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Project-level Governance, Monetary Incentives and Performance in Strategic R&D Alliances

PROJECT-LEVEL GOVERNANCE, MONETARY INCENTIVES AND PERFORMANCE IN STRATEGIC R&D ALLIANCES

Project-level Governance, Monetary Incentives and Performance in Strategic R&D Alliances

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To my parents,

Hatice and Burhan Ozdemir.

PREFACE

I worked hard during my stay in the Netherlands without whining, complaining, and finding excuses, although it had not taken too long for me to come to terms with being an expat. I believe, however, I managed to overcome the difficulties of being an expat by working hard as well as entertaining enough. I was very proud of being a member of the Rotterdam School of Management, Erasmus University and I am happily leaving by remembering the good memories and accomplishments at the end of my five and a half years in the Netherlands.

In this preface, I will primarily inform the reader about the people who helped me a lot in writing this dissertation. In addition, I want to shortly mention my future plans, barely done in the orthodox style of writing a preface. The reason I want to do it is because I would like to open avenues for future research collaborations with the readers interested in research topics that I would like to investigate in the coming years.

First, I would like to thank my supervisor: Jan. Without his patience, experience, and energy I am sure that my PhD trajectory will not be that successful. Yet, I do not want to restrict his help to the effort that he devoted to improve the articles in this thesis. He also played a crucial role in the development of my professional skills. I have learnt a lot from him, particularly about the process of academic research, from the early stages of finding funds to the late stages of publishing academic results. Thanks very much, Jan!

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Fifth, I would like to thank my friends in Rotterdam. In my opinion, academic research requires creativity, and a person can hardly be creative if he/she is not socialized. Socialization, by developing friendships with people from diverse backgrounds, was one of the most important benefits of living in the Netherlands. I was so lucky that I had very nice friends around me. Without them, I am sure I would not have stayed for such a long time abroad and would not have been that creative.

Finally, I thank my parents, Hatice and Burhan Ozdemir. They played an important role in the development of this dissertation. Without their continuous support and faith in me, I do not believe I would have successfully finished writing this thesis. I am a very lucky to be the only child of two honest, hardworking and lovely people.

Starting from July 2011, I will be assistant professor of strategy and management at the Koc University, in Istanbul, Turkey. It was very good for me to receive an excellent offer from a top university in my first job talk experience. I am motivated not only by the financial terms of the offer but also by the idea of going back to my home country in order to carry out research and give lectures to people there. It is obvious from the recent work presented in the academic conferences and published in the top management journals that there will be a growing interest in emerging markets in the coming years. Turkey, as one of the emerging markets with high growth rates, therefore, offers an excellent empirical setting to develop and test the emerging market theories of strategy and innovation. As a researcher who has used the highly advanced and institutionalized U.S. biopharmaceutical industry as the empirical setting of my PhD thesis, I am now wondering what strategy and innovation means and how they differ in emerging markets. Hence, if you are not only interested in strategic R&D alliances in the biopharmaceutical industry, but also in strategy and innovation in emerging markets, please feel free to contact me in the future.

I hope you will enjoy reading this dissertation.

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CHAPTER 1: GENERAL INTRODUCTION

1.1 PROJECT-LEVEL GOVERNANCE AND MONETARY INCENTIVES

Alliances are 'collaborative agreements between two or more independent firms to achieve various strategic purposes' (Inkpen, 2001, pg. 401). In the context of Research and Development activities, firms engage in strategic alliances to develop new technologies, products, services, standards and novel knowledge by sharing their resources (Anderson and Tushman, 1990; Chesbrough, 2006; Deeds and Hill, 1996; Katila, 2002). Increasingly, firms rely on strategic alliances to access external sources of R&D, while their internal R&D labs lose importance as innovation engines (Ahuja, Lampert, and Tandon, 2008; Carson, 2007; Dahan and Hauser, 2002; Ouchi & Bolton, 1988; Quinn, 2000). In the past alliances were primarily used as a strategic tool to decrease the degree of market rivalry; now, they are *sine qua non* for innovation, not only for introducing new products to existing markets, but also for creating novel markets. Similarly, in the past, economists and management scholars were concerned about the relationship between alliances and industry competitiveness (Arndt, 1979; Clarke, 1983; Werner and Philips, 1965); now, however, scholars are interested in how alliances can be used to support innovation (Baum, Calabrese, and Silverman, 2000; Deeds and Hill, 1996; Hagedoorn and Schakenraad, 1994; Powell, Kogut, and Smith-Doerr, 1996; Rothaermel and Deeds, 2004; Tzabbar, 2009).

Given the growing importance of alliances for innovation, firms need to effectively govern these cross-organizational business activities to realize the benefits while minimizing the risks of collaborative R&D. Otherwise, they will not be successful in developing innovations to increase their competitive advantages. Even worse, they might become victims of partner opportunism, e.g., they may lose their proprietary technologies and knowledge to their partners (Hamel, 1991). Hence, alliance governance plays an important role in explaining the performance of alliances.

Alliance governance refers to the set of mechanisms used by the partners to align their incentives. More specifically, the governance mode of an alliance represents the parties' decisions about how they allocate ownership, income and decision rights between each other and how they monitor/support and penalize/reward each other's activities. Alliance governance mechanisms can be classified into two groups: 1) formal governance

mechanisms and 2) informal governance mechanisms. Formal governance mechanisms are associated with the allocation of ownership, income and decision rights between partners. Research has extensively studied the presence and nature of various formal mechanisms, including equity investments and different forms of contractual safeguards such as exclusivity and termination rights (Gulati and Singh 1998; Lerner and Malmandier, 2010; Lerner and Merges, 1998; Pisano, 1989; Puranam and Vanneste, 2009; Reuer and Arino, 2007; Somoya, Kim, and Vonortas, 2010). Management scholars have also studied relational governance mechanisms, e.g., trust, and justice (Dyer and Singh, 1998; Gulati, 1995; Luo, 2007).

The choice of governance mode for external R&D is a complex managerial problem, and it is becoming more complex as firms experiment with novel formal governance mechanisms. One of these novel formal governance mechanisms is the appointment of alliance managers or dedicated project managers to controller and liaison roles. These dedicated managers, specialized in alliance governance and management, are primarily responsible for monitoring partner opportunism and creating healthy communication between the partners. While, in the past, the governance of alliances was under the responsibility of middle-level managers, nowadays this responsibility is often delegated to professional managers. This is largely a consequence of the establishment of the dedicated alliance management functions within the established firms. Eli Lilly was one of the first firms that adopted a professional alliance management approach by opening up its Office of Alliance Management at the beginning of the last decade (Sims, Harrison, and Gueth, 2001). Currently, almost every large pharmaceutical firm has an alliance management office. Similar examples can also be found in other industries. Firms such as Philips, Cisco Systems and Wal-Mart govern their alliances through their alliance managers (Slowinski & Sagal, 2003).

In addition, firms increasingly rely on formal joint committees for the governance of their alliances. The reason is that complex alliances are more likely to require the appointment of the senior managers to committee membership roles to monitor progress and resolve disputes should they emerge. Hence, firms are increasingly establishing joint steering and joint functional committees, e.g., joint research, development,

commercialization, regulation, manufacturing, patent and finance committees, to govern their alliances.

We term the day-to-day governance performed by dedicated alliance managers and committee members as project-level governance. Like other governance mechanisms, project-level governance plays a crucial role in mitigating opportunism, and, in turn, aligning the partner's interests. This is because the appointment of alliance representatives provides a firm with a mechanism to monitor the activities of its partner and to influence its behavior.

Another governance mechanism that has become pervasive in the context of strategic R&D alliances is performance-based monetary incentives, i.e., potential milestone payments. Nowadays, firms frequently tie higher portions of their alliance payments to their partner's realized development performance. This is particularly true for the biopharmaceutical industry (Mallik, Zbar, and Zemmel, 2004; Van Brunt, 2008). These performance-based monetary incentives are effective in reducing partner opportunism risks, because they mitigate both moral hazard and adverse selection problems addressed in agency theory (Arrow, 1985). This is because pay-for-performance not only incentivizes partners to invest in the future of alliances and not shirk their responsibilities, but also serves as a mechanism to eliminate low-quality, low competency partners, at the onset of a deal.

While project-level governance and performance-based monetary incentives are crucial to the governance of alliances, the strategic alliances literature has paid little attention to both mechanisms. This is most likely due to the difficulties of finding data on alliance managers, committees and potential milestone payments (Oxley, 1997). In addition, it might be due to the fact that these mechanisms were less important in the past. Hence, while considerable research has been devoted to different forms of alliance governance mechanisms such as *ex ante* equity investments, contractual clauses, and relational governance, relatively less attention has been paid to alliance representatives and performance-based monetary incentives. Specifically, very little is known about the antecedents of these alliance governance mechanisms, the relationship between them and their impacts on alliance-level and firm-level performance in the context of strategic R&D alliances. Hence, this dissertation aims to reveal the antecedents of project-level

governance and monetary incentives, improve our understanding of the exact relationship between these mechanisms and explain how these mechanisms influence alliance-level and firm-level performance.

1.2 LITERATURE REVIEW

To better clarify the gaps in the literature that this dissertation addresses, a closer look at two distinct streams of research is necessary. On the one hand, there is a group of studies that investigates the alliance governance choices of firms. This research mainly focuses on the different forms of formal and informal governance mechanisms in the context of strategic alliances and aims at explaining when firms use the different governance forms and how these choices affect alliance and firm performance. As seen in the review below, both project-level governance and monetary incentives received less attention than other governance mechanisms addressed in the strategic alliances literature.

On the other hand, there is another group of studies that tests the predictions of agency theory in various contexts such as corporate governance, acquisitions, franchising, sales-force compensation plans, channel coordination etc. As mechanisms for mitigating agency problems, project-level governance and performance-based monetary incentives correspond to monitoring and bonding, respectively, in the terminology of agency theory. A review of recent research on the relationship between monitoring and bonding and their impact on performance can also help us understand potential agency theory contributions that might emerge from examining these two governance mechanism in a novel business context. Therefore, we also provide a short review of the research that tested agency theory in different settings in order to clarify the gaps that we addressed in this dissertation.

Looking back: How Has the Alliance Governance Research Evolved?

Project-level governance and performance-based monetary incentives are only two of several alliance governance mechanisms used to align the incentives of partners. Indeed, the set of possible governance mechanisms is large enough to make life of those responsible for designing alliance governance structures very difficult. Even more difficult is that each governance mechanism performs different functions at the same time, thus perplexing a decision-maker to a higher extent. For instance, equity investments were primarily regarded as safeguarding mechanisms to mitigate partner opportunism risks

(Oxley; 1997; Pisano, 1989; Pisano 1990) until Gulati and Singh (1998) revealed their role in solving coordination problems between partners. Subsequent research also showed that equity plays a key role in the knowledge transfer between partners (Sampson, 2007). Therefore, we believe that a chronological classification based on theories used to explain the different functions of each governance mechanism can be very helpful to the reader. Further, such a review will highlight the extent of gaps in the literature.

Theories of Alliance Governance

Economics and sociology are two main fields from which the alliance governance literature has extensively benefited. While agency theory, transaction cost economics theory, property rights theory, game theory and more recently, evolutionary economics theory explain the economic reasoning behind the choice of governance mechanisms, social embeddedness and social network theories provide the sociological roots for governance mechanism choices.

Early alliance governance work focused primarily on joint ventures (JVs) probably because of their prevalence and the international context of the business world during the 1990s – a period in which multinationals, in developed economies, preferred joint ventures as a means to enter emerging markets. In this period, agency theory was widely recognized as a sound theoretical perspective to study the governance structure of JVs. The literature mainly focused on the following questions: How do parent firms control their joint ventures? How is coordination between the parents and their joint venture achieved? To what extent and under what conditions do control and coordination improve the performance of the joint venture? The literature identified several governance mechanisms for control and coordination. Kumar and Seth (1998) provide a comprehensive list of control and coordination mechanisms extracted from the literature. In their list, incentive plans, the structure of the JV board of directors as a means to influence voting outcomes, and the role of the board in monitoring (Killing, 1983) were the control mechanisms pertaining to agency theory. Their relationship to agency theory stems from the fact that parent firms used these output and behavior control mechanisms to align the diverging interests of the parent firms and their joint venture.

The late 1980s was the beginning of a period in which strategic R&D alliances between small startups and large incumbents received a lot of attention among management

scholars. The differences in skills between the small and large firms motivated these firms to form partnerships. Through these alliances, small firms gained access to the downstream assets of the large firms which allowed them to further develop and commercialize their innovations, and, in turn, generate revenues. On the other hand, large firms needed to control and adapt to the technological discontinuities caused by small firms (Mitchell, 1989; Rothaermel, 2001; Teece, 1986; Tripsas, 1997; Tushman and Anderson 1986). While, at first glance, these alliances appear to be profitable arrangements for both sides, because of the potential benefits, the challenges are still significant. As Teece explains in his seminal work (1986), the innovating partner has to share some part of its decision-making rights and the rights over the innovation's profits with the incumbent firm to benefit from its downstream assets. In other words, the dependence on the large firm's downstream assets negatively influences the small firm's appropriabilty of its innovation. Then, the important questions become to what extent are control rights shared? To what extent is the product ownership shared? What is the optimal organizational and governance mode of the inter-organizational exchange between partners, i.e. a contractual alliance, and equity alliance or a joint venture?

Alliance management scholars rely on transaction cost economics, property rights and game theories to understand what factors determine the allocation of control rights and ownership rights in these partnerships. Equity investments have been proposed as a governance mechanism that not only mitigates partner opportunism emerging from hold-up problems, but also reduces appropriation hazards resulting from difficulties in allocating residual control rights, i.e. rights that are not specified in alliance contracts because of the bounded rationality of partners in foreseeing contingencies *ex ante*. To explain when partners use equity investments to align their incentives, alliance governance scholars primarily rely on transaction cost economics theory which recommends higher integration under circumstances in which hold-up problems and appropriation hazards are high (Oxley; 1997; Pisano, 1989; Pisano 1990; Williamson, 1991).

While transaction cost economics theory focuses on the choice of governance modes for inter-organizational exchanges, property rights theory focuses more on the allocation of contractual control rights between partners. Property rights theorists argue that the party whose input has a greater impact on performance should have higher ownership and more

control rights, as long as that party has sufficient bargaining power (Aghion and Tirole 1994; Grossman and Hart, 1986). Lerner and Merges (1998) conducted one of the first empirical tests of this theory in the biopharmaceutical industry by examining alliance contracts. They found that biotechnology firms with strong financial positions retain more control rights than those with limited financial resources. They also showed that when the efforts of the biotechnology firm have a lower impact on performance, it gains fewer control rights.

The examination of alliance contracts in the alliance governance research is not restricted to Lerner and Merges' study. Researchers have investigated various characteristics of contracts to understand their roles in alliance governance. Reuer and Arino (2007) demonstrated that contracts not only mitigate partner opportunism, but also foster the coordination between partners. In addition, Robinson and Stuart (2007) and Lerner and Malmendier (2010) examined the importance of termination rights in aligning incentives. More recently, Somaya et al. (2011) investigated licensing terms and found that license exclusivity is a contractual safeguarding mechanism.

Game theory has also been used as a complement to transaction cost economics and property rights theories. Parkhe (1993) examined how different types of alliance structures influence the behavior of partners, and, in turn, the outcomes of alliances. He found that the payoff pattern of a strategic alliance, determined by whether the alliance is structured as a competitive game (e.g. the prisoner's dilemma) or as a cooperative game (e.g. the stag hunt game), influences the performance. Khanna, Gulati, and Nohria (1998) distinguished between common and private benefits of an alliance to show how the opportunity set of each firm outside of the alliance influences its behavior within the alliances. They define private benefits as those that 'a firm can earn unilaterally by picking up skills from its partner and applying them to its own operations in areas unrelated to the alliance activities' and common benefits as those that 'accrue to each partner in an alliance from the collective application of the learning that both firms go through as a consequence of being part of the alliance; these are obtained from operations in areas of the firm that are related to the alliance' (Khanna, Gulati, and Nohria 1998, pg.195). They argue that there will be a learning race in an alliance when a partner's ratio of private to common benefits is high, because the alliance payoff structure will resemble a prisoner's dilemma game.

The alliance governance literature also benefited from evolutionary economics theory; particularly from the ideas used in the strategic management literature under the label of 'dynamic capabilities' (Nelson and Winter, 1982). In general terms, the dynamic capabilities view focuses on the routines that help firms adapt to changing environments. The studies that used the dynamic capabilities view in alliance governance, therefore, concentrated on inter-firm routines and alliance management capabilities. Dyer and Singh (1998) highlighted inter-firm routines as critical firm resources and argued that routines for effective inter-organizational governance, among other things, create competitive advantage for firms. Kale, Dyer, and Singh (2002) extended this view to show that the dedicated alliance management functions, in which these routines are developed and deployed, explain the performance heterogeneity of firm alliances. Although the effects of alliance governance on performance are not as salient as in other theoretical perspectives, the dynamic capabilities view also suggests that governance influences performance. Yet, this view is primarily concerned with routines that ensure the correct choices of governance mechanisms instead of how governance structure affects performance *per se*.

While the economic theories of alliance governance highlight several formal governance mechanisms that can be used in alliances to align the interests of partners, these theories pay little attention to the relational aspects of alliances. Indeed, sociologists and relational contract theorists already discussed the socially embedded nature of exchange relationships between firms long before the alliance governance literature emerged (Granovetter, 1983; MacNeil, 1978). The main idea that social norms and values shape the behavior of parties in their inter-organizational relationships contrasts markedly to the arguments of economic theories which contend that formal governance mechanisms determine the behavior. However, relational governance mechanisms, such as trust, reputation, cooperation, fairness, and justice, exist in exchange relationships because the firm's behavior is constrained and shaped by social norms and values.

Trust is one of the most extensively investigated informal governance mechanisms in the alliance governance literature. Researchers, in the context of inter-organizational relationships, generally stick to the definition of goodwill trust, 'the expectation that some others in our social relationships have moral obligations and responsibility to demonstrate special concern for other's interests above their own' (Barber, 1983, pg.9). By definition,

goodwill trust reduces the transaction costs between partners, thereby eliminating the need for formal governance mechanisms. As a result, when the level of trust between partners is high, it is less likely that formal governance mechanisms will be used (Gulati, 1995). While the positive influence of trust between partners on exchange performance was discussed and demonstrated in several studies, researchers also noted that trust co-exists with other formal governance mechanisms and it complements, rather than substitutes them in explaining performance (Poppo and Zenger, 2002; Woolthuis, Hillebrand, and Nooteboom, 2005; Zaheer and Venkatraman 1995).

Indeed, the co-existence of formal and informal governance mechanisms and the relationships between them have been central to the recent alliance governance research and it seems that it will attract more attention in the future. Poppo and Zenger (2002) conducted one of the first empirical studies on the relationship between formal and informal governance mechanisms. They formulated two alternative hypotheses to test whether formal contracts and trust complement or substitute each other in buyer-supplier relationships. In contrast to Gulati's findings (1995), their results revealed that trust positively influences contractual detail. In other words, the partners are likely to write more detailed contracts when the level of trust between them is high. Furthermore, they showed that trust and contracts complement each other in enhancing the performance of inter-organizational relationships. In the same fashion, Luo (2002), Argyres, Bercovitz, and Mayer (2007), and Ryall and Sampson (2009) demonstrated that formal and informal governance mechanisms complement each other in inter-organizational exchanges. Unlike these studies, Hoetker and Mellewigt (2009) argued that formal and informal mechanism co-exist, but are not interchangeable. They found that informal mechanisms are more effective for the governance of knowledge-based assets, whereas formal mechanisms are more effective for the governance of property-based assets. Finally, Agarwal, Croson, and Mahoney (2010) investigated the relationship between a formal governance mechanism, namely, monetary incentives, and informal communication between partners in an experimental setting. Similarly, they found that formal and informal governance mechanisms complement each other in enhancing performance. Table 1.1 summarizes the research findings on the relationship between formal and informal governance mechanisms.

The review of research on governance choices in strategic alliances demonstrates that the relationships between governance mechanisms, particularly those between formal and informal governance mechanisms, are central to alliance governance studies. Interestingly, however, there is relatively less interest in examining the relationships and interactions between formal governance mechanisms. Except from a few studies, such as Reuer and Arino (2007) and Robinson and Stuart (2007), the research has overlooked relationships between the different formal governance mechanisms.

Another observation from this review is that empirical studies on both project-level governance and performance-based monetary incentives are relatively fewer. Moreover, performance-based monetary incentives have, to best of our knowledge, not been examined. Particularly, little is known about what determines the magnitude of these incentives and how they affect performance.

More importantly, the strategic alliances literature little investigates the exact relationship between project-level governance and monetary incentives and how these two mechanisms interact to determine performance. Do they complement or substitute each other in explaining alliance performance? As a result, further research is necessary to unravel the antecedents and consequences of project-level governance and performance-based monetary incentives in the context of strategic R&D alliances.

Table 1. 1 The relation between formal and informal governance mechanisms

Articles	Topic	Theories	Methodology	Findings
Poppo & Zenger (SMJ, 2002)	The interplay between formal contracts and relational governance in interorganizational exchanges	Transaction cost economics and the literature on relational governance	Survey of Information Systems executives. Buyer-supplier relationships. Relational governance is measured based on the degree of open communication, trust, dependence and cooperation.Contractual complexity is related to the extent to which contract is customized for the relationship	Formal contracts and relational governance complement each other in explaining performance of inter-organizational exchanges
Luo (SMJ, 2002)	The interplay between contracts and cooperation in IJVs.	Transaction cost economics, contract theory and the literature on relational governance	Survey of IJVs in China.A detailed cooperation scale was developed. e.g. cooperation in deciding strategic objectives and goals, reaching a consensus in making strategic decisions, cooperation in functional domains etc. A contract's term specificity and contingency adaptability is measured	Previous cooperation has a positive effect on contingency adaptability clauses. Contracts positively moderates the relationship between cooperation and performance.
Argyres, Bercovitz, and Mayer (Org. Science, 2007)	The effect of prior relations on contractual detail. The interplay between task description and contingency description clauses	Learning to contract (evolutionary view), formal and relational governance	386 contracts of an IT services supplier. Relationship history and the presence of contingency planning and task description clauses	Contingency planning and task description terms behave as complements in contractual design. Repeated exchange leads to more detailed contracts.

Articles	Topic	Theories	Methodology	Findings
Ryall and Sampson (Management Science, 2009)	The effect of prior relations on the detail of contracts	Learning to contract, formal and relational governance	52 joint technology development deals of firms in telecommunications equipment and microelectronics industries.	Contracts between firms with prior deal experience tend to be more detailed and more likely to invoke penalty clauses than contracts between firms with no such prior deal experience. Formal and relational mechanisms are complements
Hoetker and Mellewigt (SMJ, 2009)	The choice of relational governance over formal governance	TCE. Incomplete contracting, coordination requirements. Formal and relational governance mechanisms	71 completed questionnaires from German telecommunications industry. Relational governance is measured as the presence of committees, cooperation managers etc. Formal governance is measured as the use of standard operating mechanisms.	Relational governance and knowledge based assets match.
Agarwal, Croson, and Mahoney (SMJ, 2010)	The interplay between incentives and communication. How important are incentive alignment and communication to achieving success in cooperative alliances	Property rights theory the literature on common and private benefits accruing to partner firms.	Experiments	The higher positive effects of incentive alignment on performance in the presence of communication.

Project-level Governance, Monetary Incentives and Agency Theory

There is no doubt that project-level governance and performance-based monetary incentives are of central concern to agency theory. This is because of their roles in mitigating the hidden action, i.e., moral hazard, and the hidden information, i.e., adverse selection, problems in the agency relationships in which the principal depends on the agent to undertake some action on the principal's behalf, e.g. a startup biotechnology firm (the agent) will develop a drug on behalf of an established pharmaceutical firm (the principal). When it is costly and difficult *ex ante* for the principal to verify that the agent has the required characteristics to successfully complete the work, the principal faces the hidden information problem. Although this explanation refers to an *ex ante* contractual problem, the hidden information problem persists *ex post* in innovative task settings where it is difficult to verify the quality of solutions developed by the agent *ex post*,. On the other hand, the principal faces hidden action problem if the principal cannot fully observe the agent's actions. As a result of the lack of direct observation, the agent does not make its best efforts to complete the work in the course of the partnership and causes the moral hazard problem.

