances, minority equity alliance and joint ventures. They define a unilateral contract-based alliance as an agreement in which there is a well-defined transfer of property rights, such as in licensing or distribution agreements. Instead, bilateral contract-based alliances are those partnerships in which partners share resources for the creation of a common property or knowledge; i.e. joint R&D alliances, joint marketing and joint production alliances.

For the purpose of this work and to explain the conceptual framework of this study, I follow Das and Teng (2001) classification; thus, in the continuation of this thesis I will consider the following range of inter-firm organizational modes:

- *Unilateral contract-based alliances:* arm's-length transactions, in which there is a unilateral knowledge/technology flow and a clear exchange of property rights from one firm to another one. Within this category I include licensing agreements, subcontracting and distribution agreements.
- *Bilateral contract-based alliances*: partnerships in which two or more firms cooperate and share resources for the achievement of a common objective. Some

specific forms of bilateral contract-based alliances include joint production, joint marketing and promotion and joint R&D.

- *Minority equity alliances*: alliances in which one firm makes an equity investment in his partner.
- *Joint Ventures*: alliances in which two or more firms create a jointly owned legal organization that serves a limited purpose for its partners, such as R&D or marketing.
- *Mergers or Acquisitions*: one firm takes full control of another's assets and coordinates actions by the ownership rights mechanism.

As is possible to notice, the governance forms here presented are ordered following a TCE logic; namely, they reflect, from the top to the bottom of the list, an increase of the level of integration.

Unilateral contract-based alliance is the governance form closer to the market, it has a very low degree of integration, indeed firms still work separately. It does not involve shared ownership and it has generally a short to medium term. Bilateral contract-based alliance is still a non-equity governance form, not involving shared ownership, but it requires a moderate level of integration since firms have to work together for a common goal. It has a short- to medium-term, and although it is regulated by a contract it requires reciprocal control between partners. Then, minority equity alliance represents a more integrated governance mode, an 'hybrid', because of the equity participation, that entails a one-way or cross-equity ownership with a consequent interest alignment. These kinds of alliances are generally medium- to long-term. Joint ventures imply a higher degree of integration, since firms work together for the new legal entity and jointly make the equity investment. Finally, firms use totally integrated governance forms, namely mergers and acquisitions, when they desire to take full control of another's assets and coordinate actions by the ownership rights mechanism.

Thus, inter-firm relationships can be ranked on a continuum between free market transaction and complete internalization solutions (Lorange and Ross, 1993). Even if it is difficult to be specific, concrete and detailed regarding the ordinal ranking of this range, it is safe to state that equity-based agreements represent more integrated governance forms and require an higher inter-firm interdependence in comparison to non-equity agreements. It is also safe to take M&As as the most integrated governance

form in the market-hierarchy continuum. Therefore, in this study I consider that IFRs are ranked on a continuum that varies for various degrees of interorganizational interdependency and levels of integration (Hagedoorn, 1990).

2.4 Theories underlying inter-firm relationships

In literature several theoretical strands have examined the rationales for signing collaboration agreements and the factors influencing the choice of the governance of such inter-firm collaborations, including Transaction Cost Economics (TCE) (Williamson, 1979; 1985; 1991), Resource-based View (RBV) (Kogut and Zender, 2002; Zollo et al., 2002), Property Right Theory (PRT) (Hart and Moore, 1990) and Real Options theory (RO) (Folta, 1998; Kogut, 1991).

All these approaches and theories, that are only some of those who faced the issues, try to explain the creation of alliances suggesting that market uncertainty, increasing competition, efficiency requirements, resource complementarities and so on drive companies to engage in strategic alliances to reach competitive advantages. Also, these theories try to detect the factors that managers must take into account when they have to design the governance of the relationship. In particular, investment specificity and transaction uncertainty, partner's resources and capabilities, the protection of strategic assets and the possibility to create and exercise an option in a point on time.

Among all the theoretical approaches, I choose to review the most used theories that try to explain how to structure the governance form of the relationship: Transaction Cost Economics, Resource-based view, Property Right Theory, and Real Option Theory.

2.4.1 Transaction Cost Economics

The transaction cost theory (Williamson, 1975; 1985) is surely the most adopted perspective by those researchers that try to understand the rational of inter-firm relationships. According to Transaction Cost Economics (TCE) (Williamson, 1991b), transactions can take place in markets, within the organisation or hierarchy, or in the middle between the market and hierarchy. The theory emphasizes that organizations try to minimize the coordination costs of economics exchanges with other organizations; and these costs depend on the presence of transaction-specific investments, the threat of opportunistic behaviour and the frequency of interactions. Thus, different organizational

choice depends on the analysis of these cost factors. In pure market exchanges, transaction costs mainly depends on factors such as search, selection, negotiation, fulfilment and enforcement. Within firm boundaries, costs generally include agency and control costs. From a TCE perspective, alliances represents an intermediate governance form, between market and hierarchy, a 'hybrid' (Gulati, 1995); the TCE argument suggests that strategic alliances are more efficient than market or hierarchical solutions when they minimize the firm's transaction costs (Jarillo, 1988).

Summarizing, according to TCE scholars (Williamson, 1979), market transactions might be highly efficient as governance forms in different situations, since they are flexible and reversible forms and they minimize organizational costs of hierarchical structures, but on the other hand when opportunistic behaviour is likely to occur (because of asset specificity, lack of trust between partners, differences in terms of bargaining power etc.), the theory suggests to reduce this relational risk by choosing a more structured and hierarchical governance mode. Alliances contribute to reduce the opportunistic behaviour of partners (Pisano et al., 1988), arising when transactional conditions lead the firm to desire some degree of control over the transaction without fully internalizing it.

2.4.2 Resource-based view

The resource-based view (RBV) assumes that firms can be conceptualized as a bundle of resources (Wernerfelt, 1984; Peteraf, 1993), that those resources are heterogeneously distributed across firms and that resources difference persist over time (Penrose, 1959; Wernerfelt, 1984). In particular, Wernelfelt (1984) defines a resource as "anything, which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semipermanently to the firm". Thus, a firm resource can be a financial asset or a technology, as well as reputation or managerial skill.

The core idea of RBV is that a strong strategy should be based on the resources, competences and capabilities of the firms. When the resources of a firm are valuable, rare, inimitable and non-substitutable (the so-called VRIN resources), they then provide a competitive advantage over rivals (Barney, 1991).

The resource-based perspective is also often adopted when researchers study inter-firm relationships; indeed, this perspective emphasizes how firms can get the access to

valuable resources and capabilities of other firms through IFRs or by engaging in mergers and acquisitions (Eisenhardt and Schoonhoven, 1996; Chung, et al., 2000). In this sense alliances are, therefore, cooperative relationships driven by logic of strategic resource needs. However, a firm that is interested in acquiring their partners' valuable resources through a inter-firm collaboration, at the same time must be careful to protect their own resources during the alliances-making process. Thus, adopting a RBV view, when managers have to design the governance of the relationship they have to find a structure able to balance the two issues: being able to procure valuable resource from another party without losing the control of one's own resources.

Beside the traditional resource-based theory, another perspective has received several contributions, that is the dynamic capabilities approach. According to Teece et al. (1997) in situation of rapid and unpredictable change, firms may obtain sustained competitive advantage if they are able to use dynamic capabilities; namely if they are able to rapidly integrate, build and reconfigure their internal and external competences according to environmental changes.

2.4.3 Property Right Theory

Starting from the seminal works of Coase (1959), Alchian (1965), Alchian and Demsetz (1972; 1973) etc., the property right theory (PRT) started gaining a lot of attention by economics and strategic management researchers. This earlier stream of research literature is referred as 'classical property rights theory' to contrast with the 'modern property rights theory' that is mainly due to Grossman and Hart (1986) and Hart and Moore (1990) (the so-called GHM model).

In general, the 'classical' version of PRT focuses attention on the historical and institutional context that shapes and changes the property rights of a firm; whereas the 'modern' version of the theory develops models of ownership and incentive structures. The first definition of property rights is due to Alchian (1965, p.129) that states that property rights are the 'rights of individuals to the use of resources… supported by the force of etiquette, social custom, ostracism, and formal legally enacted laws supported by the states' power of violence or punishment'. Thus, a property right is the right to use resources sanctioned by the law, social conventions and behaviours. However, in this work I mainly refer to the more recent contributes to PRT; indeed, the GHM model wonders who, in a relation between two parties, should own what assets and introduces

the concept of 'residual control rights'. In the GHM model, because of potential problems of contractual opportunism (e.g. ex post opportunism), due to relation-specific investments, effort measurement, incentives determination and so on, firms must consider the residual control rights of those assets involved in the relation. Namely, this model points out that what is important, is not the residual property right on the output, but the residual control rights over assets; indeed, when contracts are incomplete, the rights to residual control over assets correspond to assets ownership that subsequently safeguards contracting parties from contractual hazards such as ex post opportunism problems. Fundamentally, the assets owner determines how to use these assets.

Thus, adopting a PRT point of view in analyzing inter-firm relationships, firms must consider how to protect their own assets and how to gain the access and control of partner' assets. In particular, the theory emphasizes the importance of assets' ownership, achievable through an integration solution, and the role of asset-specificity.

A concept strictly related to PRT, and also to TCE that will be used in my theoretical framework, is the 'appropriability hazard' (Teece, 1986). This kind of concern is especially present when inter-firm relationships involve a technology transfer. As explained by Oxley (1997), when contracts are incomplete, because of gaps in specifications, the possibility of opportunistic behaviour may arise from both partners; indeed, on the one hand, the owner of the technology may find a reason for which it not anymore convenient to transfer the technology to that particular partner and so he transfer less technology than promised in the original contract. On the other hand, the other party, after receiving the technology, may use or modify the technology in several ways that were not specified in the agreement and that may damage it or decrease its value from the developer point of view. These risks are called appropriability hazard and are associated with technology transfer in inter-firm collaborations. Those authors that analyzed the extent of an appropriability risk in IFR (Oxley, 1997; Gulati and Singh, 1998) agree to the fact that this risk leads firms to adopt a more hierarchical governance structure.

2.4.4 Real Option Theory

The real options (ROs) theory was developed as a financial method for investment decision. A real option is 'the right, but not the obligation, to take an action in the future' (Amram and Kulatilaka, 1999, p.5). Recently, real options has started to attract

significant interest also in the field of strategic management, especially from scholars analyzing inter-firm relationships, because it offers another attractive point of view for the governance mode choice (Kogut, 1991; Folta, 1998).

As suggested in the literature streams on real options, certain types of investments might be considered as the creation of an option, which might be exercised at a later point in time using a more integrated solution (i.e. Hagedoorn and Sadowski, 1999; Kogut, 1991; Vanhaverbeke et al., 2002). Indeed, ROs are usually described as an option creation and an option exercise, two different investments in two different points in time; the first is the initial decision of investment in order to create the option and the second is the subsequent and not mandatory decision of exercise this option.

Real options reasoning has become so successful mainly because it highlights the combined importance of uncertainty and managerial discretion, and it presents a dynamic view of firms' investment and organizational governance decisions. ROs point of view highlights the value associated with the ability of a firm to react flexibly to an uncertain future. The theory conceptualizes firms as an aggregation of investment opportunities and emphasizes the value of investments that allow firms to manage risk proactively by exploiting uncertainty over time in a flexible fashion (Kogut, 1991). Thus, real options are specifically designed to enable firms to postpone the investment decision under uncertainty conditions.

From the perspective of managers who have to structure the governance form of an IFR, ROs suggests that, under environmental uncertainty conditions, he must adopt flexible organizational forms, such as contract-based alliances. Especially, when partner firms are exploring new knowledge or technologies, the investing firm first have to learn from the partner and build familiarity with the new technological area through small initial learning investments that can be seen as the creation of the option. Over time, after reaching a good understanding of the new technology and of its business opportunities, the investing firm can eventually exercise the option by expanding and firming up the relation, for example through an equity investment or even an acquisition.

2.5 Literature review on drivers influencing the governance of IFRs

Being the focus of this part of the thesis the analysis of factors influencing managers' decisions about the governance of inter-firm relationships, I review the strategic

management literature on the topic. Some of the papers I analyze are only theoretical papers whereas the others are empirical ones.

The interest in this field of research dates back to early nineties and the first contributions use a transaction-cost point of view. Pisano (1990) is the first, to the best of my knowledge, who started to empirically investigate the firm's choice between internal (hierarchical) and contractual (market) modes for organizing a product R&D program. Namely, his paper posits that transaction-cost factors influence an established firm's choice between in-house and external sources of R&D. In particular, by examining data on 92 biotechnology R&D projects that major pharmaceutical companies have sponsored, he finds that small-number bargaining hazards in R&D markets motivate the established firms to internalize the project, namely they choose a hierarchical governance to manage the relation with biotech firms, source of R&D expertise.

Also authors such as Gulati (1995) and Parkhe (1993a), explore the factors that explain the governance structures in inter-firm alliances with an emphasis on transaction-cost. They point out the role of inter-firm trust that emerges from repeated alliances between the same partners, suggesting that trust can be a substitute for hierarchical contracts in many exchanges and serve as an extra-contractual control mechanism by reducing the perception of opportunism risk. Both authors find empirical evidence supporting that the familiarity established among partners mitigates the hold-up risk and leads to market-oriented models. Also, interesting for the purpose of this work, is another result of Gulati (1995); in his paper he distinguish just between equity and non-equity alliances and he finds that alliances encompassing shared research and development are likely to be equity-based. Thus, the nature of the alliance may have an impact on transaction costs leading to a greater hazard associated with the alliance. Pisano, Russo and Teece (1988) had already predicted this result. Also, Gulati and Singh (1998) focus on how the extent of coordination costs and appropriation concern in an alliance can predict the use of a particular governance structure. On the one hand, their results provide strong support for the importance of co-ordination costs; indeed, they find that the greater the anticipated coordination costs arising from interdependence associated with a strategic alliance at the time of its formation, the more hierarchical was the governance structure used to formalize it. On the other hand, also the appropriation concern increases the likelihood of firms choosing hierarchical structure.

Another paper that uses a TCE point of view is Oxley (1997); this is very interesting for several reasons. First, she make a step forward in this research field, because of the governance structures she considers; indeed, while most previous empirical research has focused only on the choice between contract-based and equity joint ventures (Gulati, 1995; Pisano, 1990; Pisano et al., 1988a), she distinguishes between three different alliances types: unilateral contract-based alliances, (i.e. licensing agreements), bilateral contract-based alliances (i.e. cross-licensing and technology sharing agreements), and equity-based alliances (i.e. joint ventures). Second, she shows that appropriability hazards are an important consideration when firms establish a new relation; she finds that the wideness of the transaction type, the technology scope and the involvement of different geographical areas increase appropriability hazards, pushing towards more hierarchical governance forms (i.e. equity joint venture). Thus, she empirically analyzes some new drivers of the governance choice: (i) transaction type, i.e. the activities covered by the agreement, product and process design vs. production and marketing, or "mixed"; (ii) the technology scope, i.e. the range of products or technologies covered by the agreement; (iii) the geographical scope, i.e. worldwide focus vs. local focus.

Hagedoorn and Narula (1996) focus on how international and sectorial differences influence the organizational mode of strategic alliances. Also these authors use only a TCE perspective and differ only between contractual alliances and equity alliances. However, they find a very interesting result; briefly, they measure the degree of technological intensity of the industry, that imply uncertainty and complexity, and find support for their hypothesis according to which contractual agreements are more likely in high-tech industries rather than in relatively mature industries.

Also the research proposed by Folta (1998) is interesting for our purpose, since the author uses a real option perspective to compares cooperative arrangements to acquisitions. He concludes that, in order to maximize the value of their real options, in environments characterized by high uncertainty, incumbents often prefer cooperative arrangements to internalization through acquisition. This result seems to be quite in contrast with Transaction Cost Economics (TCE) results (Coase, 1937; Williamson, 1979) which, in front of transactions characterized by high uncertainty, predict governance forms more hierarchy-oriented.

Steensma and Fairbank (1999) study the internalization of external technology; namely, organizations have three basic options for acquiring technological know-how: (i) develop the technology independently, (ii) acquire another company that already

possesses the technology, or (iii) enter into a technology-sourcing agreement, either unilaterally (licensing) or via joint development. Their paper has a number of differences from past efforts. From my point of view the most important one, is linked to the fact that they recognize that the use of a unique theoretical perspective, i.e. TCE, do not provide a complete framework for understanding motivations for the choice of different governance forms. In their paper they use in a complementary fashion, both a resource-based view and a real option perspective, in order to hypothesize how certain perceived attributes of the technology involved in the inter-firm relationship, such as its imitability, rarity, technological and commercial uncertainty, and dynamism, influence the risk/return of the relation and therefore the governance mode. For example, they find that the greater the perceived difficulty of technical imitation, the more likely firms are to choose acquisitions or joint development, as opposed to a more arms-length licensing arrangement. This is consistent with resource-based arguments. Another interesting point of this paper is that it is the first that consider M&As as an alternative governance form of an inter-firm relationship, since past research considers M&As as something deeply different and independent from alliances.

More recently IFRs researchers started using different theoretical perspectives in analysing the drivers influencing the choice of the governance of inter-firm relationships, going beyond the classical factors linked to transaction costs. Some very interesting papers dealing with the issue are theoretical papers that try to develop models based on the risk perception of partners.

One of the most influential theoretical model, from my point of view, is the one by Das and Teng (2001a); they propose an interesting risk perception model of alliance structuring in which they examine the antecedents of risk perception, by distinguishing between relational and performance risk. Antecedents of relational risk are: (i) the lack of a cultural understanding and responsiveness, (ii) expected inequities regarding payoffs in alliances and (iii) the lack of trust. On the other hand, performance risk depends on: (i) general environmental factors, such as political risk, (ii) competitive environment factors and (iii) internal characteristics, such as the lack of a competence. Then, they suggest which type of alliance should be preferred depending on the minimization of the total risk perceived. They develop several propositions, but they do not empirically test their model. Moreover, from my point of view, another limitation of this work is that they consider only strategic alliances, from licensing agreements to joint ventures, not considering M&As as an alternative governance form.

Another paper that analyzes the issue only from a theoretical point of view is the one by Van de Vrande et al. (2006); they examine the effect of uncertainty on governance mode choice of IFRs from both a TCE and ROs perspectives. In particular, they distinguish between factors related to endogenous uncertainty, such as technological distance or trust between partners, and exogenous uncertainty coming from technology characteristics, such as the development stage. They argue that when exogenous uncertainty is high companies are better off using governance modes that are reversible and involve a low level of commitment, namely more market-oriented governance forms. On the other hand, when exogenous uncertainty has decreased because of prior R&D investments, transaction costs considerations, namely endogenous uncertainty coming from relational factors, became dominant and companies will shift towards more hierarchical governances forms. This paper considers corporate VC investments, strategic alliances (both equity and non-equity) and acquisitions as alternatives for technology sourcing; they do not study unilateral contract-based alliances, such as licensing or supply agreements.

Furthermore, Das and Teng (2000) use a RBV perspective to detect the principal drivers shaping the governance form. They distinguish between property-based and knowledge-based resources; thus, although the governance form choice depends on how resource typologies of the two parties are mixed in the relationship, property-base resources push toward more market-oriented governance forms, while knowledge-based resources push toward more integrated governance forms. Also this paper is just theoretical and do not consider M&As as possible governance choice.

Another interesting paper on alliance governance is the one by De Man and Roijakkers (2009); they propose a framework for designing alliance governance structure analysing whether control and trust are complements or substitutes depending on the level and the type of risk an alliance faces. They argue that in high risk situations a combination of control and trust is used in a complementary way; whereas in low risk situations, depending on the type of risk, relational or performance risk, control and trust are used as substitutes. They illustrate their framework through five case studies, that of course do not represent an empirical confirmation of the framework.

Another interesting perspective is given by Contractor and Ra (2002); they develop a theoretical model examining how attributes of corporate knowledge influence the selection of alliance governance mode. Hypotheses are presented on the choice of alliance governance mode as determined by knowledge attributes (codification,

newness, complexity, and teachability) and partner characteristics (such as knowledge absorptive capacity). The continuous spectrum of alliance types they consider ranges from repeated discrete contracting to equity joint ventures. However, they do not test their propositions.

Going back to the review of empirical papers, by following the theoretical perspective by Das and Teng (2000), Chen and Chen (2003) compare TCE and RBV points in shaping the choice between contractual alliances and equity JVs and they find that, whilst the transaction cost model is powerful in explaining the choice between JVs and contractual alliances, the resource-based perspective provides useful insights into the choice between two distinctive forms of contractual alliances, namely, exchange and integration alliances. This paper examines characteristics such as asset specificity, resources typology and uncertainty through a survey that is not focus on a specific industry. Also, Rosiello (2007) analyses the issue of the governance choice in a cluster of biotech companies in Scotland, both from a TCE and a RBV perspectives. He analyses transaction factors, such as sunk costs and uncertainty, and resources characteristics, such as replaceability, complexity and replicability and he shows, through his empirical results, how technological and demand uncertainty and resources complexity make collaborative agreements more likely than standard contracts, confirming in this way both TCE and RBV perspectives.

Also the paper by Dunne et al. (2009) is particularly interesting for our purpose; indeed they use a RBV perspective to empirically study the governance choice matter in biopharmaceutical industry by analysing how firms' resources, in particular technical, commercial and social capital, influence the choice between equity and non-equity alliances.

However, from my perspective, the most important contributes, are two recent papers due to Santoro and McGill (2005) and Van de Vrande et al. (2009) that investigate the choice of a continuum of governance forms between market and hierarchy in the biopharmaceutical industry. Santoro and McGill (2005) analyse the influence of asset co-specialization, partner and task uncertainty and technology uncertainty on the choice among five different governance forms: one-way licensing, bilateral cross licensing, bilateral not licensing, minority equity and joint ventures (JVs). Consistently with TCE, they find that co-specialized assets increase the likelihood of hierarchical governance and partner and task uncertainty increases this effect. Consistently with RO, technological uncertainty decreases the likelihood of hierarchical governance. On the

other hand, Van de Vrande et al. (2009) analyse the impact of environmental turbulence, technology newness, technology distance and prior ties on five different governance forms: non-equity technology alliances, Corporate Venture Capital (CVC) investments, minority holdings, JVs and M&As. Again, appealing to TCE and RO, they obtain a controversial support to the two theoretical strands.

By concluding, the analysis of the literature on the drivers influencing the choice of the governance form of IFRs shows how several efforts have been done in order to better understand the issue.

In Table 1, I synthesize the main contributions highlighting the theoretical focus of each paper, the main drivers detected, the operationalized measures for each drivers, the governance forms considered and finally the paper's typology, namely if it is only a theoretical one or also empirical and which type of data it uses.

The literature analysis reveals several limitations and gaps; some of which are here presented.

First of all, researchers have often used different theoretical perspective combining them in pairs, but they have never tried to develop a comprehensive theoretical framework that take into account simultaneously all the identified drivers coming from different theories. In fact I show how the most important contributions that use more than one theoretical perspectives, are based just on TCE and RO theories, or TCE and RBV, or RO and RBV. What emerges from the empirical literature is instead that the main drivers influencing the governance form choice come from the analysis of different theories; they are: asset specificity (TCE), uncertainty (TCE, RO), appropriation concern (TCE, PRT), trust (TCE) and resource typology (RBV). Thus, following a recent literature strand on IFRs' governance structure (Leiblein, 2003; Leiblein and Miller, 2003; Patelli, 2009; Foss and Roemer, 2010) I strongly believe that integrate findings coming from different theoretical approaches may lead to new and interesting results.

Second, the majority of the analyzed empirical papers does not consider all the spectrum of governance possibilities from pure market transactions to totally integrated solutions; most of them study just the choice between equity vs. non-equity alliances.

Third, some very interesting papers, such as Das and Teng (2001a) and De Man and Roijakkers (2009) develop theoretical models that study how the level of risk perceived by alliance partners influence the design of the alliance governance structure.

Table 1. Synthesis of the literature on drivers influencing the governance choice

Paper	Theoretical focus	Main driver	Operationalized Drivers	Governance modes	Type of paper
Santoro and McGill (2005)	TCE RO	Asset specificity Uncertainty	Asset co-specialisation Partner uncertainty Task uncertainty Technological uncertainty	One-way licensing Bilateral cross licensing Bilateral not licensing Minority equity alliances and JVs	Empirical data bank analysis on the biopharmaceutical industry
Van de Vrande, Vanhaverbeke and Duysters (2009)	TCE RO	Uncertainty Trust	Environmental uncertainty Technology uncertainty Prior ties	Non-equity technology alliances CVC investments Minority holdings Joint Ventures and M&As	Empirical data bank analysis on the biopharmaceutical industry
Oxley (1997)	TCE PRT	Appropriation concern	Transaction focus Range of products or technologies Wideness of geographic area	Unilateral contractual alliances Bilateral contractual alliance Equity alliances	Empirical multi industry data bank analysis
Gulati (1995)	TCE	Uncertainty Trust	Previous ties Different nationality Different firms	Non-equity alliances Equity alliances	Empirical multi industry data bank analysis
Gulati and Singh (1998)	TCE	Uncertainty Appropriation concern Trust	Interdependence Technological uncertainty Appropriability regime Prior ties	Contractual alliances Minority equity investments JVs	Empirical multi industry data bank analysis
Das and Teng (2000)	RBV	Resource typology	Property-based resources Knowledge-based resources	Unilateral contractual alliances Bilateral contractual alliances Minority equity alliances JVs	Theoretical paper
Steensma and Fairbank (1999)	RBV RO	Resource typology Uncertainty	N° of previous alliances or JVs Resource potential economic rent Resource uncertainty	Licensing Joint development alliances Acquisition	Survey not on the biopharmaceutical industry
Chen and Chen (2003)	TCE RBV	Asset specificity Resource typology Uncertainty	Asset specificity Technological and environmental uncertainty Resource complementarity	Contractual alliance Joint Ventures	Survey not on the biopharmaceutical industry
Rosiello (2007)	TCE RBV	Asset specificity Resource typology Uncertainty	Sunk costs Uncertainty Resource replaceability, complexity, non replicability and strategicity	Standard contracts Collaborative agreements Integrated structures	Survey on the biopharmaceutical industry

On the one hand, the first paper, the one by Das and Teng, analyzes the antecedents of risk perception, by distinguishing between factors influencing relational risk perception and those influencing performance risk one. Whereas, De Man and Roijakkers, investigate whether control and trust are used as complements or substitutes depending on the level and the type of risk an alliance faces. However, these papers are only theoretical ones and they have never received an empirical confirmation of the developed propositions.

For the reasons set out above I strongly believe that there is still much to be investigated in order to reach a comprehensive understanding of how firms choose the governance form of their relationships.

Finally, I want to point out that a more in depth analysis of the limitations of the available literature and, thus, of the contributions of my research is stated in the introductions of chapter 4 and 5, in which I explain the motivations for the presented researches.

2.6 Research context: the bio-pharmaceutical industry

The study of the choice of the governance of IFRs presented in this thesis, both in chapters 4 and 5, has been applied to a specific research context that is the biopharmaceutical industry. Both the theoretical frameworks and empirical analyses described in the two chapters have been contextualized looking at the specific relationship between established pharmaceutical firms and young biotech firms.

The most important reason that leads me to this choice is that the biopharmaceutical industry is surely the field with the highest rate of formation of alliances, mergers and acquisitions, etc. For this reason it has already been taken as test-bed by several researchers.

The huge and constantly growing number of inter-firm relationships between pharmaceutical and biotech companies is due to the fact that the advent of biotechnology, in the mid 1970s, has radically changed the traditional process for new technology research and development; this has created a need for pharmaceutical giants to acquire new skills from outside the companies' boundaries. Indeed, the emergence of biotechnology brought in a new framework the process of discovery and development of new drugs; it has established itself as the new discovery arm of the pharmaceutical industry, modifying the traditional, chemical-based, pharmaceutical discovery method

(Tushman and Anderson, 1986). Thus, biotechnology has represented a competence-destroying technology on the R&D end, because it requires technical skills, which are fundamentally different from those pharmaceutical companies had developed until then. However, differently from other industries, the effect of this radical change has not been disruptive for the traditional pharmaceutical firms, since biotech companies have not replaced incumbent firms. Indeed, despite the considerable technological advantage of new entrants, incumbents still owned important strategic assets in developing such new biopharmaceutical products (Rothaermel, 2001), and furthermore in marketing and distribution.

This situation has created positive opportunities for collaborations between the new sources of technical expertise and the established firms (Pisano, 1990; 2006); this is the reason why since the mid 1970s the biopharmaceutical industry has been characterized by an increasing recourse to IFRs between big pharmaceutical firms and small new biotechnology firms (Hagedoorn, 1993; Higgins and Rodriguez, 2006). Indeed, when firms have to gain access to new resources and know-how they have three main options, including (1) developing them internally, (2) acquiring them from outside, i.e. through M&A, and (3) gaining access to them, i.e through strategic alliances and partnerships (Hunt, 2000; Morrow et al., 2007).

The explanation of the increasing number of IFRs in the industry is mainly related to the extent of strong asset complementarities between the two types of firms. On the one hand, a pharmaceutical firm wishing to commercialize a biotechnology-based drug needs to acquire the necessary competencies by developing the required R&D capabilities in-house or sourcing them from outside, i.e. from a biotechnology firm (Chiesa and Toletti, 2004). In this regard, Mittra (2007) suggests that the significant challenge for strategic management is to find the proper balance between in-house R&D and externally sourced knowledge; but he also underlines that the best combination between developing in-house R&D or through merger, acquisition, strategic alliance and licensing activities, changes from one company to another, because it reflects the distinct situational contexts in which the firms find themselves embedded. On the other hand, a biotech company that has developed a new compound or a technological platform and wants to bring it into the market often lacks critical functions or capabilities such as drug manufacturing and marketing ones. According to McCutchen and Swamidass (2004) biotechnology firms are, in fact, “functionally incomplete”. Thus, the presence of strong complementarities initially brought pharma and biotech

companies to cooperate instead of compete. Furthermore, pharmaceutical firms have been facing with some threats, such as the increase of R&D costs and the decline of R&D productivity (DiMasi et al., 2003; Bradfield and El-Sayed, 2009), the expiration of numerous patents, the old technologies exhausting and the increasing competition from generic pharmaceutical firms. Conversely, biotechnology firms have technological assets that allow to face with such threats (Danzon et al., 2007). Finally, a very important source of complementarities is on the financial side. Indeed, drug development process is long, costly and highly uncertain: it requires 10-15 years from research to market and costs vary from US$ 800 million (DiMasi et al., 2003; Goozner 2004) up to US$ 1.2 billion for a biopharmaceutical drug (DiMasi and Grabowski, 2007). Furthermore, out of 100 drug candidates, only one or two are launched into the market. Thus, it is easy to understand how financing is extraordinarily important for high-tech industries in general and for the biotech industry in particular. As stressed by Gopalakrishnan et al. (2008), the financial capital acquired by the smaller biotech firm in exchange for technological knowledge is in fact one of the main goals of the alliance formation process. As also highlighted by Pisano (2006), young biotech start-ups usually may obtain financial capital trough two different sources: Venture Capital (VC) financing or entering strategic deals with other firms. When the pharmaceutical company takes an equity position in the biotech it can be considered as well as a VC investment; otherwise, as in the majority of alliances, the pharma gives moneys, without taking an equity position, that are accounted for as debt in the biotech's financial statement (Gopalakrishnan et al., 2008). In the other respect, more mature companies can rely on products and technologies commercialization, as well as intellectual assets (i.e. patents) and services sale. But, since only products commercialization ensures a continuous and quantitatively sufficient cash flow to finance future R&D activities, new biotech companies, which have never sold any product, lack enough cash flow for their R&D activities. Pisano (2006) highlights how despite the commercial success of companies such as Amgen and Genentech, most biotechnology firms earn no profit. Beyond the lack of financial capital of biotech firms that is absolutely essential to carry out their activities, biotechs use alliances also as a signalling mechanism to the market of their value in order to improve their market evaluation (Janney and Folta, 2003). On the other hand, established pharmaceutical firms have high financial resources, due to their blockbusters and their long presence in the market. Thus, entering into agreements with pharmaceutical firms represents an extremely important strategic tool for biotech

companies (Pisano, 2006). This is the reason why, starting from the seminal work of Pisano (Pisano 1990), several scholars (Folta, 1998; Steensma and Fairbank, 1999; Santoro and McGill, 2005; Rothaermel and Deeds, 2006; Higgins and Rodriguez, 2006; Rosiello, 2007; Dunne et al., 2009; de Man and Roijakkers, 2009; Van de Vrande et al. 2009) have used this industry as test-bed for investigating governance forms choice in inter-firm relationships. Indeed, while the aforementioned complementarities provide reasons of why pharmaceutical and biotech companies should cooperate, questions arise about the governance form of such a relation (Pisano, 1990). There are various inter-organizational modes with which firms can develop or acquire technologies, including R&D partnerships, technology licensing, strategic alliances, joint ventures and acquisitions of other firms. This is the reason for the following theoretical framework.

2.7 Conclusions

This chapter presents the theoretical background and the literature review on the first topic addressed in this thesis, namely the choice of the governance form of IFRs. Indeed, the investigation of a problem cannot be separated from the study of the main theories underlying that problem and of the most influential contributions of the literature. This preliminary study of the most adopted theoretical approaches and literature review, led me to the identification of the main gaps and gave me inspiration for new research ideas and contributions that are objects of the two empirical researches presented in chapter 4 and 5.

Thus, in this chapter, I firstly present some definitions of IFRs explaining that for the main purpose of this study and following others authors in the field, I use the term ‘inter-firm relationship’ to refer to a broad range of collaborations including bilateral licensing agreements, outsourcing agreements, bilateral contract-based alliances, equity investments, joint ventures, and mergers and acquisitions (M&A) and so on. I then provide a clear and detailed explanation of each governance form, looking with a TCE logic, at their level of integration, control and flexibility.

It follows the review of the most adopted perspectives used in the alliance literature, i.e. Transaction Cost Economics, Resource-based View, Property Right Theory and Real Options Theory. This review is of fundamental importance for understanding the following literature analysis.

Hence, I present the state-of-the-art of IFRs literature with the main purpose of synthesizing major efforts made by past research in identifying the drivers of the choice of the governance form of IFRs. In order to find and make clear the existing gaps of the literature, I make an in-depth analysis of each of the analyzed papers, pointing out the theory/theories on which it is based, the identified drivers, the governance modes it takes into account, the paper's typology, namely if it is theoretical or empirical, and of course the main results and contributions.

Finally, the last paragraph of this chapter introduces the research context of my studies; namely I explain why I choose the biopharmaceutical industry as research field and the main characteristics of the relationships between pharmaceutical and biotech firms.

Chapter 3

THE INVESTOR-INVESTEE RELATIONSHIP IN THE VENTURE CAPITAL CONTEXT: THEORETICAL BACKGROUND AND LITERATURE REVIEW ON VC CONTRACTING

3.1 Introduction

In the past three decades, the venture capital industry has grown dramatically and at the same time it started to attract increasing attention by academic researchers. The literature has indeed dealt with investigating its role for the global economy and its forms and functions. Researchers have increasingly shown that, despite the little dimension of the industry in comparison to the public market, it has an extraordinary positive impact on the economic landscape.

In this section of the thesis I particularly focus on the investor-investee relationship, namely, the relationship between Venture Capitalists (VCs) and their portfolio companies, with the main objective of investigating venture capital contracts design. In particular, this chapter presents the main characteristics of the venture capital industry and of the VC-entrepreneur relationship; moreover, I present a literature review on venture capital contracting. I should however point out immediately that venture capital research still suffers from the relative opaqueness of the industry. For a long time, empirical work largely had to rely on survey data yielding a rich picture regarding general market assessment, but a potentially very subjective view of specific investments given the reliance on self-reporting. Hence, traditional empirical literature suffered from two types of biases: (i) a selection bias resulting from smaller VCs showing a greater willingness to participate in survey studies and (ii) a reporting bias due to the tendency of investment managers to overstate economic performance. It is therefore not surprising that for several years academics have displayed a tendency to stick to safer ground and to focus on aspects of the venture capital cycle closely related to the mainstream of corporate finance research, the selection of financial instruments and covenants.

However, in the last decade, VC research has made much more progress, especially thanks to the growing availability of data, both in form of commercial databases, and thanks to initiatives taken by researchers to build dataset based on private data.
The literature review presented in this chapter is mainly divided between theoretical and empirical literature on VC contracting and has the goal of evaluate how the advance of the theoretical research has an empirical confirmation in the practice.
The reminder of the chapter is organized as follow: in section 3.2 I present the most adopted definitions of the venture capital industry along with its main characteristics; section 3.3 is a literature review on the investor-investee relation based on agency-theoretic considerations. This section provides an overview of the mechanisms and contractual covenants used by venture capitalists in order to manage agency conflicts. The last section concerns conclusions.

3.2 Defining the venture capital industry

The venture capital industry lacks a precise legal or regulatory definition. However, definitions of venture capital usually focus on some specific characteristics. In this thesis I propose some definitions that I think are better resuming the main characteristics of the industry.

> According to Gompers and Lerner (2001), "venture capital is defined as independent and professionally managed, dedicated pools of capital that focus on equity or equity-linked investments in privately held, high growth companies."

> Shilit (1991) states: "venture capital can be thought of as financing for privately held companies, generally in the form of equity and/or long term convertible debt… The venture capitalist, like the banker, serves as an intermediary – or conduit – between the investors… and the entrepreneurs."

> Kunze (1990) adds: "the combination of equity participation plus the active involvement in the development of the company is what distinguishes venture capital from all other investment vehicles."

From these definitions, the reader should note how the core activity of Venture Capitalists (VCs), namely those who makes venture capital investments, is to invest in 'privately held companies'. Thus, they finance initiatives of private individuals that

want to become entrepreneurs. Secondly, VCs invest in 'high growth companies'; they usually select companies in the seed, start-up or expansion phase of their development, which typically operate in new technology-driven, high-growth industries. Thus, they cope with high levels of investment uncertainty associated with the market's overall economic viability as well as the quality of management in place. This concept is strictly linked to the one highlighted by Kunze (1990), i.e. the active involvement of VCs in the development of the venture. Indeed, venture capitalists are 'active financial investors' and their role goes well beyond the mere provision of financial capital. They contribute expert knowledge about the respective industry, grant access to their business network and carry out monitoring of their investments. Finally, the willingness to make an 'equity investment' (as in Gompers and Lerner, 2001; Shilit, 1991) is another defining characteristic; they typically provide a mix of debt (especially convertible debt) and equity financing.

Finally, I want to point out that the venture capitalist (VC) is an 'intermediary' that obtains money from arm's-length investors, such as individuals, pension funds and other institutional investors, and pools this money with internal resources. Hence a VC is not investing his own money; he sets up 'funds' - venture capital funds – thus, a single venture capitalist may have several funds.

3.3 Agency-theoretic considerations and literature review on the investor-investee relationship

Beyond the definition of what the venture capital industry is, in this research I mainly focus on the relationship between the venture capital (VC) investor (the principal that provides funds to a venture) and the entrepreneur (the agent with a venture that needs financing). Similar to typical principal-agent scenarios found in the general financial contracting literature, the relationship between VC and entrepreneur is characterized by a considerable potential for agency conflicts resulting from information asymmetries between the two parties.

Theoretically, an agency relationship exists between a firm's shareholders – the principal - and its managers – the agents. The owner is assumed not to be able to monitor the manager's actions. The owner does, however, observe the outcome of these actions, which we will take to be the firm's profit (Grossman and Hart, 1983). Thus, the principal-agent problem arises when ownership and control are separated and the self-

interest of managers may lead them to act not in the interest of the shareholders. The problem is to design monitoring or incentive systems that will make managers act in the best interest of the shareholders. In the VC contracting case the venture capitalist that provides capital represents the principal and the entrepreneur is the agent.

The relationship between VC and its portfolio companies follows a standard life cycle consisting of the following stages: (1) selection of target companies, (2) appraisal of potential investments, (3) contracting selected companies, (4) monitoring fund investments and (5) exiting investments. During all these stages the investor-investee relationship is characterized by considerable agency conflicts resulting from the extent of high uncertainty, information asymmetries and incentive problems between the two parties.

Unique to venture capital, however, is the extent to which these asymmetries exist[1], as well as the high degree of risk on both sides. Much more than other investors from theory, VCs invest in projects with highly uncertain outlooks, in very dynamic and volatile markets and in firms with a current asset value of practically zero. Moreover, entrepreneurs will have superior information on the firm's substance and prospects and a lot larger array of decision options regarding its future direction due to the lack of established business activity. Therefore, before the investment decision, in spite of the fact that VCs are usually specialized and have competent managers, ex-ante information asymmetries create a high possibility of an adverse selection problem that results in a 'market for lemons' (Akerlof, 1970), where either the best projects don't receive the funding terms they deserve or they don't get offered to the VCs anyway.

Consequently, early papers modelling the VC-portfolio firm relationship focused on this ex-ante information asymmetry and the associated potential for adverse selection. Chan (1983) introduces VCs as intermediaries between uninformed investors and informed entrepreneurs, who, through their expertise and superior industry experience, contribute to the diminution of uncertainty in the market, thereby reducing the prevalent danger of a 'lemons' market. Amit et al. (1990) argue, however, that factors like project quality and the capability of the entrepreneur are unknown ex-ante for the VCs, as well. Therefore, they will generally tend to offer mediocre financing conditions to all entrepreneurs, alienating better firms to alternative forms of financing. One of the

[1] External monitoring by the capital market is obviously extremely limited to non-existent. Both the potential of the company's business idea and the capabilities of the founder (team) are initially unknown.

potential loopholes out of this dilemma includes a differentiating design of contracts: by for example accepting more severe penalties in case of malperformance, the entrepreneur can signal his own degree of confidence in the success of the project and reduces the prevalent information asymmetry between the two parties. Therefore, several authors studied how pre-investment screening activities of the projects may significantly reduce agency conflicts. Namely, VCs use pre-contracting mechanisms such as syndication (e.g. Manigart et al., 2006; Tykvova, 2007), in order to access to potentially better quality information obtained through the social networks of other VCs and also have potentially increased information processing capacity through the involvement of more and different decision makers (Sah and Stiglitz, 1986). Syndication is particularly important for information sharing when the problem of information asymmetry is particularly high and an informed second opinion enhances the chances that the VC reaches a better decision (Lerner, 1994).

Also after the investment decision, VCs incur risks specific to investing in entrepreneurial companies that result in further agency costs unique to venture capital. VCs and entrepreneurs have potentially diverging interests, especially stemming from imbalanced financing structures[2] and the fact that the latter associate substantial non-monetary benefits with their role in the company and with the existence of the company as a whole.[3] This can motivate the entrepreneur to make decisions outside the VCs best interest and to engage in 'window-dressing' activities biasing the venture's short-term performance. This creates a moral hazard problem.

Venture capital contracts have to account for this discrepancy and have to be adapted with regard to the parties' major goals. The entrepreneur wants the possibility for flexible future expansion and medium- to long-term control over his company to retain above-mentioned benefits. The VC is first and foremost motivated monetarily. He aspires to the highest possible return and needs contractual downside protection. Furthermore, he wants an option to take control over the company in cases of malperformances and full control over his own exit in case the venture develops positively. Contracts, therefore, have to encompass a range of eventualities unique to

[2] For example, Admati and Pfleiderer (1994) argue that the decision whether or not to continue the company's operations is implicitly made by the better informed entrepreneur, whose typically option-like payoff structure (limited loss, but high participation in potential gains) encourages him to overinvest and to continue projects which should rather be abandoned.

[3] According to Bergemann and Hege (1998), also this misalignment can in turn lead to potential moral hazard problems, as the entrepreneur may divert funds and effort to serve his private benefits, still unobservable to the investor.

venture financing, especially regarding the venture's different lifecycle stages and its expected degree of development over time. Their efficient design can not only help to align the incentives of VC and entrepreneur, but may also prevent opportunistic behaviour on the side of the latter and value destruction of the VC's investment.

The third major unique feature in the VC-entrepreneur relationship results from the traditional role of VCs as active investors, which goes far beyond the traditional principal-agent context. Considering the usually low managerial experience of entrepreneurs, VC effort is essential for the investment success. Younger theoretical models therefore developed a double moral hazard scenario[4], in which the VC provides input in the form of monitoring (Lerner, 1995) and the provision of various kinds of managerial advice around central issues like firm strategy, financial policy, negotiation with suppliers or customers, leveraging connections in the industry, the establishment of organizational structures and the recruitment of key personnel (e.g. Gompers and Lerner, 1998; Hellmann and Puri, 2002).

Analogous to these constitutive attributes in the VC-entrepreneur relationship and the unique forms of agency problems resulting thereof, VCs contracts have to be uniquely designed to efficiently address them.

According to financial contract theory and empirical research these agency conflicts can be mitigated in three ways: (i) pre-investment screening that allows the investor to choose good projects and/or (ii) structuring financial contracts such that cash flow rights and control rights are aligned to allow optimal behaviour by the entrepreneur or decisive intervention by the principal if need be and/or (iii) post investment monitoring and advising (Hart, 2001; Kaplan and Strömberg, 2003).

Through the correct combination of these mechanisms, VCs can design incentive-optimal investment contracts, which largely mitigate the issues identified above. The use of syndication, the choice of financial instruments, the allocation of cash flow and control rights and monitoring activities will be discussed in-depth in the following paragraphs.

[4] For example Schmidt (2003), who precludes that also VC commitment has a direct impact on the success of high-potential ventures and can also not be contractually fixed, especially because the necessary amount of effort is usually unknown ex-ante. Therefore it should be taken into account when modelling this relationship.

3.3.1 Syndication as a pre-contracting mechanism

As anticipated, agency conflicts between VCs and their portfolio companies are usually mitigated during the contracting phase of the life cycle of the investment. However, agency problems can be handled also in a previous stage, namely during the pre-investment screening of projects through the use of syndication. Indeed, VCs use syndication in order to mitigate ex-ante company specific-risks due to information asymmetry and incentive problems. In venture capital syndication, two or more VC firms come together to take an equity stake in an investment. Hence, "syndication implies the making of common decisions under condition of uncertainty that will result in joint-payoffs for the investors" (Wilson, 1968).

Several authors analyzed syndication both in theory and in practice identifying the main rationales for syndication. Lerner (1994) was one of the first contributions to syndication empirical literature highlighting the rationales for syndication of venture capital investments basing on a sample of 271 private biotech companies. He identifies one rational for syndication that is linked to the advantage deriving from having more than one VC in the evaluation of the project before it is selected for investment, the so-called selection hypothesis. Namely, it is a way for the lead venture capitalist to bring other VCs in the selection process, since two or more VCs might screen projects more effectively than one. He also shows that while in first round financing, established venture capitalists tend to syndicate with one another, in later rounds they involve less established venture firms. These results are consistent with the view that syndication allows established venture capitalists to obtain information in order to decide whether to invest in risky firms.

Brander et al. (2002) add and test a new hypothesis, the value-added hypothesis, that is based on the idea that venture capitalists might add value to the venture in which they invest. Since different VCs have different skills and information, some might be useful in organizing production, others might contribute with a better knowledge of the market etc. They test whether venture capitalists are engaged primarily in selection or in managerial value-added. They find that syndicated investments have higher returns, favouring the value-added interpretation. They also discuss risk sharing and project scale as possible reasons for syndication. In particular, the risk sharing hypothesis was first suggested but not tested by Lerner (1994) and then tested by Brander et al. (2002); it is based on the idea that VCs undertake syndication so as to diversify their portfolios and reduce overall risk. Brander et al. (2002) provide some evidence on the role of risk

sharing and conclude that risk sharing may be present. Moreover, they suggest another rational, namely syndication might arise from capital constraints since a single VC might not have enough resources on hand to fully finance a large venture; however they find that such constraints are unlikely to be a major explanation for syndication.

Also Lockett and Wright (2001) focus on explanations for the syndication of venture capital investments. They compare the risk sharing motivation, namely the traditional financial approach that views syndication as a means of portfolio diversification, and the resource-based perspective, that considers syndication as a response to the need to share/access information in the selection and management of investments. They empirically prove that the finance perspective provides a strong explanation of motives for syndication, but the resource-based view is found to be much more important for those firms involved in at least some early stage transactions. The major implication of their work is that the use of syndication strongly depends on the investment stage in which the VCs operate.

Moreover, Manigart et al. (2006) analyze four main motivations to explain syndication in venture capital firms in Europe: risk sharing rational, access to deal flow, deal selection motive and monitoring skills. In contrast with U.S. findings, they show that overall VC portfolio management strategy is a major driver of syndication in Europe. Thus, European VC managers mainly consider syndication as a means to invest in several deals that otherwise would be too large and to obtain access to future deal flow, increasing portfolio diversification.

Finally, another possible rational for syndication detected in literature is collusion, indeed by banding together rather than competing, venture capitalists might improve their position with entrepreneurs.

However, beyond the various motivation for syndication analyzed in literature, in my thesis I want to emphasize the role that syndication assumes in the pre-contracting phase as a mechanism to mitigate ex-ante company-specific risks due to information asymmetry and incentive problems. This is because by syndication, VCs not only have access to potentially better quality information obtained through the other VCs, but they also have potentially increased information processing capacity through the involvement of more and different decision makers (Sah and Stiglitz, 1986).

3.3.2 Financial instruments in VC contracts

The most extensive body of literature on venture capital contracting deals with the implemented financial structure and its ability to solve or mitigate incentive problems in the VC-entrepreneur relationship. The superiority of convertible securities, in particular convertible preferred equity, has been theoretically discussed and empirically proved among researchers worldwide. Nevertheless, empirical studies have shown a variety of financing instruments being applied in practice. Obviously a VC may choose between debt securities, equity securities and a mix of both.

Among *debt securities*, straight debt financing is not very widespread in the venture capital context, despite its seniority over all other instruments that provide the investor with better downside protection. Instead, convertible debt can be observed a lot more often, since it has the same seniority advantage and furthermore provide the VC with the option of switching from a fix to a variable claim once the venture's prospect become clearer. Finally, silent partnerships represent a special form of debt financing where investors participate in the venture's profits, even if they do not hold shares in the company. Silent partnerships are not very common form of VC finance internationally.

On the other hand, through *equity securities* the investor participates in the upside development of the firm and inhibits superior information and control rights. With common equity, VC also accepts an equal portion of the risk, which may result in a misallocation of effort by the founder, as he has an incentive to accumulate private benefits he does not have to pay for by himself. Common stocks are subordinate to any debt or preferred equity. Preferred equity, instead, differs from common stock mainly through its superior dividend, liquidation and subscription rights. On the downside, straight preferred stock usually has only limited upside participation. While standard preferred stock in listed companies often does not grant voting rights, this is very uncommon in venture capital finance. Convertible preferred equity additionally incorporates an option to convert into common equity if the venture evolves positively and it is the most common instrument in the industry. The conversion ratio is contractually agreed ex-ante, but may often be adjusted ex-post in case of diluting capital increases. Also automatic conversion provisions on going public or the fulfilment of certain milestones are common. Moreover, a special form of this security is called participating preferred stock, with which investors not only receive their contractually agreed dividend and liquidation preference, but furthermore participate pro rata with all other shareholders in any remaining proceeds on top.