These two problems determine the size of agency costs faced by the principal. Agency theory aims at designing the most efficient contract for the principal by minimizing these agency costs, and, indeed, according to the theory, the fundamental mechanisms that can be used by principals to address these issues are monitoring and performance-based monetary incentives (Jensen and Meckling, 1976). The empirical tests of agency theory, predominantly with the purpose of understanding when firms use these two mechanisms in the agency relationships has been conducted in various contexts including but not limited to CEO compensation (Jensen and Meckling, 1976), acquisitions (Reuer, Shenkar, and Ragozzino, 2004), franchising agreements (Lafontaine, 1992), salesforce compensation plans and the coordination of marketing channels (see Bergen, Dutta, and Walker, 1992 for an extensive review of the agency theory research in the marketing literature). In addition, the more recent work primarily in the context of CEO compensation has begun to address the interrelationships between these two mechanisms in order to understand these mechanisms whether substitute or complement each other (Boyd, 1994; Hoskisson, Castleton, and Withers, 2009; Rediker and Seth, 1995; Rutherford, Buchholtz, and Brown,

2007; Tosi, Katz, and Gomez-Mejia, 1997; Zajac and Westphal, 1994). Moreover, the agency scholars also develop a behavioral approach, behavioral agency theory (Wiseman and Gomez-Mejia, 1998), by integrating the ideas of agency theory with Kahneman and Tversky's prospect theory (1979). Different from classical agency theory, behavioral agency theory does not assume that the controllers of the principals are acting rationally when they monitor agents. Therefore, this theory explains the conditions where the evaluations of the controllers can be biased and how these biases affect performance of the agency relationships (Wiseman and Gomez-Mejia, 1998).

Interestingly enough, to date, strategic alliance scholars have limitedly used agency theory in the context of vertical R&D alliances to explain the antecedents and consequences of monitoring and monetary incentives.. This is primarily because of the present domination of TCE theory in the literature. Yet, although TCE helps us understand the choices of alliance governance modes, it explains little about the determinants of project-level governance and potential milestone payments. It is agency theory's aim to design the optimal contract for the principal, and this decision mainly consists of the choices of the intensity of monitoring and the size of performance-based monetary incentives. Thus, agency theory offers substantial opportunities for improving our understanding of the antecedents of these governance mechanisms. Moreover, the relationship between the intensity of project-level governance and the magnitude of monetary incentives is little discussed in the literature. Again, the substitution and the complementarities positions of classical agency theory as well as behavioral agency theory can be used to reveal the possible relationships between the two mechanisms. Last, but not least, agency theory can be utilized to understand performance impacts of project-level governance and performance-based monetary incentives on alliance-level and firm-level performance. As a result of addressing these gaps in the literature from the lens of agency theory, the theory can also be tested in a novel context; thus, the findings of this dissertation can contribute to agency theory.

1.3 RESEARCH QUESTIONS

On the basis of the literature review described above, we can conclude that the alliance governance literature represents a mature research field. It is, therefore, a challenging task for a researcher to identify research questions that will ultimately lead to novel theoretical contributions, as well as practical knowledge. Yet, there are still several emerging issues because of changing trends in alliance governance and the increasing availability of data not accessible a decade ago.

One of the potential areas is micro-level governance mechanisms used for day-to-day governance of strategic R&D alliances. Project-level governance exercised by the firms' alliance representatives (e.g. committee members, alliance managers, and project managers) who are responsible for monitoring the progresses of alliances, making key project decisions and providing coordination between partners, represent an important aspect of alliance governance that needs further research. Previous studies focused both on formal and relational dimensions of project-level governance. For instance, Child, Faulkner and Tallman (2005, pg. 315) and Gerwin and Ferris (2004) note that a firm engaged in an alliance can exercise formal control over its partners through its representatives. On the other hand, project-level governance plays a relational governance role as well because the formal control role will evolve into an informal governance role as partners interact and develop trust between each other (Ring and Van de Ven, 1994). For instance, Hoetker and Mellewigt (2009) showed that these informal control mechanisms are more crucial for the governance of alliances that involve knowledge-based assets rather than property-based assets.

Yet the literature on formal project-level governance suffers from a lack of empirical research. Particularly, there is a lack of empirical studies that aim to improve our understanding of the conditions where partners use project-level governance and the exact relationship between project-level governance and other formal governance mechanisms including equity investments and contracts. Therefore, the first set of questions in this dissertation is:

1.1 What are the exogenous determinants of project-level governance?

1.2 What is the relationship between project-level governance and equity? Do project-level governance and equity complement or substitute each other in explaining alliance innovation performance?

1.3 What is the relationship between project-level governance and contractual complexity? Do project-level governance and contractual complexity complement or substitute each other in explaining alliance innovation performance?

The evolution of the alliance governance literature shows that more recent studies try to explain the relationship between governance mechanisms and their joint effects on alliance performance, rather than treating each of them in isolation. Yet, we have a limited knowledge about the potential relationships between formal governance mechanisms because of the literature's primary focus on the interplay between formal and informal governance mechanisms. Hence, there is a need for research that examines the relationship between project-level governance and monetary incentive. Particularly, we still know very little about whether these two mechanisms complement or substitute each other in the context of strategic R&D alliances.

The relationship between monitoring and performance-based monetary incentives has been extensively examined from the lens of agency theory in the corporate governance setting. Unlike the agency theory applications that aim to reveal the exogenous factors determining the presence of monitoring mechanisms and monetary incentives in agency relationships (see Eisenhardt 1989 for an extensive review), several studies in the corporate governance stream focuses on the relationship between the two governance mechanisms. Yet, the empirical tests in this corporate governance setting created two groups with opposing views: (1) substitution view (Rediker and Seth, 1995; Zajac and Westphal, 1994) and (2) complementarity view (Hoskisson, Castleton, and Withers, 2009; Milgrom and Roberts, 1992; Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997). Therefore, there remains controversy over how these two mechanisms affect each other. The strategic R&D alliances between startups and incumbents offer an appropriate context to which this debate can be extended. The presence of the agency problem,

resulting from the separation of ownership and control through a licensing agreement that grants commercialization and ownership rights of a new product, developed by a startup, to its incumbent partner, engenders the use of both governance mechanisms in order to align the incentives of the partners. Yet, little is known about whether incumbents offer higher monetary incentives to startups, in the form of milestone payments, if they control the activities of startups to a greater extent by means of greater project-level governance. Therefore, the next research question is:

2.1 What is the relationship between project-level governance and monetary incentives in the context of R&D alliances between startups and incumbents? Do managers complement the use of one governance mechanism with the other or substitute one governance mechanism for the other?

The literature on the governance mechanisms of strategic alliances requires more studies to shed light on the performance implications of governance mechanisms. The empirical research provides good insight on the circumstances in which formal and informal governance mechanisms are used and what type of relationship exist between these governance mechanisms, yet explains little about the effects of governance mechanisms on performance. Specifically, there is limited understanding about the performance impacts of project-level governance and performance-based monetary incentives in the context of startup-incumbent alliances. Do higher monetary incentives and greater project-level governance increase the odds of successful development and lead to higher abnormal stock returns following the announcement of alliances? Therefore, the final research question of this dissertation is:

3.1 To what extent do monetary incentives and project-level governance influence alliance innovation performance and the stock market performance of the startup firm?

1.4 EMPIRICAL SETTING

We picked the U.S. biotechnology industry as the empirical setting of this dissertation. Three main factors determined our choice. First, the prevalent use of strategic R&D alliances as organizational modes for innovation in the biopharmaceutical industry overcomes potential problems that may arise from small sample sizes. Startup biotechnology firms rely on pharmaceutical and other biotechnology firms' clinical development, manufacturing and marketing resources to further develop their compounds. Moreover, the strong patent protection system not only mitigates free-riding concerns for biotechnology firms, but also forges a market in which biotechnology firms can grant their licenses to pharmaceutical firms in exchange for license fees, as the first step in forming an R&D alliance. Hence, the level of alliance activity in this industry is high enough to create large samples.

Second, the disclosure requirements of the Securities Exchange Commission (SEC) force biotechnology firms to disclose their R&D agreements with other firms. This is because the SEC requires a public firm to disclose any material transactions, that represent 5 percent or more of a firm's revenues. Because many biotechnology firms experience difficulties in generating substantial revenues, their strategic R&D alliances fit the definition of material transactions. Hence, in this industry, the alliance agreements are available to a greater extent and consequently it is easier to get access to the alliance data.

The information in contracts is also available through private databases which compile and organize this information to make it more accessible to outsiders. Therefore, we collaborated with Deloitte Recap, LLC to secure access to data on the alliances of biotechnology firms. We also used the SEC Edgar database, where the alliance contacts are stored in their raw form. This allowed us to gain access to additional information. Our efforts led to the collection of scores for about 40 variables pertaining to a dataset comprised of approximately 400 strategic R&D alliances.

The third factor that shaped our decision regarding the empirical setting is the high variation across the alliance deals in the biopharmaceutical industry. The management principles used in these alliances are at an advanced level and may serve trend-setter roles for other industries. For example, Eli Lilly's Office of Alliance Management was the first dedicated alliance function. Similarly, the mega-deal concept in the context of strategic

R&D alliances, i.e., $1 billion plus deals, first emerged in the biopharmaceutical industry. As a result of this sophisticated governance choices in this industry, it is more likely to observe alliances with different deal characteristics. Thus, it is relatively easier in the biopharmaceutical industry setting to create a sample in which alliances vary in their governance modes.

1.5 OUTLINE OF THE STUDY

The following three chapters (Chapters 2-4) of the dissertation seek answers to the questions described above. In Chapter 2, we introduce one of the main constructs of this dissertation - project-level governance - by developing and testing a theory about the governance roles of alliance representatives. We define project-level governance as a formal governance mechanism exercised by partner firms through the appointment of their representatives to project manager, alliance manager, and committee membership positions. By drawing upon agency theory, transaction cost economics theory and the literature on firms' contract design capabilities, we identify three project-level governance roles for alliance representatives: contract monitoring, contract design, and adaptation to contractual disturbances. We then hypothesize about project-level governance's several antecedents and outcomes. First, we argue that there is a positive bi-directional relationship between project-level governance and contractual complexity and a negative bi-directional relationship between project-level governance and the occurrence of partial equity investments. Then, we argue that, in explaining performance, project-level governance and contracts complement each other, whereas project-level governance and equity substitutes each other (See Figure 1.2). Second, we develop hypotheses about the exogenous determinants of project-level governance. We focus on the effects of alliance development stage and the number of prior deals on project-level governance. We tested these hypotheses on a sample of 316 strategic R&D alliances of U.S.-based biotechnology firms. We find that project-level governance together with detailed contracts is a viable alternative to partial equity investments, and greater contractual complexity, encouraged in part by greater project-level governance, positively influences alliance innovation performance.

Chapter 2 examines the role of project-level governance in both horizontal and vertical alliances. In our sample, the horizontal alliances are those between two biotechnology

firms and the vertical alliances are those between a biotechnology firm and a pharmaceutical firm. Starting in Chapter 3, we focus only on vertical alliances for two reasons. First, vertical alliances, in our sample, are between a startup and an incumbent, which leads to significant asymmetries in the risk taking behavior of the parties. As a result, monetary incentives tied to the successful outcomes of startup firms are extensively used in these alliances. Therefore, it provides us with an appropriate setting to test the impact of pay-for-performance schemes on the performance of both the alliances and the startup firms.

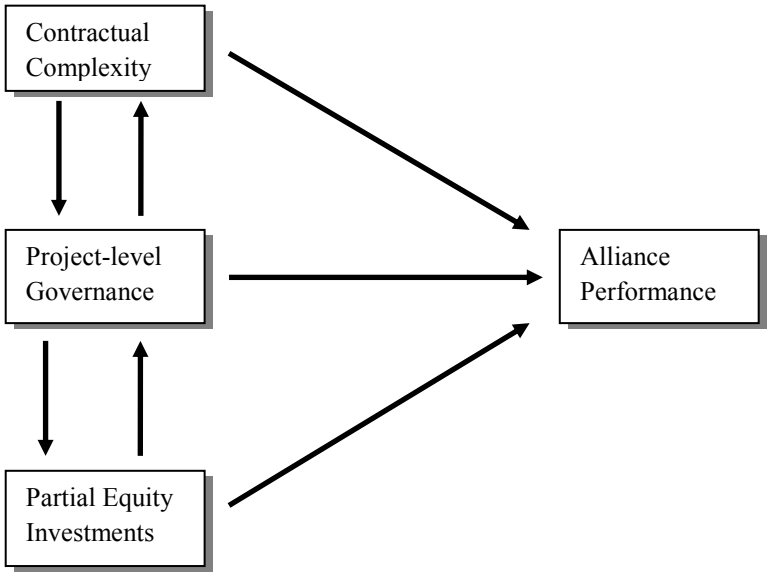

Figure 1. 1 The conceptual framework used in Chapter 2.

Second, there is a greater division of labor in vertical alliances as compared to horizontal alliances. This is because vertical alliances involve unilateral licensing agreements in which early research and development tasks are assigned to startups, and late-stage development and commercialization tasks are assigned to incumbents. In contrast, horizontal alliances involve bilateral licensing agreements in which partners prefer to work jointly through different stages of product development. Consequently, in vertical alliances, the agency problem is a more central concern that influences the choice of governance modes.

In Chapters 3 and 4, we aim to reveal the relationship between project-level governance and monetary incentives and their interactive impacts on alliance and startup performance (See Figure 1.3). To achieve our goal, we model an alliance between a startup and an incumbent as an agency relationship, in which the startup is the agent and the incumbent is the principal. In Chapter 3, we define performance-based monetary incentives as potential milestone payments offered to a startup based on a pay-for-performance scheme established in its contractual R&D agreement with the incumbent firm. We develop two competing hypotheses to shed light on the relationship between project-level governance and monetary incentives in the context of strategic R&D alliances. In our first hypothesis, by drawing upon the substitution view of classical agency theory, we propose that there will be less need for project-level governance when appropriate levels of monetary incentives are offered, and vice versa. In our second hypothesis, by drawing upon the complementarities view that addresses the unexpected outcomes of over-control and over-incentivizing of agents by principals, we argue that project-level governance and monetary incentives will reinforce each other in the context of strategic R&D alliances. We test the two hypotheses by using a sample of 220 R&D alliances between global pharmaceutical firms and U.S.-based biotechnology startups.

In Chapter 4, we focus on the performance impacts of these two governance mechanisms. To do this, we again develop two competing hypotheses. First, by drawing upon the complementarities view of classical agency theory, we propose that project-level governance provides an effective implementation of performance-based monetary incentive schemes and, vice versa. Therefore, if these two control mechanisms are used simultaneously, it will be more likely that successfully marketable products can be developed in R&D alliances, thus leading to the hypothesis: project-level governance and monetary incentives complement each other in explaining alliance innovation performance.

To challenge this hypothesis, we develop an alternative hypothesis by drawing upon behavioral agency theory (Wiseman and Gomez-Mejia, 1998). In contrast to the complementarities view of classical agency theory, behavioral agency theory assumes that the incumbent's controllers are biased in their evaluations of the startup firm. Thus, facing a diverse group of controllers can make the startup risk averse because of bearing higher performance risks (Wiseman and Gomez-Mejia, 1998). On the other hand, the higher

monetary incentives can also cause more risk aversion on the part of the incumbent's controllers because they need to more carefully evaluate the outcomes of the startup in order to avoid the risk of making wrong go/no-go decisions. As a consequence of the risk aversion by both the alliance representatives of incumbents and the startups, the rate of innovation decreases. Thus, greater project-level governance, encouraged in part by higher monetary incentives, negatively influences alliance innovation performance, and, in turn, project-level governance will offset the monetary incentives' direct positive effect on alliance innovation performance. We test the two alternative hypotheses on the same sample of the preceding chapter.

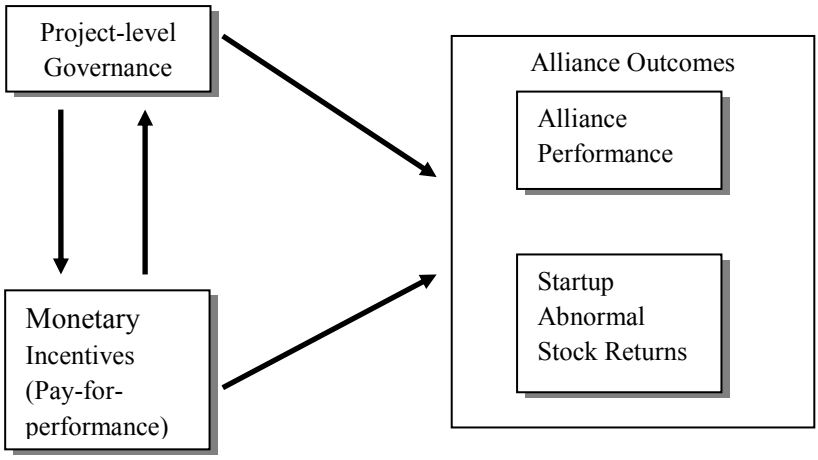

Figure 1. 2 The conceptual framework used in Chapter 3 and 4.

In Chapter 4, we also examine the impacts of project-level governance and monetary incentives on a startup's abnormal stock returns following an alliance announcement. By drawing upon the private-to-common benefits framework of Khanna, Gulati, and Nohria (1998), we argue that monetary incentives have a positive and project-level governance has a negative impact on a startup's abnormal stock returns. Our results provide mixed support for these hypotheses.

Chapter 5 is the last chapter of this dissertation. In this chapter, we summarize the key findings, clarify the theoretical contributions and explain the implications for practice. Finally, we mention several limitations of our research and discuss possible avenues for future research.

CHAPTER 2: ANTECEDENTS AND OUTCOMES OF PROJECT-LEVEL GOVERNANCE IN STRATEGIC R&D ALLIANCES

ABSTRACT

In this paper, we develop and test a theory on the formal governance roles of alliance representatives in the context of strategic R&D alliances. We define project-level governance as a formal governance mechanism employed by partner firms through the appointment of their representatives to project manager, alliance manager, and committee membership positions for their strategic alliances. By drawing upon agency theory, transaction cost economics theory, and the literature on firms' contract design capabilities, we specify three governance roles for alliance representatives: contract design, contract monitoring, and contractual adaptation. We then develop several hypotheses on the antecedents and performance consequences of project-level governance. Our tests, on a sample of 316 strategic R&D alliances of U.S.-based biotechnology firms, suggest that (1) project-level governance and contractual complexity serve as complementary governance mechanisms, (2) project-level governance and equity serve as substitute governance mechanisms, (3) the development stage, at which alliance is signed, determines the degree of project-level governance, and (4) greater contractual complexity, encouraged in part by greater project-level governance, positively influences alliance innovation performance.

2.1 INTRODUCTION

Project managers, alliance managers, and members of joint steering/functional committees represent their firms in strategic R&D alliances. Because they are the main actors responsible for day-to-day alliance governance processes including contract design, contract monitoring and daily decision-making, they play key roles in mitigating the risks of partner opportunism and increasing the capacity of alliances to adapt to changing circumstances. Yet, investigations of the effects of alliance representatives on the use of other alliance governance mechanisms and on alliance performance remain limited in the strategic alliances literature. More specifically, while the literature has demonstrated the effects of alliance representatives on monitoring, coordination, and adaptation in alliances (Child, Faulkner, and Tallman, 2005; Doz and Hamel, 1998; Gerwin, 2004; Gerwin and Ferris, 2004; Kale and Singh, 2009; Mayer and Teece, 2008), very little attention has been paid to (1) the interplay between alliance representatives and global alliance governance mechanisms such as complex contracts and equity investments, (2) the exogenous antecedents that affect a firm's decisions on the use of alliance representatives in their strategic R&D alliances and (3) the performance impacts of alliance representatives.

The extant research on strategic alliances includes extensive discussion on governance mechanisms utilized in alliances to mitigate partner opportunism, enhance coordination and facilitate adaptation. The mainstream studies on alliance governance, drawing primarily upon transaction cost economics theory, suggest the use of equity investments to control partner opportunism (Balakrishnan and Koza, 1993; Pisano, 1989; Pisano, 1990; Santoro and McGill, 2005), to facilitate coordination and knowledge transfer between firms (Faems, Janssens and Van Looy et al., 2007; Gulati, 1998; Sampson 2007) and to increase the capacity of partnerships to adapt to changing circumstances (Pisano, 1989; Gulati et al., 2005). Recently, scholars began investigating alliance contracts revealing their control and coordination functions (Reuer et al., 2006; Reuer and Arino, 2007). In addition, as contract data become more available, researchers are conducting research on finer-grained governance mechanisms such as license exclusivity (Somaya et al., 2011) and severe termination rights (Lerner and Malmandier, 2010; Robinson and Stuart, 2007).

As an alternative to the formal governance perspective, a relational governance perspective has been developed. In the relational governance perspective, the role of trust

in mitigating partner opportunism directly, as well by interacting with formal governance mechanisms, has been established (Faems et. al, 2008; Gulati, 1995; Gulati and Nickerson, 2008; Poppo and Zenger, 2002; Puranam and Vanneste 2009; Yadong, 2002).

Although alliance governance scholars address a wide range of governance mechanisms, they pay little attention to alliance representatives, primarily due to limited data availability. Because data on alliance representatives is now more easily accessible, there are ample opportunities for advancing our knowledge of alliance governance. For instance, we know from the literature that complex contracts are necessary for reducing partner opportunism (Reuer and Arino, 2007; Yadong, 2002). Yet, can a complex contract itself reduce opportunism if a firm does not appoint its representatives to oversee the extent of fulfillment of contractual obligations by its partner?

On the other hand, alliance governance scholars, as a consequence of extensively drawing on agency and transaction cost economics theories to explain alliance governance decisions, do not associate a contract design role with alliance representatives. This is because these theories posit that representatives are primarily responsible for overseeing alliance activities rather than providing input during the writing of alliance contracts. However, the theoretical work of Argyres and Mayer (2007) highlights the importance of a contract design role for the firms' managers and technical personnel in interorganizational arrangements. In line with this view, one may expect that the representatives of strategic R&D alliances, typically senior managers, middle managers and technical employees of R&D departments in their own firms, can function as repositories of contract design capabilities for their firms in strategic R&D alliances. Therefore, it is necessary to improve our understanding of the extent to which these representatives can increase the contractual complexity of an alliance.

The alliance governance literature also extensively emphasizes the role of equity investments in mitigating contractual hazards. In the context of strategic R&D alliances, equity has been viewed as a fundamental governance mechanism to reduce appropriability hazards, resulting from a lack of contractual specifications and monitoring (Oxley, 1997; Shelanski and Klein, 1995; Williamson, 1991). Yet, the presence of alliance representatives can increase the adaptive and monitoring capacities of an alliance. Hence, it is also necessary to examine whether partial ownership through minority equity

investments is necessary when a firm uses its alliance representatives to monitor the partner's behavior and make decisions on unforeseeable contingencies *ex post*.

Moreover, we know little about how project-level governance by alliance representatives interacts with contractual complexity and equity in explaining alliance performance, particularly the innovation performance of strategic R&D alliances. Given the key role that alliance governance design plays in determining alliance success, it is crucial to understand the interactive effects of these mechanisms on performance. Hence, we also aim to demonstrate whether these mechanisms substitute or complement each other in explaining alliance performance.

Previous studies in the strategic alliances literature have also extensively investigated the relation between task and partner characteristics and governance choices. For example, studies show that the R&D stage at which the alliance is signed (Santoro and McGill, 2005) and the history of cooperation between (Gulati, 1995) partners influence the choice of governance modes. Yet, we do not have enough understanding of the effects of these exogenous factors on the day-to-day governance exercised by representatives. Are late-stage strategic R&D alliances associated with more intense governance by alliance representatives? To what extent do prior relationships affect the presence of alliance representatives?

We proceed by introducing the project-level governance construct that captures the daily governance structure of an alliance according to the hierarchical status of alliance representatives. Then, by integrating agency and transaction cost theories and the literature on contract design capabilities, we identify three governance roles of alliance representatives: (1) contract design, (2) contract monitoring, and (3) contractual adaptation, and explain how greater project-level governance leads to the fulfillment of these roles to a larger extent. Following this, we propose that there is a positive reciprocal relation between project-level governance and contractual complexity and a negative reciprocal relation between project-level governance and equity. Thus, project-level governance and contractual complexity operate as complements and project-level governance and equity operate as substitutes in explaining alliance performance. Finally, we examine the effects of two exogenous factors on project-level governance. We argue that late-stage alliances require higher degrees of contract monitoring and adaptation, resulting in greater project-

level governance; and alliances between partners with a cooperation history require less project-level governance, because of relatively lower needs for contract monitoring and adaptation. We test our hypotheses on a sample of 316 strategic R&D alliances of U.S.-based biotechnology firms. We use a 3-Stage Least-Squares estimation method to account for simultaneity biases resulting from interplay between project-level governance, equity, and contractual complexity.

2.2 CONCEPTUAL BACKGROUND

We describe project-level governance as a formal day-to-day alliance governance mechanism used by partners through the appointment of their representatives to project manager, alliance manager, and joint committee membership roles. Different from other formal alliance governance mechanisms that operate at alliance and firm levels, such as contract and equity, project-level governance is a mechanism primarily concerned with the day-to-day monitoring and management of projects in alliances. Hence, we include the term 'project' in our construct label.

Understanding when alliance partners choose more intense project-level governance in a partnership and the extent to which this choice influences performance requires the examination of the contract design, contract monitoring and contractual adaptation roles of project-level governance. First, project-level governance plays a key role in contract design. Argyres and Mayer (2007) emphasize that managers and technical staff of firms, together with lawyers, play crucial roles in crafting interorganizational contracts, because they are the primary repositories of contract design capabilities. They suggest that managers and technical staff play a more important role than lawyers in specifying terms germane to the allocation and description of roles and responsibilities and the specification of communication methods that will be used in alliances. Furthermore, they mention that managers and technical staff provide crucial input to their firms in specifying terms pertaining to the allocation of decision and control rights and the description of contingencies. Because alliance representatives are senior or middle-level managers, dedicated alliance managers, or R&D personnel in their firms, they constitute the key repositories of contracting capabilities for their own firms, capabilities that can be deployed when the terms of the agreements are drafted. Thus, firms can use the knowledge

of their alliance representatives to draft detailed terms pertaining to task descriptions and contingencies in their alliances. This is particularly important for the firm's strategic R&D alliances in which task definitions can be ambiguous and the environment can be very dynamic making it costly and difficult to describe contingencies *ex ante*.

Practical evidence also supports the presence of a role in contract design for alliance representatives. Small firms without any dedicated alliance management units use their founders/directors at the contract design stage. These people also represent their firms at the alliance implementation stage. In the case of large firms, with higher levels of alliance management professionalization, practical evidence reveals that both senior managers appointed to joint steering or functional committees and alliance managers employed in dedicated alliance functions are responsible for contract drafting (Bamford, Gomes-Cassares, and Robinson, 2003). The reason is that deal-makers who are responsible for negotiating and structuring contracts with alliance partners lack an understanding of operational issues because they primarily have a legal and economic mind-set which prevents them from effectively articulating operational issues within contracts. As a result, problems may emerge in the transition from deal making to alliance management. Thus, the involvement of a senior manager who is a member of a joint committee or the involvement of an alliance manager in the deal making process can help in designing a contract that effectively address the operational alliance issues. Therefore, alliance representatives who are mainly responsible for alliance execution can also be involved in the contract writing process before alliances are launched.

Project-level governance serves as a mechanism for contract monitoring. Agency theory emphasizes observability and verifiability attributes of transactions which result in moral hazard and adverse selection problems, respectively (Arrow, 1985; Holmstrom, 1979; Jensen and Meckling, 1976; Eisenhardt, 1989). In the context of strategic R&D alliances, these attributes necessitate the monitoring of partner activities and verification of the partner's inputs and performance, both of which are positively associated with project-level governance. Overseeing the partner's activities to assess the fulfillment of contractual obligations entails the appointment of representatives to project-level governance roles. Prior research has addressed the monitoring role of alliance representatives (Child, Faulkner, and Tallman, 2005; Gerwin and Ferris, 2004; Mayer and Teece, 2008)). Yet, the

verification role has received relatively less attention. Alliance representatives are necessary when alliance outcomes are evaluated and rewards distributed based on required performance levels. A firm can use its managers and committee members to decide on whether the outputs developed by its partner fulfill the performance requirements specified in the agreement, thereby permitting a decision regarding the rewarding of its partner. Without properly working project-level governance, a firm is likely to have difficulties in assessing the quality of the partner firm's outputs which can result in an improperly functioning incentive scheme. Additionally, a firm can use project-level governance to assess whether its partner is deploying the necessary inputs for the alliance. Hence, project-level governance serves as a mechanism to mitigate problems resulting from not only observability, but also verifiability in strategic R&D alliances.

The extract below is from the contract of an alliance formed between a pharmaceutical firm and a biotechnology firm in 2008. It is possible to observe the contract monitoring functions of project-level governance, i.e. monitoring and verification of results, within this section of the contract. As stated in clause (e), the joint steering committee has the right to oversee the parties' progress in the conduct of the R&D activities. Furthermore, as mentioned in clause (f), the committee has the right to make go/no-go decisions on the licensed compounds picked by the joint research and development committee.

> Within twenty (20) Business Days after the Effective Date, PharmaCo and BiotechCo shall establish a joint steering committee (the "JSC") to review, coordinate and provide overall strategic direction to their activities pursuant to the Research Plan and any Development Plan… The JSC shall be comprised of approximately three (3) senior executives of PharmaCo and three (3) senior executives of BiotechCo with appropriate levels of decision making authority… The JSC shall be responsible for … (e) overseeing the joint research and development committee (JRDC) and the Parties' progress in the conduct of the Research Program and in Research and Development activities hereunder…(f) approving the nomination of Licensed Compounds

which have been recommended by the JRDC for advancement into Development.

Finally, project-level governance serves as a contractual adaptation mechanism in strategic R&D alliances. This is because project-level governance can help partners in solving *ex post* contingencies that are not described *ex ante* in the contracts. In incomplete contracting theory, these contingencies are called indescribable contingencies (For an extensive review see, Tirole, 1999). Incomplete contracting theory emphasizes the bounded rationality of exchange partners, which leads to omitting contingencies when the costs of anticipating, devising optimal responses to, and drafting provisions for improbable events outweigh the expected gains. The extent to which the contract is incomplete determines the need for adaptation mechanisms presented at different levels in various types of governance modes in the market-hierarchy continuum. Theories of transaction cost economics explain how an appropriate governance mode can mitigate contractual hazards of transactions (Oxley, 1997; Poppo and Zenger, 2002; Sampson, 2004; Williamson, 1991). Hierarchical governance modes with high levels of integration between partners are more appropriate if alliances involve contractual hazards on account of the considerable level of uncertainty which is hard to predict *ex ante* (Gulati and Singh, 1998; Oxley, 1997; Williamson 1991). Project-level governance offers a means of handling contingencies *ex post* because of the formal decision-making and dispute resolution roles assigned to alliance representatives. Having voting rights enables alliance representatives to protect the interests of their parent firms when unexpected events increase opportunism risks. In addition, as project-level governance increases, the level of bounded rationality decreases because alliance representatives serve as feedback instruments to help in quickly processing information and mobilizing resources accordingly (Kale and Singh, 2009). Thus, the presence of alliance representatives leads to increased adaptive capacity that can fine-tune the alliance to contractual disturbances that may emerge in the course of the relationship.

After describing governance roles, we can also develop a ranking of the ability of alliance representatives in performing these roles. Project and alliance managers (PMs and AMs) are the most important contributors to contract design because of their familiarity

with operational issues. Their input can be used in the specification of terms pertaining to the allocation of roles and responsibilities and task descriptions. They can effectively assess the appropriate division of tasks and provide considerable insight into R&D and commercialization plans. Joint steering committee (JSC) and joint functional committee (JFC) members are the primary representatives who oversee alliance activities and verify alliance results. Particularly, JFC members conduct the primary monitoring and verification roles, because they are the first-line of authority responsible for these activities in their functional domains. Mostly, JSC members perform contract monitoring based on the advice of joint functional committees. Thus, JFC members have a relatively more important role in contract monitoring than joint steering committee members. In terms of adaptation to contractual disturbances, joint steering and joint functional committee members are equally important. Their decision-making and conflict-resolution roles enable partnerships to adapt to unanticipated circumstances. They typically have voting rights in meetings. On the other hand, PMs and AMs typically do not have voting rights. Furthermore, they have limited responsibilities in the verification of results. Hence, they are the third highest in the role of both contract monitoring and adaptation to disturbance. In aggregate, the members of JFCs have the highest, members of JSCs have the second highest, and PMs/AMs have the third highest impact on project-level governance.

Table 2. 1 Alliance representatives' rankings based on their governance roles

Reps vs. Governance Roles	Contract Design	Contract Monitoring	Adaptation	Aggregate
PMs & AMs	Highest	Third Highest	Second highest	Third highest
JSC members	Second highest	Second Highest	Highest	Second Highest
JFC members	Second highest	Highest	Highest	Highest

2.3 HYPOTHESES DEVELOPMENT

Project-level governance and contractual complexity

In general terms, contractual complexity refers to the detail of contractual clauses regarding the specification of partners' roles and responsibilities, description of tasks, and contingency plans (Argyres, Bercovitz, and Mayer, 2007; Reuer and Arino 2007; Ryall and Sampson, 2009). Complex contracts require a relatively higher degree of contract monitoring than simple contracts. First, the higher level of formalization increases the need for a mechanism that will oversee the partner's behavior. For instance, if a contractual provision added by one partner obliges the other to appoint a definite number of full-time scientists to the R&D alliance, the partner that added this clause to the contract needs to appoint a project manager or an alliance manager to oversee the human resource commitments of the other partner. Similarly, if partners develop a relatively more detailed development and commercialization plan at the outset, they will both require joint development and commercialization committee members as controllers in order to effectively assess whether the project proceeds as written in the plans. Hence, the more detailed the contract, the higher the required degree of project-level governance to ensure that parties fulfill the requirements.

Second, the higher the number of contingency clauses, i.e. the clauses that specify which actions will be taken when describable contingencies occur, the higher the need for an authority to assess the contingency situation and make a decision. Hence, committee members also play a key role in enforcing the contingency clauses of R&D alliance contracts. For example, a relatively more detailed milestone payment scheme that links financial rewards to a higher number of milestone events will require relatively higher degrees of governance due to the higher needs for the evaluation of event outcomes. A partner must use its joint steering committee or research and development committee members to evaluate the claims of their partners on the performance of the developed solution in order to make a payment decision.

Contractual complexity not only influences the degree of project-level governance, but is also influenced by it, primarily due to the contract design function of project-level governance. As discussed, in a strategic R&D alliance, the representatives that will be involved in project-level governance can provide input on task descriptions and

contingencies when the partners' deal-makers draft the contract. They will be willing to provide this input, because it will be easier for them to govern a transaction whose rules are not fully imposed on them by the partners' lawyers. Their involvement in the contract writing process will result in additional clauses that can address important operational issues. The formalization of these issues at the outset will reduce ambiguities and consequently increase their effectiveness in contract monitoring.

If the degree of project-level governance is high in an alliance, partners will have different types of representatives which means that a more diverse and broad sets of issues can be formalized in the contracts. For instance, an alliance manager may contribute to the inclusion of a clause related to a general alliance management issue such as the communication media that would be used between partners in the meetings. On the other hand, a member of the joint research committee can provide his insight on which activities should be included in the research plan of the project. Hence, an alliance that has a high degree of project-level governance is likely to have a more detailed contract.

Hypothesis 1: All else being equal, as contractual complexity increases, the degree of project-level governance increases in the context of strategic R&D alliances.

Hypothesis 2: All else being equal, as the degree of project-level governance increases, contractual complexity increases in the context of strategic R&D alliances.

Performance effects of project-level governance and contractual complexity

We propose that project-level governance and contractual complexity complement each other in enhancing the performance of a strategic R&D alliance. This is because project-level governance provides for the effective implementation of complex contracts, and vice versa. Detailed contractual clauses are hardly effective if a firm does not have the ability to monitor the activities of its partner. In addition, project-level governance *ex ante* provides the necessary knowledge to draft a more effective contract that better specifies the roles

and responsibilities, tasks, and contingency plans. Therefore, project-level governance increases the effectiveness of contractual complexity in enhancing performance.

Likewise, contractual complexity leverages the effects of project-level governance on performance. Complex contracts more effectively describe the responsibilities and limits of alliance representatives' authority (Robinson and Stuart, 2007). In other words, complex contracts facilitate the establishment of a clear legal framework that resolves ambiguities regarding the allocation of decision-making authority and division of labor. Without clauses that clearly describe the responsibilities of alliance representatives, the tasks under their control, and contingency plans that will be used when unforeseen circumstances emerge, alliance representatives will contribute less to the innovation performance of an alliance. Therefore,

> *Hypothesis 3: All else being equal, project-level governance and contractual complexity complement each other in explaining alliance innovation performance in the context of strategic R&D alliances.*

Project-level governance and equity

Project-level governance and equity are likely to operate as substitute governance mechanisms, because both mechanisms serve as means for adapting alliances to changing circumstances and controlling partner opportunism. Strategic R&D alliances operate in dynamic and turbulent environments. Maneuvers of competitors, changes in customer demands, and alterations to regulations influence product requirements, leading to changes in the benefits and payoffs that alliance partners expect from their partnership. In such environments, the ability to adapt plays a key role in the continuation of the partnership. The adaptation problem emerges from the difficulty of predicting contingencies *ex ante*; a problem that worsens if partners do not develop mechanisms to handle it. This is because the indescribable contingencies make partners vulnerable to each other's opportunistic behavior. The strategic alliances literature suggests the use of equity investments to increase the adaptive capacity of the partnership (Gulati, Lawrence, and Puranam, 2005; Pisano, 1989)). Equity aligns the incentives of partners by providing residual rights of control to the partner that makes the equity investment (Grossman and Hart, 1986). The

residual rights of control enable the partner to claim rights over the issues not described in the contract. As a result, the negative effects of unexpected contingencies can be mitigated without any contract renegotiation.

Project-level governance also serves as a key adaptation mechanism. This is because partner firms delegate decision-making and conflict resolution tasks to their alliance representatives so that alliance representatives can develop solutions *ex post* for the issues not described in the contract. Particularly, senior managers appointed as committee members of joint steering and joint functional committees can adapt the alliance to changing circumstances by making decisions on unexpected and conflicting issues through use of their voting rights. Therefore, greater project-level governance can substitute for the adaptive capacity provided by the equity investments.

Equity's role in mitigating partner opportunism risks has been pointed out in the strategic alliances literature (Pisano, 1989; Pisano, 1990; Santoro and McGill, 2005). Equity reduces partner opportunism risks through incentive alignment because a partner with equity investment will cause economic disadvantages to itself if it acts opportunistically to its partner. Furthermore, prior research has reported that the equity holding partner is often granted a seat on the target's board which increases the degree of joint governance at the board of the target partner (Allen & Phillips, 2000; Mjoen & Tallman, 1997; Pisano, 1989; Robinson & Stuart, 2007; Yan & Gray, 1994). Through representation on its partner's board, the partner with the equity investment can influence the behavior of its partner and, in turn, the overall progress of the partnership.

Project-level governance's contract monitoring role represents the control function of alliance representatives to mitigate partner opportunism risks. As the degree-of project level governance increases, a firm is, to a higher extent, able to deter its alliance partner from opportunistic behavior and control whether its partner breaches the conditions of the agreement. Therefore, if a firm is able to monitor its partner through its alliance representatives, there will be less need for equity investments. Similarly, if equity is used, there will less need for alliance representatives.

> *Hypothesis 4: All else being equal, as the degree of project-level governance increases, the alliance will be less likely to be an equity alliance in the context of strategic R&D alliances.*

Hypothesis 5: All else being equal, the presence of equity will be negatively related to the degree of project-level governance in the context of strategic R&D alliances.

Performance effects of project-level governance and equity

We define the performance of an alliance as the extent to which development efforts lead to marketable products. Therefore, we do not include the costs of governance in our definition of performance. Thus, although both equity and governance mechanisms are likely to enhance alliance innovation performance, when they are used in isolation, they will substitute each other in explaining alliance performance. As discussed above, partners will opt for either a high project-level governance with no equity investment governance structure or a low project-level governance with equity investment governance structure, because of the similarities between the functions of two governance mechanisms in improving control and adaptation. This will lead to the governance choice with minimum governance costs. Nevertheless, either decision will not allow partners to gain the benefits of one of the two governance mechanisms. Hence, while the use of only one of these governance mechanisms minimizes the costs of governance, it negatively affects the innovation performance of a strategic R&D alliance. Therefore,

Hypothesis 6: All else being equal, project-level governance and equity substitute each other in explaining alliance innovation performance in the context of strategic R&D alliances.

Stage at signing and prior relationships as exogenous antecedents

Exogenous factors that influence governance decisions are the prevailing conditions in which deal-makers of partner firms must operate when they design the governance structures of their alliances. These are the factors that are external to the system, i.e., not determined by one of the variables in the system. The development stage at which alliance is signed is one of these factors. Prior research has found that the stage at signing influences the governance choices in strategic R&D alliances (Santoro and McGill, 2005).

Early-stage alliances face less severe observability and verifiability problems. Partners typically explore alternative solutions at this stage to resolve technical uncertainties. Thus, the required degree of monitoring, due to higher experimentation and creative problem-solving needs, is relatively lower for early-stage projects than late-stage projects. Furthermore, it is generally too early to assess the ultimate market performance of outputs. Therefore, the need for contract monitoring is lower. Additionally, because the solution is not developed enough to be commercialized in the market, the need for adaptation to changing market circumstances is lower.

On the other hand, late-stage alliances involve high levels of technical and market uncertainties. Furthermore, the level of behavioral uncertainty also increases, as a solution gets close to the market. Hence, the likelihood of opportunistic behavior increases, which in turn, increases the required degree of monitoring. Furthermore, the need for a more detailed evaluation of project outcomes becomes higher. The input of downstream specialists, such as marketers and manufacturing engineers, is necessary to assess the marketing and manufacturing costs of a solution. As a result of the increased contract monitroing needs, in terms of verifying the quality of developed solutions, joint commercialization and manufacturing committees will be formed in addition to joint research and development committees. Moreover, adaptation needs will be higher at later stages due to increased behavioral uncertainties. Therefore, we expect that the degree of project-level governance will be relatively higher for late-stage projects than early-stage projects.

> *Hypothesis 7: All else being equal, late-stage alliances are likely to have greater project-level governance than early-stage alliances in the context of strategic R&D alliances.*

Previous research on strategic alliances suggests that partners with prior relationships experience opportunism risks to a lesser degree. For instance, Parkhe (1993) finds that the history of cooperation reduces the level of perception of opportunistic behavior. Moreover, the literature suggests that partners with prior relationships will develop trust that decreases the need for safeguarding mechanisms such as equity investments (Gulati, 1995). Thus,

there is a negative association between prior relationships and the need for formal governance due to the relatively lower risks of opportunism. In line with these findings, we expect that the degree of project-level governance will be lower for alliances between partners that have a cooperation history because of the reduced need for monitoring. In addition, we argue that the adaptation role of project-level governance will be less salient, because prior relationships lead to the development of informal adaptation mechanisms such as trust, justice, and fairness that can substitute for formal governance through alliance representatives. However, first-time partners are more likely to rely on project-level governance as a control and adaptation mechanism. Therefore,

> *Hypothesis 8: All else being equal, as the number of prior relationships increases, the degree of project-level governance decreases in the context of strategic R&D alliances.*

2.4 METHOD

The empirical setting of this study was the US biotechnology industry. The U.S. biotechnology industry offered an attractive setting to conduct our study. First, the disclosure requirements of the Securities Exchange Commission (SEC) force biotechnology firms to disclose their R&D agreements with other firms. This is because the SEC requires a public firm to disclose all material transactions, representing 5 percent or more of a firm's revenues. Because many biotechnology firms experience difficulties in generating substantial revenues, their strategic R&D alliances fit the definition of material transactions. Hence, deal information is widely available as compared to other high-tech industries, making the biotechnology industry an ideal setting for our study. Second, the professionalization of alliance management in the biotechnology industry has created diversity in the degree of project-level governance. Hence, alliances with both low and high degrees of project-level governance are observable in the industry.

We primarily used the Deloitte's Recap and SEC Edgar databases for data collection. We used the Recap database to create our sample. Recap's specialization in the biotechnology industry and it is superiority in covering alliances has been recognized in the literature (Schilling, 2009). Specifically, we received deal data including, presence of equity, stage at signing, the number of prior deals, nationality of partners, therapeutic scope, alliance type, i.e. bio-bio or bio-pharma, and alliance formation year from Recap. We checked the accuracy of information by analyzing annual reports and press releases of the biotechnology firms whose alliances were included in our sample. We used the SEC Edgar database to conduct an in-depth analysis of contracts. We gathered data on project-level governance by downloading alliance contracts. We analyzed the 'Alliance Governance' sections of these contracts and codified all necessary information for our study.

Sample

We used several criteria for sampling. First, we included only dyadic alliances. Alliances with multiple partners were excluded from our sample. Second, our sample consisted of only U.S.-based biotechnology firms. Yet, the pharmaceutical firms in the sample were from the U.S., Europe and Japan. Third, we picked the period 1996-2008. Fourth, only contractual alliances and minority investment alliances were in the sample because project-

level governance, as we described in this paper, does not take place in equity joint ventures. The creation of a new entity in joint ventures typically leads to a department-based structure in which committee membership, alliance management, and project management roles are barely observed. In addition, if any of these roles exist, it is not possible to gather data on them through the analysis of contracts. Finally, we pick alliances with relatively higher levels of technical difficulties and market potential. We analyzed medical journals, specialized in clinical trials, to avoid including trivial development alliances. As a result, we picked alliances targeting areas with relatively low drug approval rates, including oncology, central nervous system, cardiovascular, endocrinological and metabolic, hematologic, autoimmune/ inflammatory and psychiatry. Based on these criteria, we randomly picked 316 dyadic R&D alliances.

Model specification

To account for endogeneity, we used the simultaneous equation modeling (SEM) approach (Wooldridge, 2002). SEM requires the identification of equations for each endogenous variable. Given that project-level governance, contractual complexity, equity and alliance innovation performance are endogenous variables in the model, we identified four equations: (1) the project-level governance equation, (2) the contractual complexity equation, (3) the equity equation, and (4) the alliance innovation performance equation. The right-hand side of each equation consists of endogenous independent variables, exogenous independent variables used only in a single equation, exogenous independent variables used in more than one equation, and an error term.

As we discussed in the hypotheses development section, the project-level governance equation involves contractual complexity, equity, stage at signing and prior deals. In addition, we control for the effects of partner type (i.e. a vertical R&D alliance between a biotechnology firm and a pharmaceutical firm or a horizontal R&D alliance between two biotechnology firms) on the required degree of project-level governance. Vertical R&D alliances involve unilateral licensing agreements. In contrast, horizontal R&D alliances involve bi-lateral (i.e. cross-licensing) agreements. We expect that bi-lateral licensing reduces the need for project-level governance, because the presence of a bi-lateral license safeguards against partner opportunism. Furthermore, in horizontal alliances, because partners bring similar resources and skills to the alliance, they pursue a pooling strategy

that consists of sharing similar resources. On the other hand, vertical alliances are typically characterized by skill and resource contributions that differ between partners. Although these differences create complementarities and increase the chances of innovation, they may also lead to inter-firm conflicts and partner opportunism. Therefore, it is more likely that vertical alliances will have greater project-level governance than horizontal alliances.

The contractual complexity equation involves project-level governance as an endogenous variable. In addition, we include equity as the second endogenous variable. Robinson and Stuart (2007) found that equity ownership and contractual complexity act as complements in the setting of early stage biotech R&D alliances. They argue that the partner holding the equity investment has the desire to include clauses that describe in detail the circumstances under which equity-based control can be exercised. Hence, the presence of equity increases contractual complexity. On the other hand, Reuer and Arino (2007) controlled for the effect of equity on contractual complexity in their model explaining the factors affecting the complexity of contracts and found some mixed results. They demonstrated that equity has a positive effect on contractual complexity, when contractual complexity is measured at an aggregate level, however, equity substitutes for some enforcement and coordination clauses. In line with these studies, we add equity to the contractual complexity equation.

In addition, alliance formation year, therapeutic scope, prior deals, and partner type are included in the contractual complexity equation to control for their effects on contractual complexity. The formation year reflects the extent to which industry-level contracting capabilities evolve over time. From the beginning of the second half of the 1990s, strategic R&D alliances became an important organizational mode to conduct R&D in the biotechnology and pharmaceutical industries. Until now, the trend has continued. We expect that various industry participants, including firm founders, senior managers, alliance managers and lawyers, learned to write more detailed contracts because their accumulated experience helped them in identifying contingencies more effectively. Therefore, we control for the effects of learning on contractual complexity by proposing that alliances signed more recently will have higher complexity than alliances signed in the late 1990s.

We also control for the therapeutic scope of the alliance. Broad scope alliances involve multiple therapeutic areas, leading to the need for more detailed task descriptions and

contingency plans. Therefore, contractual complexity is positively related to the scope of the alliance in terms of the number of therapeutic areas. Previous research demonstrated that prior relationships allow contracts to be specified in greater detail due to learning effects (Mayer and Argyres, 2004; Vanneste and Puranam 2010). Hence, we control for prior deals in the contractual complexity equation. Finally, partner type is included to control for its effect on contractual complexity. As mentioned, vertical alliances may require higher levels of control than horizontal alliances, because of higher opportunism risks. Therefore, if a biotechnology firm partners with a pharmaceutical firm, it will draft a more detailed contract to avoid any risks resulting from the opportunism of the pharmaceutical firm.

The equity equation involves project-level governance, as discussed in the hypothesis development section, and contractual complexity, as discussed above. Prior research has examined the effect of technical uncertainty on the choice of alliance governance modes, i.e., equity vs. non-equity alliances (Gulati and Singh 1998; Santoro and McGill 2005). Hence, we include alliance formation stage as a proxy for technical uncertainty.. Following, the literature on international alliances (Beamish and Lupton, 2009; Brouthers, 2002; Gulati, 1995), we add the presence of a cross-border partnership to our model to account for the effect of nationality differences on the governance choice. We also add the number of prior deals to the equation in line with the prior literature that demonstrated a negative association between the number of prior deals between partners and the use of hierarchical governance structures (Gulati, 1995). We also include partner type to control for the influence of partner type in terms of the required degree of incentive alignment. Following our prior arguments, we contend that vertical alliances are riskier than horizontal alliances in terms of partner opportunism, and therefore, horizontal alliances are less likely to have equity investments as compared to vertical alliances.