In this section I summarise the main contributions of both theoretical and empirical literature on the financial instrument choice; it is to be noticed that the most extensive body of research in venture capital finance concerns optimality considerations between different securities combinations.

Several instruments or instrument combinations are perceived as substitutes in most models. Cumming (2001) identifies three major groups of functionally equivalent securities: straight debt and straight preferred equity, straight common stock and warrants, as well as all 'convertible-preferred-like' securities. Note that for example debt-equity mixes are functionally equivalent to convertibles in some of the models (Marx, 1998; Bergemann and Hege, 1998), while in others they are not (Berglöf, 1994; Cornelli and Yosha, 2002; Schmidt, 2003).

As theoretical research over time fully adapted double moral hazard models, academics have more and more reached consensus on the efficiency of convertible preferred equity in venture finance. Reasons identified by researchers are diverse: like convertible debt, convertible preferred stocks can be used as a signalling instrument that forces entrepreneurs to indicate their confidence in the venture's future potential and align the incentives of VCs and founders by allocating cash flow rights efficiently during the relationship and when approaching an exit. Moreover, they underlie a favourable tax treatment at least in the US and are supposed to allocate control contingent on company success. Especially the control right explanation should be observed with care. In reality, VCs apparently structure convertible preferred equity in a way that voting rights are determined on an 'as-converted basis', so that control tends to be the identical before and after conversion. Also the rationale that conversion triggers a switch between a fix and a variable VC claim does at least not hold for participating preferred equity, which is reasonably popular in practice.

Moreover, it is noteworthy that empirical results in the US leave no room for doubt that convertible preferred equity is the most used financing instrument in the industry, as it is nearly exclusively applied in VC investments (Sahlman, 1990; Trester, 1998; Kaplan and Strömberg, 2003). On the other respect, the overall picture in other countries is substantially more variegated; outside US borders, VCs apparently structure their investments substantially different (Bascha and Walz, 2002; Cumming, 2005a; Cumming, 2005b; Cumming, 2008). Some VCs thereby implement similar incentive mechanisms with different instruments, but many do not. For example Bascha and Walz

(2002) find that German VCs use much more silent partnerships, straight equity and debt-equity mixes than convertible preferred equity.

By concluding, the securities choice is surely one of the most important decisions in VC investments; of course the combination of equity and/or debt securities determines the allocation of several cash flow rights that allow aligning the incentives of VCs and founders; in particular, convertible securities, both debt and equity, allow allocating cash flow rights efficiently during the relationship and also when approaching an exit.

3.3.3 Cash flow rights

Investment contracts are obviously not limited to an incentive optimal cash flow allocation through the use of financial instruments; additional terms and conditions governing the underlying contractual relationship play a very important role in preventing opportunistic behaviour on either sides. In this paragraph I give an overview of most adopted cash flow rights examining how these rights are effectively used in VC contracts to reduce agency problems.

Cash flow related covenants are generally intended to secure the VC's purely financial stakes. They are applied as a downside protection for the VC to prevent a dilution or reduction of his investment value and as a measure to maintain control over the constitution and duration of his share in the portfolio firm.

The most applied cash flow right is *staged financing*. It is used to restrain VCs' initial investment amount, and to not commit the entire amount all at once by making cash flows conditional on the achievement of specific milestones.

Also, to manage VCs' financial claims after total capital infusion, *conversion options* are used to regulate the conditional type of claim; for example, they enable a swap between debt and equity stakes respectively between a fix high-order claim in case of distress and a participating claim on high returns.

A third group of cash flow related covenants warrants the VCs' ability to back down from their investment after a certain time period (*redemption rights*) and alleviate VCs to force an exit and satisfy own cash requirements (*exit rights*). In particular, exit rights are fundamental in the venture capital cycle since they are used to solve or at least mitigate potential hold problems between the VC and the firm's founder in the case of exit. In parallel, they also provide protection from unwanted entrepreneur share sales at their cost (registration rights and co-sale agreements).

Last but not least, a final group of covenants, commonly known as *VC safeguards*, is intended to protect the VC's financial position in cases where certain events would otherwise potentially dilute his share and influence in the company.

Among the above described cash flow related covenants, the staging of capital infusion is surely the one that received most attention by both theoretical and empirical literature; through staged financing the VC cannot only abandon projects falling short of initial expectations, but also provides clear incentives to the founder to focus his efforts. Such goals often include financial performance targets, but may also correspond to the achievement of operational milestones, like the development of a prototype, patent filing or market entry.

Neher (1999) describes a hold-up problem in a multi-stage model on a fix investment path under perfect certainty and symmetric information, in which the entrepreneur provides exclusively human and the investor provides exclusively financial capital. Staging, in this context, alleviates the entrepreneur's inability to commit not renegotiating down the VC's cash flow claims after a sunk investment by threatening to withdraw his valuable human capital. As stages progress, the founder's human capital becomes gradually embodied in the physical capital of the venture. Since the collateral for the investor thereby increases, the latter should be willing to provide more money at the subsequent stage. While the author provides an explanation for staging, the assumptions of his model remain questionable, especially with regards to symmetric information and the certainty of the project's outcome given continuous provision of both founder effort and VC funding.

The paper by Wang and Zhou (2004) is particularly interesting since the authors show that stage financing is an effective complementary mechanism to contracting in reducing risks and agency costs. They investigate staging of investments in an imperfect capital market, in which only the VC understands the entrepreneur's project potential (its profit distribution function), but faces moral hazard and uncertainty, as the project is risky and the entrepreneur's effort unverifiable. Their model point out how many projects that would have possibly been abandoned under an upfront financing scenario become profitable through staging. However, staging may also cause VCs to underinvest in or abandon non-promising projects too early. Similarly, Bigus (2006) investigates stage financing in a real option framework and concludes that it provides the investor with a valuable real option under external uncertainty, as he can choose to terminate his investment in the venture at any time.

The implications of theoretical studies have been confirmed by empirical research as well. Firstly, empiric researches demonstrate that staging is very widespread in practice, but more prevalent for investments with high agency costs (Gompers, 1995; Kaplan and Strömberg, 2003). Also, authors such as Gompers (1995) show that actually VCs decide to discontinue investments in portfolio firms once they learn about negative information regarding their future development and profit potential.

3.3.4 Control rights

Finally, VCs use control rights to secure their operational and strategic influence in the portfolio firm. Through a combination of instrument choice and the implementation of specific control-related covenants, VCs are able to allocate control independent of cash flow rights. Adhering to their role as active contributors beyond the mere provision of financial capital, they use decision and veto rights to influence both the general strategic direction of the venture and to enforce or block individual decisions even after the contract has been designed.

Decision rights mainly relate to the constitution and consent requirements of the venture's supervisory board, namely board rights and board seats, regulations for voting rights, either enforcing or offsetting the "one share one vote" principle and management replacement clauses. *Veto rights* concern instead a number of important strategic, financial or operative decisions, such as veto on changes to shareholder's agreement, asset sales, sales of shares, capital structure, business plan, etc.

VCs contribute their own resources and experience to the development of the firm and thereby protect their investment in case of potentially conflicts with the founder. Also the distribution of control rights is frequently made contingent on measures of the venture's financial or non-financial performance.

The theoretical literature mainly investigate the efficiency of a separation between control and cash flow rights in designing VC contracts, in order to mitigate agency conflicts arising from imperfect ex-ante contracting. The allocation is generally designed to provide optimal performance incentives for both parties involved and to eventually protect the value of the VC's investment.

Aghion and Bolton (1992) and Dewatripont and Tirole (1994) predict a shift of control to the investor in bad states and both papers emphasize the role of the capital structure in achieving these control shifts. Hellmann (1998) offers a more explicit explanation of

why entrepreneurs voluntarily relinquish control by allowing VCs to negotiate comprehensive control rights beyond instrument choice. Specifically, his model examines the right to appoint the CEO, which might obviously result in the replacement of the founder. According to the model, entrepreneurs will be more willing to relinquish control the smaller their own equity stake, the higher their wealth constraint and the higher the expected quality of external management. Kirilenko (2001) analyzes cash flow and control right dynamics comprehensively and explains why the share of control should be allocated independently and why most VCs' control rights exceed their equity share. The entrepreneur does not disclose the value of his private benefit of control and other non-contractible aspects of running the venture, which leads to an adverse selection problem. In equilibrium, VC's control rights disproportionately increase with higher adverse selection problems. The risk-averse entrepreneur (as opposed to a risk-neutral investor) is compensated with better financing conditions and a lower risk share.

Dessein (2005) differentiates between formal control and actual interference. His fundamental assumption implies that the entrepreneur is not necessarily worried about the allocation of formal control rights, but derives his private benefits from having real control over the direction of his firm and individual strategic decisions. He points out that giving up control functions as a signalling mechanism of the entrepreneur confidence on the venture's success.

Moreover, several papers investigate control rights dynamics empirically. Lerner (1995) identifies indications confirming that VCs attain more control in portfolio firms with low performance; specifically he finds that VC's board involvement increases significantly after CEO replacements, which generally indicate a crisis. Gompers (1997) shows that VCs implement covenants to allocate control independent from cash flow rights. The use of these control covenants in his sample increases with the amount of agency costs, as it is higher for early stage and R&D-intensive portfolio firms.

Both authors' findings are roughly consistent with Kaplan and Strömberg (2003), who investigate the issue in much more detail. In essence, they confirm that VCs manage to allocate control rights and cash flow rights independently and that control is commonly contingent on the development of the venture. In the case of bad performance, control gradually shifts to the investor. Moreover, Kaplan and Strömberg (2003) also confirm that investor control correlates with agency costs. Investor voting majority was found to be more common in pre-revenue firms than in post-revenue ones.

Bienz and Walz (2006) examine the structure and evolution of decision and control rights and they document that VCs adjust the structure of control rights throughout the relationship with their portfolio firms, even though the overall level of control rights remained the same.

Summarizing, theoretical and empirical literature affirms the efficiency of a separation of control and cash flow rights accomplished by combining financial instruments with covenants. Also the allocation of control rights, designed to provide optimal performance incentives for both parties involved, is generally contingent on observable measures of venture performance.

3.4 Conclusions

This chapter presents the theoretical background and the literature review on the second topic addressed in this thesis, namely contract design in venture capital investments. Indeed, the analysis of the existing literature, both theoretical and empirical, has been of fundamental importance in order to understand the state-of-the-art of VC contracting and which are the main gaps in this literature stream. This preliminary study led me to the identification of new interesting research ideas and contributions that are object of the empirical research on VC contracting presented in chapter 6.

Thus, at the beginning of this chapter, I introduce some definitions of 'venture capital investment', underling its peculiarities: they are investments in privately held companies, with high growth rates, made by active financial investors that not only provide capital, but also support the development of the venture with their knowledge and expertise.

Afterwards, I present the main object of my research, that is the analysis of the relationship between the venture capital (VC) investor (the principal that provides funds to a venture) and the entrepreneur (the agent with a venture that needs financing).

In this part I point out how all these stages of the investor-investee relationship are characterized by considerable agency conflicts resulting from the extent of high uncertainty, information asymmetries and incentive problems between the two parties. Then, through the analysis of financial contract theory and of the existing literature I highlight that these agency conflicts can be mitigated in three ways: (i) pre-investment screening that allows the investor to choose good projects and/or (ii) structuring financial contracts such that cash flow rights and control rights are aligned to allow

optimal behaviour by the entrepreneur or decisive intervention by the principal if need be and/or (iii) post investment monitoring and advising.

Hence, it follows a review of the most important contributions on the use of syndicated investments, on the choice of the financial instruments and on the allocation of cash flow and control rights in venture capital contracting practices.

Chapter 4

DRIVERS INFLUENCING THE GOVERNANCE FORM CHOICE IN IFRs: A SURVEY IN THE ITALIAN BIO-PHARMACEUTICAL INDUSTRY

4.1 Introduction

This chapter presents a research work that aims at identifying factors affecting decision making on the governance mode of inter-firm relationships in the biopharmaceutical industry. The theoretical framework here presented is then tested through an empirical analysis based on a survey carried out in the Italian context, between firms associated to Farmindustria.

The literature review on the drivers influencing the choice of the governance form of IFRs, discussed in section 2.4, reveals several interesting findings and at the some time points out some gaps. The reader can notice from the analysis of Table 1 how the main drivers studied in previous research are referable to the four theoretical perspectives described in Chapter 2, namely Transaction Costs Economy, Property-right Theory, Resource-based View and Real Option theory. These drivers are: asset specificity (TCE), uncertainty (TCE, RO), appropriation concern and resources' typology (TCE, PRT, RBV) and trust (TCE).

Since all the mentioned papers considered just one or two theoretical strands, it comes how there is not an empirical work in the literature analysing the impact of all the above drivers on the selection of the governance form. This is, in my opinion, an important limitation in the available literature; indeed, as also stressed by recent literature on IFRs' governance structure (Leiblein, 2003; Leiblein and Miller, 2003; Patelli, 2009; Foss and Roemer, 2010), I strongly believe that the lack of empirical studies that integrate findings coming from different theoretical approaches is unfortunate for several reasons. First, the importance of common concepts, such as uncertainty and appropriation concern, suggests that important connections exist that may enhance our understanding of organizational governance. Also, some recent research has demonstrated that the failure to integrate theories of organizational governance choice

may lead to misleading empirical findings (Leiblein, Reuer and Dalsace, 2002). Thus, the clear separation between these theories, namely the fact that past research focused on just one or two theoretical strands at the same time, is in my opinion, a limitation in the available literature that I would like to overcome. Therefore, the first contribution of the present research is to develop a framework combining all the aforementioned drivers, contributions and theoretical perspectives coming from all past research efforts.

Second, it should be noticed how all the reviewed researches formulate their theoretical frameworks (hypotheses sets) on the main drivers and afterwards they operationalize them; while this approach is aimed at developing a general framework, it lacks in capturing the specificity of a given industry. Such a problem is quite evident with the driver uncertainty; indeed, although the relationship between uncertainty and firm's governance decisions is stressed in much of the existing literature, empirical studies often found contradictory results. Depending on the typology of uncertainty considered, i.e. behavioural uncertainty, technological uncertainty or demand uncertainty, researchers have demonstrated positive/negative relationship between uncertainty and integrated solutions. These contradictions may be due to the different sources of uncertainty considered and also to the variety of measures employed by researchers (Sutcliffe and Zaheer, 1998). On the contrary, the goal of this research is to formulate hypotheses directly on operationalized drivers, distinguishing for example between factors influencing relational uncertainty rather than technological uncertainty; in this way I'm also able to gather factors that are very specific of the biopharmaceutical industry. Of course in this way I obtain a less general framework, but very focalised and consistent with the industry and more useful from a managerial point of view.

Third, in the present research I introduce a new driver that is very specific of this industry, i.e. the level of "functional completeness" that has never been studied in previous research. Below I'll highlight the importance of this driver, especially in industrial context here investigated.

Finally, the last contribution of the present research is that I analyse a dual perspective problem deriving from the extent of conflicting objectives and a bargaining power problem between biotech and pharmaceutical companies, an issue often neglected in literature.

This chapter is organized as follow: in the next paragraph 4.2, I introduce the context of my research, i.e. the bio-pharmaceutical industry and I explain why I choose this industry as the field of my analysis. Then, in paragraph 4.3 I present the theoretical

framework consisting of a set of seven hypotheses; afterward, in paragraph 4.4 I present the empirical analysis concerning a survey I conducted within the Italian bio-pharmaceutical industry and the results obtained. Finally in paragraph 4.5 I present discussion and conclusions.

4.2 Theoretical framework developing: first set of hypotheses

Before starting the description of the theoretical framework, it is noteworthy to clarify the object of this study. I concentrate my research on one single relationship between a pharmaceutical/biopharmaceutical and a pure biotech firm. Namely, I focus on a specific transaction of assets, as unit of analysis, that is the transaction of a biotech-based compound or technology under development or already developed, that comes from the biotech company's research. In fact, the focal point of this study is on how established pharmaceutical firms are approaching to the new technology; thus, depending on the governance form selected to manage the transaction, they can: (i) get the licence of a product already developed (licensing agreements), (ii) share resources and efforts in order to jointly develop the compound (R&D alliances), (iii) create a new legal entity that assumes the ownership of the asset (JVs) or (iv) acquire the biotech firm in order to internalize the transaction and obtain the rights of all the products and assets of the acquired firm (M&As).

Thus, the hereafter I consider the following governance forms: (i) unilateral contract-based alliances, that in the bio-pharmaceutical industry, are mainly licensing agreements, through which the pharmaceutical firm seeks to acquire a technology developed by the biotech company through a legal contract, in order to gain the right to use that technology in exchange for royalty payments; (ii) bilateral contract-based alliances, such as non-equity R&D alliances, usually used to jointly research and develop a new compound; (iii) equity alliances and joint ventures, in which both the pharmaceutical and the biotech firms share resources and efforts for a common goal and finally, (iv) mergers and acquisitions.

The theoretical framework here proposed is based on the literature review discussed in chapter 2. Indeed, the analysis of past researches leads me to detect five main drivers that influence the governance of IFRs: asset specificity, uncertainty, appropriation concern, resource typology and trust. Starting from these main drivers I identify some

operationalized measures that are specific of the biopharmaceutical industry, on which I formulate our hypotheses.

4.2.1 Investment specificity

As highlighted in the literature review, David and Han (2004) provide strong empirical support on how asset specificity increases transaction costs and creates a greater opportunism risk. In this case, TCE suggests internalizing the transaction in order to reduce these costs. In other respect, in order to protect strategic assets arising from inter-firm specific investments, also PRT suggests gaining the property of these assets. The above considerations lead me to the first driver significantly influencing the relationship, i.e. the presence of *transaction-specific investment (d1);* thus, I formulate the following hypothesis:

Hypothesis 1 (H1)*: If the level of transaction-specific investment (d1) is high, the pharmaceutical firm will prefer a more hierarchical governance form.*

4.2.2. Uncertainty

The presence of uncertainty, coming from both performance and relational risk, is a crucial factor in IFRs governance choice (Lo Nigro and Abbate, 2011). Specifically in R&D inter-firm relationships, it is quite acknowledged how the "technological newness" is one of the most important fonts of uncertainty (Van de Vrande et al., 2009). Moreover, as highlighted by Pisano (2006), in biotechnology R&D the levels of risk and uncertainty go well beyond what is entailed in normal R&D. Also, the emergence of biotechnology is considered a radical process innovation in the pharmaceutical industry (Stuart et al., 1999), since the activities of chemical synthesis deployed by traditional incumbents are becoming quite obsolete within the new biotechnology paradigm. So, beyond the classical distinction between incremental innovation (drug enhancement) and radical innovation (new drug development) (Cardinal, 2001), the depth of innovation in this industry can be associated to the extent to which the new process paradigm, the biotech one, is used to enhance former pharmaceutical products, or even to develop new classes of drugs. Of course, the "technological distance", i.e. the dissimilarities between the knowledge bases of the partners, contributes to the depth of

innovation; indeed, a pharmaceutical company that has no knowledge or experience in the biotechnology process, 'feels' a higher technological distance, and therefore, a more radical innovation. However, while this last issue concerns the relational uncertainty, the former being more technical, impacts on the performance one.

Thus, the *depth of innovation (d2)* is an important driver that must be taken into account in order to cope with uncertainty. In this case, RO literature suggests that investment affected by such exogenous uncertainty might be considered as the creation of an option, which might be exercised at a later point in time using a more integrated solution; these investments should preserve their intrinsic nature of options. This means that, when the partner's technology is quite novel, the pharmaceutical firm will be more likely to pursue market agreements, such as non-equity alliances, in order to remain flexible and to reduce the failure risk maintaining the intrinsic options (Vanhaverbeke, et al., 2002). Pisano (1990) also suggests the use of less integrated governance forms under conditions of technological newness. From an RBV perspective, the deeper the innovation, the more the resources involved are very specific of the firm, more property-based (for instance patents, human resources) and less transferable; this occurrence increases the relational risk, since it is quite difficult to evaluate both the strategic value and degree of transferability of such a resource. Hence, the investing firm can address the high relational uncertainty surrounding new technologies through small initial investments, so called "learning investments" (Janney and Dess, 2004), which are specific of market-oriented governance forms.

Therefore, I formulate the following hypothesis:

Hypothesis 2 (H2): *If the level of depth of innovation (d2) is high, the pharmaceutical company will prefer a more market-oriented governance form.*

Another interesting driver of the technological uncertainty in biopharmaceutical industry is the *development stage of the product/technology (d3)* object of the deal. Indeed, failure risk is greater in the very early phases of the R&D process. The drug development process is composed by four macro phases prior to commercialization: the drug discovery phase, the preclinical development, the clinical trials (composed by three stages, i.e. phase I, phase II and phase III) and the approval phase. Each of these steps is complex and uncertain, so that the more advanced the development stage, the more likely the drug succeeds in reaching the market; it should be considered that even when

a drug has completed phase II-A of clinical studies, the expected probability of success does not even reach the 50 percent (DiMasi, 2001). Thus, since in early stages performance risk is high, while the relational one is quite low, according to RO, the investing firm prefers alliances to acquisitions (Lambe and Spekman, 1997). Also Higgins and Rodriguez (2006) suggest that pharmaceutical firms seeking early stage research may best accomplish their goal using strategic alliances. However, as projects move further along the development process, pharmaceutical firms give up more rights if they try to access those products via an alliance. Therefore, according to PRT, it may be more beneficial for firms to make an acquisition, in order to acquire all of the products rights and avoid any potential costly hold-up issues (Klein and Murphy, 1997). So, moving along the development stage technical uncertainty (performance risk) decreases and appropriation concern, due to the relational risk, increases. Therefore, the following hypothesis can be formulated:

Hypothesis 3 (H3): *If the development of the product/technology (d3) is at a late stage, the pharmaceutical firm will prefer a more hierarchical governance model.*

The reader should note that the biotech firm's perspective regarding *d3* is instead opposite. Indeed, the amount invested till the agreement date to carry out a compound development up to a late stage will induce the biotech to put up greater resistance to an acquisition; indeed, if the biotech has been able to carry out the compound up to a late stage, it will try to complete last stages by its own in order to maintain all the compound rights.

Another issue often affecting uncertainty in technology agreements is the "technological distance" (According to Van de Vrande et al., 2009). In fact, in this case, it might be difficult for the investing firm to recognize and absorb its partner's technological capabilities (Cohen and Levinthal, 1990). Specifically, "technological distance", in bio-pharma R&D relationships, may occur in two main cases: (i) when the two firms are not specialized in the same therapeutic areas and (ii) when the pharmaceutical firm has never developed biotechnology in-house. It is here noteworthy to mention that a pharmaceutical firm can be catalogued as a "biopharmaceutical" company or as a "pure" one, depending on whether the firm has developed in-house biotech competencies.

Therefore, I detect other two fundamental drivers in the governance form choice: the overlapping of *therapeutic areas (d4)* and the *integration of the pharma in the biotech field (d5)*. Both drivers are signs of similarities or dissimilarities between the knowledge base of the two partners. Large dissimilarities lead to two types of problems. The first one concerns the 'absorptive capacity' (Cohen and Levinthal, 1990), indeed, the pharmaceutical firm has a limited internal scientific capability firstly to sort out which projects are attractive and which are 'lemons' (Pisano, 2006), and secondly to assimilate and integrate the new technology. In this case, Gulati and Singh (1998) suggest a more integrated governance form in order to facilitate the effective transfer of distant knowledge. Second, a large technological distance between partners may also lead to relational uncertainty and opportunistic behaviours due to information asymmetry. So, according to TCE higher level of integration becomes a more attractive alternative.
These argumentations bring me to the following two hypotheses:

Hypothesis 4a (H4a): *If the partners are not specialized in the same therapeutic areas (d4), the pharmaceutical firm will prefer a more hierarchical governance model.*

Hypothesis 5a (H5a): *If the pharmaceutical firm is not integrated in the biotech field (d5), it will prefer a more hierarchical governance model.*

On the other hand, other researchers, such as Pisano (1990), observe how a firm that is not yet familiar with the technological know-how of its partner will have first to learn from the partner through an arm's length transaction before being able to accumulate knowledge. Indeed, Pisano (1990) argues that a firm's ability to internalize new projects may depend on the number of its previous in-house projects in the relevant technology. This reasoning is consistent with the concept of "dynamic capability" in the RBV theoretical stream (Eisenhardt and Martin, 2000). As matter of fact, dynamic learning capabilities have been observed in the biopharmaceutical industry in contexts such as product development (Deeds et al., 1999), project development (Pisano, 2000) and international diffusion of technology (Madhok and Osegowitsch, 2000). Therefore, if a pharmaceutical company is integrated in the biotech field or, alternatively, is specialized in the same therapeutic area of its biotech partner, it has already developed internal knowledge-based resources in the field and therefore it will prefer a more hierarchical governance form, because learning occurs most efficiently inside the organization rather

than across organizational boundaries. On the contrary it will prefer a market transaction. Therefore, I hypothesize two alternatives to H4a and H5a:

Hypothesis 4b (H4b): *If the partners are specialized in the same therapeutic areas (d4), the pharmaceutical firm will prefer a more hierarchical governance model.*

Hypothesis 5b (H5b): *If the pharmaceutical firm is integrated in the biotech field (d5), it will prefer a more hierarchical governance model.*

4.2.3 Trust

Several scholars highlight the importance of characteristics such as trust, reputation, commitment, cooperation and communication for the success of IFRs (Gulati 1995; Gulati, Nohria and Zaheer 2000). Delerue (2004) finds that relational risk perception is mitigated by trust in biopharmaceutical relations. Indeed, trust and reputation establish norms and expectations about appropriate behaviour, lowering the perception of opportunism risk. The existence of *previous relations (d6)* between the partners is generally assumed as a measure of trust in a relationship, because it allows better evaluating partner's resources, capabilities and reliability (Gulati, 1995). Thus, the number of previous ties influences the choice of the governance in the subsequent relation modifying the assessments of transaction costs associated with a specific alliance and limiting the fears of opportunistic behaviour.