Finally, we specify an equation for alliance innovation performance which refers to the extent to which the alliance attained successful development outcomes. Following our hypotheses, this equation involves project-level governance, equity, and contractual complexity. In addition, we control for the effects of stage at signing, the number of prior relationships, and the nationality of partners on alliance innovation performance.

As a result, the following four equations were specified to test our hypotheses associated with the antecedents and outcomes of project-level governance in the context of strategic R&D alliances.

$$\textit{project-level governance} = \alpha_{10} + \gamma_{12}\ \textit{contractual complexity} + \gamma_{13}\ \textit{equity} + \beta_{11}\ \textit{stage at signing} + \beta_{12}\ \textit{prior deals} + \beta_{13}\ \textit{partner type} + \varepsilon_1 \quad (1)$$

$$\textit{contractual complexity} = \alpha_{20} + \gamma_{21}\ \textit{project-level governance} + \gamma_{23}\ \textit{equity} + \beta_{21}\ \textit{alliance formation year} + \beta_{22}\ \textit{therapeutic scope} + \beta_{23}\ \textit{prior deals} + \beta_{24}\ \textit{partner type} + \varepsilon_2 \quad (2)$$

$$\textit{equity} = \alpha_{30} + \gamma_{31}\ \textit{project-level governance} + \gamma_{32}\ \textit{contractual complexity} + \beta_{31}\ \textit{stage at signing} + \beta_{32}\ \textit{cross-border} + \beta_{33}\ \textit{prior deals} + \beta_{34}\ \textit{partner type} + \varepsilon_3 \quad (3)$$

$$\textit{alliance innovation performance} = \alpha_{40} + \gamma_{41}\ \textit{project-level governance} + \gamma_{42}\ \textit{contractual complexity} + \gamma_{43}\ \textit{equity} + \beta_{41}\ \textit{stage at signing} + \beta_{42}\ \textit{cross-border} + \beta_{43}\ \textit{prior deals} + \varepsilon_4 \quad (4)$$

Measures

Main dependent variable

Alliance Innovation Performance

Alliance innovation performance represents the extent of success of the pre-commercialization activities of the partners. It was operationalized as an ordinal variable with scores 0, 1, and 2, corresponding to low, moderate, and high success scores, respectively. We assigned the highest score, 2, to alliances during which partners were successful in developing a drug that received an approval from either the Federal Drug Agency (FDA) or the European Medicines Agency (EMA). We assigned a score of 1 to alliances during which partners were still not successful by January 2011 in developing a drug that received approval from either the Federal Drug Agency (FDA) or the European Medicines Agency (EMA), but the partners had not terminated the alliance for any reason; or the incumbent partner licensed the compound developed during the partnership, yet decided not to ally with the startup for further development. Finally, the score 0 was assigned to alliances terminated without any successful drug approvals or licensing by incumbents.

Endogenous variables

Project-level governance

This variable captures whether senior and middle-level managers of the partner firms were appointed to committee membership, alliance management and project management roles. As mentioned, we obtained scores for this variable by reading the 'alliance governance' sections of agreements. These sections describe in detail which joint committees should be formed and whether liaison personnel, such as project and alliance managers, should be appointed.

Based on our reasoning in the theory section, we assigned weights to formal alliance representative roles. We also included joint finance and patent committees in our measure, because these committees occasionally appear in alliances. However, they are peripheral committees that support other committees in decision-making. They have the lowest governance ranking among all the roles. Hence, we call them peripheral committees. In line with measurements used in prior studies, a weight was assigned to each of these dimensions based on their governance complexities (Kumar and Seth, 1998). A rank of 1 was assigned to 'peripheral joint functional committees', 2 to 'project and alliance managers', 3 to 'joint steering committees', and 4 to 'joint functional committees'. Then the sum of the scores of each dimension was divided by 24, the maximum score[1] attainable.

Contractual complexity

This variable captures the extent of contractual detail pertaining to the specification of roles and responsibilities, monitoring and non-compliance penalties, processes for dispute resolution and termination clauses. There are alternative ways of measuring contractual complexity. Until recently, the scale developed by MacNeil (1978) was commonly used in the contracting literature to measure contractual complexity. This scale counts the appearances of specific clauses in the contract. The biotechnology alliance contracts written in the US, however, typically include most, if not all of the sections specified in the scale. Therefore, we encountered difficulties in measuring the differences among contracts by using this scale. Previous studies that used this measure investigated contracts which are

[1] Twenty-four is the maximum score obtained when governance consists of a joint peripheral committee, project managers, alliance managers, a steering committee, and joint research, development, commercialization, and manufacturing committees.

either written for the relationships that can be described as arm's length contractual relationships, rather than strategic alliances (Mellewigt, Madhok, & Weibel, 2007), or as alliances between partners not operating in the biotechnology or pharmaceutical industries (Mellewigt et al., 2007; Reuer & Arino, 2007), or as alliances between partners outside the US, where regulations demand relatively less standardization regarding the inclusion of specific clauses (Reuer & Arino, 2007). Hence, by using this scale, those studies found enough variance for contractual complexity among contracts. This was not, however, the case for the contracts in our sample. Therefore, in line with some other studies in the literature, we measured contractual complexity as the number of pages in the contract,(Joskow, 1988). Although we employ a rather coarse measure, it was a viable option for measuring the contractual complexity of alliances in our sample.

Equity

Equity is a binary value that takes the value of 1 for equity alliances (i.e. minority equity alliances in our cases) and 0 for non-equity, contractual alliances.

Exogenous variables

Stage at signing. We included 9 dummy variables that represent the stages of biotechnology drug development: formulation, discovery, lead molecule, pre-clinical, phase I, phase II, phase III, BLA/NDA filed, and approved. We picked phase III as the base category.

Therapeutic Scope. The Recap database provides information on the therapeutic areas that will be covered by the alliance. Some alliances relate to a single therapeutic area. On the other hand, some alliances cover multiple therapeutic areas. We categorized the former alliances as narrow scope projects and the latter ones as broad scope projects. We used a dummy variable which equals 1 if the alliance scope is broad and 0 if the alliance scope is narrow.

Partner type. Because our sample consists of alliances between either two biotech firms or a biotech and a pharmaceutical firm, we used a dummy variable which equals 0 if the partnership is between a biotech and a pharmaceutical firm (i.e. vertical), and 1 if the partnership is between two biotech firms (i.e. horizontal).

Prior deals. We measured the number of prior relationships between partners by counting the number of alliance agreements between partners.

Cross-border. Using the Recap database, we identified the nationality of partners. We used a dummy variable which equals 0 if the partnership is between partners in the same locality and 1 otherwise.

Alliance formation year. We included 13 dummy variables for each year in our model. We used the ending year *2008* as the base category.

Methods

To control for endogeneity, we solve the equations by a three-stage least squares (3SLS) regression. To ease the interpretation of results, when regressing the alliance innovation performance over the independent variables in the alliance innovation performance equation, we estimate a linear probability model instead of probit and logit models. Wooldridge (2002) suggests the use of linear probability models in complex models with discrete response variables to ease interpretations because they provide good estimates of the partial effects of independent variables on the response probability, at average values for the independent variables. Hence, the size and significance of the effect, derived by solving a linear probability model, will be close to those derived by solving a probit or logit model, at average values for the independent variables. Because solving simultaneous equations by 3SLS is not a trivial approach in itself, we decide to pursue the linear probability model heuristic.

2.5 RESULTS

Table 2.2 and 2.3 illustrate the descriptive statistics and correlation matrix, respectively. The results of 3SLS estimation are summarized in Table 2.4. Hypotheses 1 and 2 examine the complementarities between project-level governance and contractual complexity. As predicted, the coefficient for contractual complexity is positive and statistically significant in the project-level governance equation ($p < .10$) and the coefficient for project-level governance is positive and statistically significant in the contractual complexity equation ($p < .01$). These results support our reasoning that there is a positive reciprocal relation between project-level governance and contractual complexity. Therefore, Hypotheses 1 and 2 are supported.

Table 2. 2 Descriptive statistics

Variables	Mean	Std. Dev.	Minimum	Maximum
Alliance innovation performance	.58	.72	.00	2.00
Project-level governance	.34	.18	.1250	.9167
Contractual complexity	72.78	33.91	11	197
Equity	.37	.48	0	1
Formulation	.07	.26	0	1
Discovery	.33	.47	0	1
Lead molecule	.09	.29	0	1
Pre-clinical	.15	.36	0	1
Phase I	.08	.27	0	1
Phase II	.11	.32	0	1
Phase III	.12	.33	0	1
BLA/NDA filed	.02	.14	0	1
Approved	.02	.13	0	1
Therapeutic scope	.61	.49	0	1
Crossborder	.50	.50	0	1
Prior deals	.27	.70	0	5
Partner type	.27	.45	0	1

Table 2. 3 Pearson correlations

Variables	1	2	3	4	5	6	7	8
1. Alliance innovation performance	1							
2.Project-level governance	.063	1						
3. Contractual complexity	.011	.363**	1					
4. Equity	-.073	-.038	.084	1				
5. Therapeutic scope	-.061	.006	.093	.021	1			
6. Crossborder deal	.128*	.104	.115*	-.136*	-.008	1		
7. Prior deals	.073	.101	.089	-.022	.004	-.029	1	
8. Partner type	-.105	-.069	-.120*	.028	.018	-.317**	-.090	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed)

Hypotheses 4 and 5 propose that equity and project-level governance serve as substitute governance mechanisms. As predicted in this hypothesis, the coefficient for equity in the project-level governance equation is negative and statistically significant ($p < .001$), and the coefficient for project-level governance is negative and statistically significant in the equity equation ($p < .001$). Hence, these findings suggest a substitution relationship between project-level governance and equity, thereby providing support for Hypotheses 3 and 4.

The examination of the effect sizes provides important insights into the impact of each governance mechanism on each other. For instance, the formation of a joint development and commercialization committee will increase project-level governance by 0.33 units, thereby increasing the contractual complexity by around 34 pages, which is slightly larger than 1 standard deviation of contractual complexity. On the other hand, the effect of size of contractual complexity in the project-level governance equation is rather small. Regarding the relationship between project-level governance and equity, the formation of two joint functional committees will decrease the chances of equity investments by 0.85 percentage points. Likewise, the presence of equity will reduce project-level governance by 0.29 units,

which is close to the score when two joint functional committees are not formed or an alliance manager, a steering committee and a peripheral committee are not utilized.

Hypotheses 3 and 6 relate to the performance impacts of alliance governance mechanisms. Hypothesis 3 states that project-level governance and contractual complexity complement each other and Hypothesis 6 states that project-level governance and equity substitute each other in explaining alliance innovation performance. As can be seen in Table 2.5, only the coefficient for contractual complexity is significant and positive in the alliance innovation performance equation ($p < .05$). Both coefficients for project-level governance and equity are insignificant. Therefore, only greater contractual complexity, encouraged in part by greater project-level governance, positively influences alliance innovation performance. One-unit increase in contractual complexity increases the probability of success by 0.015 in a 0 to 2 scale. Converting this scale to a 0-100 scale results in an effect size of 0.75 percentage points. Hence, the formation of two joint committees, for instance, increases the contractual complexity by 34 units which in turn increases the probability of success by 34*0.75 = 25.5 percentage points.

Hypothesis 7 proposes that alliances formed at late development stages have relatively greater project-level governance than those alliances formed at an early stage. As shown in the project-level governance equation, the coefficients for Discovery, Formulation, Lead Molecule and Preclinical stages are negative and statistically significant ($p < .01$) thereby supporting Hypothesis 7. Finally, Hypothesis 8 posits a negative relationship between prior deals and project-level governance. The regression results show that the coefficient for prior deals in the project-level governance equation is positive and not statistically significant. Hence, prior relations do not appear to substitute for the governance functions of alliance representatives. Thus, Hypothesis 8 is not supported.

Table 2. 4 Estimation results for the relationships among the governance mechanisms

	Project-level Governance Equation	Contractual Complexity Equation	Equity Equation
Endogenous variables			
Project-level governance	-	103.07** (40.543)	-2.577*** (0.543)
Contractual Complexity	0.002+ (0.001)	-	0.035 (0.004)
Equity	-0.293*** (0.068)	11.366 (17.891)	-
Equation(s)-specific exogenous variables			
Formulation	-0.161** (0.053)	-	-0.503** (0.153)
Discovery	-0.087** (0.032)	-	-0.298** (0.107)
Lead molecule	-0.137** (0.045)	-	-0.451** (0.143)
Preclinical	-0.113** (0.039)	-	-0.360** (0.114)
Phase I	-0.060 (0.042)	-	-0.131 (0.144)
Phase II	-0.020 (0.034)	-	-0.166 (0.132)
BLA/NDA filed	-0.127+ (0.067)	-	-0.457+ (0.239)
Approved	0.117+ (0.070)	-	-0.485+ (0.259)
1996	-	-4.366 (12.005)	-
1997	-	-23.696+ (14.529)	-
1998	-	-8.616 (13.311)	-
1999	-	-11.034 (11.729)	-
2000	-	-15.246+ (9.030)	-
2001	-	-19.145* (12.198)	-
2002	-	-8.415 (13.311)	-
2003	-	-9.173 (7.459)	-
2004	-	-9.799 (7.536)	-
2005	-	-6.544 (4.881)	-
2006	-	-4.199 (5.544)	-

2007	-	-2.976 (4.778)	-
Therapeutic scope	-	4.133^{+} (2.500)	-
Cross-border	-	-	-0.050 (0.050)
Common exogenous variables			
Prior deals	0.012 (0.015)	0.757 (2.665)	0.037 (0.045)
Partner type	0.007 (0.024)	-5.154 (3.983)	-0.015 (0.074)
Constant	0.372** (0.124)	41.340* (16.362)	1.289*** (0.272)
N	316	316	316
χ	64.49	53.35	36.52
Prob > χ^2	0.0000	0.0000	0.0005

+ indicates p < 0.1, two tailed,
* indicates p < 0.05, two tailed,
** indicates p < 0.01, two tailed,
*** indicates p < 0.001, two tailed.

In addition, several exogenous variables showed significant relationships with governance mechanisms and alliance innovation performance. The contracts of alliances that were written before 2001 are more likely to be shorter than the alliance contracts written in 2008. Broad scope alliances that involve multiple therapeutic areas are more likely to have longer contracts than narrow scope alliances involving only a single therapeutic area. Firms are less likely to use partial equity investments as safeguarding mechanisms in their early stage alliances compared to late stage alliances signed at Phase III testing. Finally, our results show that the stage at signing is a determinant of alliance innovation performance. Late stage alliances, i.e. Phase III, are more likely to be successful in new product development than early stage alliances.

Table 2. 5 Governance mechanisms and performance

Variables	Alliance Innovation Performance
Project-level governance	-1.01
	(1.17)
Contractual complexity	0.015*
	(0.01)
Equity	-0.41
	(0.46)
Formulation	-0.07
	(0.29)
Discovery	-0.35+
	(0.18)
Lead molecule	-0.17
	(0.26)
Preclinical	-0.21
	(0.22)
Phase I	-0.12
	(0.21)
Phase II	-0.32+
	(0.18)
BLA/NDA filed	0.44
	(0.36)
Approved	0.72+
	(0.39)
Prior deals	0.04
	(0.07)
Crossborder	0.06
	(0.10)
Constant	.13
	(0.66)
N	316
X	41.38
Prob > χ^2	0.0001

+ indicates p < 0.1, two tailed,
* indicates p < 0.05, two tailed,

2.6 DISCUSSION

In this study, we introduced the project-level governance construct and explained its effects on alliance governance and alliance innovation performance. We described the degree to which project managers, alliance managers and joint committee members are responsible for contract monitoring, contract design and adapting their alliances to changing circumstances. As a result, we provided the reader with a theory of how alliance representatives serve as governance agents for their firms. Based on our theory, we tested a model for the antecedents and outcomes of project-level governance. We found that project-level governance and contractual complexity serve as complementary governance mechanisms while project-level governance and equity serve as substitute governance mechanisms. Moreover, we showed that greater contractual complexity, encouraged in part by greater project-level governance, positively influences the chances of successful product development in strategic R&D alliances. Finally, we found that late-stage alliances are more likely to have high degrees of project-level governance compared to early-stage alliances.

By focusing on alliance representatives, we extended prior research on alliance governance mechanisms which has focused extensively on equity, contracts and informal governance mechanisms until now. We illustrated the interplay between these mechanisms and project-level governance and thus, highlighted the importance of alliance representatives in governance. We also advanced alliance research by uncovering exogenous factors that determine the need for alliance representatives. Moreover, we introduced a novel construct and develop a scale to measure it. This empirical contribution opens up new research avenues for scholars studying governance of alliances.

Our findings have important implications for the governance of strategic R&D alliances. We contribute to the literature on alliance governance by showing that alliance representatives play a key role in designing contracts. Theories of transaction cost economics have emphasized the monitoring role of alliance representatives (Balakrishnan and Wernerfelt 1986; Barthélemy and Quélin 2006; Williamson, 1991). Consistent with this view, we showed that complex contracts require greater monitoring and in turn greater project-level governance. Yet, in addition to contract monitoring, alliance representatives are likely to increase the contractual complexity of alliances because of their contract

design roles. In line with the organizational learning view that alliance representative's expertise, knowledge and status in their firms make them important sources of knowledge in contract design (Argyres and Mayer, 2007), our findings show that these representatives play key roles in the contract design processes in inter-organizational relationships. We explain why alliance representatives should be involved in the design of alliance contracts by arguing that their involvement facilitates the description of their roles, responsibilities, the boundaries of their authority, and the specification of tasks and unexpected contingencies, thereby resulting in the avoidance of operational problems.

Interestingly, our findings reveal that while greater contractual complexity, encouraged in part by greater project-level governance, positively influences alliance innovation performance; greater project-level governance, encouraged in part by greater contractual complexity, has no significant effect on alliance innovation performance. This result is important because it suggests that the contract design role of alliance representatives is relatively more important than the contract monitoring role of alliance representatives in explaining performance. In contrast to the predictions of the transaction cost view, that explain performance outcomes by safeguarding against partner opportunism, the predictions of the learning-based theories applied in the context of inter-organizational contracting literature (Argyres, Bercovitz, and Mayer, 2007; Argyres and Mayer, 2007; Mayer and Argyres, 2004), explain better why some alliances are more successful in developing new products and sustaining healthy relationships.

Contrary to the focus in previous research on equity vs. contractual governance choices, we focus on micro-level governance mechanisms used for monitoring, coordination, and adaptation. Oxley (1997) emphasized the necessity and, at the same time, difficulty of collecting and analyzing micro-level data. We exploited micro-level data availability to advance the current literature by developing a finer-grained understanding of alliance governance mechanisms. In turn, we were able to reveal the interplay between macro-level governance mechanisms, such as partial equity investments, and micro-level governance mechanisms, such as project-level governance. Our findings show that partial equity investments and project-level governance substitute each other in the context of strategic alliances. This and our findings on the complementarities between project-level governance and contractual complexity provide important insights into the two distinct

global governance mechanisms adopted by firms in their strategic R&D alliances: (1) complex contracts with high degrees of project level-governance and (2) partial equity investments with low degrees of project-level governance and less contractual complexity. Apparently, to managers, these two distinct governance mechanisms offer two alternative ways of governing strategic R&D alliances. However, our findings demonstrate that equity and project-level governance have no significant effect on alliance innovation performance. Therefore, the managers who choose the first governance option are likely to experience higher performance than the managers who choose the second governance option.

Our finding that links the alliance formation stage to the degree of project-level governance contributes to the emerging literature on the organization of inter-firm product development teams (Carson, 2007; Gerwin and Ferris, 2004; Staudenmayer, Tripsas, and Tucci, 2005) and the literature on organizing teams for the pursuit of exploitation and exploration (Jansen et al., 2009; Tiwana 2008). Consistent with these literatures, we showed that formal monitoring by alliance representatives is less necessary under circumstances which require more creative problem-solving and exploration. On the other hand, late-stage deals, characterized by exploitation, are more likely to necessitate the use of hierarchical control mechanisms at the project-level to mitigate risks of partner opportunism and effectively verify the efforts and outcomes of the partners.

The results regarding no significant effects of prior relationships on project-level governance and alliance innovation performance were in contrast with the predictions of a relational view in strategic alliances. Although previous studies point out that prior relationships can contribute to the development of inter-firm and inter-personal trust and in turn reduce the need for formal safeguarding mechanisms (Dyer and Singh, 1998; Gulati, 1995; Larson, 1992), we found that prior relationships do not eliminate the need for project-level governance. Moreover, in contrast with studies that showed the link between partner-specific experience and alliance performance (Gualti, Lavie, and Singh, 2009; Zollo. Reuer, and Singh, 2002), we could not find any significant effects of prior relationships on performance. The latter may be explained by the differences in performance measures used in studies by researchers. On the other hand, the former can be attributed to the fact that prior relationships may have a more significant effect on macro-

level governance mechanisms, such as equity and contracts, rather than micro-level governance mechanisms, such as *ex post* monitoring by alliance representatives.

Future research and extensions

Our study also offers avenues for future research. Future research may investigate the effects of project-level governance at different levels. For instance, the investigation of the relationship between alliance portfolio size and project-level governance would enable us to understand the effectiveness of project-level governance for large firms that govern a significant number of external R&D partnerships simultaneously. Firms with large portfolios can leverage their alliance representatives' expertise to a higher extent, in the sense that both partners can benefit from that expertise. As an example, formal project-level governance can help a large firm to access the knowledge of a small firm to a higher extent and apply it in its other partnerships. On the other hand, small firms can benefit from the ties of the large firm's representatives with other firms in the alliance portfolio. In this way these representatives might externally champion their projects, which result in higher reputation and legitimacy for the small partner. Social network theory and the literature on inter-firm learning can be used to explain the roles of project-level governance in external championing and inter-firm knowledge transfer.

In addition, alliance researchers may also investigate the influence of project-level governance on alliance operating teams and alliance staff from the lenses of organizational behavior theory. Project-level governance is a formal governance mechanism used to oversee the progress of alliances. The formalization of the governance of day-to-day alliance activities may cause some dysfunctions for alliance operating teams responsible for performing the day-to-day tasks of alliances. The motivation literature can inspire an examination of how project-level governance influences the motivation of the members of the operating teams of alliances.

In this paper, we aim to explain under which circumstances partner firms use their alliance representatives for contract design, contract monitoring and contract adaptation roles to govern their relationships. We tested our theory in the setting of R&D alliances of U.S.-based biotechnology firms and our findings demonstrated that project-level governance go together with contractual complexity, indirectly influencing alliance

innovation performance via an effect on contractual complexity; this governance is an alternative to equity, and is influenced by the stage at which the alliance is signed. We hope that our findings help scholars and practitioners to understand the importance of project-level governance in the realm of strategic alliances.

CHAPTER 3: MONETARY INCENTIVES AND PROJECT-LEVEL GOVERNANCE IN STARTUP-INCUMBENT STRATEGIC R&D ALLIANCES: SUBSTITUTES OR COMPLEMENTS?

ABSTRACT

Incumbents use several mechanisms to align incentives with their startup alliance partners. This paper investigates the relationship between two of these mechanisms that are understudied in the literature: performance-based monetary incentives and project-level governance. While the substitution position of classical agency theory predicts that these mechanisms are substitutes, we argue by drawing upon the complementarities position of classical agency theory and the innovation management literature that in the context of innovation alliances they are complements. We test these alternative hypotheses by using a sample of 220 R&D alliances of global pharmaceutical firms with U.S.-based biotechnology startups. We find support for our complementarities hypothesis, by showing that monetary incentives and project-level governance go hand in hand in the context of strategic R&D alliances.

3.1 INTRODUCTION

Incumbents in high-tech industries rely on R&D alliances with startups to develop new products (Garrette, Castaner, and Dussauge, 2009; Powell, Koput, and Smith-Doer, 1996, Rothaermel and Hess, 2009; Schilling and Phelps, 2007). In these alliances, aligning incentives to avoid conflicts of interests is one of the fundamental managerial challenges. The strategic alliances literature has investigated both formal and informal governance mechanisms for incentive alignment with a primary emphasis on equity investments, contracts and trust (Gulati, 1995; Gulati, Lawrence, and Puranam, 2005; Gulati and Nickerson, 2008; Gulati and Singh, 1998; Kogut, 1988; Pisano, 1990; Sampson, 2004; Poppo and Zenger, 2002; Puranam and Vanneste, 2009; Reuer and Arino, 2007; Santoro and McGill, 2005). However, the literature has paid little attention to performance-based monetary incentives offered by incumbents to startups, i.e. potential milestone payments that will be made to startups upon the successful completion of research and development milestones. Particularly, the relationship between monetary incentives and project-level governance exercised on startups by incumbents is not well known, although management scholars have investigated the relation between monetary incentives and monitoring in several other principal-agent settings. In this paper, by drawing upon two competing theoretical lenses, we investigate the relationship between these two mechanisms in the context of startup-incumbent strategic R&D alliances to develop an understanding as to whether these mechanisms serve as substitutes or complements.

Monetary incentives refer to the potential pre-commercialization milestone payments offered to a startup. Monetary incentives are contingent payments made by incumbents if a startup successfully achieves predetermined milestones. Such pay-for-performance schemes incentivize the startup to invest its best efforts into alliance projects and provides an incumbent with a means of controlling the startup's behavior. An incumbent also controls a startup's daily project activities by appointing its senior and middle-level managers to committee membership, alliance management and project management roles. As more representatives are used, the intensity of control will be higher, and in turn, a startup will be less likely to act opportunistically. We use the term *project-level governance* to define this type of monitoring-based governance.

To understand the relation between the two mechanisms we modeled a strategic R&D alliance between a startup and an incumbent as a principal-agent relationship in which the incumbent is the principals and the startup is the agent. According to the substitution position of classical agency theory, when appropriate levels of monitoring are exercised on the agent by the principal, it is less likely that the agent will diverge from the interests of the principal. In turn, there will be less need for monetary incentives to achieve incentive alignment. Hence, agency theory would predict that as the incumbent increase the intensity of project-level governance, it will be able to offer fewer monetary incentives, meaning that the two governance mechanisms are substitutes.

Nevertheless, the substitution position of agency theory overlooks several dysfunctions of formal control mechanisms. First, the startup may misrepresent its results to receive a higher portion of monetary incentives. Second, the intense control of the incumbent may create additional performance risks to the startup. Therefore, while the former will lead to greater project-level governance by incumbents, the latter will lead to the startup's request of higher monetary incentives, thereby the two mechanisms reinforce each other. Hence, by drawing upon the complementarities position of classical agency theory and the innovation management literature, we challenge the substitution position by arguing that monetary incentives and project-level governance go hand-in-hand in the context of incumbent-startup R&D alliances.

We empirically tested these competing hypotheses on a sample of 220 R&D alliances of global pharmaceutical firms with U.S.-based biotechnology firms. There is a growing interest on the phenomenon in the biotechnology industry (Mallik, Zbar and Zemmel, 2004; Van Brunt, 2008). The number of both $100 million-plus and $1 billion-plus alliances increased substantially from 1998 to 2007. The biotechnology industry did not experience a single $1 billion-plus deal until 2001. Yet, between 2001 and just before the credit crisis in September 2008, the number of $1 billion-plus deals was 25. Moreover, in these deals, on average, potential pre-commercialization milestone payments represent the most significant portion of the deal sizes (Van Brunt, 2008). Given these figures, it is important to understand the antecedents of monetary incentives. Moreover, the U.S. biotechnology industry offers an attractive setting to conduct our study. First, the prevalent use of strategic R&D alliances to develop new therapeutic solutions and the availability of

information about the alliance contracts eased our data collection efforts. Second, the professionalization of alliance management in the pharmaceutical industry has created variety in the degree of monitoring. Hence, alliances with both low and high degrees of project-level governance are observable.

In addition to its contributions to practice, this study makes several theoretical contributions. First, our study contributes to the strategic alliances literature. As data availability increases, the strategic alliances literature is beginning to explore distinct governance mechanisms. Specifically, scholars are developing finer-grained approaches that will improve our understanding of a broader set of governance mechanisms used in alliances, such as the exclusivity of licensing (Somaya, et al., 2011) and termination rights (Lerner and Malmandier, 2010). Our study extends this literature by revealing the relationship between levels of monetary incentives and monitoring. In addition, the literature generally adopts a focal-firm perspective. Yet, it has drawbacks because it provides 'a one-sided analysis of a dyadic phenomenon' (Zajac and Olsen, 1993). By using a simultaneous equation modeling approach, we conduct a two-sided analysis of alliances that demonstrates how an incumbent's project-level governance decision affects a startup's request for monetary incentives, and vice versa.

Second, our study also contributes to the technology licensing literature by demonstrating the extent to which project-level governance influences the size of monetary incentives. Prior studies in the literature predominantly focused on understanding when firms license their technologies instead of developing them in-house (Aggarwal and Hsu, 2009; Arora and Fosfuri, 2003; Fosfuri, 2006; Gans, Hsu and Stern, 2002). So far, pre-commercialization payments received relatively little attention. Sakakibara (2010) examined the antecedents of upfront payments and royalties in the context of Japanese patent licensing agreements; however, pre-commercialization performance-based payments were not in the scope of her study.

Third, our study contributes to the emerging literature on inter-firm teams, particularly on the choice of inter-firm team structures and staffing. Because of difficulties in accessing micro-level data, the studies in this literature are predominantly theoretical (Gerwin, 2004; Gerwin and Ferris, 2004). By developing a novel way of collecting micro-level alliance

staffing data through contracts, our paper sheds light on how micro-level organizational structures determine the level of monetary incentives.

Finally, by showing the conditions under which startups will require higher levels of monetary incentives, we contribute to research on entrepreneurship. The entrepreneurship research views alliances as key to the growth of entrepreneurial firms in the face of their lack of the financial resources and commercialization capabilities (Baum, Calabrese and Silverman 2000; Niosi, 2003; Powell, Koput, and Smith-Doer 1996; Stuart, 2000). However, the literature has paid little attention to research and development milestones as sources of revenue. Further, this literature has little investigated the managerial practices of incumbents that can stifle innovation in R&D alliances. Therefore, the examination of the link between monetary incentives and project-level governance fills a gap in this literature.

This paper begins by defining the study's two main constructs: monetary incentives and project-level governance. Then, we develop the two competing hypotheses. Following this, we specify the equations for monetary incentives and monitoring. We specified two equations because of potential endogeneity. In other words, we take into account the possible bi-directional relationship between monetary incentives and monitoring by specifying and simultaneously solving the two equations by three-stage least squares (3SLS) regression. Finally, we present the results of the 3SLS regression and close with a discussion of the results and implications for theory and practice.

3.2 CONCEPTUAL BACKGROUND

Incumbents and startups form strategic R&D alliances to benefit from each other's complementary resources (Teece, 1986). Startups typically lack financial resources and commercialization capabilities necessary to develop and commercialize their discoveries. On the other hand, incumbents experience difficulties in innovating because of their culture, organizational structures and path dependencies (Tushman & Anderson, 1986). Thus, incumbents can obtain access to the specialized knowledge of startups by forming R&D alliances with them (Rothaermel, 2001a).

Startup-incumbent R&D alliances typically involve a licensing and development agreement. First, partners sign a licensing agreement in which the startup grants commercialization rights of their invention/technology to the incumbent. Typically at this

stage, incumbents pay license fees and agree on the level of royalties on net sales of products that will be developed based on licensed technologies. Then, partners sign a development agreement that specifies, among other things, the responsibilities of partners, alliance governance structure, and milestones that will be paid upon successful accomplishment of discovery targets and product tests.

A development agreement specifies monetary incentives, i.e. the potential pre-commercialization milestone payments offered to startups. Milestone payments are different from upfront payments in the sense that they are not committed payments. They are typical pay-for-performance schemes that ensure startups share the development risks with their incumbent partners. Without milestone payments, a startup may not invest in the success of the alliance after the agreement is signed. Therefore, from an incumbent's perspective, monetary incentives function as an incentive alignment mechanism by influencing the extent to which a startup will invest in the success of an alliance over the long-term and ensure that a startup will not make decisions that are against its interests. Prior research also showed that when appropriate levels of monetary incentives are offered, startups are more likely to invest their time on project tasks, reveal timely and accurate information and share their know-how with their partners (Mayer and Teece, 2008).

Development agreements also specify the responsibilities of partners and the governance structures of alliances. In these alliances, startups are responsible for basic research and development activities, while incumbents are responsible for commercializing the product. Therefore, there is a clear division of responsibilities between partners. However, descriptions of alliance governance structures in the agreements provide us with evidence that incumbents tend to exercise control on the activities of startups and intervene in the startups' decisions by appointing their representatives to committee membership, alliance management and project management roles. For instance, below is an extract from the contract of the 2008 alliance between Synta and Roche. This extract clearly depicts that Roche's representatives have the rights to monitor Synta's activities, to be involved in development related decision-making and to evaluate Synta's efforts.

> Within twenty (20) Business Days after the Effective Date, ROCHE and SYNTA shall establish a joint steering committee (the "JSC") to review, coordinate and provide overall strategic direction to their activities

> pursuant to the Research Plan and any Development Plan… The JSC shall be comprised of approximately three (3) senior executives of ROCHE and three (3) senior executives of SYNTA with appropriate levels of decision making authority… The JSC shall be responsible for … (b) periodically reviewing the Research Plan and any Development Plan and suggesting or approving such amendments to the Research Plan or Development Plan as the JSC deems appropriate, including budget amendments;… (e) overseeing the JRDC and the Parties' progress in the conduct of the Research Program and in Research and Development activities hereunder…(f) approving the nomination of Licensed Compounds which have been recommended by the JRDC for advancement into Development;… (k) attempting to resolve disputes arising under this Agreement that are referred to the JSC by the JRDC or either of the Parties.

Supporting this view, prior research has discussed the monitoring and decision-making roles representatives play in controlling partner behavior. For instance, Child, Faulkner, and Tallman (2005, p. 315) mention that a firm engaged in an alliance can exercise control over its partner by appointing key personnel to alliance governance and management roles. In line with this view, prior studies have documented that firms use project managers, alliance managers and committee representatives to oversee the progress of alliance projects, and in particular, the activities of their partners (Bamford, Gomes-Casseres, and Robinson, 2003; Gerwin, 2004; Gerwin and Ferris, 2004; Kale and Singh, 2009; Mayer and Teece, 2008).

In order to make our arguments clearer, it will be useful to distinguish the monitoring roles of representatives from their decision-making roles. Monitoring involves detecting opportunistic actions of startups and evaluating the outcomes generated by them. Therefore, monitoring is important to reduce shirking and information asymmetries. However, it has a passive meaning in the sense that it does not contain the rights of representatives to engage in decision-making and conflict resolution – means by which an incumbent would be able to actively intervene in the development decisions of startups. Given the dynamism and technical uncertainties in high-tech industries, the decision-

making and conflict resolution responsibilities of an incumbent's representatives are crucial to *ex post* incentive alignment. This is because whenever a contingency arises, incumbents can influence decisions made in the committee meetings by using the voting rights of their representatives. Hence, having the full responsibility for development tasks does not mean that startups will make development decisions autonomously. The degree to which incumbents exert, through their representatives, project-level governance on startups is a key determinant of the level of autonomy the startups possess in their partnerships with incumbents.

3.3 HYPOTHESES DEVELOPMENT

Startup-incumbent R&D alliances involve agency problems because the division of labor leads to the separation of ownership and decision-making rights. More specifically, incumbents own the license for the product and are thus mainly responsible for commercialization activities; however, they have limited control over the development activities of startups. Furthermore, the transfer of the ownership makes agents more risk averse compared to principals, thus increasing the goal incongruence. As a result, moral hazard and adverse selection problems may emerge, resulting in agency problems.

The extant research provides some evidence of moral hazard and adverse selection problems in strategic alliances (Deeds and Hill, 1999). For instance, the licensing literature claims that firms have the tendency to develop more attractive products in-house and license the ones that are less attractive to other firms (Gambardella, Giuri, and Luzzi, 2007). Thus, startups might license out products which have less profit potential to incumbents. Further, startups may shirk their responsibilities (Dickson, Weaver, and Hoy, 2006). Shirking happens when a startup takes advantage of the incumbent's limited managerial control and does not devote enough effort to the alliance activities taking advantage of the incumbent's limited managerial control (Argyres and Mayer, 2007; Eisenhardt, 1989). A shirking partner may not provide enough resources in terms of necessary quantity and quality. For instance, a startup firm may not appoint any of its star scientists to the alliance project on the basis that the star scientists can be more beneficial to the firm if used in internal projects (Robinson and Stuart, 2007). Moreover, the startup may also use the research support, provided by the incumbent, for its internal projects

rather than for the alliance, a type of opportunistic behavior called cross-subsidization (Lerner and Malmendier, 2010). Alternatively, the startup may not be willing to share its know-how due to risks of losing its competitive advantage (Hamel, 1991). Insufficient knowledge sharing may result in severe negative performance outcomes for the alliance and in turn for the incumbent (Sampson, 2007). Without integrating their knowledge, the partners may develop a lower quality solution which can particularly be problematic for incumbents who possess the commercialization rights of the solution.

Agency theory addresses these issues by offering the use of monitoring and monetary incentives by principals. However, the exact relation between monitoring and monetary incentives remain a controversy. According to the substitution position of classical agency theory, monetary incentives and monitoring act as substitutes. This is because when the appropriate degree of monitoring is exercised, there is less need for monetary incentives, and vice versa (Fama and Jensen, 1983; Jensen and Meckling, 1976, Rediker and Seth; 1995; Zajac and Westphal, 1994). For instance, if an incumbent is able to exercise strict governance on its startup partner by appointing its representatives to project-level monitoring and decision-making roles, then the startup is not able to shirk, hide information, and make decisions that harm the interest of incumbents. In turn, the incumbent will face less performance risks, and in turn, will need to offer relatively less financial compensation.

In a similar way, when appropriate levels of monetary incentives are offered to startups, there will be less need for monitoring. This is because of the theory's assumption that startups are primarily motivated by financial incentives. Startups will strive to accomplish the project tasks in a way that satisfies the interests of incumbents, because doing so will guarantee the payments from the incumbents. Therefore, following the substitution position of classical agency theory, monetary incentives and project-level governance operate as substitute governance mechanisms in the context of incumbent-startup R&D alliances.

> *Hypothesis 1: There is a negative bi-directional relationship between the level of monetary incentives and the degree of project-level governance in the context of strategic R&D alliances between startups and incumbents.*

Yet, the performance risks shifted to startups because of greater project-level governance may result in an outcome different from what the substitution position predicts. This is because the substitution position focuses on minimizing the risks of principals and overlooks the performance risks of agents. Indeed, it might be the case that strict project-level governance might result in the transfer of more than necessary risks from incumbents to startups. Below, we describe the sources of these risks.

First, intense project-level governance is likely to reduce the intrinsic motivation of the startup firm. The innovation management literature has demonstrated the negative effects of control on innovation and creativity (Amabile, 1983; Carson, 2007). In line with this literature, one can expect that project-level governance negatively influences intrinsic motivation of the startup. However, the loss of intrinsic motivation must be compensated by the incumbent. One way of doing this is offering higher monetary incentives to increase the overall motivation of the startup. Therefore, greater project-level governance might result in higher monetary incentives in innovative task settings such as R&D alliances.

Second, alliance representatives of the incumbent tend to make decisions in areas that fall into the startup's specialization under strict project-level governance. As a result, the startup will lose its autonomy which will cause two problems. First, joint decision-making might result in less favorable decisions for startups. Shan, Walker, and Kogut (1994) discuss how interference by an incumbent in a startup's research agenda may reduce its innovative output. Second, because joint decision-making is slower than autonomous decision-making, startups can lose a considerable amount of time, which can influence the project's ultimate success as well as the firm's survival in dynamic environments (Eisenhardt, 1989b).

The third source of performance risk pertains to knowledge leakage hazards. Strategic alliances are mechanisms by which knowledge transfers take place between partners (Hamel, 1991; Kale and Singh, 2000; Lazzarini, Claro, and Mesquita, 2008; Mowery, Oxley, and Silverman, 1996; Tarun, Ranjay, and Nitin, 1998). Greater project-level governance allows for greater transfer of tacit knowledge between partners due to stronger integration. Hence, as the degree of project-level governance increases, a startup faces relatively higher risks in transferring its proprietary knowledge to its incumbent partner. If

an incumbent succeeds in transferring the knowledge of a startup through its representatives, the competitive advantage of the startup will erode.

Finally, as project-level governance becomes more intense, startups face higher costs of administrative complexity, which will result in higher performance risks due to a diversion of efforts from innovative tasks to administrative tasks. Prior research emphasized the administrative difficulties startups face in implementing alliances (Arino, Ragozzino, and Reuer, 2008; Mayer and Teece, 2008). These difficulties can be exacerbated under complex governance structures that demand higher degrees of professionalism and expertise in the management of alliances from startups. Complex governance structures require specialization in downstream business functions, especially when commercialization and manufacturing committees have to be formed. In addition, if the project requires the appointment of liaison personnel, such as alliance managers, then the project will require the development of alliance management capabilities. These factors will, then, cause additional effort and overhead costs to startups. Given that startups have limited resources, the use of these resources for administrative tasks of partnership will put pressure on the resources allocated for innovation. It is likely that they will transfer some of these resources for the administrative tasks, which will lead to an increase in performance risks.

Prior empirical research has emphasized the performance risks that startups face in their partnerships. Rothaermel (2001a) mentioned the importance of alliances for incumbents as a means to exploit the innovative capabilities of a startup. Particularly, startups face higher performance risks when they form highly integrated partnerships with incumbents. Also, prior research on acquisitions found evidence for negative effects of higher levels of acquirer integration on the performance of innovative partners (Puranam, Singh, and Zollo, 2006).

In summary, the higher the degree of project-level governance, the greater the chance that intrinsic motivation is eroded and innovative performance, at the startup, suffers because of the loss of autonomy, the risk of knowledge leakages, and an increase in administrative complexity. In turn, these risks function to increase the required level of monetary incentives for startups.

Finally, in line with the complementarities position of agency theory (Tosi, Katz, and Gomez-Mejia, 1997), higher monetary incentives will increase the need for control to avoid startups' misrepresentations of their results to receive milestone payments from incumbents. Hence, incumbents will require more controllers to assess the real value of solutions developed by startups which in turn increase project-level governance. Hence, not only greater project-level governance results in higher monetary incentives, but also higher monetary incentives will lead to greater project-level governance by alliance representatives of incumbents. Therefore, we hypothesize that monetary incentives and project-level governance are complements.

> *Hypothesis 2: There is a positive bi-directional relationship between the level of monetary incentives and the degree of project-level governance in the context of strategic R&D alliances between startups and incumbents.*

3.4 METHOD

The empirical setting of the study was the US biotechnology industry. The disclosure requirements of the Securities Exchange Commission (SEC) force biotechnology firms to disclose their R&D agreements with pharmaceutical firms. This is because the SEC requires a public firm to disclose its material transactions, representing 5 percent or more of a firm's revenues. Because many biotechnology firms experience difficulties in generating substantial revenues, their strategic R&D alliances, particularly those with large pharmaceutical firms, fit the definition of material transactions. Hence, deal information is widely available as compared to other high-tech industries, making the biotechnology industry an ideal setting for our study.

We primarily used the Deloitte's Recap and SEC Edgar databases for data collection. We used the Recap database to create our sample. Recap's specialization in the biotechnology industry and it is superiority in covering alliances has been recognized in the literature (Schilling, 2009). We received deal data including, potential milestone payments, upfront payments, equity investments, therapeutic areas, stage at signing, alliance formation year and technology bases. We checked the accuracy of information by analyzing annual reports and press releases of the biotechnology firms whose alliances

included into our sample. We used the SEC Edgar database to conduct an in-depth analysis of contracts. We gathered data on project-level governance and license exclusivity by downloading alliance contracts. We analyzed the 'Alliance Governance' and 'Grants of Licenses' sections of these contracts and codified all necessary information for our study. Finally, we codified firm-related information including each biotech's age, biotech's listing in the stock exchange, and pharmaceutical firm's R&D intensity from the Compustat database and other publicly available data sources.

Sample

We used several criteria for sampling. First, we included only dyadic alliances between a biotechnology and a pharmaceutical firm, because our study investigates startup-incumbent alliances. Thus, dyadic alliances between only biotechnology or only pharmaceutical firms were excluded from our sample. Second, our sample consisted only of U.S.-based biotechnology firms. Yet, the pharmaceutical firms in the sample were from the U.S., Europe and Japan. Third, we picked the period 1996-2008. We started from 1996 because strategic R&D alliances began gaining popularity in this industry starting in the late 1990s. Fourth, only contractual alliances and minority investment alliances were in the sample because project-level governance, as we described in this paper, does not take place in equity joint ventures. The creation of a new entity in joint ventures typically leads to a department-based structure in which committee membership, alliance management, and project management roles are barely observed. Further, if any of these roles exist it is not possible to gather data on the role simply by analyzing contracts. Finally, we pick alliances with relatively higher levels of technical difficulties but at the same time higher levels of market potential. We analyzed medical journals, specialized in clinical trials, to avoid including trivial development alliances. As a result, we picked alliances targeting areas with relatively low drug approval rates, including oncology, central nervous system, cardiovascular, endocrinological and metabolic, hematologic, autoimmune/ inflammatory and psychiatry. Based on these criteria, we randomly picked 220 dyadic R&D alliances.

Model identification

To test the feedback relationship between monetary incentives and project-level governance, we used the simultaneous equation modeling (SEM) approach (Wooldridge, 2002). SEM requires the identification of equations for each endogenous variable. As

monetary incentives and project-level governance are endogenous variables in the model, we need to identify two equations: (1) the monetary incentives equation, and (2) the project-level governance equation. The right-hand side of each equation consists of an endogenous independent variable (i.e. project-level governance in the monetary incentives equation and monetary incentives in the project-level governance equation), exogenous independent variables that are used only in a single equation (i.e. potential identifying variables), exogenous independent variables used in both equations, and an error term.

We use the year effects, the therapeutic areas covered by the alliance, the listing of the biotech in the stock market, the biotech's age at alliance formation, and the incumbent's R&D intensity as the identifying variables for the monetary incentives equation. The year effects account for the change in market conditions in the industry. Specifically, after the late 1990s the market shifted from a buyer's market to a seller's market (Van Brunt, 2008). This is because the increased rivalry caused by generic drug producers (Hamel and Valikangas, 2003) and increased regulations by the FDA that resulted in higher attrition rates (Kola and Landis, 2004), both of which led pharmaceutical firms to rely more on biotechnology firms to innovate. As a consequence, the bargaining power of biotechnology firms increased considerably. In turn, for biotechnology firms, the chances to close deals with relatively higher levels of monetary incentives increased considerably. Another reason for including year effects in the equation is that we can control for changes in economic conditions. For instance, the 2005-2007 period experienced a peak in megadeals due to the positive economic conditions. During this period, large firms were likely to more easily find the resources necessary to invest in alliances.

Therapeutic areas covered in an alliance can potentially influence the level of monetary incentives. The reason is, as the number of therapeutic areas increases, the level of project complexity increases, which makes development more challenging. As a result, biotechnology firms are likely to be compensated by pharmaceutical firms for the extra effort required to develop a compound for alternative therapeutic uses.

The level of monetary incentives may also depend on whether a biotechnology firm is a publicly traded or a private firm. Publicly traded firms send signals to the market through their announcements (Janney and Folta, 2003; Gulati, Lavie, and Singh, 2009). For a publicly traded firm, an alliance announcement with substantial monetary incentives is a

key signal to investors in the market because potential payments may generate revenues in the future. Therefore, publicly traded biotechnology firms will negotiate more on monetary incentives than private firms and strive to close the deal with substantial monetary incentives. The age of a biotechnology firm might also affect its bargaining power. Younger firms face the liability of newness and rely more on incumbent firms (Freeman, Carroll, and Hannan, 1983). As a result, they have less bargaining power in negotiations. However, as entrepreneurial firms age, they obtain access to alternative financial resources, build partnerships with other incumbents, and increase their legitimacy in the market. Thus, it is relatively easier for older biotechnology firms to close the deal with higher levels of monetary incentives. Finally, a pharmaceutical firm's R&D intensity may have a positive impact on the level of monetary incentives. This is because firms with higher R&D expenditures to sales ratios are likely to be more willing to invest in both internal and external R&D.

We use the level of committed payments and the stage at signing as the identifying variables for the project-level governance equation. As noted, project-level governance provides an incumbent firm with the opportunity to monitor its partner and intervene in key development decisions. Therefore, when the required degree of monitoring and intervention is high, the degree of project-level governance will also be high. The level of committed payments (i.e., the total of license fees, equity investments, research funding and reimbursement of prior R&D expenses) can influence both the required degree of monitoring and intervention. As the level of committed payments increases, the pharmaceutical firm faces a hold-up problem to a higher extent because of the irreversibility of its investments (Williamson, 1991). As a result, it will monitor the activities of the biotech to a higher extent to avoid any opportunism and intervene into the biotech's decisions to a higher extent to adjust its risks. Therefore, we expect that the higher the level of committed payments, the higher the degree of project-level governance.

Rothaermel (2001b) and Santoro and McGill (2005) showed that early stages alliances had higher uncertainty than late stage alliances. Thus, early-stage R&D alliances involve tasks that demand higher levels of creativity and problem-solving ability of biotechnology firms. This requires that the pharmaceutical firm must give more leeway. We expect,

therefore, that early-stage alliances require lower degrees of project-level governance compared to those formed at later stages.