Authors such as Gulati (1995) and Parkhe (1993a) suggest that trust can be a substitute for hierarchical contracts in many exchanges and serves as an extra-contractual control mechanism. Therefore, the familiarity established among partners mitigates the hold-up risk and leads to market-oriented models. Gulati (1995) finds empirical evidence supporting this view. Also Ring and Van der Ven (1994) show that trust is an essential condition for market transactions. Santoro and McGill (2005) find that the lack of previous relationships, increasing the partner uncertainty, leads to more hierarchical governances in biopharmaceutical IFRs. Finally, trust improves the absorptive capacity of the partners in a relationship, reducing also the performance risk. Therefore, I posit:

Hypothesis 6 (H6): *The existence of previous relations (d6) between partners will be positively related to a more market-oriented governance form.*

4.2.4 Functional completeness

Finally, beyond the drivers already analyzed in literature, I consider a new one that is very specific of this industry, i.e. the level of functional completeness of a firm. I refer to the ability of the biotechnology firm to bring products into the market, thus I operationalize it by the *number of commercialized products (d7).* This is a measure of the biotech's expertise to complete its value chain by bringing its products to the market, obtaining in this way cash to finance its research activity. Surely, a company that has already marketed products is more attractive for a possible acquisition. Indeed, first, the pharmaceutical company can easily evaluate the economic value of its partner, and secondly, by an acquisition it inherits the control of the marketed biotech products. In this case, being the performance risk very low, the pharmaceutical firm will try to minimize the relational risk, and therefore the appropriation concern, by acquiring the partner. This reasoning leads me to formulate the following hypothesis:

Hypothesis 7 (H7): *The higher the number of commercialized products (d7) by the biotech firm, the more the pharmaceutical company will prefer a more hierarchical governance form.*

I underline, however, that the biotech company point of view is very different. Indeed, the higher the number of commercialized products, the more the company is functionally complete and able to finance new R&D projects individually. Thus, the biotech firm will avoid to be acquired once it has already supported costs and risks of products development and commercialization by his own. Therefore, due to the opposite objectives of the parties, the governance mode, in this case, will also depend on who has the greater bargaining power.

A synthesis of the theoretical framework discussed above is reported in Table 2.

Table 2. Synthesis of the theoretical framework

Operationalized driver	Main driver	Theories supporting the hypothesis	Hypothesis	Empirical support
d1: Transaction-specific investment	Asset specificity	TCE PRT	H1	NO
d2: Depth of innovation	Uncertainty Resource typology	RO RBV	H2	NO
d3: Development stage of the product/technology	Uncertainty Appropriation concern	RO PRT	H3	YES
d4: Therapeutic areas	Uncertainty	TCE Absorptive capacity	H4a	NO
	Resource typology	RBV	H4b	NO
d5: Integration of the pharma in the biotech field	Uncertainty	TCE Absorptive capacity	H5a	NO
	Resource typology	RBV	H5b	NO
d6: Previous relations	Trust	TCE Absorptive capacity	H6	YES
d7: Number of commercialized products	Functional completeness Appropriation concern	TCE PRT	H7	YES

4.3 Empirical analyses: a survey in the Italian bio-pharmaceutical industry

4.3.1 Research setting

To test the above hypotheses set, I analysed the Italian biopharmaceutical sector through a survey that was conducted in collaboration with Farmindustria (the Italian Association of Pharmaceutical and Biotechnology companies). Farmindustria aggregates approximately 204 companies, (biotechs, biopharmaceuticals and pure pharmaceuticals), most of which are Italians. Out of these 204 firms, 18 are pure biotech companies; these companies were not included in the survey because they were too few and, principally, because, in all those cases in which we expect conflicting outcomes, our hypotheses are formulated by expressing the biopharmaceutical company perspective. Finally, a substantial part of the contacted firms that are either foreign subsidiaries of big pharmas, having only sales departments in Italy, or small Italian biopharmaceutical companies, explained us they could not answer to our questionnaire because they do not make any strategic decisions about bio-pharmaceutical agreements. Therefore, the eligible sample for our survey was reduced to 52 companies.

4.3.2 Data collection and sample

Data collection was based on a survey that was conducted using a questionnaire that, with the support of Farmindustria, was pre-tested on two sample companies. Subsequently, the questionnaire was illustrated to a representative of each company by a phone call interview. Finally, each company representative returned us the completed questionnaire by e-mail. The duration of the investigation was of about 3 months. We received a total of 40 questionnaires out of 52, from pharmaceutical and biopharmaceutical companies. The 75% of the respondents are big Italian companies with more than 250 employees and annual turnover exciding 50 million of Euro. Despite the rather small size of the sample, it must be kept in mind that our sample represents nearly 20% of the total population (204 firms) and the 77% of the eligible population (52 firms). Moreover, the respondents account for the 35% of the whole turnover of the industry and, by considering that 50% of the whole

turnover is due to Italian subsidiary of foreign firms only selling products in Italy, one recognises how our sample is representative of the Italian biopharmaceutical industry.
From the respondents we collected data on 51 bio-pharmaceutical IFRs divided into 11 licensing agreements, 16 non-equity R&D alliances, 4 joint ventures and 20 mergers or acquisitions. Finally, since a certain number of companies in the sample failed to respond we controlled for a non-response bias. Comparing the respondents with the non-respondents on company sales volume and number of employees, and comparing the early and late respondents on the model variables, the t-tests showed no significant differences, suggesting that the response bias is not a significant problem in this study.

4.3.3 Variables and measures

4.3.3.1 Dependent variable

I model the variable *Governance Form, G,* as a three levels nominal variable taking values of: '0' for licensing agreements, '1' for non-equity R&D alliances and '2' for joint-ventures and M&As. The reason of such a modelling choice is straightforward. As explained in chapter 2, I consider licensing agreements as a unilateral contract-based alliance that is the governance form closest to a pure market transaction through which the pharmaceutical firm seeks to gain the right to use the technology developed by the biotech company. On the other hand, I consider JVs and M&As as the closest to hierarchical structures, because of the increasing level of vertical integration. In particular in my analysis, I grouped JVs and M&As together because the number of JVs in our data is quite irrelevant, just four, in comparison with M&As. Finally, R&D bilateral contractual alliances lie in the middle between market and hierarchy. The reader should notice how almost every scholar reviewed in the literature review have adopted a quite similar modelling of the governance form variable addressing the same motivations of above.

4.3.3.2 Independent variables

The scale used for each independent variable derives from a specific question addressed in the questionnaire. Depending on the possible answers, the independent variables are of

three main types: two are based on a five-point Likert scale of importance, four are binary and one is a six-level ordered variable.

The five-point Likert scale variables result from an assessment of the respondent about the importance of the driver for the specific agreement; thus, the value '1' means not important at all, '2' unimportant, '3' of medium importance, '4' important enough and '5' very important. These variables are:

- *Transaction-specific investment (d1)*; the variable expresses how much the respondent believes that transaction investments are idiosyncratic.
- *Depth of innovation (d2)*; the variable expresses how much the respondent believes that the object of the agreement (product or technology) is a deep innovation. As already discussed, the higher the extent of biotechnology process in the object of the agreement, the deeper has been considered the innovation. Moreover, deep innovations have been considered also in consideration of the "technological distance". Thus, respondents have autonomously expressed their evaluation on innovation depth once the interviewer has clarified the above concepts.

The following variables are dummy:

- *Therapeutic area (d4)*; the variable concerns the overlapping of the therapeutic areas between the two firms. It takes value '0' if the agreement concerns a therapeutic area where the pharmaceutical company is already specialized, '1' otherwise.
- *Integration of the pharma in the biotech field (d5)*; the variable expresses the degree of integration of the pharmaceutical company in the biotech field. Thus, it assumes value '0' if the pharma is a biopharmaceutical firm, '1' if it is a pure pharma.
- *Previous relations (d6)*; the variable considers if the two firms have already had relationships in the past. Thus, it takes value '0' if the two companies have never entered into any agreement in the past, '1' if they have already signed at least one agreement (of any type).

- *Number of commercialized products (d7)*; the variable considers if the biotech company have commercialized products. Hence, it assumes value '0' if the biotech has never marketed any product in the past, '1' otherwise.

Finally, the last variable is an ordinal one:

- *Development stage of the product/technology (d3)*: the variable analizes the development stage of the product/technology object of the agreement. It takes value '1', if the product/technology is in the discovery phase or preclinical development; '2', if in phase I of clinical trials; '3', if in phase II; '4', if in phase III; '5', if in approval stage and 6, if already approved or commercialized.

As previously described, our sample is fairly homogeneous in terms of firms' size, typology and decision structure, so that no control variables were needed for our model.

4.3.4 Results

In order to analyse data I first conducted a descriptive statistic and a correlation analysis (see Table 3). Only two variables (d4 and d6) are slightly, but significantly correlated; therefore, we decided not to exclude any variable from the regression analysis. The descriptive statistic reveals a first important result concerning the *transaction-specific investment (d1)*: a mean of 4.47 over a maximum of 5 indicates that no matter the governance form adopted, companies believe that investments are always highly idiosyncratic. So I do not expect significant results for this variable that, nevertheless, has been considered in the model.

Then, I conducted a Principal Component Analysis (PCA) on the independent variables in order to understand if they could be reduced in a smaller number of underlying latent dimensions. By using a factor loading analysis based on the correlation matrix and by applying the varimax rotation method, we found that variables *d4* and *d5* have high loading factors in the fourth component (respectively 0.70 and 0.60). This result suggests me that variable *d5* can be omitted by the regression analysis.

Table 3. Descriptive statistics and correlation matrix

	Independent variables	Mean	S.D	Min	Max	d1	d2	d3	d4	d5	d6
d1	Transaction-specific investment	4.47	1.06	1	5						
d2	Depth of innovation	3.58	1.52	1	5	0.069					
d3	Development stage of the product	3.52	1.97	1	6	0.221	-0.130				
d4	Therapeutic area	0.35	0.48	0	1	0.223	0.038	-0.032			
d5	Integration in the biotech field	0.35	0.48	0	1	0.100	-0.177	-0.011	0.056		
d6	Previous relations	0.27	0.44	0	1	-0.143	-0.093	0.013	-0.362**	-0.178	
d7	N° of commercialized products	0.29	0.45	0	1	-0.166	-0.165	0.045	0.064	-0.026	0.085

As concern as the regression analysis, since the dependent variable is modelled as a three levels nominal one, I have used a multinomial logistic regression. Indeed, it allows the simultaneous estimation of parameters when there are more than two categories in the dependent variable. Thus I evaluate, as a pair comparison, the choice of each governance form in comparison to the base outcome, that is assumed to be *G* = 2, that is JVs and M&As[5]. The general specification of the multinomial logistic regression here applied is:

$$Ln(P_j/P_o) = A + B_jX_j$$

Where Pj is the probability of an event taking place for the jth case. In this analysis the two possible events are: j=0 for a licensing agreement and j=1 for a R&D alliance. Po is the probability of the default condition, namely a JV or a M&A. Xj is the vector of the independent variables. Results of the regression analysis are organised in Table 4.

As the reader can notice, results for variable d3, the development stage of the product, and d6, the existence of previous relations, are confirmed just at level g = 1. In particular, the negative coefficient for d3 (-3.071) confirms that, as hypothesised in H3, hierarchy-oriented governance forms, such as JVs and M&As, are more likely than non-equity alliances when d3 assumes high values; the same cannot be confirmed for lower values of G, i.e. G = 0. Also the positive coefficient for d6 (5.717) confirms, as hypothesised in H6, how the existence of previous relations makes non-equity alliances more likely than JVs or M&As; the same cannot be confirmed for licensing agreements (G = 0).

Finally, result for d7 are confirmed, as in the hypothesis H7, even if not as expected when moving along the governance forms continuum; indeed, the negative value of the coefficient for G = 1 (-9.596) confirms that higher values of d7 are more likely associated with JVs or M&As, when compared with non-equity alliances; however, the increasing negative level of the coefficient for G = 0 (-2.739), while confirms that higher values of d7 are more likely associated with JVs or M&As than with licensing agreements, does not confirm that these last governance forms are less likely than non-equity alliances.

[5] Note that the choice of baseline category is irrelevant for the overall estimation of the model and can be set according to the authors preferences.

Table 4. Multinomial regression analysis results

G		Coef	Std. Error	Wald	p-value
0	Intercept	2.016	2.868	0.494	0.482
	d1 Transaction-specific investment	-0.254	0.509	0.250	0.617
	d2 Depth of innovation	-0.209	0.341	0.376	0.540
	d3 Development stage	-0.050	0.311	0.026	0.872
	d4 Therapeutic area	-0.737	1.051	0.492	0.483
	d6 Previous relations	1.368	1.050	1.697	0.193
	d7 N° of commercialized products	-2.739	1.270	4.655	0.031 **
1	Intercept	11.914	5.563	4.587	0.032 **
	d1 Transaction-specific investment	-0.415	0.602	0.476	0.490
	d2 Depth of innovation	-0.908	0.737	1.518	0.218
	d3 Development stage	-3.071	1.199	6.555	0.010 **
	d4 Therapeutic area	1.178	1.892	0.387	0.534
	d6 Previous relations	5.717	3.019	3.587	0.058 *
	d7 N° of commercialized products	-9.596	3.965	5.857	0.016 **

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.005$.

The reference category is 2

McFadden pseudo R-square: 0.543; Cox and Snell pseudo R-square: 0.682

Log likelihood: −47.747; Chi-Square: 58.488 ($p<0.01$)

Thus, in this case, I find a sort of U-shaped behaviour when moving along the governance forms continuum.

4.4 Discussion

This research aims at identifying factors affecting decision making on the governance mode of IFRs in the Italian biopharmaceutical industry. Main findings of this study are that the *development stage of the product/technology (d3)* object of the agreement, the existence of *previous relations (d6)* between the partners and the *number of commercialized products (d7)* by the biotech firm actually influence such decision.

As far as d3, the empirical evidence highlights that when the object of the collaborative agreement is a late-stage product the pharmaceutical company prefers a hierarchical governance form (JV or M&A). This result supports the RO and PRT view of the relation between technological uncertainty and governance form; indeed, through an integrated governance, the pharmaceutical firm can acquire the product's rights and avoid any potential costly hold-up issues. Also, this result confirms the prevalence of the pharmaceutical company point of view, since, as I have already stressed, the biotech company will have an opposite view regarding this driver. It is also quite interesting to notice how Santoro and McGill (2005) find an opposite result for this driver that, in the authors' view, is supportive of TCE considerations; they find that alliances in early stages rely on more hierarchical governance. In my opinion, this difference might be due to the distinct characteristics of firms in the two data sets; indeed, Santoro and McGill (2005) use data on US and non-US public biotech and pharma firms and surely biotech companies in their sample have greater bargaining power than the Italian ones, pushing the agreement towards a more contractual one in case of late stage products. On the contrary, Italian biotech companies are for the most part very small and they are not able to put up resistance to the excessive power of pharmaceutical companies; moreover, the limited development of the venture capital industry in Italy compared to the other countries strengthens these differences.

Then, as far as the result for the existence of *previous relations (d6)*, it is quite expected and it confirms the view that trust can be a substitute for hierarchical contracts, as in Gulati (1995) and Santoro and McGill (2005).

Finally, with regard to the *number of commercialized product (d7)* by the biotech firm, I believe that the explanation of the U-shaped result for *d7* comes again from the controversial perspective problem between the partners; indeed, there are two possible cases when the number of commercialized products is high: i) the pharmaceutical firm succeeds in integrating the biotech, acquiring all its products rights; ii) the pharmaceutical firm fails to achieve an integration, because the biotech's bargaining power is high enough to hold out against an acquisition, and thus the pharmaceutical part can only gets the products rights through licensing agreements. Thus, M&As and JVs from one side and licensing agreements from the other side are more likely to happen when *d7* is high, being

M&As and JVs the most likely governance forms because, as hypothesised in H7, these are the governance forms preferred by the pharmaceutical company.

Thus, the present research contributes to the existing literature on alliance governance in the following ways. First, I provide insights on the complementarity of transaction costs, resource-based, property rights and real options perspectives in explaining firm governance preferences, contributing to a recent literature strand that supports the integration of several theoretical approaches for a deeper understanding of rationales for IFRs governance (Leiblein, 2003; Foss and Roemer, 2010). Indeed, this is, to the best of my knowledge, the first empirical research in the biopharmaceutical industry integrating drivers belonging to different theoretical perspectives. Furthermore, my results confirm the validity of this integrated approach; indeed, looking at Table 2 and focusing just on the confirmed hypotheses, the reader can notice how several theoretical contributions (TCE, RO, PRT, the concept of absorptive capacity) provide explanations to the problem of the governance choice. This is certainly an advance regards the available literature that, mainly, provided a comparison in pair of the main theoretical strands. Also, I want to emphasize again the importance of the concept of "absorptive capacity" in explaining IFRs governance, as also stressed by Contractor and Ra (1992); however, up to my knowledge there is not an empirical study, apart from a case study analysis conducted by O'Dwyer and O'Flynn (2005), confirming the prediction that the concept of "absorptive capacity" poses on governance form selection.

Second, this research highlights the importance of considering the dual perspective in bio-pharmaceuticals IFRs, since pharmas and biotechs often have conflicting goals about the governance mode selection, thus, it strongly depends on their relative bargaining powers. I'm aware that, in here I just pose this problem from a theoretical point of view, but I do not face it from an empirical point of view, since I do not have data from pure biotech firms in our survey. Of course, this will be a path for further development of this research.

Third, this study empirically confirms how uncertainty, appropriation concern and trust influence the governance choice in biopharmaceutical IFRs, results already discussed in literature. However, I find that a new driver, i.e. the functional completeness of a firm, here measured by the number of commercialised products by the biotech company, is also important in determining this choice; the variable is particular significant in the analysis

and I think it can be a good proxy of the contractual power of the biotech company. Nevertheless, it has never been considered in literature, thus, the theoretical framework here proposed enlarges the set of drivers influencing the governance modes in biopharmaceutical industry beyond those most considered by the literature.

This research has several managerial implications. First, I propose an operationalized framework for making governance decisions in biopharmaceutical IFRs. The advantage of this approach, from a managerial perspective, consists on having formulated hypothesis directly on operationalized measures; this makes the theoretical framework easily applicable in the industrial practice. Secondly, the focus on bargaining power provides interesting indications to managers in charge with IFRs in this industry: they must be aware that the industry context, the Italian one in this case, matters, indeed, in some more mature contexts, the contractual power between the partners could be significantly different, leading to different governance solutions. Then, managers need to carefully evaluate measure of functional completeness, such as the number of commercialized products of the biotech firm, when approaching IFRs in biopharmaceutical industry.

There are limitations to this study. The most important one is that I rely solely on field-based primary data of a specific country and that the small sample size deriving from this choice may undermine the reliability and generalizability of my results. The small sample size might provide also an explanation for the non-significance of some variables. Therefore, I recognise that, despite the confirmative approach used in this research, the theoretical framework needs a further confirmation through a larger dataset including other countries with a similar industry structure or through a worldwide comprehensive databank analysis.

Chapter 5

RISK ASSESSMENT AND GOVERNANCE FORM CHOICE IN IFRs: A CONFIRMATIVE ANALYSIS IN AN INTERNATIONAL SAMPLE

5.1 Introduction

As pointed out in chapter 2, the scientific literature on IFRs has already received a lot of important contributions, but how firms choose the right governance mode for managing a particular relation is still not so clear. In particular, in spite of the fact that the role of risk has gained increasing attention in the study of inter-firm relations, few studies have deeply investigated the issue, some exceptions are Das and Teng works (1996, 1998, 2000, 2001a,b) and Nooteboom's model (1996). Moreover, few of them are empirical research, except Delerue (2004), Delerue and Simon (2009) and Noteboom et al. (1997) that however analyze only the effect of relational risk on the governance form.

In this part of the thesis, I propose a risk perception model for making governance decisions in inter-firm relationships. Firstly, according to the most influential literature on the issue, I identify two risk dimensions, relational risk and performance risk, and I study in which way the perception of each dimension separately influence the governance of the IFR. The risk perception model is based on two main theoretical perspectives: transaction cost economics (TCE) and real options (ROs). Secondly, I combine both relational and performance risk factors to examine how the perception of both risk' dimensions influence the decision-maker choice. Third, I operationalize the developed model through the detection of specific drivers influencing both relational and performance risk; the operationalized framework is developed within a specific context that is again the bio-pharmaceutical industry. Finally, in order to test the hypotheses, I carry out an empirical analysis based on a secondary dataset consisting of 353 IFRs signed worldwide between pharma and biotech firms.

Previous research discussing governance forms in IFR dates back to the nineties, but it is still limited for several reasons. First, most researchers focused on the choice between two or three different governance modes. For example, many authors studied the choice

between different kinds of alliances, mainly dividing between equity and non-equity alliances, such as Gulati and Singh (1998) or more recent papers such as Dunne et al. (2009). As concern to this limitation, I consider a full picture of how firms use external sources of knowledge, by analyzing all the continuum of governance forms from pure market transactions to hierarchical governances. Actually some authors have already tried to overcome such a limitation, but in most cases, such as Van de Vrande et al. (2006), these papers are only theoretical papers that not test empirically the developed hypotheses.

Secondly, most prior studies about the impact of perceived risk on IFR decisions have not explicitly analyzed how the interaction of different risk dimensions may mitigate the trend to go for a pure market transaction or for a hierarchical solution. Again, some authors such as Das and Teng (2001a) have theorized this kind of effect; their paper is original in constructing a relationship between risk dimensions (performance and relational) and governance structures, but it has however several limitations. First, from a theoretical point of view, it does not provide a relation with the most acknowledged theoretical strands in governance structure literature such as TCE, RO or RBV; so, the way how risk dimensions influence the choice of the governance forms along a continuum remains not linked to the main research stream of the literature. Secondly, the framework remains basically a theoretical one, since it has never been operationalized and, overall, empirically tested.

Finally, most prior researches have examined the governance choice decision using a unique theoretical perspective, mainly the TCE (Folta, 1998; Santoro and McGill, 2005). Following the work by Van de Vrande et al. (2006), I instead propose a theoretical framework mapping performance and relational risk on a continuum of governance forms by constructing a relation with TCE and RO theoretical strands.

For these reasons I think this research could significantly contribute to fill a gap in the strategic management literature; moreover, such knowledge could represent an insight for managerial decision by supporting managers in making successful decisions about the governance of new cooperative arrangements.

This chapter is organized as follow: in the next paragraph 5.2, I introduce the theoretical framework that is a risk model linking both the relational and performance risk to the

governance form; afterward, in paragraph 5.3, I present the empirical analysis that is based on a secondary dataset of 353 IFRs signed worldwide between a pharmaceutical and a biotech company during the period 2007-2010 and the results obtained. Finally, in paragraph 5.4, I present discussion and conclusions of the research.

5.2 Theoretical framework developing: second set of hypotheses

As previously mentioned Das and Teng (2001a) distinguish two kinds of risk in inter-firm relationships: *relational risk* and *performance risk. Relational risk* is the probability and consequence of not having satisfactory cooperation between partner firms; it is linked to endogenous factors, which are embedded in the specific relationship and can be controlled by partners' actions. This risk comes from the possibility of opportunistic behaviour of partners. On the other hand, *performance risk* refers to the factors that may jeopardize the success of an alliance, even when the partners cooperate fully; it is related to exogenous factors inherent in the activity that is taking place regardless of whether partners behave as agreed (contract completeness) or not.

5.2.1 Relational risk

Relational risk only exists because the inter-firm relation does exist; indeed, it depends on the probability and consequences that a partner firm does not commit itself to the inter-firm relation in the desired manner (Das and Teng, 1996). This risk arises from the possibility of opportunistic behaviour of one or both firms; since firms have their own individual interests that may not coincide with those of their partners (Williamson, 1975). Examples of opportunistic behaviour are shirking or cheating the partner, distorting or hiding information, getting resources and asset of the other firm and so on. This kind of behaviour is very common, thus firms tend to prevent it by controlling partners behaviours and detailing contracts with explicit deterrents.

Accoring to Das and Teng (2001a), several factors may enhance the perception of relational risk, for example expected inequities regarding payoffs of the alliance (Alchian and Demsetz, 1973; Grossman and Hart, 1986), differences in terms of bargaining power of the

partner firms (Williamson, 1993), the lack of trust in the partner competences and skills (Kale et al., 2000), the lack of confidence in the good faith of the partner (Gulati, 1995; de Man and Roijakkers, 2009), and also factors related to a different cultural background (Oxley, 1997; Oxley and Sampson, 2004; Delerue and Simon, 2009). All of these elements lead to a higher perception of relational risk.

5.2.2 Performance risk

Performance risk depends on several factors that can lead to not achieving the strategic objectives of a firm, or, in this case, of an alliance, despite firms fully co-operate (Das and Teng, 1996). These factors include changing in the competitive environment, such as intensified competition and new entrants, changing in the general environment, for example in regulations and government policies, or finally changing in the internal environment, such as the lack of a particular competence due to a new technology advent. Of course, performance risk strongly depends on the nature of the objectives of the partners; namely, if they are cooperating in technology development in R&D intensive industries the performance risk embedded on the activity is high in itself. Thus, according to the alliance objectives and types there are different sources of performance risk in the inter-firm relationship; for example R&D risk is the most important risk component in R&D alliances, while commercial risk is the most important one in marketing and commercialization alliances. International risk is an important factor when partner firms belong to different countries. Thus, no matter how alliance partners behave and how is the level of co-operation between them, these kinds of risk will anyway be present.