We include exclusivity of license, equity and cross-border in both equations to control for their effects. When the license is non-exclusive, a biotechnology firm can grant the commercialization rights of the compound to other firms. That causes a hold-up problem for the pharmaceutical firm (Somaya et al., 2011; Williamson, 1991). As a result, the pharmaceutical firm will monitor the activities of the biotech to a higher extent to avoid any opportunism and intervene in the biotech's decisions to a higher extent to adjust its risks. Therefore, we expect that non-exclusivity leads to higher degrees of project-level governance. Further, as biotechnology firms will face fewer performance risks under a nonexclusive license agreement, the level of monetary incentives will be lower. Hence, non-exclusivity is likely to have a negative impact on the level of monetary incentives. A minority investment alliance is more effective in aligning the incentives of partners than a non-equity contractual alliance (Gulati and Singh, 1998, Pisano 1989). Therefore, we expect that the presence of equity investment will reduce the degrees of project-level governance and the level of monetary incentives. In addition, cross-border alliances may cause higher monitoring requirements for a pharmaceutical firm because of the unfamiliarity with the partner's way of doing business. Therefore, cross-border alliances are likely to have higher degrees of project-level governance. Moreover, the pharmaceutical firm needs to incentivize a cross-border partner more than a local partner, because approaching a cross-border partner signals that in its own region there are a limited number of available partners. In negotiations, the biotechnology firm may take advantage of this situation and demand higher levels of monetary incentives. Finally, biotechnology firms typically deploy a mixed set of technologies to develop products. These technologies represent scientific techniques and tools utilized to develop products. To control for their effects on monetary incentives and monitoring, we also included them in both equations. Therefore, we define the following two equations:

$$\begin{aligned} monetary\_incentives = {} & \alpha_{10} + \gamma_{12}\, project\text{-}level\_governance + \beta_{11}\, year\_effects + \\ & \beta_{12}\, therapeutic\_areas + \beta_{13}\, public + \beta_{14}\, biotech\ age + \\ & \beta_{15}\, pharma\_R\&D\_\ intensity + \beta_{16}\, exclusivity + \beta_{17}\, equity + \\ & \beta_{18}\, cross\text{-}border + \beta_{19}\, technologies + \varepsilon_1 \end{aligned} \quad (1)$$

$$project\text{-}level\_governance = \alpha_{10} + \gamma_{21}\ monetary\_incentives + \beta_{21}\ committed\_payments + \beta_{22}\ stage\_at\_signing + \beta_{23}\ exclusivity + \beta_{24}\ equity + \beta_{25}\ cross\text{-}border + \beta_{26}\ technologies + \varepsilon_2 \quad (2)$$

Endogenous variables

Monetary incentives

Monetary incentives refers to the total dollar value of the deal, that is the sum of research and development milestone payments offered to a biotech by its pharmaceutical partner. These are potential payments that will be made when the biotech firm achieves the specific milestones defined in the agreement. Given its evident right skewed distribution, we use the natural logarithm in our estimations. We also control for the effects of inflation. We created inflation-adjusted values by taking 1996 as the base year.

Project-level governance

This variable captures whether senior and middle-level managers of a pharmaceutical firm were appointed to committee membership, alliance management and project management roles. As we mentioned, we obtained scores for this variable by reading the 'alliance governance' sections of agreements. These sections describe in detail which joint committees were formed and whether liaison personnel such as project and alliance managers were appointed.

Under the monitoring of joint steering committees, specialized joint functional committees exist. We considered joint functional committees in two separate groups. The first group, core joint functional committees, includes those associated with either a core upstream or downstream alliance activity. Joint research, development, commercialization, and manufacturing committees constitute the fundamental upstream and downstream functional committees formed in alliances between biotechnology and pharmaceutical firms. The second group, peripheral joint functional committees, involves committees responsible for activities pertaining to either finance or intellectual property rights. We call them peripheral because of their limited monitoring and decision-making rights. Typically, they provide input to decisions made by the core committees. For instance, joint patent committees assist research committees in specifying how a novel technology developed in

the partnership can be protected and how the patent ownership will be handled. Similarly, joint finance committees assist joint research teams to control the costs of research activities or to assist commercialization committees in preparing a budget for co-promotion activities.

As a result of distinguishing core joint committees from peripheral ones, we ended up with four dimensions of project team structure: (1) core joint functional committees, (2) peripheral joint functional committees, (3) liaison personnel, and (4) steering committees. Parallel to the measurements used in prior studies, a weight was assigned to each of these dimensions based on their governance complexities (Kumar and Seth, 1998). A rank of 1 was assigned to 'peripheral joint functional committees', 2 to 'project and alliance managers', 3 to 'steering committees', and 4 to 'core joint functional committees'. Then, the sum of the scores of each dimension divided by 24[2], the maximum score that can be attained, was taken to obtain the score for the degree of project-level governance. We assigned the highest weight to joint functional committees because through these committees an incumbent exerts the most intense monitoring to its partner in a particular functional domain. Furthermore, these committees are the first line of defense in resolving conflicts that arise in the alliance. The steering committees resolve conflicts that cannot be solved at joint functional committees; they also have less chance to observe project activities as compared to joint committees. Hence, joint steering committees received a lower weight than joint functional committees. Liaison personnel have rights to participate committee meetings, however they may not have decision-making rights, or they represent a single vote in decisions. They are mainly responsible for providing healthy communication between partners. Therefore, they received the weight of two.

Exogenous variables

For year effects, we included 13 dummies for each year. We used the year 2008 as the base category. *Therapeutic areas* is a measure of the technical scope of an alliance. It captures the total number of therapeutic areas covered within the alliance agreement. For instance, if an alliance's therapeutic area covers only two indications in total (e.g. cancer and central

[2] This is the maximum score obtained when governance consists of a joint peripheral committee, project managers, alliance managers, a steering committee, and joint research, development, commercialization, and manufacturing committees.

nervous system) this variable receives a value of 2. The variable *Public* is a dummy, coded as 1 if the biotechnology firm is publicly traded. The variable *Biotech's age* is the difference between the alliance formation year and the biotech's foundation year. The variable *Pharma's R&D intensity* is the ratio of R&D expenditures to turnover.

Following Santoro and McGill (2005), we included three dummy variables that represent the stages of drug development: *Early research* (i.e. formulation, discovery, lead molecule, pre-clinical), *Early clinical* (i.e. phase I, phase II), and *Late clinical* (i.e. phase III, BLA/NDA filed, and approved). We picked *Late clinical* as the base category. *Committed payments* measure pharmaceutical firm's upfront irreversible payments; this involves license fees, equity investments, research funding, reimbursement of prior research expenses. Like monetary incentives, we use the natural logarithm of the variable and its inflation adjusted values by picking 1996 as the base year.

We captured license exclusivity by an ordinal scale, 0 if the license is non-exclusive, 1 if it is co-exclusive, 2 if it is exclusive. We included the *Equity* dummy, 1 if there is an equity investment by the incumbent and 0 otherwise. The variable *Cross-border* measures the nationality differences between partners. We coded it as 1 if the partnership is cross-border, and 0 otherwise. The variable *Technologies* measures the total number of different technologies used by the biotech to develop solutions.

3.5 RESULTS

Tables 3.1 and 3.2 illustrate the descriptive statistics and Pearson correlations, respectively. We use 3SLS regression to estimate the simultaneous equation model (Wooldridge, 2002). Table 3.3 presents the results of the 3SLS regression. We report unstandardized coefficients, and standard errors for each variable, respectively.

Contrary to the predictions of Hypothesis 1, the coefficient for project-level governance is not negative in the monetary incentives equation and the coefficient for monetary incentives is not negative in the project-level governance equation. Hence, Hypothesis 1 is not supported.

Table 3. 1 Descriptive statistics of variables in the project-level governance-monetary incentives model

Variable	Mean/Freqs	St. Dev.	Variable	Mean/Freqs	St. Dev.
Ln (Monetary incentives)	4.36	1.44	1998	0.07	-
Project-level governance	0.35	0.18	1999	0.12	-
Therapeutic areas	1.43	0.83	2000	0.10	-
Public	0.70	0.46	2001	0.06	-
Biotech's age	10.83	6.61	2002	0.07	-
Pharma's R&D intensity	0.14	0.57	2003	0.06	-
Ln (Committed payments)	2.79	1.19	2004	0.06	-
Exclusivity	1.79	0.49	2005	0.08	-
Equity	0.36	0.48	2006	0.11	-
Cross-border	0.60	0.49	2007	0.12	-
Technologies	1.41	0.69	2008	0.07	-
Early Research	0.65	-			
Early clinical	0.20	-			
Late Research	0.16	-			
1996	0.04	-			
1997	0.02	-			

Table 3. 2 Pearson correlations between variables in the project-level governance-monetary incentives model

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Ln (Monetary Incentives)	1										
2. Project-level governance	.378**	1									
3. Therapeutic areas	.173*	-.012	1								
4. Public	.081	.107	-.003	1							
5. Biotech's age	.144*	.085	-.063	.373**	1						
6. Pharma's R&D intensity	.126	.178**	.087	.107	.148*	1					
7. Ln (Committed payments)	.499**	.373**	-.016	.287**	.207**	.240**	1				
8. License exclusivity	-.033	-.160*	-.218**	-.094	.136*	-.025	-.077	1			
9. Equity	-.059	.016	.203**	-.172*	-.227**	.089	-.041	-.129	1		
10. Cross-border	.053	.030	.137*	.006	-.015	-.007	.048	-.004	-.054	1	
11. Technologies	-.037	-.026	.097	-.162*	-.198**	-.100	-.084	-.013	.146*	-.068	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed)

On the other hand, as predicted in Hypothesis 2, there is a positive significant bi-directional relationship between monetary incentives and project-level governance. The coefficient for project-level governance is positive and statistically significant in the monetary incentives equation ($p < 0.001$) and the coefficient for monetary incentives is positive and statistically significant in the project-level governance equation ($p < 0.05$). These results reveal the complementarities between monetary incentives and project-level governance. Regarding the interpretation of effect sizes, an average increase in project-level governance corresponding to 0.35 units, i.e., close to the value when two functional committees are formed, lead to 2.14 times higher monetary incentives offered to startups. On the other hand, one percent increase in monetary incentives increases the degree of project-level governance by 0.03 units.

In the monetary incentives equation, consistent with our predictions, the formation year of an alliance has an impact on the level of monetary incentives. The coefficients for dummies for the alliance formation years 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, and 2004 are negative and statistically significant in the monetary incentives equation ($p < 0.05$, $p < 0.05$, $p < 0.05$, $p < 0.05$, $p < 0.001$, $p < 0.001$, $p < 0.01$ $p < 0.10$, $p < 0.10$). This result suggests that year effects is a significant determinant of monetary incentives. It is apparent that, after 2004, the favorable market conditions, combined with the demand of pharmaceutical firms to expand their R&D pipelines, resulted in relatively higher levels of monetary incentives. Another factor that has an impact on the size of monetary incentives is the number of therapeutic areas. The coefficient for therapeutic areas is positive and statically significant ($p < 0.001$) -- expanding the scope of the alliance, by adding another therapeutic area, increases the level of monetary incentives by 29%.

Regarding other results, the coefficient for committed payments is positive and statistically significant in the project-level governance equation ($p < 0.001$). This corroborates the argument that as pharmaceutical firms' upfront or irreversible investments increase, they employ more intense governance to avoid partner opportunism. Finally, the coefficient for exclusivity is positive and statistically significant in the project-level governance equation. This supports the idea that exclusivity mitigates opportunism risks (Somaya et al., 2011), and in turn reduces the need for project-level governance.

Table 3. 3 Estimation results for the project-level governance and monetary incentives model

Variables	PLG Equation	Monetary Incentives Equation
Endogenous variables		
Ln (Monetary incentives)	0.03*	-
	(0.01)	
Project-level governance	-	6.48***
		(1.33)
Equation-specific exogenous variables		
1996	-	-1.74**
		(0.51)
1997	-	-1.60**
		(0.58)
1998	-	-1.30**
		(0.45)
1999	-	-1.15**
		(0.41)
2000	-	-1.59***
		(0.37)
2001	-	-1.26***
		(0.35)
2002	-	-0.73*
		(0.32)
2003	-	-0.65+
		(0.34)
2004	-	-0.63+
		(0.34)
2005	-	-0.15
		(0.30)
2006	-	-0.30
		(0.29)
2007	-	0.04
		(0.28)

Therapeutic areas	-	0.29***
		(0.08)
Public	-	-0.22
		(0.14)
Biotech's age	-	-0.01
		(0.01)
Pharma's R&D intensity	-	-0.52
		(1.13)
Early research	-0.01	-
	(0.02)	
Early clinical	0.01	-
	(0.02)	
Ln (Committed payments)	0.05***	-
	(0.01)	
Common exogenous variables		
License exclusivity	-0.004+	0.26
	(0.02)	(0.20)
Equity	-0.03	-0.12
	(0.03)	(0.19)
Crossborder	-0.003	-0.06
	(0.02)	(0.19)
Technologies	0.002	-0.06
	(0.02)	(0.13)
Constant	0.15*	2.39**
	(0.06)	(0.88)
X square	83.43	176.80
Prob > χ square	0.000	0.000
N	220	220

3.6 DISCUSSION

While prior research on the governance of strategic alliances has extensively covered the antecedents and outcomes of various formal and informal governance mechanisms, little attention has been paid to monetary incentives as a governance mechanism used by partners to align their incentives. Hence, we were motivated by the dearth of research on monetary incentives and study its antecedents and outcomes in the context of startup-incumbent strategic R&D alliances. We suggested that there is an interplay between the level of monetary incentives offered to startups and the degree of project-level governance exercised on startups by incumbents. To improve our understanding of the direction of the relationship between these governance mechanisms, we contrasted two competing perspectives, one derived from the substitution position of classical agency theory, and the other derived from the integration of the complementarities position of classical agency theory and the literature on innovation management. Our findings reveal that monetary incentives and project-level governance function as complements rather than substitutes, thus conforming the latter view.

By contrasting the substitution and complementarities views, we also had the opportunity to understand the extent to which incumbents choose between alternative project-level governance mechanisms and the extent to which startups are primarily motivated by financial rewards. The findings showed that generous compensation and intense governance go hand in hand. The use of project-level governance as a mechanism to monitor startups and intervene in their development decisions explains why these two mechanisms act as complements. For incumbents, the upside of exercising strict project-level governance is a reduction in risks, but the downside is a decline of intrinsic motivations and the innovative performance of startups. Incumbents need to use additional monetary incentives to compensate for the decline of both factors.

By distinguishing licensing from the development process, we found significant effects of committed payments and license exclusivity on project-level governance. Both committed payments and non-exclusive licenses cause hold-up problems in partnerships which require the incumbents' monitoring of and involvement in decision-making processes during development to mitigate partner opportunism concerns.

This study provides several theoretically and empirically imported contributions to the literature. The extant literature on strategic alliances has extensively focused on equity vs. non-equity governance choices. However, the presence of equity investments is related to the structure of monetary incentives and does not reflect the magnitude of monetary incentives. To the best of our knowledge, this study is the first to investigate the magnitude of monetary incentives in the context of strategic R&D alliances. Alliance governance scholars have recently started to delve into different safeguarding mechanism such as termination rights and exclusivity. For instance, Somaya et al. (2011) showed that exclusivity of licensing agreements provides safeguarding to licensee's investments. Further, Lerner and Malmandier (2010) showed the incentive alignment function of termination rights in controlling partner opportunism. By introducing monetary incentives and project-level governance constructs, and showing the complementarity between them, we extended the literature on formal alliance governance mechanisms one step further. Finally, we develop measures for monetary incentives and project-level governance. We distinguish milestone payments from upfront committed payments in a manner that allows us to build a better understanding of the differential effects of committed payments and performance-based payments on project-level governance. We also take into account the different roles appointed to alliance representatives and develop a finer-grained approach to examine the day-to-day monitoring and decision-making processes in alliances.

Our study also contributes to the literature on the micro-level governance of alliances. Recent studies have suggested that micro-level governance is crucial to monitoring, coordination and adaptation in alliances (Gerwin, 2004; Gerwin and Ferris, 2004; Kale and Singh, 2009; Tiwana, 2008). However, prior research on micro-level governance mechanisms has treated project-level governance in isolation, and paid little attention to its interplay with global governance mechanisms such as monetary incentives. We filled this gap by showing on a sample of 220 strategic R&D alliances that micro-level governance and macro-level governance are interrelated.

By showing the complementarities between project-level governance and monetary incentives in the context of strategic R&D alliances, we contributed to debate over whether these mechanisms complement or substitute each other. Our findings extended the previous agency theory research which showed the complementarities between the two

mechanisms particularly in the context of corporate governance (Hoskisson, Castleton, and Withers, 2009; Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997). In addition, our findings have implications for transaction cost economics theory (TCE). TCE theory predicts the positive effects of monetary incentives on project-level governance because the theory suggest that complex contractual agreements that involve pay-for-performance schemes lead to higher *ex post* transaction costs because of higher verification needs (Barthélemy and Quélin 2006, Williamson, 1991). However, the theory pays little attention to project-level governance's influence on monetary incentives thus limitedly captures the overall transaction costs. In the terminology of TCE, project-level governance is the main constituent of *ex post* transaction costs for the controlling party. However, in strategic alliances partners know also *ex ante* the extent of control their counterparts exercise on them. Indeed, it is formalized in the contractual agreement. Therefore, the party that is under control can try to minimize the negative effects of *ex post* control in negotiation by increasing the required performance-based payment. Consequently, *ex post* transaction costs can become even higher for the controlling party. Hence, project-level governance not only increases *ex post* transaction costs directly but also indirectly through its effect on monetary incentives.

Our study has contributions to the entrepreneurship literature as well. The literature has found that the formal management practices of firms can stifle innovation in alliance (Carson et al., 2003; Carson, 2007; Dhanaraj and Parkhe, 2006; Dyer and Singh 1998), M&A (Puranam, Singh, and Zollo, 2006), and corporate venture capital (Dushnitsky and Lenox, 2005; Dushnitsky and Shaver, 2009) settings. The findings of this study reveal a mechanism that can help startups adjust their risks when they face strict governance: requesting higher monetary incentives. In this vein, we explained why it is plausible for startups to request higher levels of monetary incentives when they encounter intense project-level governance from their incumbent partners. Future research should address alternative ways by which startups can minimize the performance risks and complexity costs in their R&D partnerships. A viable option is to diversify alliance portfolios by forming alliances with not-for-profit entities. For instance, startups can form partnerships with research institutes, and governmental and nongovernmental organizations; entities that would exert relatively less governance on the startup. Even though these partnerships

do not reward huge milestone payments and do not help much in commercialization, more autonomy and a lower risk of knowledge leakage can help startups survive their infancy. They can also search alternative partners for the commercialization of their technologies. For instance, in the biotechnology industry, the biotechnology startups can collaborate with other biotechnology firms that have already established downstream capabilities in the market. Alternatively, startups may choose to integrate downstream to reduce their dependency on incumbents.

One may ask the question whether it is possible to break the positive feedback loop between the two formal governance mechanisms. Such a strategy may be exemplified by a setting in which the startup believes that the incumbent's actions are fair and in compliance with its justice perceptions, both during the negotiation and implementation stages of the alliance. In such a situation, the startup may agree on a relatively low level of monetary incentives. Future research might serve to benefit from the literature on justice in strategic alliances and behavioral agency theory to determine the boundary conditions for the complementary relationships revealed in this study.

Another important question is: How should these governance mechanisms be used to increase alliance performance? Do they crowd out or leverage each other in influencing different dimensions of alliance performance including innovativeness, stability and commercial success? Future research should seek answers to these questions. Furthermore, to what extent do misalignment of incentives create conflicts? For instance, a startup firm strictly controlled by an incumbent can create conflicts in the partnership if an appropriate level of monetary incentives are not provided. Future research should investigate the relationship between the emergence of conflicts and the match between the monetary incentives and project-level governance.

Managerial implications

There are two important managerial implications in our study, one for incumbents and the other for startups. Our suggestion to the senior managers and deal-making teams of large incumbents is that they must take into account the compensation that will be asked by the startups who put a price tag on the governance exercised on them. Typical calculations of alliance governance costs solely focus on the time spent by project/alliance managers and key executives appointed to the partnerships. Our study reveals an additional cost item

awaiting incumbents in these alliances. Therefore, without taking the impact of their governance structure into consideration, they can miscalculate the costs and benefits of control in these alliances.

On the other hand, our suggestion to founders and relationship managers of startups is that they must ask for compensation if they believe the incumbent will intervene into their research agendas, because these interventions can significantly increase the development costs, development time and amount of rework. Therefore, without any compensation, they put the future of their alliances as well as their enterprises in risk.

We began this research with the goal of revealing what determines the size of performance-based monetary incentives offered to startups in their R&D alliances with incumbents. We hope that our findings can help the managers of startups and incumbents who devote their time to the management and governance of these partnerships. Our findings should make it clear that the size of monetary incentives significantly depend upon the degree of project-level governance exercised over the startups that engage in these partnerships by the controllers of incumbents.

CHAPTER 4: PERFORMANCE IMPACTS OF PROJECT-LEVEL GOVERNANCE AND MONETARY INCENTIVES

ABSTRACT

We examine how the *ex post* monitoring of a startup's activities by the incumbent and *ex ante* performance-based contingent pay influences the innovation performance of startup-incumbent R&D alliances and the startup's abnormal stock market returns following the announcement of these alliances. By contrasting the complementarities view in the classic agency model with behavioral agency theory, we develop two alternative hypotheses. First, drawing upon the complementarities view in agency theory, we hypothesize that project-level governance and monetary incentives complement each other in enhancing alliance innovation performance. Second, building on behavioral agency theory, we alternatively propose that project-level governance, encouraged in part by monetary incentives, has a negative impact on innovation performance, because it increases the startup's and incumbent's risk aversion, and thus negatively influences innovation. Hence, the two mechanisms neutralize, instead of complement, each other in explaining performance. Finally, we argue that the two governance mechanisms neutralize each other in explaining the startup's value creation because of the project-level governance's negative and the monetary incentives' positive impact on the startup's private benefits. We test our hypotheses on a sample of 220 strategic alliances between global pharmaceutical firms and U.S.-based biotechnology firms. We found that higher monetary incentives, encouraged in part by greater project-level governance, increase alliance innovation performance and a startup's abnormal market return. Nonetheless, greater project-level governance, encouraged in part by higher monetary incentives, has a negative impact on the innovation performance of alliances and has no significant effect on a startup's abnormal market return.

4.1 INTRODUCTION

Strategic R&D alliances between startups and incumbents are pervasive (Cyr, 2001; Kalaignanam, Shankar, and Varadarajan; 2007). In these alliances, incumbents employ two fundamental governance mechanisms to align their incentives with the incentives of their partners. First, project-level governance, i.e., the *ex-post* monitoring of the startup's activities by the incumbent's alliance representatives, such as committee members, alliance managers, and project managers, is used to control the behavior of startups. Second, incumbents rely on *ex ante* pay-for-performance schemes to incentivize startups to invest in the future success of R&D alliances.

Although considerable research has been devoted to the performance implications of different alliance governance mechanisms such as the presence of equity investments (Das and Teng, 1996; Pangarkar, 2003; Sampson, 2004; Sampson, 2007), the allocation of ownership (Beamish and Inkpen, 1995; Chung and Beamish, 2010; Yan and Gray, 1994) and control rights (Lerner, Shane, and Tsai, 2003) and the complexity of contractual agreements (Luo, 2002; Poppo and Zenger, 2002), very little is known about the performance effects of the two underemphasized mechanisms: project-level governance and performance-based monetary incentives. Of particular interest is the impact of these mechanisms on alliance innovation performance and a startup's abnormal market returns. Given the key roles that these formal governance mechanisms play in aligning interests between partners, our aim, in this paper, is to show the extent to which these two mechanisms can influence alliance-level performance and firm-level performance.

The literature on strategic alliances highlights the poor governance choices as one of the reasons for the low success rates of alliances. Previous studies found that the misalignment of governance with transaction characteristics results in low alliance (Hoetker and Mellewigt, 2009) and firm performance (Sampson, 2004). While these studies demonstrated that alliance and firm performance vary depending on governance choices, they treat each governance mechanism in isolation by overlooking the fact that alliances involve the simultaneous use of multiple governance mechanisms which influence each other as well as the performance outcomes through their interaction.

Nevertheless, there is growing interest in examining the interactive effects of formal and informal governance mechanisms on alliance performance. For instance, Poppo and

Zenger (2002) and Luo (2002) found that trust and contracts complement each other in enhancing the performance of buyer-supplier relationships and international joint ventures, respectively. Likewise, Agarwal, Croson and Mahoney (2009) demonstrated in an experimental setting that the formal payoff structure of an alliance and informal communication between partners complement each other in explaining alliance performance. Although this stream of literature extensively studied the interplay between formal and informal governance mechanisms, it neglected to consider the potential interactive effects of different formal governance mechanisms on alliance performance. Hence, we know little about how the interactive effects of project-level governance and performance-based monetary incentives influence performance.

The stream of the strategic alliances literature on the relation between alliances and firm performance has been limited to studies that investigate the effects of firm-level and alliance-level factors on firm-level performance measures. These studies used event study methodology in order to reveal when a firm enjoys greater than abnormal stock returns following its alliance announcement and thus creates more value in its alliance (Gulati, Lavie, and Singh, 2009; Kale, Dyer, and Singh, 2002). For instance, Koh and Venkatraman (1991) and McConnell and Nantell (1995) showed that joint venture formation has a positive effect on abnormal stock returns. Likewise, Chung, Kofrod and Lee (1993) found that international joint ventures create value for firms. Das, Sen and Sengupta (1998) found that technology alliances create more value than marketing alliances. Anand and Khanna (2000) and Kale, Dyer, and Singh (2002) demonstrated the positive effects of alliance capabilities on abnormal stock returns following alliance announcements. Similarly, Kalaignanam, Shakar, and Varadarajan (2007) focused on firm and alliance-level factors that explain the differences in short-term changes in shareholder values of small and large established firms following the announcements of new product development alliances. However, all of these studies paid little attention to the relationship between governance choices and a firm's abnormal stock returns following alliance announcements. For example, little is known about whether higher monetary incentives would result in higher abnormal stock returns for startup firms. Likewise, there is a limited understanding of the link between the intensity of project-level governance exercised by an incumbent and a startup's abnormal stock returns following the announcement of the alliance.