5.2.3 Hypotheses development

When designing the governance form of an inter-firm relation, managers have to choose between different organizational modes. As highlighted in the previous section, this choice is strongly related to their perception of performance and relational risk.

The literature on the governance form choice has traditionally used different theoretical perspectives in order to explain why managers choose, for example, a licensing agreement rather than an equity alliance.

As previously highlighted, the main reference theories are TCE (Williamson, 1991, Gulati and Singh, 1998), RO theory (Kogut, 1991, Folta, 1998) and RBV (Kogut and Zander, 1992, Zollo et al., 2002). However, more and more authors are convinced that a combination of different perspectives is required to understand governance mode choice (Chen and Chen, 2003; Santoro and McGill, 2005; Van de Vrende et al., 2006; Rosiello, 2007).

In this part of my thesis, I focus just on TCE and RO in order to examine how the risk perception influence the choice of a particular governance mode. Starting with a TCE point of view and according to TCE scholars, transactions can take place in markets, within the organisation or hierarchy, or in the middle between market and hierarchy. The different organizational choice depends on the minimization of transaction costs of economic exchanges with other organizations, and these costs vary on the basis of the presence of transaction-specific investments, threat of opportunistic behaviour and frequency of interactions. Thus, on the one hand, TCE suggests that market transactions might be highly efficient as governance forms in different situations, since they are flexible and reversible forms and they minimize organizational costs of hierarchical structures, but on the other hand, when opportunistic behaviour is likely to occur the theory suggests to reduce this relational risk by choosing a hierarchical governance mode. Hence, TCE theory focuses on the transaction and on the costs arising from the possible opportunistic behaviours among the parties. It is worth noting that, also when TCE refers to uncertainty, it is seen as a possible source of opportunistic behaviour among the parties. Furthermore, being TCE focused on the design of firm boundaries, it looks at the governance structure, i.e. the relation structure, as the way to reduce the risk arising from the transaction.

Thus, it is quite evident how TCE focuses on relational risk: when relational risk is high, namely opportunistic behaviour is likely to occur (because of asset specificity, lack of trust between partners, differences in terms of bargaining power etc.), firms will prefer more hierarchical governance modes in order to mitigate such a risk. Thus, in accordance to TCE reasoning I formulate our first hypothesis (Figure 1).

Hypothesis 1 (H1): *When perceived relational risk is high firms prefer more hierarchal oriented governance modes, (i.e. equity alliances, M&A); conversely, when this kind of risk*

is low, firms prefer more market-oriented transactions (i.e. licensing agreements, non-equity alliances).

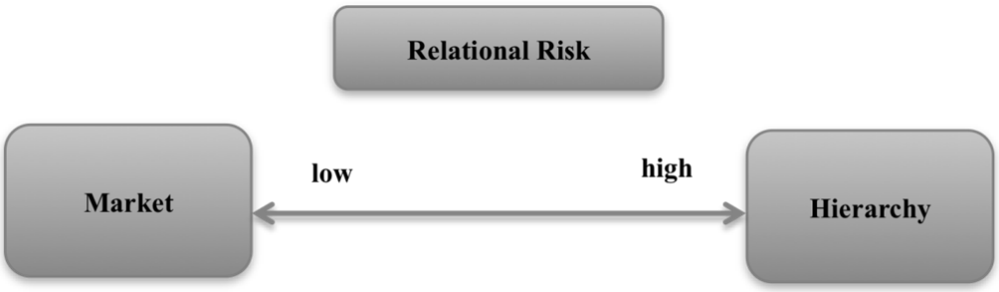

Figure 1. The influence of relational risk on the governance form

On the other respect, as suggested by the real options (ROs) literature stream, certain types of investment might be considered as the creation of an option, which might be exercised at a later point in time using a more integrated solution (i.e. Hagedoorn and Sadowski, 1999; Kogut, 1991; Vanhaverbeke et al., 2002). Indeed, ROs are usually described as an option creation and an option exercise, two different investments in two different points in time; the first is the initial decision of investment in order to create the option and the second is the subsequent and not mandatory decision of exercise this option.

However, real options reasoning has become so successful mainly because it is strictly related to the concepts of uncertainty and risk; indeed, ROs point of view highlights the value associated with the ability of a firm to react flexibly to an uncertain future. The theory conceptualizes firms as an aggregation of investment opportunities and emphasizes the value of investments that allow firms to manage risk proactively by exploiting uncertainty over time in a flexible fashion (Kogut, 1991). Thus, real options are specifically designed to enable firms to postpone the investment decision under uncertainty conditions. Especially, when partner firms are exploring new technologies, the investing firm first has to learn from the partner and build familiarity with the new technological area through small initial learning investments that can be seen as the creation of the option. Over time, after reaching a good understanding of the new technology and of its business opportunities, the investing firm can eventually exercise the option by expanding and firming up the relation, for example through an equity investment or even an acquisition.

As previously stated, the performance risk does not depend on partners' behaviour, but just on factors characterising the transaction deal; thus, when such a risk is high, RO suggests to postpone investments, adopting market-oriented governance forms. Thus, the presence of technological risk, as well as international risk and the lack of technological competences, lead firms to postpone some decisions in the future. Following this reasoning I formulate the following hypothesis (Figure 2):

Hypothesis 2 (H2): *When perceived performance risk is high firms prefer market-oriented governance modes, (i.e. licensing agreements, non-equity alliances); conversely, when this kind of risk is low, firms prefer more integrated governance forms (i.e. equity alliances, M&A).*

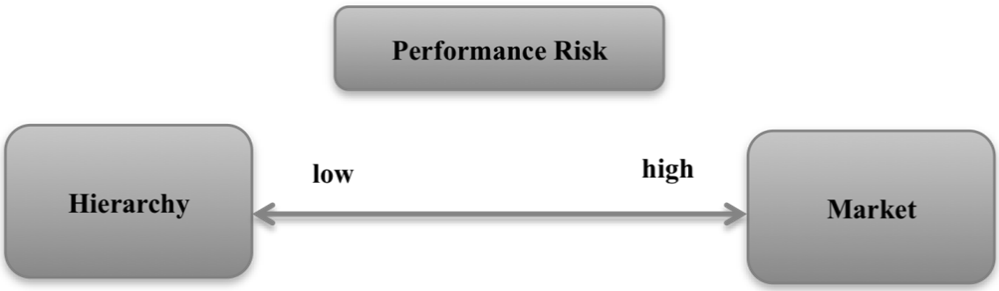

Figure 2. The influence of performance risk on the governance form

As the reader can notice, TCE and ROs theories, looking at different components of the risk, lead to opposite results in terms of governance form choice. However, as also highlighted by previous contributions (Das and Teng, 2001a; de Man and Roijakkers, 2009), both the two typologies of risk are present in an inter-firm agreement, thus the two theoretical approaches influence each other. Indeed, when relational risk is high, TCE suggests a more hierarchical governance form to reduce it; however, if the performance risk is also significant, a hierarchical governance form does not reduce such a risk, because it does not depend on the relation, while it increases the coordination costs. Thus, the presence of a significant level of performance risk reduces the effect of the relational risk on the governance form choice (Figure 3). According to this reasoning I formulate the following hypothesis:

Hypothesis 3 (H3): *A significant level of performance risk moderates (reduces) the relation between relational risk and governance form.*

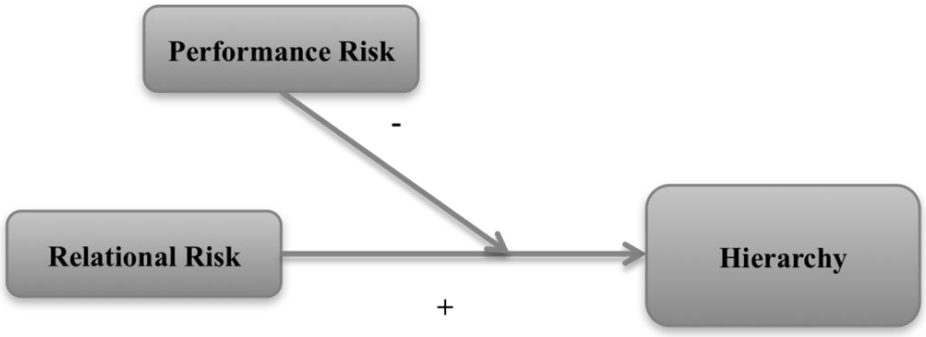

Figure 3. The influence of performance risk on the relation between relational risk and governance form

Conversely, when the performance risk is high RO suggests choosing a flexible governance structure in order to reduce such a risk. However, if the relational risk is also significant, a market-based governance form adds some relational risk to the transaction. Thus, the presence of a significant relational risk reduces the effect of the performance risk on the governance form choice (Figure 4). According to this reasoning I formulate the following hypothesis:

Hypothesis 4 (H4): *A significant level of relational risk moderates (reduces) the relation between performance risk and governance form.*

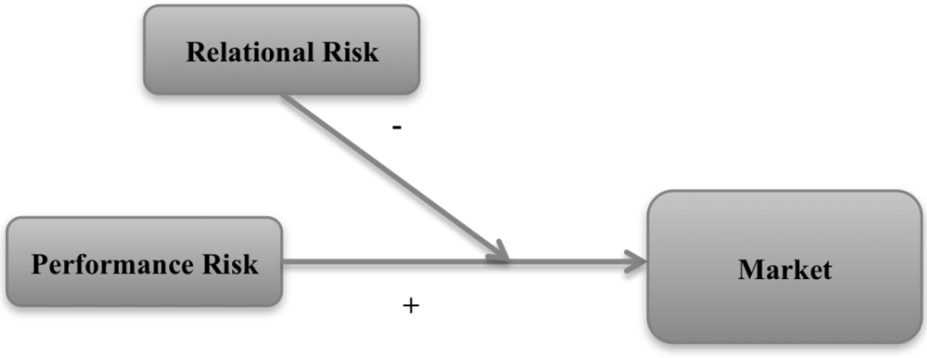

Figure 4. The influence of relational risk on the relation between performance risk and governance form

5.2.4 Framework operationalization

5.2.4.1 Relational risk operationalization

According to Das and Teng (2001a) relational risk reflects decision-makers' concerns about the level of co-operation between the partners. Partners' co-operation level is threatened by the possibility of opportunistic behaviours (Williamson, 1975; Parkhe, 1993) and is made easier by trust and firm's experience with inter-firm relationships. Following previous researchers, I detect some the main factors leading to a high relational risk perception; they are: investment specificity, partners' asymmetry, lack of trust and lack of IFRs experience.

Investment specificity: TCE emphasizes the role of transaction-specific investments in determining high levels of opportunistic behaviour. As defined by Williamson (1975), asset specificity is the extent to which the investments made to support a particular transaction have a higher value to that transaction than they would have if they were redeployed for any other purpose.

According to TCE, the more an investment is relation-specific, the higher will be sunk and search costs associated with the relationship. The more such costs are not equally balanced over the partners, the higher is the probability that one partner will act in an opportunistic way, trying to usurp the counterpart rent. Thus, high relation-specific investments might increase the expected inequities of payoff in a relationship, and therefore, according to Das and Teng (2000) they are related with relational risk. David and Han (2004) provided strong empirical support to asset specificity in influencing transaction costs, indeed the extent of asset-specificity increases transaction costs and creates a greater opportunism risk and thus a higher relational risk. In this case, TCE suggests that the transaction should be internalized in order to reduce these risks. Santoro and McGill (2005) find strong empirical evidence to asset co-specialization in influencing governance form in the biopharmaceutical industry. Hence, for the aforementioned reasons, I consider investment specificity as a driver influencing relational risk.

Partners' asymmetry: the presence of asymmetry between alliance partners in terms of relative size, different resources and bargaining power determines an increase in the

perceived relational risk. Several authors (Oliver, 1990; Bleeke and Ernst, 1995) observe that inequality between parties, which allows the stronger firm to exercise power and control over its partner, leads the weaker party to perceive high relational risk. Also, Bleeke and Ernst (1995) suggest that alliances between unequal parties are unlikely to be successful. Delerue (2004) finds as partners' asymmetry is one of the main fonts of relational risk in biopharmaceutical industry.

Lack of trust: trust in inter-firms relationships has received a huge amount of contributions as a key driver influencing governance form choice (Ring and Van de Ven, 1992). Relational scholars suggest that successful IFRs result from characteristics such as trust, reputation, commitment, cooperation and communication (Williamson, 1971; Dyer and Singh, 1998; Gulati et al., 2000). In particular, trust and reputation establish norms and expectations about appropriate behaviour, lowering the perception of relational risk. Authors such as Gulati (1995) and Parkhe (1993) suggest that trust can be a substitute for hierarchical contracts in many exchanges and serve as an extra-contractual control mechanism by reducing the perception of relational risk. Indeed, the familiarity established among partners mitigates the hold-up risk and reduces relational risk. Gulati (1995) finds empirical evidence supporting this view.

Also Ring and Van de Ven (1994) show that trust is an essential condition for market transactions. In the same way, the lack of trust between the partners determines higher partner uncertainty, namely relational risk perception, increasing the need for the costly monitoring and control of hierarchical governance (Santoro and McGill, 2005). Trust has been deeply investigated as a driver influencing governance form choice in biopharmaceutical industry (Santoro and McGill, 2005; Delerue, 2004; van de Vrende et al., 2009).

Lack of IFRs experience: the collaboration propensity of a firm may influence its relational risk perception, indeed having a successful partnership history should determine an higher confidence about the success of the new relation. The experience of past alliances enables partner firms to accumulate valuable knowledge about alliance management (Hagedoorn and Duysters, 2002). Kale and Singh (2007) find that alliances offer great learning

opportunities for firms to develop firm capabilities. Other research has found evidence that firms learn to manage alliances more effectively over time (Anand and Khanna, 2000; Barkema and Vermeulen, 1997).

I argue that IFRs experience has a double effect in reducing relational risk: (i) from the point of view of the company that has experienced several inter-firm relationships, it increases its confidence about capabilities in managing such relationships; (ii) from the partner point of view, the higher the number of relationships the counterpart has been involved, the higher is its reputation in being a good partner for a relationship.

Villalonga and Mcgahan (2005) show how former alliances and acquisitions experience increases the number of the same typology of inter-firm agreements. Lai and Chang (2010) point out how firm's attributes, such as alliances experience, significantly influence the relationships between the governance structure and performance. Teng and Das (2008) show how previous alliances experience, by reducing the relational risk, leads to more market oriented alliances.

At the same time, I evaluate how the lack of IFRs experience determines a higher perceived relational risk, leading to more structured and integrated governance forms. Zollo et al. (2002) by analysing a biopharmaceutical sample, have empirical showed how general experience accumulation at the partnering-firm level positively influences alliance performance. Finally, both van de Vrande et al. (2009) and Santoro and McGill (2005) have used firm's experience in previous relationship as control variable in studying the choice of the governance mode in biopharmaceutical industry. Up to now, IFRs experience has not been related to relational risk in any empirical study involving biopharmaceutical industry. Figure 5 summarizes the relationship among the former discussed measures and the relational risk.

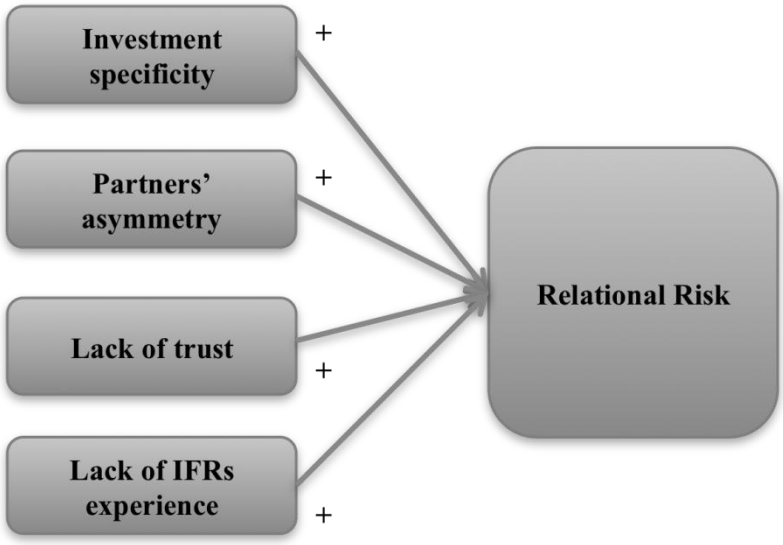

Figure 5. Relational risk operationalization

5.2.4.2 Performance risk operationalization

According to Das and Teng (2001a), performance risk, in strategic alliances, is the probability and consequences that a firm's strategic objectives are not achieved, despite full co-operation, i.e. when the relational risk is assumed to be non-existent. Performance risk arises from factors such as commercial and technological risks, R&D risk, international risk, corporate risk, and strategic risk. Thus in line with above, I operationalize performance risk through the following drivers: technology/product newness, technological distance, nationality.

Technology/product newness: technology/product newness is one of the main fonts of performance risk. The newer is the technology involved in the agreement, no matter the level of cooperation among the partners, the higher is the risk of not gaining the expected results. Indeed, uncertainty on the market feasibility of products or technologies cannot easily be reduced by the investing firm. In particular, when a technology is in an early stage of development, its basic concepts stem from practice, thereby raising the uncertainties associated with it (Ahuja and Lampert, 2001); however, the risk typically decreases over time as the technology matures or the investing firm acquires more knowledge about it. This is particularly true in the biopharmaceutical industry, where specific applications from

chemistry, functional genomics, and bioinformatics are combined to target and test new molecules, making applications in therapeutics more uncertain than those in diagnostics, as indicated by systematic financial market variances among therapeutic, diagnostic, and other biotechnology sub-fields (Folta, 1998). According to this, Lambe and Spekman (1997) find that early stages of a biotech compound development makes performance risk particularly high. Also Higgins and Rodriguez (2006) suggest that pharmaceutical firms seeking early stage research may incur in high performance risk. Finally, also van de Vrande et al. (2009) find technology newness as one of the main fonts of performance risk in biopharmaceutical industry. Hence, I consider the newness of the technology/product object of the agreement, measured as the development stage of the product/compound, as a driver of performance risk.

Technological distance: I refer to the distance between the technological knowledge bases of the two partners; indeed, the extent of strong dissimilarities between their knowledge bases might have significant implication on the perceived performance risk. Large dissimilarities could lead to a limited capability to detect, assimilate and integrate the partner's technology. This problem is related to the concept of absorptive capacity of a firm (Cohen and Levinthal, 1990), i.e. the more dissimilar the knowledge bases of two partners, the larger the probability that the absorptive capacity of the investing firm falls short, affecting the extent to which a firm can recognize and absorb its partner's technological capabilities. This, of course, increases performance risk. Moreover, Colombo (2003) observes how opportunistic behaviour is not a real threat as long as the business potential of the technology is not crystallized into a viable business model. Also, greater technological distance makes unintended spill-over of knowledge less likely, decreasing the threat of opportunistic behaviour. Furthermore, Oxley and Sampson (2004) argue that high technology dissimilarities, increasing the performance risk, reduce the broadness of alliances' scope. Conversely, Villalonga and McGahan (2005) argue how greater relatedness between the two parties implies a lower cost of integration, because of economies of scale within the organization, and therefore reduces performance risk. Authors, such as Folta (1998), found empirical evidence in the biopharmaceutical industry showing that when knowledge bases of the firms are dissimilar, companies are more likely

to use less integrated governance forms in order to reduce the performance risk. Also Pisano (1990) finds that uncertainty coming from technological distance plays a critical role in pharmaceutical firms' decision to acquire biotechnology R&D from outside; he observes that a firm, that is not yet familiar with the technological know-how of his partner, reduces the performance risk by first learning from the partner through arm's length transactions before being able to accumulate knowledge. Moreover, the greater the knowledge base dissimilarities, the longer it will take before the problem of transaction risk is solved, making an integration solution less attractive. Hence, I examine the effect of technological distance in increasing performance risk.

Nationality: international alliances are exposed to an additional risk called international risk, which has its roots in national differences in terms of distances, cultures, regulations, technological standards and business practices (Brouthers, 1995). Several authors, such as McCutchen et al. (2008), analyse alliances risk both in domestic and international alliances, highlighting the main managerial difficulties linked to the so-called international risk (Miller, 1992). International risk depends on several factors: (i) distance increases coordination costs; (ii) partners in international alliances have different needs and offer different resources and capabilities (Hitt et al., 2000); (iii) different legal, institutional, historical and language environments (Lane and Beamish, 1990) make more difficult communicating and increase the chance of misunderstanding between partners; (iv) different managerial cultures create difficulties and lead to alliance failure (Delerue and Simon, 2009); (v) different economies in which partners operate entail different risks and uncertainties associated with politics, foreign exchange rates and local laws and regulations (Kogut and Singh, 1988) and (vi) finally, international differences in intellectual property rights protection make more difficult managing R&D collaborations and gaining common results such as patents (Oxley, 1999; Hagedoorn et al., 2005). As the reader can notice, different nationality of the partners leads an increasing level of risk no matter as the partners behave, thus in this research I study how different nationality of the partners increases performance risk.

Figure 6 summarizes the relationship among the former discussed measures and the performance risk, highlighting the sign of the relation, if each driver has a positive or

negative effect on relational risk.

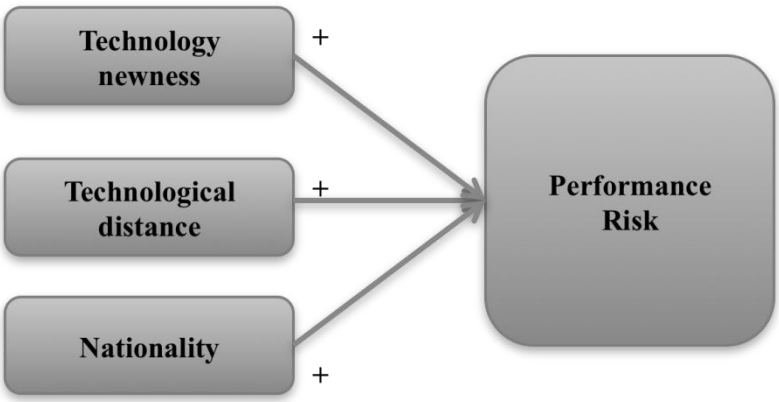

Figure 6. Performance risk operationalization

5.3 Empirical analysis: a confirmative analysis in an international sample

5.3.1 Governance forms in the market-hierarchy continuum

In this part of the research I again follow the main empirical literature on the issue and I consider four different governance modes along the continuum between market and hierarchy. Starting from the governance form closer to the market that is a unilateral contract-based alliance, I then locate bilateral contract-based alliances, minority equity alliances, equity joint ventures and at last mergers and acquisitions.

5.3.2 Data collection and sample

In order to test the proposed framework I built my own data set by using as the main source of data the Biotech & Pharma Collaboration section of the BioWorld Industry Snapshot database. This data source was used for identifying worldwide inter-firm relationships among biotech and pharmaceutical companies during the period January 2007 to December 2010. I selected the BioWorld database because it is a new and reliable source of records specific for the biopharmaceutical industry; it contains information about partners' business names, deal type/objective, product area and financial terms. In the period examined, 1781

deals were included in the BioWorld database. However, my dataset comprises 353 deals and it was constructed in the following way. First I collected data about all the deals signed in the period 2007-2010; next I excluded those agreements, 982, for which financial terms were not disclosed in the BioWorld data base, this because the deal value is a main issue of my analysis. Afterwards, I also excluded agreements involving more than two parents companies and those involving public research entities, such as universities. Finally, to ensure the quality of the dataset I checked whether the deal was actually signed between a pure biotech company and a pharmaceutical/biopharmaceutical firm, since this is a main assumption of my research; many deals were excluded because they were signed between two biopharmaceutical companies.

In this way I obtained the final dataset consisting of 353 agreements divided in 90 unilateral contract-based alliances (licensing and supply agreements), 126 bilateral contract-based alliances (R&D alliances, marketing and commercialization alliances), 41 equity alliances (minority equity alliances and joint ventures) and 93 between mergers and acquisitions.

Once the main information about the agreements was collected, I completed the dataset by integrating information such as nationality, number of employees, age of the partners and main NACE codes from the Orbis Database, that is a global database containing profiles and financial information of over 80 million companies.

5.3.3 Variables and measures

5.3.3.1 Dependent variable

I indicate with *G* the governance form that is the dependent variable of the analysis; again, according to a TCE rationality of the market-hierarchy continuum, I code *G* through an ordered basis as it follows: unilateral contract-based alliances = ‘1’; bilateral contract-based alliances = ‘2’; equity alliances = ‘3’ and M&A = ‘4’.

5.3.3.2 Independent variables

Independent variables are all related to factors influencing the two typologies of risk discussed in paragraph 3.2. Concerning relational risk we identify the following variables.

Investment specificity

As a proxy of the *investment specificity* I consider the log value of the up-front payment the pharmaceutical company pays to the biotech in all the types of alliances. In case of M&A I consider the overall log value of the transaction. I assume that, the higher is the value of such payments the higher is the investment specificity.

Partners' asymmetry

As a proxy of *partners' asymmetry* I develop a measure of the different size of the firms involved in the agreement. I first group firms into five different classes basing on their size: '1' for micro firms (i.e. from 1 to 10 employees), '2' for small firms (from 11 to 50), '3' for medium firms (from 51 to 250), '4' for big firms6 (pharmaceutical firms from 251 to 750 employees; biotech firms from 251 to 500 employees), and '5' for big enterprises (number of employees bigger than 500 for biotech firms and 750 for pharmaceutical firms). Afterwards, I calculate the size difference obtaining in this way, an ordinal variable ranging from 0 to 4 measuring partners' asymmetry.

Lack of trust

As commonly encountered in literature I assess the *lack of trust* between the same partners through the absence of previous ties. Based on BioWorld data availability I count prior relationships between the two firms in a 7-year period prior to the agreement date. I code the variable lack of trust assumes value 0 if the partners reported previous relations in vice versa it assumes value 1. So, when the variable increases the relational risk increases too.

Lack of IFRs experience

As concern as the measure of *lack of IFRs experience*, the variable is computed as: (Maxln(IFRs) - ln(IFRs))/ln(IFRs), being Maxln(IFRs) the maximum number of the log transformation of the number of alliances (any kind) signed by the pharmaceutical firms in a 7-year period prior to the agreement in the whole data set. Again, relational risk increases with the lack of IFRs experience.

[6] According to the US. Small Business Administration Classification.

Regarding performance risk we identify the following measures.

Technology newness

As a proxy of the *technology newness* I identify the development stage of the product/technology involved in the agreement. As it is well know the drug development process is composed by four macro phases prior to commercialization: the drug discovery phase, the preclinical development, the clinical trials (composed by three stages, i.e. phase I, phase II and phase III) and the approval phase. Each of these steps is complex and uncertain, so that the more advanced the development stage, the more likely the drug succeeds in reaching the market; it should be considered that even when a drug has completed phase II-A of clinical studies, the expected probability of success does not even reach the 50 percent (DiMasi, 2001). Thus, the development stage is a good measure of the technology newness in biopharmaceutical agreements. Using both BioWorld data and hand-collected data from public announcement of alliances and M&As available in the companies' web-sites, I develop the following ordinal measure for the development stage: '1', if the product/technology is in the discovery phase or preclinical development; '2', if in phase I of clinical trials; '3', if in phase II; ' '4', if in phase III; '5' if in approval stage or phase IV and '6', if already been approved or commercialized. Thus, as a measure of the technology newness I assume the value: '6 - development stage'. In this way, technology newness varies from 0 to 5, so that the higher is its value the higher is performance risk.

Technological distance

As a measure of the *technological distance* I use a dichotomy variable assuming the value '0' if the pharmaceutical is a biopharmaceutical company, i.e. a company already integrated in the biotech field; in this case the low technological distance is low. On the other hand, the variable assumes value '1' in case of a 'pure pharma', i.e. a pharmaceutical company that has never experienced integration in the biotech field; in this case we assume a higher technological distance.

Nationality

Finally, the variable *nationality* is an ordinal variable coded '0' if the partners have their headquarters in the same country, '1' if they are in the same continent, but in different countries, '2' otherwise. Thus, the greater the variable value the more significant the international risk and thus the performance risk.

5.3.3.3 Control variables

In the empirical analysis I also include four control variables. First, I control for the effects of firms' size. Thus, I use two variables, i.e. *pharma size* and *biotech size*, measuring the number of employees of each partner. Since the two continuous variables present a high range of variability, I applied a log transformation. Controlling for firms' size is quite common in researches having our purpose (Santoro and McGill, 2005; van de Vrande et al., 2009).

Secondly, I control for *biotech patents*, namely for the number of patents registered by the biotech firm in the period 2004-2010. We collected patents data both from the publicly available NBER Patent data, described by Trajtenberg et al. (2001) for US companies and from Espacenet Database for European companies. This is a continuous variable for which we applied the log transformation. Also the influence of such a variable on governance form is quite known; indeed, patenting is often assumed as a measure of the knowledge accumulated by the biotech firm (van de Vrande at al., 2009; Bosse and Alvarez, 2010) and, also, as a measure of the capacity to finance its own activities (Bosse and Alvarez, 2010; Lo Nigro et al., 2011). Both these characteristics increase the bargaining power of the biotech firm allowing it to resist to possible acquisition, but, from the other hand, they make the biotech company an interesting subject for acquisitions.

Finally, I consider the variable *n° of M&A*s signed by the pharmaceutical firm with any other partner in the period 2004-2010. Also this variable is quite considered as control variable in studies with the same subject (van de Vrande et al., 2009). Indeed, especially in the biopharmaceutical industry, the number of previous M&As signed by a pharmaceutical company identifies its attitude to make acquisitions as a source of external technologies, thus influencing the governance form choice. It should be noted how the M&A experience

of the pharmaceutical company does not reduce the relational risk, as discussed in relation to the driver called firms' familiarity with IFRs, rather, from the biotech point of view, increases it because of the attitude previously mentioned.

5.3.4 Methods

The previously discussed dataset is a cross sectional database where each unit of analysis represent an inter-firm relationship between a pharmaceutical and a biotech company. In this kind of analysis, where the dependent variable can be ordered along a continuum from market oriented governance forms to hierarchical ones, some researchers have used an ordinal logit model in order to preserve the ordered nature of the dependent variable (Santoro and McGill, 2005). Following other authors such as van de Vrande et al., (2009) and Steensma and Fairbank (1999), I have instead decided to use a multinomial logit model that allows for the simultaneous estimation of parameters when there are more than two categories in the dependent variable. Thus I evaluate, as a pair comparison, the choice of each governance form in comparison to the base outcome, that we assume being M&A. Note that the choice of baseline category is irrelevant for the overall estimation of the model and can be set according to the authors preferences.
The general specification of the multinomial logistic regression applied here is:

$$Ln(P_j/P_o) = A + B_jX_j$$

Where Pj is the probability of an event taking place for the jth case. In this analysis the three possible events are: j=1 for a unilateral contract-based alliance, j=2 for a bilateral contract-based alliance and j=3 for a minority equity alliance. Po is the probability of the default condition, namely a M&A. Xj is the vector of the independent variables.

5.3.5 Results

Table 5 provides some descriptive statistics and correlations for all variables. As the reader can notice collinearity does not seem a problem with our data (all VIFs are further below

10). Due to the high correlation value between *pharma size* and *lack of IFRs experience* (-0.57) and due to a better fitting of the models I decide to remove the variable *pharma size* from the regression analyses.

Table 6 shows the regression results and contains three different models. Model 1 aims at supporting hypotheses H1 and H2, so it contains only relational and performance risk variables. After having tuned different models, I have reported in Table 6 the best fitting model according the pseudo R-square evaluation.

Starting with control variables we find that *biotech size* is significant at all levels of the dependent variable and it also shows increasing positive coefficients. This means that the larger is the biotech company the less likely it will accept M&As over other forms of governance forms. *Biotech patents* is instead not significant for any of the levels of the dependent variable. On the other hand the *N° of M&A* signed by the pharmaceutical company is significant at all the levels of the dependent variable with negative coefficients (respectively -0.244, -0.180 and -0.356). This result indicates that the higher the number of previous M&As signed by the pharmaceutical company the more likely it will sign one more M&A over the other governance forms.

Let me analyse now the results for relational risk variables (see Model 1).

The variable *investment specificity* is significant for any level of the dependent variable and its coefficients are negative and quite constant across the levels of G; this means that when relational risk increases due to higher investment specificity, M&As are more likely than any other governance form. This result confirms the predictions in hypothesis H1.

The variable *partners' asymmetry* is significant at any level of G with positive coefficients. This means that the greater the partners' asymmetry, the less likely are M&As if compared with other governance forms. This result is in contrast with my prediction that partners' asymmetry increases relational risk leading toward more hierarchical solutions; however, while coefficients are quite constant at levels G = 1, 2, it significantly increases when G = 3, showing how JVs are much more likely than unilateral and bilateral contractual alliances; this is in line with my predictions.

Table 5. Descriptive statistics and correlation matrix

Variable	Min	Max	Mean	Std. Dev.	VIF	1	2	3	4	5	6	7	8	9	10
Dependent variable															
G (governance form)	1	4	2.40	1.13											
Control variables															
1. Pharma size (log n° employees)	0.69	11.69	9.11	2.42	2.36										
2. Biotech size (log n° employees)	0.69	9.77	4.42	1.59	3.02	0.23									
3. Biotech patents (log patents)	0	7.44	1.96	1.79	1.40	0.09	0.48								
4. N° of M&A	0	17	2.82	2.90	1.50	0.38	0.00	-0.07							
Relational risk variables															
5. Investment specificity (log of investment in $ million)	0	9.69	3.78	1.88	1.14	0.14	0.08	-0.03	0.03						
6. Partners' asymmetry	0	4	1.90	1.08	2.96	0.26	-0.68	-0.41	0.14	0.01					
7. Lack of trust (no previous ties)	0	1	0.80	0.40	1.07	-0.16	-0.11	-0.17	-0.08	-0.00	0.01				
8. Lack of IFRs experience	0	1	0.72	0.29	1.92	-0.57	-0.12	-0.06	-0.54	0.02	-0.11	0.12			
Performance risk variables															
9. Tech newness (development stage)	0	5	2.85	1.61	1.23	0.24	-0.14	-0.05	0.08	-0.22	0.23	-0.01	-0.24		
10. Nationality	0	2	1.34	0.82	1.09	0.08	0.08	0.05	0.09	-0.12	0.04	0.05	-0.11	0.02	
11. Tech distance (pharma's integration in biotech field)	0	1	0.52	0.50	1.07	-0.05	0.08	0.13	-0.02	-0.07	-0.05	-0.04	0.05	-0.08	0.17

Table 6. Multinomial regression analysis results

	Model 1			**Model 2**			**Model 3**		
	G=1	G=2	G=3	G=1	G=2	G=3	G=1	G=2	G=3
Const	-0.812	-2.085	-1.910	0.582	1.019	-1.195	-4.245***	-5.747***	-5.971***
	(1.597)	(1.589)	(2.212)	(1.584)	(1.583)	(2.203)	(0.887)	(0.937)	(1.225)
Control variables									
Biotech size	0.612***	0.796***	0.877***	0.745***	0.941***	1.019***	0.494***	0.667***	0.768***
	(0.185)	(0.188)	(0.253)	(0.197)	(0.202)	(0.258)	(0.166)	(0.167)	(0.219)
Biotech patents	0.119	0.106	-0.148	0.168	0.147	-0.090	0.137	0.118	-0.104
	(0.125)	(0.122)	(0.158)	(0.133)	(0.132)	(0.168)	(0.119)	(0.116)	(0.153)
Number of M&A	-0.244***	-0.179**	-0.356***	-0.255***	-0.199**	-0.371***	-0.173**	-0.104	-0.242**
	(0.082)	(0.075)	(0.110)	(0.085)	(0.078)	(0.115)	(0.076)	(0.070)	(0.103)
Relational risk variables									
Investment specificity	-0.747***	-0.753***	-0.793***	-1.286***	-1.485***	-1.180***			
	(0.125)	(0.122)	(0.150)	(0.241)	(0.237)	(0.291)			
Partner's asymmetry	0.730***	0.792***	1.184***	0.788**	1.218***	1.946***			
	(0.241)	(0.247)	(0.361)	(0.316)	(0.324)	(0.443)			
Lack of trust	0.312	-0.231	0.816	0.991	1.063	1.330			
	(0.516)	(0.480)	(0.696)	(0.968)	(0.921)	(1.177)			
Lack of IFRs experience	-2.358 ***	-2.110**	-4.033***	-3.312**	-4.540***	-7.066***			
	(0.909)	(0.855)	(1.058)	(1.539)	(1.460)	(1.716)			
Performance risk variables									
Tech newness	0.289**	0.590***	0.437***				1.089***	1.632***	0.951*
	(0.131)	(0.131)	(0.168)				(0.398)	(0.387)	(0.103)
Nationality	0.585**	0.660***	0.473*				1.295**	0.970*	0.979
	(0.225)	(0.221)	(0.276)				(0.514)	(0.523)	(0.690)
Tech distance	1.039***	0.659*	0.176						
	(0.380)	(0.370)	(0.467)						

Table 6 (continue). Multinomial regression analysis results

	Model 1			**Model 2**			**Model 3**		
	G=1	G=2	G=3	G=1	G=2	G=3	G=1	G=2	G=3
Interactions									
Investment * Tech newness				0.094***	0.159***	0.144***	-0.051	-0.078	-0.027
				(0.033)	(0.033)	(0.045)	(0.051)	(0.049)	(0.063)
Investment * Nationality				0.204*	0.177	-0.019	-0.168*	-0.171*	-0.334**
				(0.121)	(0.113)	(0.145)	(0.0.95)	(0.096)	(0.136)
Investment * Tech distance							-0.475***	-0.432***	-0.387
							(0.164)	(0.159)	(0.200)
Asymmetry * Tech Newness							0.059	0.073	0.202*
							(0.082)	(0.079)	(0.108)
Asymmetry * Nationality							0.031	0.246	0.418*
							(0.181)	(0.184)	(0.238)
Asymmetry * Tech distance				-0.090	-0.592*	-1.200***	0.605**	0.060	-0.375
				(0.308)	(0.303)	(0.375)	(0.300)	(0.294)	(0.368)
Lack of trust * Tech newness							0.105	-0.039	0.444*
							(0.171)	(0.158)	(0.254)
Lack of trust * Nationality				-0.764	-1.196**	-0.670	-0.670		
				(0.655)	(0.626)	(0.772)	(0.772)		
Lack of experience * Tech newness							-0.858***	-0.928***	-1.299***
							(0.320)	(0.306)	(0.345)
Lack of experience * Nationality				0.533	1.088	1.305			
				(0.801)	(0.775)	(0.899)			
Lack of experience * Tech distance				1.771**	2.699***	4.114***	2.412***	3.264***	3.694***
				(0.833)	(0.849)	(1.152)	(0.910)	(0.914)	(1.117)
Pseudo R square	0.227			0.256			0.222		
Log likelihood	−360.53			−346.95			-362.86		
Log likelihood Chi-square test	[0.000]			[0.000]			[0.000]		

The variable *lack of trust* is not significant at any level in our dataset.

Finally, results for the variable *lack of IFRs experience* is in line with H1 predictions; indeed, the variable is significant at all levels of G with negative coefficients. Thus, when the relation risk increases as a consequence of scarce familiarity of the pharmaceutical firm with alliances, M&As are more likely than contractual alliances, both unilateral and bilateral, and JVs. Also while coefficients for G = 1, 2 are quite similar, JVs are less likely than unilateral and bilateral contractual alliances and this is not according with our predictions. Summarising, a part from *partners' asymmetry*, H1 predictions are satisfied when comparing M&As with other governance forms. When comparing contractual governance forms, unilateral and bilateral, and JVs, H1 predictions depend on pairwise comparison. Concerning *trust*, my empirical results are not significant.

Going to the estimates of performance risk variables (see Model 1), the variable *technology newness* is significant at all the levels of the dependent variable with positive coefficients. Thus, when performance risk arises, due to higher technology newness, M&As are less likely than other governance structures, and this is in line with expectation of H2. Also, in line with H2 predictions bilateral alliances are more likely than JVs; while unilateral agreements result less likely than bilateral ones and JVs, not confirming our expectations.

The variable *technology distance* is significant at G = 1, 2 with positive and decreasing coefficients. These results imply that when performance risk increases as a consequence of a higher technology distance, unilateral contractual agreements are more likely than bilateral ones and both are more likely than M&As; this is fully in line with my predictions confirming hypothesis H2.

Finally, the variable *nationality* is significant at all the levels of the dependent variable with positive coefficients. Again, this means that the greater the performance risk related to the variable nationality, the more likely is to have market-oriented governance forms in comparison to M&As. Also, while unilateral and bilateral agreements are quite equally likely, JVs are much less likely than contractual governance forms. So the results confirm my prediction for this variable. Summarising, H2 predictions are satisfied when comparing M&As with other governance forms; also, a part some exceptions, H2 predictions hold also along the continuum of governance forms.

Model 2 is designed to test H3, namely the hypothesis predicting a moderating effect of

performance risk on the relation between relational risk and the governance form. Thus the model includes all main effects variables influencing relational risk, and all the interaction variables. VIF analysis does not highlight multi-collinearity problems for this model. After having tuned different models with all the possible interactions, I have reported in Table 6 the best fitting model according the pseudo R-square evaluation.

Results for control variables are substantially the same of those in Model 1. Looking at the variables *investment specificity, partners' asymmetry* and *lack of IFRs experience* results are quite the same than in Model 1. Also, *lack of trust* is not significant as in Model 1. The moderating effect of performance risk variables on relational risk ones is significant for the following interactions: a) *investment* and *technology newness* (all G levels); b) *investment* and *nationality* (G = 1, 2); c) *partners' asymmetry* and *technology distance* (G = 2, 3); d) *lack of IFRs experience* and *technology distance* (all G levels); e) *lack of IFRs experience* and *nationality* (level G = 2, 3). In cases a), b), d) and e) the positive coefficients show how the extent of factors increasing performance risk moderates the effect of the relational risk variables on governance forms, reducing the likelihood of M&As in front of other governance forms. Furthermore, in cases b), d) and e) intermediate governance forms such as JVs and bilateral contractual contracts are more likely than other governance forms. All these results provide a strong support to H3. On the other hand, results for case c) are controversial; indeed, in contrast with my predictions, M&As are more likely than other governance forms; on the other hand, in line with my prediction bilateral contractual alliances are more likely than JVs when technology distance increases.

Finally, Model 3 is for H4 appraisal and, therefore, it includes main effect variables influencing performance risk, and all the interaction variables.

However, VIF analysis reveals high values of VIF for the variable *technology distance* (18.13), thus it has been removed from the model in order to do not incur into multi-collinearity problems. Again, after having tuned different models with all the possible interactions, I have reported in Table 5 the best fitting model according the pseudo R-square evaluation.

Results for control variables are substantially the same of those in Model 1. Looking at the variables *technology newness* and *nationality* results are quite similar to Model 1. The moderating effect of relational risk variables on performance risk ones is significant in the interactions between: a) *technology newness* and *investment* (G = 2); b)

technology newness and *absence of previous relations* (G = 3); c) *technology newness* and *partners' asymmetry* (G = 3); d) *technology newness* and *lack of IFRs experience* (all G levels); e) *nationality* and *investment* (all G levels); f) *partners' asymmetry* and *nationality* (G = 3). In cases a) d) and e) the negative coefficients show how the presence of high levels of relational risk variables moderates the effect of performance risk variables on governance forms increasing the likelihood of M&As on other governance forms. In cases b), c) and f) although the coefficients are still positive (respectively 0.202, 0.444, 0.418), they are all lower than coefficients of the technology newness (0.951) and the nationality (0.980) still evidencing the moderating effect of the relational risk variables. All these results in Model 3 provide a strong support to H4.

5.4 Discussion

The main contribution of this research is to bring theoretical and empirical support to risk-evaluation in the choice of inter-firm relationships governance. Indeed, in spite of the fact that the role of risk has gained increasing attention in the study of inter-firm relations, few studies have deeply investigated the issue, some exceptions are Das and Teng works (1996, 1998, 2000, 2001a) and Nooteboom's model (1996). Moreover, few of them are empirical researches, except Delerue (2004), Delerue and Simon (2009) and Noteboom et al. (1997) that however analyze only the effect of relational risk perception on the governance form decision.

According to Das and Teng (2001a), the design and the structure of the relationship stems from risk perception; thus, my theoretical model applies TCE and RO theories in a discriminated fashion in order to shed new light on IFRs governance by identifying and distinguishing among factors influencing the perception of a relational risk and those influencing the perception of a performance risk in undertaking a new relation. My theoretical model seems to be strongly supported by empirical evidences. In particular, I find support for the first hypothesis (H1) for which, in accordance to TCE, the perception of high levels of relational risk leads firms to choose more hierarchical governance forms. In particular, I find that the higher the investment specificity and the lack of IFRs experience, factors determining a higher perception of relational risk, the more likely firms will choose an integrated and structured governance, such as a joint venture or even an acquisition. Unfortunately, I didn't find significance for the variable

lack of trust. Furthermore, I find support also for the second hypothesis (H2) according to which, following a RO logic, the extent of high levels of perceived performance risk pushes firms to remain flexible through a more market-oriented governance, as they possibly delay a more binding choice. I find that the higher the newness of the technology object of the relationship, the higher the technological distance between the partners and the more different are the partners' nationalities, the more likely firms will go for a flexible and market-oriented relationship, such as a unilateral or bilateral contract-based alliance.

Moreover, I add to theory by providing evidence that a moderating effect between relational and performance risk factors does exist; namely, as hypothesized in H3 and H4, the extent of high levels of both relational risk and performance risk factors reduces both the tendency to move toward totally integrated governance forms, such as M&As and toward pure market transactions, such as licensing agreements, leading in practice to hybrid forms, such as equity and non-equity alliances. In particular, my findings suggest that the extent of drivers influencing performance risk, such as the technological newness and the partners' different nationality, moderates the relationship between investment specificity and hierarchical governance; this indicates that the higher risks associated with early-stage products or with partners' differences in terms of nationalities make less important the extent of investment specificity in the governance form choice.

Again, a moderating effect has been found for the relationship between the lack of IFRs experience and hierarchical governance when the technological distance and the different nationality also assume high values. Also the extent of technological distance seems to moderate the relationship between partners' asymmetry and hierarchical governance forms. On the other hand I find support also for the opposite, namely the extent of relational risk factors, such as the investment specificity, the lack of previous relations, the partners' asymmetry and the lack of IFRs experience, mitigate the relationship between performance risk factors, such as technological newness and nationality, and market-oriented governance modes.

Thus, this research contributes to the existing literature on IFRs governance in the following ways. First, I provide insights on the complementarities of TCE and RO theories in assessing the risk of an inter-firm relationship. Indeed, this is, to the best of my knowledge, the first empirical research that tests how factors related to relational

risk perception and those related to performance risk perception influence together the governance choice. Moreover, as explained before, this is the first work that provides empirical evidences of the interaction effect existing between different kinds of factors. Santoro and McGill (2005) already tested a moderating effect of partner uncertainty in the relationship between task uncertainty and hierarchical governance, but they limit their analysis only to this interaction.

Second, this analysis shows that relational and performance risk are multidimensional risks since each of them depends on several factors, namely managers have to simultaneously consider several factors that may contribute to risk perception. Of course some of them are more important than others.

Third, my results reinforce the importance of investment specificity as an important factor in determining the governance choice, as most prior empirical research have not considered it as a driver of the choice.

The study has several managerial implications. First, as already suggested but not tested by Das and Teng (2001a), the model here proposed and its empirical confirmation recognize that the perception of strategy-makers substantially influence inter-firm strategic decisions, namely managers tend to make decisions based on their evaluation of both relational and performance risk. Also, I propose a general and comprehensive framework for making governance decisions in inter-firm relationships that is easily adaptable to any industry.

Thus, from a managerial perspective, it may represent a tool for decision supporting when managers have to undertake a new relation with another firm, by specifically analyze drivers of relational and performance risk in each situation. At the some time my results are very specific of a particular industry, namely they can be used immediately as guidelines for relationships between pharmaceutical and biotech companies.

While the study makes contributions to the alliance literature, several potential limitations should be noted. First, I rely solely on secondary data in the biopharmaceutical industry; these data could be supplemented with field-based primary data of firms in this and other sectors to increase generalizability. Second, this research is based on a cross-sectional data and this provides limited insight into the temporal aspects of relational and performance risk in inter-firm relationships.

Chapter 6

CONTRACT SETTINGS IN VENTURE CAPITAL INVESTMENTS: AN EMPIRICAL ANALYSIS OF VC INVESTMENTS IN US AND EUROPE

6.1 Introduction

As pointed out in chapter 3, the scientific literature on venture capital contracting has received important contributions especially in the last decade, but this literature strand still suffers from the relative opaqueness of the industry. On the one hand, a large body of literature have addressed the incentive-optimal design of venture capital contracts in a theoretical context. On the other hand, empirical literature is much more limited and shows a discrepancy between theoretical models and observed contracting practices. For a long time, empirical work largely had to rely on survey data yielding a rich picture regarding general market assessment, but a potentially very subjective view of specific investments given the reliance on self-reporting. Moreover, while venture capitalists in the US seem to structure their contracts consistent with optimal characteristics predicted by the theory (Kaplan and Strömberg, 2003; 2004), contracts in the rest of the world seem to be much more heterogeneous (Bascha and Walz, 2002; Bottazzi et al., 2004; Cumming, 2005b, 2008). Still today there are no empirical studies on VC contracting across the different European countries. Empirical analyses outside the US are country-based studies mainly coming from Germany or Canada.

In this research I investigate venture capital contracting practices looking at how VCs mitigate principal agent conflicts between them and entrepreneurs. I showed in Chapter 2 that according to financial contract theory and empirical research VCs try to mitigate agency conflicts in three ways: (i) pre-investment screening that allows the investor to choose good projects and/or (ii) structuring financial contracts such that cash flow rights and control rights are aligned to allow optimal behaviour by the entrepreneur or decisive intervention by the principal if need be and/or (iii) post investment monitoring and advising (Hart, 2001; Kaplan and Strömberg, 2003).

Not surprisingly some empirical research has focused on the interaction and complementarity of these activities, for example between the design of cash-flow and control rights in contracts and post investment activities such as monitoring (e.g. Hellmann and Puri, 2002). However, no research has focused on how the use of these mitigatory mechanisms such as pre-investment screening and design of financial contract provisions is associated to the perceived degree of agency conflict. It is also not clear how pre-investment screening activities such as syndication (e.g. Manigart et al, 2006; Tykvova, 2007) are better used alongside or as a substitute to the design of contractual rights and post investment activities. Another issue that has not been examined is how better selection of ventures through syndication relates to the subsequent design of financial contracts provisions such as use of higher ranking equity financial instruments, cash flow and control rights in financial contracts. Also I ask if superior screening coming from the use of syndication results in the use of covenant rights as complements or substitutes.