The factors that influence the performance of inter-organizational new product development projects are central to the innovation management literature. This literature primarily focuses on the negative effects of control on innovation and creativity, by drawing upon the findings of previous studies conducted in a single firm product development setting (Amabile 1983, Andrews and Smith, 1996; Thompson, 1965; Zaltman, Duncan, and Holbek, 1973). For instance, Carson (2007) used the control theories of innovation in the setting of outsourced development projects and revealed negative effects of control on the supplier's innovation performance. This literature, however, generally does not take into account the relation between monitoring and monetary incentives, i.e., the reciprocal effects between the two. This can be problematic, particularly if complementarities exist, because monetary incentives offered to startups can compensate for the downsides of control. Furthermore, previous studies have been restricted to the relation between control and partnership performance while overlooking the effects of control on firm-level performance, particularly on the performance of the innovative partner.

Agency theory provides useful insights into the performance impacts of monitoring and monetary incentives in principal-agent relationships characterized by the separation of ownership and control. In startup-incumbent R&D alliances, startups represent agents and incumbents represent principals. Because incumbents license the development and commercialization rights of the technologies developed by startups, their interests are aligned with alliance performance. Yet, the transfer of the rights to incumbents makes startups less concerned about the market success, causing goal incongruence. In other words, startups become more risk-averse than incumbents. Furthermore, the licensing agreement makes incumbents depend on startups' early stage research and development decisions and efforts; activities that are beyond the incumbents' control (Deeds, 1999; Gopalakrishnan, Scillitoe, and Santoro, 2008).

Classical agency theory suggests that in settings where agents and principals have divergent interests, principals need to rely on monitoring and monetary incentives to protect their interests (Eisenhardt, 1989; Fama and Jensen, 1983). Specifically, principals employ monitoring and monetary incentives simultaneously to minimize their output measurement errors in settings that involve high environmental dynamism and ambiguity

(Milgrom and Roberts, 1992; Rutherford, Buchholtz, and Brown, 2007; Shapira, 2000). The proponents of the complementarities view, therefore, argue that these two governance mechanisms complement each other for enhancing performance in uncertain and ambiguous settings such as collaborative R&D. However, there still remains controversy over whether the combination of these two mechanisms generate higher performance (Hoskisson, Castleton, and Withers, 2009; Rutherford, Buchholtz, and Brown, 2007). In this paper, by drawing upon the behavioral agency theory model (Wiseman and Gomez-Mejia, 1998), we develop an alternative hypothesis to challenge the complementarities view in the context of strategic R&D alliances. We argue that although there is a positive reciprocal relation between project-level governance and monetary incentives (as we showed in the previous chapter), the two mechanisms reveal opposite effects on performance, i.e. project-level governance has negative effects and monetary incentives have positive effects, resulting in the partial satisfaction of the complementarities conditions. Furthermore, by concentrating on the relationship between the startups' private benefits and the two governance mechanisms, we propose that the same will also be true for their impacts on startups' performance.

4.2 THEORETICAL BACKGROUND

Agency theory and startup-incumbent strategic R&D alliances

Strategic alliances are long-term collaborations between two or more firms during which they share their resources, knowledge and capabilities to create value and competitive advantage (Gulati and Singh, 1998; Spekman et al, 1998). Joint R&D alliances between startups and incumbents represent one pervasively observed type of alliance, in which startups grant the commercialization licenses of their technologies to incumbents and cooperate with them on the development and commercialization of the products pertaining to the licensed technologies. As a consequence of these license grants, ownership is separated from control in these alliances. Therefore, although incumbents have market ownership of the product associated with the license, the successful launch of the product depends highly on the decisions made by startups during the research and development stages. In fact, early stage research and development decisions are typically made by startups, because they have the necessary knowledge and expertise to make effective decisions as inventors of scientific outputs. As a result, although market ownership belongs to the incumbents, they are less capable of controlling R&D decisions.

This separation of ownership from control causes two generic problems for principals, as described by agency theory. The first problem, moral hazard, is defined as the tendency of agents to shirk their responsibilities, not invest the necessary efforts in the alliances, and act opportunistically (Deeds, 1999; Pratt & Zeckhauser, 1985). For example, a startup may prefer not to assign its best personnel to the alliance. Alternatively, it may not share its proprietary knowledge with the partner and in turn cause difficulties to its partner especially at the late-stages of development. The second problem, adverse selection, refers to the principals' inability to verify the information that agents provide (Pratt & Zeckhauser, 1985; Rutherford, Buchholtz, and Brown, 2007). This is a particularly important issue in the context of R&D alliances because of the high degree of technical novelty involved. This high degree of novelty can make assessments on the quality of the startups' outputs difficult for incumbents.

Agency theory offers two solutions to principals in order to mitigate agency problems stemming from moral hazard and adverse selection. First, principals can rely on monitoring to a higher extent in order to collect more information about agents. The

increase in monitoring will result in a decrease in information asymmetries and a better verification of agents' efforts. Furthermore, agents will act less opportunistically because of the increased monitoring they face. Finally, strict levels of monitoring to prevent the opportunistic behavior of agents might also limit the agent's decision making authority, causing a higher degree of interest alignment. In the context of strategic R&D alliances, the alliance representatives of incumbents appointed to project manager, alliance manager, and committee membership roles in order to carry out day-to-day task monitoring. Each of these representatives has the responsibility to monitor the alliance's progress. Committee membership roles are designated to facilitate the incumbents' review of startups' deliverables. The committee members have formal decision-making authority allowing them to make key go-no-go decisions and resolve conflicts between partners. Overall, we define this type of operational, day-to-day monitoring and control by the representatives of incumbents as project-level governance – the greater the use of these formal alliance representative roles, the more intense the project-level governance.

In addition to monitoring, principals may employ performance-based incentive mechanisms in order align their incentives with the agents' incentives. In the context of strategic R&D alliances, incumbents rely extensively on milestone-based incentive schemes designed to reward startups when they reach certain milestones such as prototype designs, development tests, and product launches (Davida, Foster, and Li, 2009).

Although agency theory suggests the use of monitoring and monetary incentives to mitigate agency problems, research on the exact relationship between monitoring and monetary incentives provides mixed results. Specifically, while some empirical studies in the corporate governance setting showed that they complement each other (Hoskisson, Castleton, and Withers, 2009; Milgrom and Roberts, 1992; Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997), others found that they substitute each other (Rediker and Seth, 1995; Zajac and Westphal, 1994). In the context of strategic R&D alliances between startups and incumbents, we demonstrated, in the previous chapter, that these mechanisms complement each other. The reason that higher monetary incentives lead to greater project-level governance is due to the incumbents' increased need to effectively evaluate the performance of startups; performance that is tied to their compensation. On

the other hand, startups require higher monetary incentives because greater project-level governance by incumbents increases their performance risks.

Alliance performance implications of project-level governance and monetary incentives

Agency theory focuses on the maximization of the principals' interests. In a strategic R&D alliance, the main interest of an incumbent, i.e. the principal, is to own a marketable product at the end of the alliance. Project-level governance helps incumbents achieve this goal by minimizing any self-serving and opportunistic behavior of startups. Facing strict governance, a startup is less likely to behave against the interests of its partner.

Strict governance, however, may result in negative consequences. For instance, project-level governance may limit a startup's ability to apply its expertise because of the intervention of the incumbent's representatives in their R&D decisions. In addition, startups may lose their intrinsic motivation to contribute to the alliance. Previous studies contend that scientists and engineers in entrepreneurial firms must have fun in performing their tasks in order to develop creative and innovative solutions (Gottschalg and Zollo, 2007; Ness, 2009). Hence, control might negatively influence the intrinsic motivation of a startup firm, which in turn decreases alliance innovation performance. Yet, these negative consequences of strict governance can be mitigated by monetary incentives. Increasing the magnitude of monetary incentives may increase a startup's willingness to contribute its expertise to the alliance by balancing its interests with its partner's interests. Furthermore, monetary rewards may compensate for the loss of intrinsic motivation due to the over-control. Hence, monetary incentives help incumbents effectively implement project-level governance and in turn achieve benefits rather than losses from strict governance.

It may also be the case that project-level governance helps incumbents effectively implement pay-for-performance type monetary incentives. When the proportion of compensation tied to performance increases, agents have tendency to misrepresent the results of their efforts (Holthausen and Leftwich, 1983; Hunt 1986). Therefore, principals require greater monitoring to measure the performance of agents with less error (Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997). For example, it is less likely that startups misrepresent their results to earn milestone payments when strict project-level governance is exercised on them. In that sense, project-level

governance curbs problems that may arise in the implementation of pay-for performance schemes by improving an incumbent's ability to verify the outcomes of its startup partner. Therefore, the combination of project-level governance and monetary incentives should generate higher alliance innovation performance than either control mechanism in isolation.

> *Hypothesis 1: Project-level governance and monetary incentives complement each other in explaining alliance innovation performance.*

The complementarities view of classical agency theory predicts that greater project-level governance by incumbents, encouraged in part by higher monetary incentives, increases alliance innovation performance. This is because incumbents use project-level governance to ensure that they reward their partners with minimum error. Such a conclusion requires the assumption that alliance representatives can without any biases accurately assess the efforts and outputs of startups. Behavioral agency theory differs from the complementarities view of classical agency theory in this assumption. According to behavioral agency theorists, the controllers of principals typically do not utilize accurate and unbiased information about the agent's efforts (Walsh and Seward, 1990; Wiseman and Gomez-Mejia, 1998). Furthermore, they argue that performance appraisals will be influenced by the backgrounds of evaluators, thus controllers with diverse backgrounds will have different opinions on the performance of a startup, which in turn makes reaching a consensus riskier (Wiseman and Gomez-Mejia, 1998). Therefore, as project-level governance increases, startups bear higher risks.

When startups bear higher risks, they will be less willing to take risks. Knowing that taking risks may lead to negative evaluations because of ambiguities in performance appraisals, startups will opt for less riskier decisions. As a result of this risk aversion, startups will explore less and invest less time in riskier efforts. However, this behavior hampers the development of successful products because innovation requires risk-taking and exploration (Eisenhardt and Tabrizi, 1995, March, 1991). By not investing the time and effort in attempts with a possibly high variance in outcomes, as a means to avoid

negative appraisals by the incumbents' alliance representatives, a startup is making a trade-off between long-term innovation performance and short-term partner satisfaction. To avoid the short-term losses of alliance termination due to negative evaluations of riskier efforts, startups may avoid taking risks. Hence, we expect that project-level governance by the incumbents' alliance representatives can result in the reduction of risk taking by startups and in turn, reduce alliance innovation performance.

Interestingly, project-level governance may lead to risk averse behavior on the part of the incumbents as well, particularly when the size of contingent payments are higher. In other words, monetary incentives negatively moderate the relationship between project-level governance and the incumbent's risk taking. When incumbents try to minimize their measurement errors by forming more complex project-level governance modes, they may become too strict that they either steer the project to a path where they can assess the performance easily or completely terminate it when they receive some initial negative feedback. This effect will be stronger for alliances with higher performance-based payments, because the higher the magnitude of payments, the higher the incumbents' alliance representatives' risk. Alliance representatives bear the risks of wrong go/approval decisions to a higher extent the greater the size of the startup's compensation for performance is. This scenario instantiates a low-probability loss frame for the incumbent's alliance representatives, thus increasing the tendency to limit the innovativeness of the project or completely terminate it (Kahneman and Tversky, 1979). In addition, alliance representatives typically lack the necessary in-depth knowledge to evaluate the technology of their partner, because the startups brought highly specialized technologies to the R&D alliances. Hence, it is less costly for them to sway the direction of a project in a way that makes assessments easier or yields a termination, rather than take risks and commit themselves.

However, innovation projects are, in general, high risk-high return projects that require risk-taking to facilitate experimentation. The innovation management literature tells us that new product development entails experimenting with new ways of doing as well as learning from failures (Eisenhardt and Tabrizi, 1995). As long as project-level governance, because of higher monetary incentives offered to startups, functions to inhibit startups'

experimentation and confront them with their failures, it will negatively influence innovation and reduce the likelihood that marketable products will be developed.

Although we challenge the prediction of classical agency theory's complementarities view on the direct effect of project-level governance on alliance innovation performance, we still hold its prediction on the positive impact of monetary incentives on performance. As monetary incentives grow, startups will take risks and invest time and effort in innovative attempts, which in turn increase the chances of developing successful products.

However, two control mechanisms do not completely satisfy complementarity conditions. If project-level governance, encouraged in part by higher monetary incentives, decreases and higher monetary incentives, encouraged in part by greater project-level governance, increases, then the project-level governance and monetary incentives offset each other in explaining alliance innovation performance and the chances of developing marketable products,. Therefore,

Hypothesis 2: Project-level governance and monetary incentives offset each other in explaining alliance innovation performance.

Thus far, we concentrated on the effects of project-level governance and monetary incentives on innovation performance in alliances. It is possible, however, that these mechanisms influence firm-level performance; particularly the performance of startup firms. We discuss next how the market's perception of the value creation potential of a strategic alliance for a startup firm might be shaped by the degree of project-level governance exercised on the startup and the magnitude of monetary incentives offered to startup.

Firm-level performance implications of project-level governance and monetary incentives

Khanna, Gulati, and Nohria (1998) distinguish an alliance's private benefits from its common benefits. According to them, private benefits are those that accrue to individual firms, and common benefits are those that accrue collectively to all participants in the alliance. In a startup-incumbent alliance, both private and common benefits determine a

startup's value creation and in turn, its abnormal returns following the alliance announcement. Nevertheless, some private benefits are accrued at the expense of the other partner. This is because, while common benefits create value for both partners, some private benefits create value for one partner at the expense of the other and other private benefits create value for one partner without destroying the value of the other partner (Kumar, 2010). Such value destroying private benefits necessitate the use of contractual safeguards by the firm whose value is at risk of destruction, because of the opportunistic actions of the other firm (Parkhe 1993).

Strategic R&D alliances offer several opportunities for startup firms to create private benefits. These benefits, such as access to financial resources, an increase in prestige and legitimacy, connections to the suppliers and customers of incumbents, and access to the marketing and alliance management expertise of incumbents can be exploited by the startup outside of the terms of the alliance and in turn induce a positive market reaction. However, some of these benefits might be derived at the expense of the incumbent. One well known example is the cross-subsidizing problem, i.e. the use of money provided by the project sponsor not only for the sponsor's project, but also for other projects (Lerner and Malmandier, 2010). Likewise, a startup firm may use its partner's network to form or expand its own network. Furthermore, the startup may bypass the connections of the incumbent to get in touch with new customers and partners, resulting in the destruction of the incumbent's value.

Intense governance of the startup, exerted by alliance representatives of the incumbent, however, reduces the chance that the startup can gain these types of private benefits. First, project-level governance limits the startup's ability to utilize the incumbent's research funding outside the scope of the alliance, thus negatively impacting cross-subsidizing. Likewise, it is difficult for the startup to transfer its human resources from one project to another under intense project-level governance. In addition, the formalization of communication channels through the formation of committees serves to hamper the uncontrolled transfer of contacts, knowledge and capabilities to the startup firm. Hence, greater project-level governance, encouraged in part by monetary incentives, reduces the startup's value creation at the expense of its partner and thus, negatively influences a startup's abnormal stock market return following the alliance announcement.

In contrast, the market will react positively to alliance announcements with high monetary incentives. Although monetary incentives are conditional payments, they send signals to the market that the startup firm has a chance of receiving additional cash flows in the short term. Indeed, these cash flows, when received, can be used by the startup at its own discretion. Therefore, they represent an important source of private benefits that can be accrued by the startup firm, albeit not at the expense of its partner. Hence, higher monetary incentives, encouraged in part by greater project-level governance, will increase the startup's abnormal stock market returns following the alliance announcement. Therefore,

> *Hypothesis 3: Project-level governance and monetary incentives neutralize each other in explaining a startup's abnormal stock returns following an alliance announcement.*

4.3 DATA AND METHODS

The empirical setting of the study is the U.S. biotechnology industry, the same empirical setting of the study in the previous chapter. We utilize a longitudinal research methodology and event study methodology to reveal the antecedents of alliance innovation performance and a startup's abnormal stock returns following alliance announcements, respectively.

We obtained a significant portion of alliance information from Recombinant Capital (Recap), a California-based consultancy firm recently acquired by Deloitte. Recap provided us with deal data including, potential milestone payments, upfront payments, equity investments, therapeutic areas, stage at signing, alliance formation year, and technology bases. More importantly, Recap enabled us to identify R&D alliances whose contracts are publicly available. We then used the SEC Edgar database to collect publicly available contracts. From these contracts, we obtained information about project-level governance by analyzing the collaboration governance section, typically the second section of these contracts. We collected data for other independent variables from the Compustat database, and publicly available sources such as the firm's annual reports and industry-specific trade journals.

The alliance innovation performance data came from multiple secondary data sources. For each alliance, we searched for announcements of test results and alliance termination/expansion decisions from different sources including publicly available data sets such as clinicaltrials.gov, FDA.com, and ema.europe.eu, the biotechnology firm's annual reports, the pharmaceutical firm's websites giving information about their product pipelines, industry magazines, and internet search engines. Likewise, the daily stock return data of the biotech companies came from archival data sources, mainly from publicly available datasets on the Web.

Samples

We use two different samples to test our hypotheses. The first one is the same sample of the previous section, i.e. the sample of 220 randomly selected strategic R&D alliances between U.S.-based biotechnology firms and global pharmaceutical firms. We test our hypotheses pertaining to alliance innovation performance on this sample. Because we used the same sample, the sample selection criteria is also the same:

- One partner is a biotechnology firm and the other partner is a pharmaceutical firm;
- None of the partners was a government agency, a nonprofit organization, or a university;
- The biotechnology firm must be U.S.-based;
- There exists at least one R&D component of the alliance complemented with a licensing agreement in which the biotechnology firm grants technology rights to a pharmaceutical firm;
- The market potential and technical difficulties of different alliances must be close to each other and both of them must be high;
- The type of alliance is either a contractual alliance or minority equity alliance that does not result in the creation of a new entity.

The second sample, however, is a sub-set of the first sample because of the limited availability of data for calculating abnormal market returns. This was due to three reasons. First, there were private companies in the first sample for which the information on their stock market values was not available. Second, several firms were acquired or were bankrupt at the time of data collection, and as a result, they were deleted from stock exchanges, which in turn made it difficult for us to find their previous stock prices. Finally, several biotechnology firms had completed their IPOs just before their alliance formations, therefore it was not possible to find the necessary history of stock return data for these firms. As a result, we ended up with 116 strategic R&D alliances for which the biotech's stock returns, following alliance announcements, can be calculated and classified as abnormal or not.

Model identification

At first glance, we have two equations to solve, one for the alliance innovation performance and the other for the abnormal stock returns of the startup. Yet, as a result of the complementarities between project-level governance and monetary incentives, we need to identify two additional equations for the two endogenously determined variables in the system: project-level governance and monetary incentives. Because of the presence of the endogeneity, we cannot treat these two variables as exogenous determinants of alliance innovation performance and the biotech's abnormal stock returns. Hence, we use the

simultaneous equation modeling (SEM) approach to generate estimates for the coefficients of project level-governance and monetary incentives (Wooldridge, 2002).

SEM requires the identification of equations for each endogenous variable. As monetary incentives and project-level governance are two of the four endogenous variables in the model, we first identified equations for them: (1) the monetary incentives equation, and (2) the project-level governance equation. The right-hand side of each equation consists of an endogenous independent variable (i.e. project-level governance in the monetary incentives equation and monetary incentives in the project-level governance equation), exogenous independent variables that are used only in a single equation (i.e. potential identifying variables), exogenous independent variables used in both equations, and an error term.

We use the year effects, the therapeutic areas covered by the alliance, the listing of the biotech in the stock market, the biotech's age at alliance formation, and the incumbent's R&D intensity as the identifying variables for the monetary incentives equation. The year effects account for the change in market conditions in the industry. Specifically, after the late 1990s the market shifted from a buyer's market to a seller's market (Van Brunt, 2008). This is because the increased rivalry caused by generic drug producers (Hamel and Valikangas, 2003) and increased regulations by the FDA that resulted in higher attrition rates (Kola and Landis, 2004), both of which led pharmaceutical firms to rely more on biotechnology firms to innovate. As a consequence, the bargaining power of biotechnology firms increased considerably. In turn, for biotechnology firms, the chances to close deals with relatively higher levels of monetary incentives increased considerably. Another reason for including year effects in the equation is that we can control for changes in economic conditions. For instance, the 2005-2007 period experienced a peak in megadeals due to the positive economic conditions. During this period, large firms were likely to easily find the resources necessary to invest in alliances.

Therapeutic areas covered in an alliance can potentially influence the level of monetary incentives. The reason is, as the number of therapeutic areas increases, the level of project complexity increases, which makes development more challenging. As a result, biotechnology firms are likely to be compensated by pharmaceutical firms for the extra effort required to develop a compound for alternative therapeutic uses.

The level of monetary incentives may also depend on whether a biotechnology firm is a publicly traded or private firm. Publicly traded firms send signals to the market through their announcements (Janney and Folta, 2003; Gulati, Lavie, and Singh, 2009). For a publicly traded firm, an alliance announcement with substantial monetary incentives is a key signal to market investors because potential payments may generate revenues in the future. Therefore, publicly traded biotechnology firms will negotiate more on monetary incentives than private firms and strive to close a deal with substantial monetary incentives. The age of a biotechnology firm might also affect its bargaining power. Younger firms face the liability of newness and rely more on incumbent firms (Freeman, Carroll, and Hannan, 1983). As a result, they have less bargaining power in negotiations. However, as entrepreneurial firms age, they obtain access to alternative financial resources, build partnerships with other incumbents, and increase their legitimacy in the market. Thus, it is relatively easier for older biotechnology firms to close a deal with higher levels of monetary incentives. Finally, a pharmaceutical firm's R&D intensity may have a positive impact on the level of monetary incentives. This is because firms with higher R&D expenditures to sales ratios are likely to be more willing to invest in both internal and external R&D.

We use the level of payments committed and the stage at signing as the identifying variables for the project-level governance equation. As noted, project-level governance provides an incumbent firm with the opportunity to monitor its partner and intervene in key development decisions. Therefore, when the required degree of monitoring and intervention is high, the degree of project-level governance will also be high. The level of committed payments (i.e., the total of license fees, equity investments, research funding and reimbursement of prior R&D expenses) can influence both the required degree of monitoring and intervention. As the level of committed payments increases, the pharmaceutical firm faces a hold-up problem to a higher extent, because of the irreversibility of its investments (Williamson, 1991). As a result, it will monitor the activities of the biotech firm to a higher extent in order to avoid any opportunism and intervene in the biotech firm's decisions to a higher extent in order to adjust its risks. Therefore, we expect that the higher the level of committed payments, the higher the degree of project-level governance.

Rothaermel (2001b) and Santoro and McGill (2005) showed that early stage alliances had higher uncertainty than late stage alliances. Thus, early-stage R&D alliances involve tasks that demand higher levels of creativity and problem-solving ability from the biotechnology firms. This requires that the pharmaceutical firm must give more leeway. We expect, therefore, that early-stage alliances require lower degrees of project-level governance compared to those formed at later stages.

We include exclusivity of license, equity and cross-border in both equations to control for their effects. When the license is non-exclusive, a biotechnology firm can grant the commercialization rights of the compound to other firms. This causes a hold-up problem for the pharmaceutical firm (Somaya et al., 2011; Williamson, 1991). As a result, the pharmaceutical firm will monitor the activities of the biotech to a higher extent in order to avoid any opportunism and intervene in the biotech's decisions to a higher extent in order to adjust its risks. Therefore, we expect that non-exclusivity leads to higher degrees of project-level governance. Furthermore, as biotechnology firms will face fewer performance risks under a nonexclusive license agreement, the level of monetary incentives will be lower. Hence, non-exclusivity is likely to have a negative impact on the level of monetary incentives. A minority investment alliance is more effective in aligning the incentives of partners than a non-equity contractual alliance (Gulati and Singh, 1998, Pisano 1989). Therefore, we expect that the presence of equity investment will reduce the degree of project-level governance and the level of monetary incentives. In addition, cross-border alliances may cause higher monitoring requirements for a pharmaceutical firm because of the unfamiliarity with the partner's way of doing business. Therefore, cross-border alliances are likely to have higher degrees of project-level governance. Moreover, the pharmaceutical firm needs to incentivize a cross-border partner more than a local partner, because approaching a cross-border partner signals that there is a limited number of available partners in its own region. In negotiations, the biotechnology firm may take advantage of this situation and demand higher levels of monetary incentives. Finally, biotechnology firms typically deploy a mixed set of technologies, with varying costs, to develop products. These technologies represent scientific techniques and tools utilized to develop products. To control for their effects on monetary incentives and monitoring, we also included them in both equations.