In order to give an answer to the above described research questions I firstly develop a theoretical model that analyzes how venture capitalists manage adverse selection and moral hazard problems in the investor-investee relation depending on the level of agency conflicts. Following past studies, I model the level of agency conflict in the investor-investee relation to be related to the venture development stage at which the investment occurs (e.g. Podolny, 2001; Gompers, 1995). Following Podolny (2001), I use three financing stages namely: first (seed and start up), second (early stage) and third financing stage (expansion and recapitalization).

In particular, the first part of the research investigates how pre-investment screening activities, the use of equity financial instruments, the allocation of cash flow and control rights are employed with respect to each development stage of the venture at which the investment occurs. I also examine how these mechanisms interact, i.e. as complements or as substitutes.

Then, the developed hypotheses are tested by analyzing contractual practices actually used in a sample of 265 venture capital investments in 127 portfolio companies by 90 different lead VCs both in the United States and in European countries.

This is to the best of my knowledge the first empirical work that assesses this kind of in-depth information across the largest VC markets in Europe and also the first dataset covering the US together with non-US countries.

The rest of the chapter is organized as follows: the next section 6.2 provides the theoretical framework and develops a set of hypotheses that show how VCs mitigate agency problems through the use of syndication, financing instruments, cash flow and control rights. I then present the methodology in section 6.3. In section 6.4 I discuss the results obtained from the empirical investigation and finally section 6.5 is on discussion and conclusions.

6.2 Theoretical framework developing: third set of hypotheses

Potential investments by VCs in prospective promising entrepreneurs give rise to principal agent conflicts because of the high information asymmetry, high uncertainty and incentive problems involved in the interaction between the two parties. These agency conflicts may generate two kinds of problems: adverse selection and moral hazard.

The first problem is adverse selection. VCs as investors are not quite certain which projects are good or bad and face the risk of suboptimal allocation of funds to really good projects, in the belief that entrepreneurs withhold really good projects anyway, a situation first described by George Akerlof as the 'market for lemons' (Akerlof, 1970). VCs can mitigate this problem by gaining competences in due diligence and ensuring they hire executives with deep industry experience. However, due to high risk and uncertainty arising from high information asymmetry, during the projects pre-investment screening phase, VCs are further aided by either (i) syndication (e.g. Lerner, 1994) and/or (ii) looking for signals, such as the willingness of the entrepreneur to ex-ante accept penalties for mal-performance as a vote of their confidence in the quality of their ideas (Amit et al., 1990), i.e. the use of higher ranking equity financing instruments such as preferred equity. In paragraph 6.2.1 and 6.2.2 I investigate how VCs use syndication and equity instruments as mechanisms to manage adverse selection issues.

At the same time, the contractual interactions between VCs and the entrepreneur are also subject to a moral hazard problem. On investment, the VC takes on part of the risk

and the potential surplus from the project. The moral hazard problem is that the entrepreneur may exert less effort than he would if he had full control of the project.

Moreover, there is the danger that the entrepreneur, left to themselves, may take on more risk or waste the invested resources. The literature suggests that VCs mitigate moral hazard problems by including control rights such as staged financing provisions and sitting on the board of directors (Lerner, 1995; Gompers, 1997). Despite the control rights that the VCs may exercise, some features of the entrepreneur's business will remain unobservable or unverifiable. This situation is expected to improve as the VCs get access to the firm more and more over time. In paragraph 6.2.3 and 6.2.4 I investigate the use of standalone cash flow covenants, such as staging investments, and control rights, i.e. board rights, as instruments to reduce moral hazard problems.

6.2.1 Pre-investment screening mechanism: the use of syndication

In paragraph 3.3.1 of this doctoral thesis I reviewed the most important literature on the rationales for syndication highlighting that one of the motives for syndication of VC investment is that it is used as a pre-investment screening mechanism that mitigates agency problems. Indeed, ex-ante, company specific risk is generally high due to information asymmetry and incentive problems, and VCs syndication can lead to a better assessment and selection of the project in which to invest.

Thus, I follow the syndication literature that supports the selection hypothesis, according to which there is an advantage derived from having more than one VC in the evaluation of the project before it is selected for investment (Lerner, 1994; Lockett and Wright, 2001; Manigart et al., 2006). Moreover, by syndication, VCs not only have access to potentially better quality information obtained through the social networks of other VCs, they also have potentially increased information processing capacity through the involvement of more and different decision makers (Sah and Stiglitz, 1986).

Thus, syndication is particularly important for information sharing when the problem of information asymmetry is particularly high and an informed second opinion enhances the chances that the VC reaches a better decision (Lerner, 1994). The pre-investment screening through syndication results in VCs identifying what they perceive to be performance risks in the project (Kaplan and Strömberg, 2004). Past empirical research has identified management risk as the major performance risk that arises out of pre-investment screening.

Accordingly the value of an informed second and maybe third opinion increases with increased perceived degree of agency problems or information asymmetry problems. Finally, consistent with earlier work on the rationale underlying the decision to syndicate, Cumming (2006) finds empirical evidence supporting the conjecture that syndication mitigates problems of adverse selection.

Adverse selection is a problem that VCs face when evaluating proposals for start-ups. However once a VC makes an investment, it has privileged access to information about the venture and accordingly the uncertainty around a reinvestment decision is relatively lower than the initial investment decision, hence I posit that:

Hypothesis 1 (H1): *The higher (lower) the degree of syndication used, the more likely the investment stage is associated with higher (lower) perceived venture selection risk.*

6.2.2 Signalling venture quality: preferred equity

The second way of mitigating adverse selection problems is for VCs to design incentive-optimal investment contracts. From the entrepreneurs' point of view, their primary incentive is substantial equity ownership of a company that successfully commercializes their ideas. Their fortunes are tied up to the company's development and therefore are exposed to the idiosyncratic risk of the venture. This risk is increased when their stake is subordinated to that of the VC investors in that they receive no payoff until VC claimants have received prescribed payoffs in the event of exit.

When entrepreneurs accept VCs to have higher-ranking equity stakes, they signal the confidence they have in their ideas in that they are willing to accept an incentive structure that punishes future mal-performance. In addition, most VC backed entrepreneurs receive submarket salaries during the start-up phase to induce self-selection among applicants for venture capital funding because only applicants with confidence in their ideas can accept negative pay-offs as designed (Hall and Woodward, 2010).

Higher-ranking financing instruments used include preferred equity, convertible preferred equity and participating preferred equity. These financing instruments raise the seniority of VCs' equity and allow them to secure increased dividend, liquidation and subscription rights relative to the founder in the event of mal-performance (Ippolito, 2006).

As the venture develops, adverse selection is expected to decrease as uncertainty around the investment reduces, hence I posit that:

Hypothesis 2a (H2a): *The higher (lower) the use of preferred equity instruments, the more likely the investment stage is associated with higher (lower) perceived venture selection risk.*

The pre-investment screening through syndication results in VCs identifying what they perceive to be performance risks in the project. For example, past empirical research has identified management risk as the major performance risk that arises out of pre-investment screening (e.g. Kaplan and Stromberg, 2004). I therefore expect VCs that use pre-screening mechanisms such as syndication to also employ higher ranking financing instruments such as preferred equity to mitigate against perceived management risk etc., hence I posit that:

Hypothesis 2b (H2b): *A higher (lower) use of syndication will be used alongside higher (lower) use of preferred equity instruments in investment stages associated with higher (lower) perceived venture selection risk.*

6.2.3 Contractual rights: standalone cash flow covenants

On the other hand, VCs face a moral hazard problem in that they are unable to monitor or specify the efforts of entrepreneurs in commercializing their ideas. When VCs commit to an investment, they face the risk that the entrepreneur exerts suboptimal effort, or takes on too much business risk or even squanders the firm's resources, because the risk is now borne or shared by the investor. VCs may mitigate this risk by continuously controlling the firm through contractual rights such as cash flow and control rights to influence the general operational and strategic direction of the venture (Lerner, 1995; Gompers, 1997). VCs tend to allocate control rights contingent on observable measures of the venture performance. Thus in case of bad performance control gradually shifts to the investor (Kaplan and Strömberg, 2003).

Standalone covenants are used in practice to bolster the incentive optimal cash flow allocation through the use of cash flow rights and covenants. The use of further cash

flow rights (in addition to financing instruments), which are costly for the VC to write and enforce is an indicator of the higher level of agency conflict potential observed by the VC (Gompers and Lerner, 1996).

Cash flow related covenants are generally intended to secure the VC's purely financial stakes from hold up problems rather than selection problems. They are applied as a downside protection for the VC to prevent a dilution or reduction of his investment value and as a measure to maintain control over the constitution and duration of his share in the portfolio firm.

As already pointed out in paragraph 3.3.3 VCs can use a range of covenants as follows: (i) staged financing, to make cash investments conditional on specific milestones; (ii) conversion option,s to protect minimal interests in case of distress and have the option to claim high returns when they occur; (iii) redemption rights, that provide a VC the right to back down from an agreement after a certain period of time; (iv) exit rights, that provide a VC the right to force an exit if and (v) safeguards against events that they may dilute the VCs' ownership position. In particular, the literature review has highlighted how several authors (such as Neher, 1999; Wang and Zhou, 2004) have studied the role of staged financing in reducing moral hazard and uncertainty. Also, empirical research shows how staging is very widespread, but more prevalent for investments with high agency costs, since it mitigates moral hazard and hold-up by both parties and motivates the entrepreneur to exert optimal effort (Gompers, 1995).

The potential misallocation of effort by the founder who has an incentive to accumulate private benefits at the expense of the VC investor is likely to increase as the venture develops. As the venture grows, the entrepreneurs have more resources under their control and they increase in confidence as they obtain superior information on the firm's substance and prospects. Moral hazard problems also stem from potentially diverging interests that worsens over time between VCs and entrepreneurs, especially from imbalanced financing structures and the fact entrepreneurs associate substantial non-monetary benefits with their role in the company and with the existence of the company as a whole (Bergemann and Hege, 1998). Hence, I hypothesize:

Hypothesis 3 (H3): *The higher (lower) the use of standalone cash flow covenants, the more likely the investment stage is associated with higher (lower) perceived venture moral hazard risk.*

6.2.4 Contractual rights: control rights

Finally, VCs can use their role as value adding investors to ensure they have the ability to influence the operational and strategic activities and direction of the venture they are investing in. Control rights provide VCs with the ability to enforce certain behaviour by the entrepreneur. As pointed out in paragraph 3.3.4 control rights can be divided between decision rights and veto rights (Tikvova, 2007). Decision rights mainly relate to the VC rights on the venture's supervisory board, namely board rights and board seats, voting rights, and management replacement clauses. Veto rights concerns instead a number of important strategic, financial or operative decisions, such as veto on changes to shareholder's agreement, asset sales, sales of shares, capital structure, business plan, etc.

In empirical literature the most investigated control rights are board and voting rights, mainly because of the extensive use of these rights in real world contracting practices (Kaplan and Strömberg, 2003).

Control rights are important in the early stages of the venture, when the venture is at its most premature stage and it needs managerial support and direction. However, control rights become relatively more important as the venture matures, and requires more resources from the investors. Moreover, as the venture matures, the bargaining power of the entrepreneur increases, thus the possibility of opportunistic behaviour increases.

Hence, I hypothesize:

Hypothesis 4a (H4a): *The higher (lower) the use of board control rights, the more likely the investment stage is associated with higher (lower) perceived venture moral hazard risk.*

Moreover, contracting practice shows that VCs use control rights alongside cash flow rights covenants. VCs are able to allocate control independent of the amount of cash-flow rights and very often they retain control rights, which are often disproportionately larger than the size of their equity investment (Tikvova, 2007). Hence I posit:

Hypothesis 4b (H4b): *A higher (lower) use of standalone cash flow covenants will be used alongside higher (lower) use of board control rights in investment stages associated with higher (lower) perceived venture moral hazard risk.*

6.3 Empirical analysis: an investigation on VC contracting practices in US and Europe

6.3.1 Dataset and data collection

The dataset used to empirically test the above described hypotheses consists of hand-collected details on international VC financing contracts for a sample of 265 investments in 127 portfolio companies by 90 different lead VCs in the United States, Germany, the United Kingdom, Israel, France, Scandinavia and a few other European countries. The analyzed investments took place between 1997 and 2008.

To collect the data, a number of VC partnerships have been approached and asked them to provide details of their original investment contracts. The sample includes both small and large VCs and those with a national and/or international investment focus. The selection of target countries was motivated by a lack of contracting research in Europe[7], together with the ambition to capture contracting practices from largely developed VC markets. To ensure that country-based results are not driven by outliers, country subsamples are of at least 20 investments for all major countries in the sample.

The data collection process itself considered a wide range of contractual information to include all possibly relevant elements for this study. Where available, financing structures were collected together with information on covenants and both VC and portfolio firm characteristics. In light of the industry's very high confidentiality standards, all contracts were accessed at the VCs' offices, and all data was encoded anonymously upon receipt. Overall, collected information cover five broad areas:

- *general investment information*, such as round number, date of investment, financing phase;
- *portfolio firm information*, i.e. country and industry;
- *investment details*, information such as investment timing (staging) and syndication;
- *security design*, i.e. investment amounts by financing instrument, equity vs. debt financing;

[7] Due to a very fragmented and opaque VC industry, only very few researchers have been able to analyze European contracting with hand-collected cross-country samples. The only exceptions are Cumming (2008) and Cumming and Johan (2008), who analyze the interdependency of contracts and venture capital exits. Moreover, most of the data by Kaplan et al. (2007) stems from European countries.

- *specific VC control rights*, mainly information about VCs voting and board rights.

Overall, the dataset has several advantages over most others used in previous studies in the field. First, data collection by hand eliminates a common bias from survey-based studies, which implies a high quality of data and a large degree of detail. Second, the information used in this study is quite comprehensive and goes beyond what is customarily analyzed in other studies with hand-collected data.[8] Third, I'm the first to access this kind of in-depth information across the largest VC markets in Europe. Moreover, this is also the first dataset on VC contracts details covering the US together with non-US countries.

6.3.2 Dataset summary

Table 7 below gives an overview of the major data characteristics in the sample. Panel A in Table 7 displays information by financing stage and shows that contracts cover all stages of the venture capital investment cycle from seed to recapitalization[9]. The investment stages are divided into first, second and third stage investments.

First-stage investments include seed and start-up financing. In seed investments capital is provided to research, assess and develop an initial concept before a business has reached the start-up phase either before or immediately after founding. Start-up financing is provided to companies for product development and initial marketing. Companies may be in the process of being set up or may have been in business for a short time, but have not sold their product commercially.

Second-stage investments cover other early stage financings that are provided to companies in final development (product testing and pilot production) and initial market entry and establishment stages that may or may not be generating revenue.

[8] The scope of examined documents exceeds that of most other studies. For example, Antonczyk et al. (2007a,b) and Cumming (2008) limit their analyses to investment agreements, while Lerner and Schoar (2005) analyze only investment agreements, investment memoranda and business plans. Our data is most similar in scope to work by Kaplan and omberg (2003), Bienz and Walz (2006) and Kaplan et al. (2007).

[9] Our stage classification has been adapted from Cumming et al. (2010), who use an adjusted version of the EVCA definitions. Few other studies report summary statistics on the distribution of their contracts across stages. Ours is similar to the distribution in those studies that do (compare Bienz and Walz, 2006; Antonczyk et al., 2007a).

Third-stage investments include expansion and recapitalization. Expansion financing is provided to companies in need of development capital for the growth and expansion of a company, which may or may not break even or trade profitability. Capital may be used to finance increased production capacity, develop new markets or products or provide additional working capital. Recapitalization financing is provided to recapitalize more mature companies that have traded profitability in the past.

Panel A shows that nearly 39% of investments were for first-stage financing where the company had not begun any production. About 40,4% of investments were for second-stage financing and 20,6% of the investments were for expansion or recapitalization. Moreover, the figures on average investment amounts yield an interesting picture. Average investment amounts decrease going from first to third investments. This indicates that investors provide largest amounts of funds per capita in very early investment stages, when the portfolio firm has not yet delivered any proof-of-concept and when the financing need is obviously higher.

Panel B displays information by country; I divided data in three subsamples, namely investments from Europe, US and Other countries. The biggest subsample stems from Europe with a total of 198 investments (66% of the total). The reader should know, even if it is not displayed in the summary information table, that within Europe, Germany has the highest number of investments (81), followed by United Kingdom (34), Scandinavia (30) and France (19). Moreover, 67 investments are from US (25,3% of the total) and 23 investments (8,7%) are from Israel. With the UK, France, Sweden and Germany, the sample includes data from the largest venture capital markets in Europe (at least in absolute terms). Including contracts from the US enables direct comparisons between US and European data, which no study to date has been able to accomplish.

Panel B also shows that contracts have been structured by a number of different lead investors in all major countries in the sample. This ensures that country results are not dominated by contracting practices of individual VCs. The figures also show a significant difference in the investment amount between countries. Larger investment amounts are found in US.

The contracts are from a range of different industries (see Panel C) and are distributed fairly evenly over time (Panel D).[10]

[10] All investments in our sample took place between 1997 and 2008. Except for the first and last two years of this period, the collected investments are distributed evenly with a little peak only in the years 2000 and 2001.

Table 7. Summary information on the analyzed VC investments

	Investment Rounds		Portfolio Firms		First Round Only		Roundsize (in € 1,000) Mean
Overall Sample	265	100%	127	100%	60	100%	7,322
Panel A: Investments by Investment Stage							
First-stage financing	100	38.91%			41	68.34%	9,191
Second-stage financing	104	40.47%			12	20.00%	7,585
Third-stage financing	53	20.62%			7	11.66%	3,439
Panel B: Investment by Country							
Europe	198	66.04%	91	71.66%	50	83.34%	7,846
United States	67	25.28%	26	20.47%	8	13.33%	11,634
Other countries	23	8.68%	10	7.87%	2	3.33%	4,123
Panel C: Investment by Primary Industry							
Life Science	66	24.91%	32	25.19%	16	26.67%	9,663
ICT	186	70.19%	86	67.72%	40	66.67%	6,444
Other industries	13	4.90%	9	7.09%	4	6.66%	8,644
Panel D: Investments by Investment Year							
1997	2	0.75%	2	1.57%	1	1.67%	15,529
1998	4	1.51%	4	3.15%	3	5.00%	1,865
1999	18	6.79%	14	11.02%	6	10.00%	6,588
2000	42	15.85%	24	18.90%	14	23.33%	9,172
2001	40	15.09%	20	15.75%	9	15.00%	9,354
2002	27	10.19%	17	13.39%	8	13.33%	7,270
2003	33	12.45%	11	8.66%	4	6.67%	5,498
2004	34	12.83%	8	6.30%	2	3.33%	5,313
2005	30	11.32%	13	10.24%	8	13.33%	5,726
2006	26	9.81%	10	7.87%	2	3.33%	7,489
2007	8	3.02%	3	2.36%	2	3.33%	8,880
2008	1	0.38%	1	0.79%	1	1.67%	24,790

Major industries in our sample include IT/software, semiconductors and communication, that were grouped under the term 'ICT' (70%), followed by biotech and medical technology, that were grouped under 'Life Science'(25%).[11] The remainder 5% is composed of firms operating in 'Other industries', such as media, F&B services and traditional industries. Not very surprisingly, the figures indicate that companies in relatively less complex and capital-intensive industries such as IT, software and other ICT require lower round amounts. Life Science firms, on the other hand, have very large round sizes in our sample. It can be observed that the average investment size peaked in the years 2000 and 2001, even though especially 2000 contained a lot of first rounds. This is in line with the overall phenomenon of very high valuations in the pre-2001 run-up.

6.3.3 Variables and measures

6.3.3.1 Dependent variable: financing stage

The dependent variable used in this study is a measure of the degree of information asymmetry between the investor (VC) and the investee (entrepreneurial firm) at the time of the investment. Following the work of Podonly (2001), I assume that the degree of information asymmetry between investor and investee is related to the firm's development stage at the time of the investment. I therefore denote the degree of information asymmetry by the development stage that the investment is taking place in. Thus, the dependent variable, *Financing Stage*, is an ordinal variable taking values: '1' for first stage financing; '2' for second stage financing and '3' for third stage financing.

6.3.3.2 Independent variables

N° of VCs in syndication

Several researches have treated syndication as a dummy variable, either syndication occurs, or it does not occur. In this research I decided to treat syndication more comprehensively (as in Brander et al. 2002), as I know the number of syndicating venture capitalists associated with each venture. In this way I can evaluate the degree of

[11] Although these studies report slightly different industry categories, this distribution is fairly similar to those found in previous samples by for example Kaplan and omberg (2003), Bienz and Walz (2006), Antonczyk et al. (2007b) and Kaplan et al. (2007).

syndication. The variable, *N° of VCs in Syndication*, is a count variable denoting the number of additional VC investors involved and assuming value '0' where syndication is not involved.

Preferred Equity

I analyse the use of all forms of *Preferred Equity*, i.e. straight preferred equity, convertible preferred equity, and participating preferred equity securities. A central advantage of equity securities is that investors participate in the upside development of the firm. Preferred equity differs from common stock mainly through its superior dividend, liquidation and subscription rights. In this analysis I consider preferred equity securities since they are the primary financing instruments used in VC investments. As observed from the literature review in section 3.3.2, empirical research, in the US, leave no room for doubt that convertible preferred equity is the prime financing instrument in VC investments (see for example Sahlman, 1990; Trester, 1998; Kaplan & Strömberg, 2003). On the other hand, in European VC investments, researchers find a more heterogeneous picture, however equity securities, especially common, straight preferred and convertible preferred stock, are used in almost 50% of cases (Cumming, 2005a; Cumming 2005b; Bottazzi et al., 2004). Hence, our variable *Preferred Equity* is coded with value '1' when the VC used either preferred equity or convertible preferred equity or participating preferred equity as a financing instrument of the investment or "0" otherwise.

Cash-Flow rights

Cash-flow related covenants are generally intended to secure the VC's financial stakes. They are applied as a downside protection for the VC to prevent a dilution or reduction of his investment value and as a control mechanism. As discussed in earlier sections, VCs can use a range of cash flow rights. In the empirical analysis I include one of the most used cash-flow rights in the literature, that is *Staged Financing.* This choice was also related to data availability. Through staged financing the VC investor can make future cash flows conditional on the achievement of specific milestones. The variable is coded '1' where the VC used this right and '0' where it is not.

Control rights

VCs use control rights to secure their influence in the portfolio firm. These rights allow VCs to enforce certain behaviours by the entrepreneur and exert influence in important operational and strategic decisions.

Control rights are mainly related to the VC supervision on the venture's board and may include voting rights and also veto rights for a number of important strategic, financial and operative decisions. In this empirical analysis, mainly because of data availability, I use the variable *Board Rights of the VCs* that measures the total percentage of rights of all the VCs on the board of the entrepreneurial firm.

6.3.3.3 Control variables

I include five control variables in the analysis. First, I include the variable *Date*, that is a categorical variable ranging from 1997 to 2008 in order to control for temporal trends in investments. I also control for cross-country differences in contracting practices by using the variables *Europe* and *US*, that are dummy variables assuming value '1' whether the entrepreneurial firm is European or US. Then, I control for size as a motive for syndicating by the use of the variable *Average Investment*. Average investment is obtained by dividing the overall value of the investment by the number of VCs syndicating. Finally, I control for industry effects by including the two control variables *ICT* and *Life Science*; that are dummy variables assuming value '1' whether the entrepreneurial firm is operating in one of those industries.

6.3.4 Methods

I assessed the association between the use of syndication, senior equity financial instruments and contractual rights *AND* the degree of information asymmetry as represented by the three firm's development and financing stages, (first stage, second stage and third stage financing), with a multinomial logistic regression. The general specification of the multinomial logistic regression applied here was:

$$Ln(P_j/P_o) = A + B_jX_j$$

Where Pj is the probability of an event occurring for the jth case. The two possible events here are defined as investment occurring in stage one (seed or start-up) i=1; or

investment occurring in stage two (early stage investment) i=2. Po is the probability of the investment occurring in stage 3 (expansion). Xj is the vector of independent variables.

6.3.5 Results

Table 8 reports the basic descriptive statistics and correlations for both the dependent and independent variables included in this study. The average of *N° of VCs in Syndication* is 3 although there is considerable variability with a relatively high standard deviation of about 3. About 48% of VC contracts on average use *Staged Financing*. *Preferred Equity* is used as financing instrument in 55% of investments. Finally, VCs dominate the *Board Rights* with a mean of 56%. The standard deviation of this variable is relatively small at 0.2 indicating that this practice is much more generally employed.
The average investment amount is €1812000, although there is considerable variability with a standard deviation of €1810000. The correlations show high values between some of the control dummy variables, such as the value -0.79 between the variables *Europe* and *US* and -0.92 between *ICT* and *Life Science*; this might indicate possible multicollinearity problems. Therefore a collinearity test was performed to analyze the extent each of the individual regressors were dependent on the other regressors. The variance inflation factors (VIF) are much lower than 10 for all the variables, thus we assumed that multicollinearity is not a problem for the data.
Table 9 present the results of the multinomial logistic regression analysis. These results provide a detailed assessment of the contractual mechanism firms use in making investments at each development or financing stage (first, second or third stage). Each model estimates coefficients for the likelihood of the mechanisms allowing VCs to manage adverse selection and moral hazard problems to be employed at the first and second financing stages against the default category of the third financing stage of the venture. Model 1 shows control variables only. Model 2 contains control variables and the first independent variable of syndication. Model 3 shows control variables and the second independent variable of preferred equity. Model 4 shows control variables, both syndication and preferred equity independent variables and the interaction effect between syndication and preferred equity. Model 5 shows control variables and the third independent variable of staged financing. Model 6 shows control variables and the forth independent variable of board rights.

Table 8. Descriptive statistics and correlation matrix

Variable	Mean	S.D.	Min.	Max.	1	2	3	4	5	6	7	8	9
Financing Stage	1.81	0.74	1	3									
1. Europe	0.66	0.47	0	1									
2. US	0.24	0.43	0	1	-0.79**								
3. Date	2002	2.38	1997	2008	-0-14	0.14							
4. Av. Investment (in €1000)	1812.45	1819.79	24.14	15450	0.01	0.01	-0.12*						
5. ICT	0.70	0.45	0	1	-0.16**	0.17**	0.04	-0.17**					
6. Life Science	0.25	0.43	0	1	0.20**	-0.20**	-0.01	0.14*	-0.88**				
7. N° of VCs in Syndication	3.53	3.38	0	25	-0.30**	0.36**	0.14*	0.08	-0.01	0.03			
8. Preferred Equity	0.55	0.49	0	1	-0.33**	0.26**	0.18	0.25*	-0.03	0.04	0.36**		
9. Staged Financing	0.48	0.50	0	1	-0.02	0.01	0.10	-0.14	-0.02	0.01	0.06	-0.14	
10. VC's Board Rights	0.56	0.21	0	1	0.09	-0.01	0.39*	0.02	-0.02	-0.01	0.32**	0.22**	0.17**

Table 9. Multinomial regression analysis results: models 1 - 4

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	stage=1	stage=2	stage=1	stage=2	stage=1	stage=2	stage=1	stage=2
Const	900.52***	724.61***	1002.38***	835.70***	981.45***	744.06***	1040.17***	851.28***
	(183.75)	(175.41)	(192.03)	(184.18)	(190.63)	(179.22)	(198.46)	(189.57)
Europe	0.518	-0.453	0.621	-0.344	0.982	-0.282	0.945	-0.304
	(0.728)	(0.599)	(0.740)	(0.619)	(0.754)	(0.639)	(0.773)	(0.673)
US	0.888	-0.037	0.462	-0.550	0.956	0.023	0.562	-0.419
	(0.787)	(0.654)	(0.823)	(0.699)	(0.785)	(0.661)	(0.857)	(0.746)
Date	-0.450***	-0.361***	-0.501***	-0.417***	-0.491***	-0.371***	-0.520***	-0.425***
	(0.092)	(0.087)	(0.095)	(0.092)	(0.095)	(0.089)	(0.099)	(0.095)
Av. Investment	-0.001	-0.001	-0.003	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ICT	1.446	0.643	1.022	0.137	1.257	0.602	0.935	0.212
	(0.987)	(0.806)	(1.017)	(0.844)	(1.007)	(0.819)	(1.022)	(0.855)
Life Science	4.132***	2.514***	3.674***	1.970*	3.848***	2.399**	3.557***	1.994**
	(1.187)	(1.045)	(1.215)	(1.075)	(1.202)	(1.056)	(1.222)	(1.091)
N° of VCs in Syndication			0.234***	0.267***			0.101	0.327***
			(0.086)	(0.083)			(0.161)	(0.140)
Preferred Equity					1.137**	0.274	0.698	0.169
					(0.450)	(0.417)	(0.655)	(0.642)
Syndication*Pref Equity							0.099	-0.091
							(0.194)	(0.176)
Pseudo R-square	0.107		0.128		0.128		0.148	
Log likelihood	-243.79		−237.90		-237.90		-232.44	
LR Chi-square [Prob.]	(12) 58.40 [0.000]		(14) 70.17 [0.000]		(14) 70.17 [0.000]		(18) 81.10 [0.000]	

Table 10. Multinomial regression analysis results: models 5 - 8

	Model 5		**Model 6**		**Model 7**		**Model 8**	
	stage=1	stage=2	stage=1	stage=2	stage=1	stage=2	stage=1	stage=2
Const	888.31***	735.70***	884.26***	802.50***	903.87***	810.02***	1011.93***	876.32***
	(186.35)	(176.75)	(210.21)	(202.85)	(215.70)	(205.73)	(229.04)	(217.92)
Europe	0.512	-0.465	0.749	-0.435	0.724	-0.453	1.425*	-0.076
	(0.739)	(0.599)	(0.764)	(0.626)	(0.778)	(0.627)	(0.833)	(0.704)
US	0.906	-0.051	1.251	0.300	1.207	0.265	0.945	-0.133
	(0.797)	(0.655)	(0.833)	(0.691)	(0.848)	(0.693)	(0.887)	(0.739)
Date	-0.444***	-0.367***	-0.442***	-0.400***	-0.451***	-0.404***	-0.505***	-0.437***
	(0.093)	(0.088)	(0.105)	(0.101)	(0.107)	(0.103)	(0.114)	(0.109)
Av. Investment	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ICT	1.507	0.643	0.949	0.807	0.684	0.760	0.306	0.206
	(1.000)	(0.808)	(1.112)	(1.008)	(1.157)	(1.021)	(1.273)	(1.125)
Life Science	4.276***	2.493**	3.736***	2.843**	3.629***	2.776**	3.065**	2.093
	(1.200)	(1.044)	(1.303)	(1.220)	(1.340)	(0.024)	(1.444)	(1.315)
N° of VCs in syndication							0.255**	0.291***
							(0.106)	(0.103)
Preferred Equity							1.080**	0.145
							(0.541)	(0.507)
Staged Financing	-0.965**	0.025			0.151	0.480	-1.050**	-0.058
	(0.391)	(0.363)			(1.418)	(1.378)	(0.455)	(0.429)
VC's Board Rights			-0.018*	-0.006	-0.005	-0.001	-0.033**	-0.019*
			(0.011)	(0.011)	(0.016)	(0.017)	(0.013)	(0.012)
StagedFin*BoardRights					-0.022	-0.007		
					(0.022)	(0.021)		
Pseudo R-square	0.129		0.119		0.151		0.184	
Log likelihood	-237.70		−217.73		-209.87		-201.65	
LR Chi-square [Prob.]	(14) 70.59		(14) 58.93		(18) 74.65		(20) 91.08	

Model 7 shows control variables and both staged financing and boards rights variables and the interaction effect between staged financing and board rights. Using results from Model 8 (the one with all the independent variables), we interpret the likelihood of each independent variable being associated with the first and second financing stages relative to the third financing stage.

Model 1 includes the control variables only. The results show that the variables *Date* and *Life Science* have a significant relation with the financing stage of the venture at both the levels of the dependent variable. For example, being negative the coefficients of *Date* (-0.45 and -0.36 respectively for stage=1 and stage=2), with the increase of the variable, namely going on in the years, it becomes less likely to have first-stage financing and second-stage financing relative to third-stage ventures. Also, the positive and big values of the coefficients of *Life Science* at both stage=1 (4.13) and stage=2 (2.51) indicate that in this industry it is much more likely to have a first-stage financing and a little less likely to have a second-stage relative to third-stage financing. The rest of the control variables are not significant.

Turning to independent variables, Hypothesis 1 (H1) associates the high use of syndication as occurring at financing stages with high degrees of information asymmetry. In model 2, the variable, N° of VCs in syndication is significant at both stage=1 and stage=2 ($p<0.01$) with positive coefficients equal to 0.23 and 0.26.

In particular the positive coefficient at stage=1, namely seed and start-up phase, indicates that it is more likely to have a higher number of VCs in syndication in early stages in comparison to later stages; moreover, since the coefficient increases at second-stage financing it is much more likely to have a higher number of VCs in syndication in early growth stages rather than in expansion and recapitalization stages. This result is in line with my expectations in Hypothesis 1 (H1) and holds true in the full model 8 as well.

Model 3 analyzes the use of *Preferred Equity* financing; the variable is significant only at stage=l ($p<0.05$) and the coefficient is positive and equal to 1.13. Thus, the use of preferred equity instruments is more likely in seed or start-up investments relative to expansion or recapitalization investments. Namely, this result supports Hypothesis 2a (H2a) that suggests that the high use of preferred equity instruments is more likely to be associated with investment stages that have high information asymmetry problems, namely early-stages. This result is confirmed also in the full model 8.

Model 4 includes both the aforementioned variables, *N° of VCs in syndication* and *Preferred Equity* plus a new variable that represent the interaction term between the two, *Syndication*PrefEquity*. This model has been developed in order to test Hypothesis 2b (H2b) that suggests a complementary use of the two mechanisms in investment stages associated with a high venture selection risk. The interaction term is not statistically significant; thus, I conclude that no interaction exists between the two variables. This result seems to confirm the conjecture in Hypothesis 2b (H2b) that the two variables are used as complements.

Model 5 includes the variable *Staged Financing* which is significant only at stage=1 ($p<0.05$), with a negative coefficient equal to -0.96. This result suggests that VCs use the provision to stage the capital infusions more frequently in late-stage venture, namely in expansion or recapitalization, relative to early stages. This confirms Hypothesis 3 (H3) predicting that the high use of cash flow rights, in this case of staged investments, is more likely to be associated with investment stages that have high moral hazard problems, namely late stages. Again, the hypothesis is confirmed also in the full model 8 where the variable is still significant at stage=1 and the coefficient is still negative.

In model 6, I enter the variable *Board Rights of the VCs* which shows up as significant at stage=1 ($p<0.1$). The coefficient (-0.018) is small and negative and indicates that there is a higher likelihood to have a higher percentage of VC's board rights in late stages relative to early stages. The result confirms Hypothesis 4a (H4a), which predict a high use of control rights to be more likely to be associated with investments stages that have high moral hazard problems. In the full model, the variable *Board Rights of the VCs* become significant also at stage=2; thus we can confirm Hypothesis 4a (H4a) at both the levels of the dependent variable.

Model 7 uses both *Staged Financing* and *VC's Board Rights* and the interaction term between the two *StagedFin*BoardRights*. Because of the non-significance of the interaction variable, I suggest that the result confirms Hypothesis 4b (H4b). Namely no interaction exists between the use of cash flow and control rights, thus they are used as complements.

6.4 Discussion

This research sheds some light on some of the factors that underlie how VCs mitigate the considerable but varied principal agent conflict that takes the form of adverse

selection and moral hazard problems in their investor-investee relation with prospective entrepreneurs. Using a typology of three investment and venture development stages of first financing stage (seed and start-up), second financing stage (early stage) and third financing stage (expansion and recapitalization), the extent of principal agent conflict embedded in this relation is modelled as a function of the degree of information asymmetry and incentive problems being faced by both parties at each investment stage.

I found that the use of pre-investment screening mechanisms and higher ranking financing instruments could predictably be linked to the degree of adverse selection risk at each investment or financing stage. Similarly, we also found that the use of cash flow rights and control rights can predictably be linked to the degree of moral hazard risk at each stage of investment or financing stage. By directly modelling the use of these sets of pre-investment screening and contractual mechanisms and how they are associated to the separate constituents of the principal agency risk of adverse selection and moral hazard, I provide some insight into the multiple logics behind the choice of what gets included in VC contracts design.

The results provide strong support for the importance of syndication, as a pre-investment screening mechanism, and higher ranking financing instruments, such as preferred equity, as levers VCs employ to manage adverse selection problems. These two levers are important in their own right as they had a direct and persistent association with the perceived level of adverse selection risk at each investment stage. However, additionally, the two levers also tend to be used alongside each other in a complementary manner rather than as substitutes.

The important finding on syndication as a means to improve pre-investment selection is supportive of a number of existing studies in general that support syndication as promoting better decision making in selection of investments and have argued that: (i) syndicates are a way to better access information about portfolio companies and (ii) VCs in syndicates make use of additional resources from syndicate partners (Manigart et al, 2006; Tykvova, 2007). This study highlights that the deliberations on the rationale for use of syndication are not dominated by other reasons such as risk sharing, loan size, deal flow access etc (Manigart et al, 2006; Lerner, 1994).

I also examined the prevalence of preferred equity in VC contracts and how likely their use is linked to selection risk. I confirm the findings from previous studies (i.e. Trester, 1998) that the use of preferred equity is a mechanism to mitigate adverse selection in

particular and that its use is associated with the perceived degree of venture selection risk (Gompers, 1995). This important finding confirms the second mechanism that VCs employ to mitigate risk, i.e. signalling the quality of the venture by the entrepreneur's willingness to accept an incentive structure that punishes them in the event of mal-perfomance (Hall and Woodward, 2010; Ippolito, 2006). An interesting contribution by our study is that the signalling effect is not diminished by the use of syndication as a pre-investment selection mechanism alongside higher ranking financing instruments (Lerner, 1994). This link merits serious consideration because the use of pre-investment selection mechanisms may unearth the presence of specific types of risk (e.g. managerial performance risk) which information in turn is used to choose the specific financing instrument to use alongside syndication. Although out conjecture provides a compelling reason why the two mechanism may be used as complements, this is an exciting area for on-going future research.

I also examined the likely use of cash flow rights in investment stages associated with moral hazard risk. Cash flow rights are a set of standalone covenant provisions that can be included in VC contracts to control the downside risk of loss of VC future cash flow position. The results are supportive of the predictions that the writing of cash flow rights is mainly to mitigate moral hazard problems. In drawing up the normative argument, I hypothesize that the relative contribution of moral hazard problems over adverse selection problems to the total agency risk perceived at each investment stage increases with each stage of investment. Even though the overall agency risk reduces with each investment stage, the main effective perception of moral hazard risk is that it increases over time. This means that adverse selection risk dominates the early stages of financing, but diminishes in importance relatively quickly with each investment stage.

This research provides some empirical evidence that, although adverse selection and moral hazard problems are usually both present in the VC-entrepreneur relationship, since they are not mutually exclusive, their relative importance differs over time. Thus, the effects of the former are salient at early stage investments when information asymmetry and uncertainty are higher, whilst the latter seems to be more important at later stage investments. This has important practical implications for contract design and for pre- and post-investment project's evaluation activities.

This argument is supported by the findings on board rights and how they are used in VC contracts when related to investment stages. The higher percentage of the VCs' board

rights employed are in later stages of financing such as expansion or recapitalization investments relative to seed or start up.

Finally, the important finding that a mix of cash flow and control rights are used alongside each other rather than as substitutes points to the complex nature of achieving control in a risky venture. Whilst cash flow rights allow the VC to control against potential downside risk of diluting their stake against various potential scenarios related to moral hazard problems that induce opportunism and therefore malperformance, board rights are a form of direct control used to shape and align the on-going strategy of the venture.

There is also reason to hypothesize how one type of control right may influence another, concurrently. For example, as the VC seats on the board and gets more information regarding the performance of the venture, this may in turn inform on future decisions regarding the potential use of staged financing or other similar types of cash flow rights.

These findings have practical implications for the design of VC contracts because they present robust theory and empirical arguments why certain provisions should be included in VC contracts.

Finally, this research has several limitations that at the same time present opportunities future research. First, I have only considered a few of the most prevalent financing instruments and contractual rights. Future research can investigate other financing instruments such as debt, other cash flow rights such as those listed in the theory section of this study and other control rights (e.g. conversion options, redemption rights, exit rights, voting rights, board seats etc). Future research can also look at VC contract practice and link to performance data. Ultimately, best practice must be related to successful outcomes.

Chapter 7

DISCUSSION AND CONCLUSIONS

7.1 Introduction

This final chapter aims at drawing together the studies presented in this thesis and their main contributions. From a global point of view, this thesis deals with the analysis of two different phenomenon that strongly characterize the turbulent and competitive environment in which nowadays firms try to foster innovation. On the one hand, the more and more frequent formation of relationships between separate firms that seeks to exploit their complementarities in order to achieve a goal. On the other hand, the diffusion of external financial backers, such as Venture Capitalists (VCs), that finance start-up firms that usually are the engine of innovation fostering and developing.

This thesis looks at both topics from a strategic management perspective using the most influential theoretical approaches of the organization theory, namely transaction cost economics, resource-based view, property right theory, real options theory and agency theory.

Over the chapters of this thesis, I explained how the interest in these issues and the identification of some gaps in the existing literature, led me to focus on particular aspects of the two research topics; on the one hand, I addressed the issue of the choice of the governance of inter-firm relationships, and on the other, I studied the choice of the most suitable contract design in venture capital investments.

Main results of such researches are now presented and discussed, together with the identification of main contributions and limitations.

7.2 Contributions

This thesis makes both scientifically and managerially significant contributions.

As far as the governance of IFRs, as widely discussed in Chapter 2, 4 and 5, there is a growing interest on the topic arising from both academic and industry world and a substantial body of literature still exists. The matter under discussion is how managers could determine the most suitable governance form for a particular relationship among

two or more firms, considering both the goals that such relationship seek to achieve and trying to reduce the possibility of opportunistic behaviours between the partners resulting from the presence of information asymmetry.

In Chapter 4, I addressed the problem of choosing the governance form of IFRs by looking for factors that could be discriminatory for such a decision with a particular focus at bio-pharmaceutical relationships. Hereinafter I briefly summarize the contributions of this research:

- From a theoretical point of view, this is the first work that formulates a framework that considers simultaneously different theories in order to identify the main drivers of the governance form decision in biopharmaceutical relationships. Thus, I provide insights on the complementarities of transaction costs, resource-based, property rights and real options perspectives in explaining firm governance preferences, contributing to a recent literature strand that supports the integration of several theoretical approaches for a deeper understanding of rationales for IFRs governance. Moreover, this study contributes to understand the importance of considering a dual perspective in bio-pharmaceuticals IFRs, since pharma and biotech firms often have conflicting goals about the governance of their relationship; thus, the selected governance mode strongly depends on their relative bargaining powers.

- From an empirical point of view, this is the first research in the biopharmaceutical industry that integrates drivers belonging to different theoretical perspectives and confirms the validity of this integrated approach. I empirically confirm how uncertainty, appropriation concern and trust influence the governance choice in the Italian biopharmaceutical industry. Furthermore, I demonstrate the importance of a new driver that is the functional completeness of a firm, in determining this decision.

- From a managerial point of view, results of this research enhance the understanding of the decision making process on IFRs governance. This study can help managers to make more aware decisions regarding the choice among different governance structures when they are approaching new relationships.

Moreover, the advantage of having formulated hypothesis directly on operationalized measures, that are specific of a particular industry, makes the theoretical framework easily applicable in the industrial practice. Also, the focus on firms' bargaining power provides interesting indications to managers in charge with IFRs in this industry: they must be aware that the industry context, the Italian one in this case, matters, indeed, in some more mature contexts, the contractual power between the partners could be significantly different, leading to different governance solutions. Finally, managers need to carefully evaluate measures of functional completeness of their partner firms, such as the number of commercialized products of the biotech firm, when approaching IFRs in biopharmaceutical industry.

In Chapter 5, I approached the same research issue concerning the governance of IFRs, but using a different point of view. In this research I focused on the managers risk perception in evaluating the governance. Thus, I construct a second theoretical model that studies how the perception of both a relational risk and a performance risk influence such a decision. Hereinafter I briefly summarize the contributions of this research:

- From a theoretical point of view, I contribute to the literature by bringing a comprehensive theoretical framework that supports risk-evaluation in the choice of inter-firm relationships governance. In particular, my theoretical model applies TCE and RO theories in a discriminated fashion in order to shed new light on IFRs governance by identifying and distinguishing among factors influencing the perception of a relational risk and those influencing the perception of a performance risk in undertaking a new relation. Moreover, I add to theory by providing evidence that a moderating effect between relational and performance risk factors does exist; namely, the extent of high levels of both relational risk and performance risk factors reduces both the tendency to move toward totally integrated governance forms, such as M&As and toward pure market transactions, such as licensing agreements, leading in practice to hybrid forms, such as equity and non-equity alliances.

- From an empirical point of view, this is, to the best of my knowledge, the first empirical work that provides evidence of both the influence of relational and performance risk factors. I find support for the fact that the investment specificity and the lack of IFRs experience, that are relational risk drivers, lead firms to choose more hierarchical governance forms. On the contrary, I find that the newness of the technology object of the relationship, the technological distance between the partners and the different partners' nationalities, by influencing the perceived performance risk, push firms to market-oriented governance modes. Finally, this is the first empirical study that demonstrate how several interactions between performance risk and relational risk factors are significantly important in the governance choice; namely, several moderating effects have been found significant: (i) the technological newness and the partners' different nationality, moderates the relationship between investment specificity and hierarchical governance; (ii) the relationship between the lack of IFRs experience and hierarchical governance is moderated by the technological distance and the different nationality; (iii) the extent of technological distance seems to moderate the relationship between partners' asymmetry and hierarchical governance forms; (iv) the investment specificity, the lack of previous relations, the partners' asymmetry and the lack of IFRs experience, mitigate the relationship between technological newness and nationality, and market-oriented governance modes.

- From a managerial point of view, the model here proposed and its empirical confirmation recognize that the perception of strategy-makers substantially influence inter-firm strategic decisions, namely managers tend to make decisions based on their evaluation of both relational and performance risk. Also, I propose a general and comprehensive framework for making governance decisions in inter-firm relationships that is easily adaptable to any industry. Thus, from a managerial perspective, it may represent a tool for decision supporting when managers have to undertake a new relation with another firm, by specifically analyze drivers of relational and performance risk in each situation.

At the same time my results are very specific of a particular industry, namely they can be used immediately as guidelines for relationships between pharmaceutical and biotech companies.

As far as the second research topic addressed in this thesis, namely venture capital contracts design, presented in Chapter 6, it aimed at investigating how venture capitalists mitigate agency conflicts in the investor-investee relationship. In particular, I developed a set of hypotheses linking the level of adverse selection and moral hazard problems with pre-investment and contractual mechanisms that VCs may use in order to mitigate such problems. Hereinafter I briefly summarize the contributions of this research:

- From a theoretical point of view, this research contributes to the available literature by sheding some light on the factors that underlie how VCs mitigate the principal agent conflicts that takes the form of adverse selection and moral hazard problems in their investor-investee relation with prospective entrepreneurs. In particular, this is the first research that studies how pre-investment screening mechanisms, financial instruments and contractual rights are used depending on the degree and type of perceived agency conflicts.

- From an empirical point of view, this research provides some empirical evidence that, although adverse selection and moral hazard problems are usually both present in the VC-entrepreneur relationship, since they are not mutually exclusive, their relative importance differs over time. My empirical analysis shows that the effects of the former are salient at early stage investments when information asymmetry and uncertainty are higher, whilst the latter seems to be more important at later stage investments. Also, the results provide strong support for the importance of pre-investment screening mechanism, such as syndication, and higher ranking financing instruments, such as preferred equity, as levers VCs employ when they have to manage higher adverse selection problems.

On the other hand, the results show the likely use of cash flow and board rights in later investment stages that are associated with higher moral hazard risk. Additionally, I find that syndication, and preferred equity tend to be used alongside each other in a complementary manner rather than as substitutes. In the same way, I also provide another important finding that points to the complex nature of achieving control in a risky venture, namely a mix of cash flow and control rights are used alongside each other rather than as substitutes.

- From a managerial point of view, the findings of this study have several practical implications for the design of VC contracts, because they present robust theory and empirical arguments why certain provisions should be included in VC contracts. For example, important practical implications for contract design and for pre- and post-investment project's evaluation activities derive from the finding that the relative importance of adverse selection and moral hazard problems vary along the venture development stage. Also, other important managerial suggestions come from the evidence that VCs tend to use in a complementary manner, namely alongside each other, both (i) pre-investment activities, such as syndication, and the use of higher ranking financing instruments, such as equity securities, and (ii) cash flow and control rights.

7.3 Limitation of the study and future research

It is important to consider the entire previous findings in the light of several limitations associated with the studies. At this point, several limitations have been seen.

The first consideration is related to the research presented in Chapter 4, namely the analysis of the drivers influencing the governance form of biopharmaceutical IFRs. The most important limitation is linked to the dataset I used in order to test the hypotheses, since I rely solely on field-based primary data of a specific country, i.e. Italy. Indeed, as a consequence of the fact that Italian biotech companies are few and for the most part very small, I collected few data on inter-firm relationships in my country.

Thus, the small sample size deriving from this choice could undermine the reliability and generalizability of my results. Therefore, I recognise that, despite the confirmative approach used in this research, the theoretical framework needs a further confirmation. Future research can replicate the analysis by using a larger dataset including for example firms from other countries with a similar industry structure or through a worldwide comprehensive databank analysis.

The second consideration concerns the research presented in Chapter 5, namely the study of the risk evaluation in IFRs governance form choice. As already explained the developed theoretical framework is potentially adaptable to any industry, thus future research can replicate the study within another industrial context different from the biopharmaceutical one; this in order to see if it will be confirmed also in a different context and also in order to evaluate how sectoral differences may determine a different risk perception. Moreover, future research can also use field-based primary data in order to increase the generalizability of my framework.

Finally, the third consideration is related to the research in chapter 6 on venture capital investments contracts. I think that the most important issue comes from the fact that I have only considered a few of the most prevalent financing instruments and contractual rights, due to data availability. Hence, future research can investigate other financing instruments such as debt, other cash flow rights such as those listed in the theory section of this study and other control rights (e.g. conversion options, redemption rights, exit rights, voting rights, board seats etc). Future research can also look at VC contract practice and link to performance data.

Acknowledging these limitations and insisting on the conclusions, I believe that this thesis offers significant contributions to the relevant literature on both inter-firm relationships and venture capital contracting.

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