We also identified two equations for the two main dependent variables in the system of equations. The first is the alliance innovation performance equation and the second is the startup's abnormal stock returns equation. Following the literature on alliance performance, we control for the effects of the task, partner, and experience-related factors that might influence alliance innovation performance and a startup's value creation in a strategic alliance. Therefore, we controlled for the effects of the number of therapeutic areas, the stage at signing, the presence of equity investment, the presence of a non-local incumbent partner, the number of prior deals between partners and the number of technologies employed by the biotech firm.

Measures

Main dependent variables

Alliance Innovation Performance

Alliance innovation performance represents the extent of success of pre-commercialization activities by the partners. It was operationalized as an ordinal variable with scores of 0, 1, and 2, corresponding to low, moderate, and high success scores, respectively. We assigned the highest score, 2, to alliances in which the partners were successful in developing a drug that received an approval from either the Federal Drug Agency (FDA) or the European Medicines Agency (EMA). We assigned a score of 1 to alliances for which partners were still not successful by January 2011 in developing a drug that received an approval from either the Federal Drug Agency (FDA) or the European Medicines Agency (EMA), but the partners had not terminated the alliance for any reason; or the incumbent partner licensed-in the compound developed during the partnership, but decided not to ally with the startup for further development. Finally, the score 0 was assigned to alliances terminated without any successful drug approvals or licensing-ins by incumbents.

Biotech's abnormal stock returns

We measured the firm-level value creation effects of strategic R&D alliance events by calculating the cumulative abnormal stock market return (CAR) for each alliance announcement. CAR is an *ex ante* market-based measure of expected return for a firm participating in an alliance. It has been extensively used as a performance measure in alliance event studies (Balakrishnan and Koza, 1993; Chung, Koford,and Lee, 1993;

Finnerty, Owers, and Rogers, 1986; Koh and Venkatraman, 1991; McConnell and Nantell, 1985; Park and Kim, 1997; Reuer and Koza, 2000).

We calculated abnormal returns using residual analysis of the market model (Fama *et al*., 1969). Based on the alliance announcement, the event date was set as $t = 0$. We estimated the market model for the period $t = [-250,-10]$: $r_{it} = \alpha_i + \beta i\, r_{mt} + \varepsilon_{it}$, where r_{it} is the common stock return of firm i on day t , r_{mt} is the corresponding daily market return on the Nasdaq biotechnology index, α_i and β_i are firm-specific parameters, and ε_{it} is the error term. The resulting estimates were used for predicting the daily returns for firm i over the two-day event window $[-1, 0]$: $\bar{r}_{it} = \bar{\alpha}_i + \bar{\beta}_i\, r_{mt}$, where $\bar{r}_{it}$ is the predicted return, and $\bar{\alpha}_i$ and $\bar{\beta}_i$ are the model estimates. We calculated the daily firm-level abnormal returns: $\bar{\varepsilon}_{it} = r_{it} - \bar{r}_{it}$, and then computed the cumulative abnormal return of firm i during the event window using the formula: $CAR_i = \sum_t \bar{\varepsilon}_{it}$, where t ranges from −1 to 0.

Endogenous variables

Monetary incentives

Monetary incentives refer to the total dollar value of the deal; that is the sum of research and development milestone payments offered to a biotech firm by its pharmaceutical partner. These are potential payments that will be made when the biotech firm achieves the specific milestones defined in the agreement. Given its evidently right skewed distribution, we use the natural logarithm in our estimations. We also control for the effects of inflation. We created inflation-adjusted values by taking 1996 as the base year.

Project-level governance

This variable captures whether senior and middle-level managers of a pharmaceutical firm were appointed to committee membership, alliance management or project management roles. As mentioned, we obtained scores for this variable by reading the 'alliance governance' sections of the agreements. These sections describe in detail which joint committees were formed and whether liaison personnel, such as project and alliance managers, were appointed.

Under the monitoring of joint steering committees, specialized joint functional committees exist. We considered joint functional committees in two separate groups. The first group, core joint functional committees, includes those associated with either a core upstream or downstream alliance activity. Joint research, development, commercialization,

and manufacturing committees constitute the fundamental upstream and downstream functional committees formed in alliances between biotechnology and pharmaceutical firms. The second group, peripheral joint functional committees, involves committees responsible for activities pertaining to either finance or intellectual property rights. We call them peripheral because of their limited monitoring and decision-making rights. Typically, they provide input to decisions made by the core committees. For instance, joint patent committees assist research committees in specifying how a novel technology developed in the partnership can be protected and how the patent ownership can be handled. Similarly, joint finance committees assist joint research teams in controlling the costs of research activities or assisting commercialization committees in preparing a budget for co-promotion activities.

As a result of distinguishing core joint committees from peripheral ones, we ended up with four dimensions of project team structure: (1) core joint functional committees, (2) peripheral joint functional committees, (3) liaison personnel, and (4) steering committees. Parallel to the measurements used in prior studies, a weight was assigned to each of these dimensions based on their governance complexities (Kumar and Seth, 1998). A rank of 1 was assigned to 'peripheral joint functional committees', 2 to 'project and alliance managers', 3 to 'steering committees', and 4 to 'core joint functional committees'. Then, the sum of the scores of each dimension divided by 24[3], the maximum score possible, was taken to obtain the score for the degree of project-level governance. We assigned the highest weight to joint functional committees, because through these committees an incumbent exerts the most intense monitoring of its partner in a particular functional domain. Furthermore, these committees are the first line of defense in resolving conflicts that arise in the alliance. The steering committees resolve conflicts that cannot be solved in the joint functional committees; they also have fewer chances to observe project activities as compared to joint committees. Hence, joint steering committees received a lower weight than joint functional committees. Liaison personnel have the right to participate in committee meetings, however they may not have decision-making/voting rights, or they

[3] This is the maximum score obtained when governance consists of a joint peripheral committee, project managers, alliance managers, a steering committee, and joint research, development, commercialization, and manufacturing committees.

represent a single vote in decisions. They are mainly responsible for ensuring healthy communication between partners. Therefore, they received the weight of two.

Exogenous variables

For year effects, we included 13 dummies for each year. We used the year 2008 as the base category. *Therapeutic areas* is a measure of the technical scope of an alliance. It captures the total number of therapeutic areas covered within the alliance agreement. For instance, if an alliance's therapeutic area covers only two indications in total (e.g. cancer and central nervous system) this variable receives a value of 2. The variable *Public* is a dummy, coded as 1 if the biotechnology firm is publicly traded. The variable *Biotech's age* is the difference between the alliance formation year and the biotech's foundation year. The variable *Pharma's R&D intensity* is the ratio of R&D expenditures to turnover.

Following Santoro and McGill (2005), we included three dummy variables that represent the stages of drug development: *Early research* (i.e. formulation, discovery, lead molecule, pre-clinical), *Early clinical* (i.e. phase I, phase II), and *Late clinical* (i.e. phase III, BLA/NDA filed, and approved). We picked *Late clinical* as the base category. *Committed payments* measure a pharmaceutical firm's upfront irreversible payments; this involves license fees, equity investments, research funding, and reimbursement of prior research expenses. Like monetary incentives, we use the natural logarithm of the variable and its inflation adjusted values using 1996 as the base year.

We captured license exclusivity by an ordinal scale, 0 if the license is non-exclusive, 1 if it is co-exclusive, 2 if it is exclusive. We included the *Equity* dummy, 1 if there is an equity investment by the incumbent and 0 otherwise. The variable *Cross-border* measures the nationality differences between partners. We coded this variable as 1 if the partnership is cross-border, and 0 otherwise. The variable *Technologies* measures the total number of different technologies used by the biotech to develop the solutions. Finally, we included *prior deals*, i.e., the number of prior alliances between the partners, to control for the effects of partner-specific experience on alliance innovation performance and startups' abnormal stock returns.

Methods

To generate the estimates for our system of linear equations with a discrete choice dependent variable, i.e. alliance innovation performance, we first derived the estimates for project-level governance and monetary incentives by three-stage least-squares (3SLS) estimation. Using 3SLS regression enables us to control for the endogeneity between project-level governance and monetary incentives. In the second step, we regress alliance innovation performance over the estimates of project-level governance and monetary incentives and the control variables. Because alliance innovation performance is an ordinal discrete choice dependent variable, taking values "low, moderate, or high performance", we used ordered logit regression to generate the alliance innovation performance model estimates. However, because of the difficulties in interpreting the ordered logit estimates, we also conducted an ordinary least squares regression (OLS) of alliance innovation performance on explanatory variables by considering that linear probability models provide good approximations for the estimates of discrete choice models (Wooldridge, 2002). As will be seen in our results, signs and significances are the same for the discrete choice model and the linear probability model. In addition, given that the linear probability models provided us with good approximations for the ordered logit model at average values of its independent variables, we could approximately calculate the effect sizes of independent variables, thereby having a better assessment of the practical importance of project-level governance and monetary incentives.

Because abnormal stock returns is a continuous dependent variable, generating estimates for the abnormal stock returns model was relatively more straightforward. Similarly, we used 3SLS regression to control for the endogeneity between project-level governance and monetary incentives. We simultaneously solved three models to calculate 3SLS estimates. We used the sample with 220 strategic R&D alliances for testing the alliance innovation performance model and the sample with 116 strategic R&D alliances for testing the biotech firm's abnormal stock returns model.

4.4 RESULTS

Tables 4.1 and 4.3 present the descriptive statistics and correlations for the alliance innovation performance model, respectively; whereas, Tables 4.2 and 4.4 illustrate the descriptive statistics and correlations for the biotech firm's abnormal market returns model, respectively. Only 15 percent of alliances were successful in developing new drugs, i.e. receiving market approvals from the regulatory bodies in the US and/or Europe. Fifty-two percent of them terminated without any successful outcomes and 33 percent of them were either terminated with licensing-in of the compound by the pharmaceutical firm or still in progress in January 2011. On the other hand, the average abnormal stock return of a biotech firm was 8.2 percent following the alliance announcement.

Table 4. 1 Descriptive statistics (alliance innovation performance model , n=220)

Variable	Mean/Freqs	Std. Dev.	Variable	Mean/Freqs	Std. Dev.
Alliance innov. per. = 0	0.52	-	Early clinical	0.20	-
Alliance innov. per. = 1	0.33	-	Late Research	0.16	-
Alliance innov. per. = 2	0.15	-	1996	0.04	-
Ln (Monetary incentives)	4.36	1.44	1997	0.02	-
Project-level governance	0.35	0.18	1998	0.07	-
Therapeutic areas	1.43	0.83	1999	0.12	-
Public	0.70	0.46	2000	0.10	-
Biotech's age	10.83	6.61	2001	0.06	-
Pharma's R&D intensity	0.14	0.57	2002	0.07	-
Ln (Committed payments)	2.79	1.19	2003	0.06	-
Exclusivity	1.79	0.49	2004	0.06	-
Equity	0.36	0.48	2005	0.08	-
Cross-border	0.60	0.49	2006	0.11	-
Technologies	1.41	0.69	2007	0.12	-
Early Research	0.64	-	2008	0.07	-

Table 4. 2 Descriptive statistics (biotech's abnormal stock returns model , n=116)

Variables	Mean/Freqs	Std. Deviation	Variables	Mean/Freqs	Std. Deviation
Biotech's ASR	.082	.12	Late clinical	.17	-
Ln (Monetary Incentives)	4.55	1.41	1996	.03	-
Project-level governance	.38	.18	1997	.03	-
Therapeutic areas	1.37	.68	1998	.03	-
Biotech's Age	13.22	6.51	1999	.09	-
Pharma's R&D Intensity	.15	.06	2000	.10	-
Ln (Committed payments)	3.06	1.15	2001	.05	-
Exclusivity	1.79	.50	2002	.05	-
Equity	.27	.44	2003	.05	-
Crossborder	.60	.49	2004	.07	-
Technologies	1.34	.60	2005	.12	-
Prior deals	.41	.90	2006	.10	-
Discovery	.57	-	2007	.16	-
Early clinical	.26	-	2008	.11	-

Table 4. 3 Correlations (alliance innovation performance model, n=220)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Alliance innovation performance	1												
2. Ln (Monetary incentives)	.047	1											
3. Project-level governance	.043	.378**	1										
4. Therapeutic areas	.076	.173*	-.012	1									
5. Public	.018	.081	.107	-.003	1								
6. Biotech's Age	.072	.144*	.085	-.063	.373**	1							
7. Pharma's R&D Intensity	.111	.126	.178**	.087	.107	.148*	1						
8. Ln (Committed payments)	.164*	.477**	.455**	.083	.266**	.138*	.199**	1					
9. Exclusivity	.143*	-.033	-.160*	-.218**	-.094	.136*	-.025	-.163*	1				
10. Equity	-.042	-.130	-.029	.175**	-.159*	-.228**	.057	.232**	-.106	1			
11. Crossborder	.144*	.053	.030	.137*	.006	-.015	-.007	.052	-.004	-.073	1		
12. Technologies	-.017	-.037	-.026	.097	-.162*	-.198**	-.100	-.031	-.013	.115	-.068	1	
13. Prior deals	.081	.015	.093	-.030	.136*	.152*	.055	.098	.015	-.069	-.039	-.001	1

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 4. 4 Correlations (biotech's abnormal stock returns model , n=116)

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Biotech's ASR	1										
2. Ln (Monetary incentives)	.241**	1									
3. Project-level governance	.125	.341**	1								
4. Therapaeutic areas	.057	.161	-.054	1							
5. Biotech's age	-.020	.100	.049	.007	1						
6. Pharma's R&D Intensity	.142	.148	.283**	.111	.178	1					
7. Exclusivity	-.032	-.164	-.221*	-.130	.109	-.100	1				
8. Equity	.131	-.098	-.092	.159	-.137	.078	-.101	1			
9. Crossborder	-.066	.089	-.040	.080	.002	-.049	-.089	-.187*	1		
10. Technologies	-.076	-.009	-.098	.181	-.220*	-.081	.031	-.046	-.104	1	
11. Prior deals	-.075	-.033	.124	-.077	.153	.042	.052	-.120	-.066	-.029	1

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 4.5 presents the results of the regressions. Model 1 and Model 2 capture the complementarities between project-level governance and monetary incentives in the large and small samples, respectively. We report unstandardized 3SLS coefficients and standard errors for all of the equations of both models. Model 3 is a logit model and captures the effects of project-level governance and monetary incentives on alliance innovation performance. We report odds ratios and standard errors in the equation. Model 4 is the linear probability model for the alliance innovation performance. Finally, Model 5 captures the effects of project-level governance and monetary incentives on the abnormal stock returns of biotechnology firms. We report standardized OLS coefficients and standard errors for each independent variable in Model 5.

The significant and positive reciprocal relationship between project-level governance and monetary incentives exists in both Model 1 and Model 2. The coefficients for project-level governance in the monetary incentives equations are positive and significant in both models ($p < 0.001$, $\beta = 6.48$; $p < 0.05$, $\beta = 4.41$, respectively) and the coefficients for

monetary incentives in the project-level governance equations are positive and significant in both models ($p < 0.05$, $\beta = 0.03$; $p < 0.05$, $\beta = 0.04$, respectively).

Hypothesis 1 argues that project-level governance and monetary incentives complement each other in explaining alliance innovation performance. Contrary to the predictions of Hypothesis 1, the odds ratio for project-level governance in the alliance innovation performance equation is significant and smaller than 1 in Model 3, and the coefficient for project-level governance is significant and negative in Model 4. Hence, these results suggest that as the degree of project-level governance increases, the odds of developing a successful product in the course of an R&D alliance becomes smaller. Thus, greater project-level governance, encouraged in part by higher monetary incentives, negatively influences alliance innovation performance. The odds ratio value 0.0002 indicates that project-level governance decreases the odds of developing successful products. For a one unit increase in project-level governance, the probability of a high alliance innovation performance event occurring versus the occurrence of the combined moderate and low alliance innovation performance events is close to 0.

Hypothesis 2 states that project-level governance and monetary incentives neutralize each other in explaining performance. Because the coefficient for project-level governance in the alliance innovation performance equation is significant and negative and the coefficient for monetary incentives in the alliance innovation performance equation is significant and positive, Hypothesis 2 is supported. For a one percent increase in monetary incentives, the odds of high alliance innovation performance versus the combined moderate and low alliance innovation performance categories are 4.09 times greater (80.4% probability). Hence, monetary incentives, encouraged in part by greater project-level governance, positively influence alliance innovation performance.

Nevertheless, the innovation performance effects of project-level governance and monetary incentives are both mixed. The negative, direct effect of project-level governance is offset by an indirect, positive effect because of the complementarities between the two mechanisms and the direct positive effect of monetary incentives on alliance innovation performance. On the other hand, the positive, direct effect of monetary incentives is offset by an indirect, negative effect, because of the complementarities between the two mechanisms and the direct, negative effect of project-level governance on alliance

innovation performance. Model 4 provides a good explanation for the effect sizes of project-level governance and monetary incentives. For instance, the formation of two joint functional committees such as joint development and commercialization committees decreases the probability of high performance approximately 0.33*(-2.95*100/2), 48.7 percentage points because of the direct negative effect of project-level governance on alliance innovation performance. On the other hand, the formation of two committees increases the log of monetary incentives by 6.48*0.33 = 2.14 units, which in turn increases the probability of success 2.14 (0.46*100/2), 49.2 percentage points. Hence the total effect size is 0.05 percentage points (0.05%).

Hypothesis 3 argues that project-level governance and monetary incentives neutralize each other in explaining a startup's abnormal stock returns following alliance announcements. This hypothesis is not supported. The reason is that the coefficient for project-level governance is not significant, though the coefficient for monetary incentives is significant and positive. Hence, the market only responds to monetary incentives and it is good for startups to announce higher monetary incentives to receive positive reactions from the market. Figure 4.1 summarizes the main findings of the study

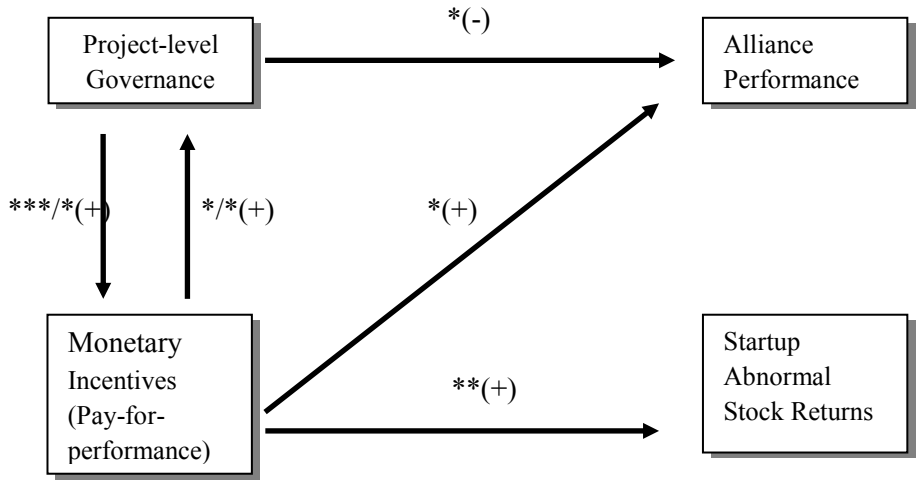

Figure 4. 1 Summary of results

Among the other variables, we first note that alliances formed at early research stages have lower alliance innovation performance than alliances formed at the late stages of

development. Moreover, cross-border alliances are more successful than alliances between two partners located in the U.S.

Table 4. 5 Estimation results

Variables	Model 1		Model 2		Model 3	Model 4	Model 5
	PLG Equation	Monetary Incentives Equation	PLG Equation	Monetary Incentives Equation	Alliance Innovation Performance (Logit; Odds Ratio)	Alliance Innovation Performance (Linear Prob.)[a]	Biotech Abnormal Stock Returns
Endogenous variables							
Ln (Monetary incentives)	0.03*	-	0.04*	-	4.09*	0.46*	0.05**
	(0.01)		(0.02)		(2.35)	(0.22)	(0.02)
Project-level governance	-	6.48***	-	4.41*	0.0002*	-2.95*	-0.20
		(1.33)			(0.001)	(1.47)	(0 .17)
Equation-specific exogenous variables							
1996	-	-1.74**	-	-2.40**	-	0.94	-
		(0.51)		(0.83)		(0.61)	
1997	-	-1.60**	-	-1.60*	-	0.03	-
		(0.58)		(0.67)		(0.46)	
1998	-	-1.30**	-	-2.03**	-	0.23	-
		(0.45)		(0.69)		(0.44)	
1999	-	-1.15**	-	-0.79+	-	0.42	-
		(0.41)		(0.48)		(0.41)	
2000	-	-1.59***	-	-1.43**	-	0.36	-
		(0.37)		(0.45)		(0.45)	
2001	-	-1.26***	-	-1.07*	-	0.32	-
		(0.35)		(0.47)		(0.42)	
2002	-	-0.73*	-	-0.32	-	0.19	-
		(0.32)		(0.44)		(0.33)	

2003	-	-0.65^{+} (0.34)	-	-0.21 (0.43)	-	0.20 (0.34)	-
2004	-	-0.63^{+} (0.34)	-	-0.56 (0.47)	-	-0.14 (0.33)	-
2005	-	-0.15 (0.30)	-	-0.07 (0.40)	-	-0.008 (0.27)	-
2006	-	-0.30 (0.29)	-	0.24 (0.34)	-	0.13 (0.27)	-
2007	-	0.04 (0.28)	-	0.04 (0.31)	-	-0.18 (0.24)	-
Therapeutic areas	-	0.29*** (0.08)	-	0.16	-		-0.003 (0.02)
Public	-	-0.22 (0.14)	-	-	1.06 (0.39)	0.03 (0.13)	-0.02 (0.08)
Biotech's age	-	-0.01 (0.01)	-	-0.01 (0.01)	1.01 (0.03)	0.004 (0.009)	-0.001 (0.002)
Pharma's R&D intensity	-	-0.52 (1.13)	-	1.04 (1.96)	-		-
Early research	-0.01 (0.02)	-	-0.01 (0.03)	-	0.24** (0.11)	-0.51** (0.19)	-0.005 (0.03)
Early clinical	0.01 (0.02)	-	0.002 (0.03)	-	0.45^{+} (0.21)	-0.28 (0.21)	-0.02 (0.03)
Ln (Committed payments)	0.05*** (0.01)	-	0.06** (0.02)	-	-	-	-
Common exogenous variables							
License exclusivity	-0.004^{+} (0.02)	0.26 (0.20)	-0.03 (0.03)	0.03 (0.27)	-	-	-

Equity	-0.03	-0.12	-0.07	0.06	1.06	0.03	0.03
	(0.03)	(0.19)	(0.04)	(0.28)	(0.34)	(0.12)	(0.03)
Crossborder	-0.003	-0.06	-0.05	0.14	1.91*	0.21*	-0.03
	(0.02)	(0.19)	(0.03)	(0.26)	(0.56)	(0.10)	(0.02)
Technologies	0.002	-0.06	-0.01	0.01	1.28	0.07	-0.03
	(0.02)	(0.13)	(0.03)	(0.20)	(0.27)	(0.07)	(0.02)
Constant	0.15*	2.39**	0.14	2.94*	-	0.44	-0.08
	(0.06)	(0.88)	(0.10)	(1.42)		(0.84)	(0.07)
χ square	83.43	176.80	65.88	109.24	42.29	-	76.74
Prob > χ square	0.000	0.000	0.000	0.000	0.006	-	0.000
R-square	-	-	-	-	-	0.17	-
N	220	220	116	116	220	220	116

+ indicates $p < 0.1$, two tailed,
* indicates $p < 0.05$, two tailed,
** indicates $p < 0.01$, two tailed,
*** indicates $p < 0.001$, two tailed.
a: All standard errors in the model are heteroskedasticity-robust standard errors.
Prior deals' odds ratio and std error in the alliance innovation performance equation, respectively: 1.36 , 0.39 (p<0.20)
Prior deals' coefficient and std errors for the biotech's abnormal stock returns equation, respectively: -.0061536 .0128177

4.5 DISCUSSION

In this study, we examined vertical alliances between startups and incumbents and our results revealed that project-level governance decreases the likelihood of successful alliance outcomes. Therefore, we showed that the strict governance of incumbents by alliance representatives, which is partly triggered by monetary incentives, is likely to cause alliances without successful development outcomes. On the other hand, monetary incentives increase the odds of having successful alliance outcomes. In R&D alliances where incumbents offer relatively higher monetary incentives to startups, it is more likely that marketable products can be developed. These findings indicate that the innovative performance of a partnership is positively associated with monetary incentives, while it is negatively associated with the project-level governance of daily activities by the incumbent partner. Nevertheless, the direct negative effect of project-level governance is offset by its indirect positive effect on innovation performance, because of the complementarities between monetary incentives and project-level governance. Hence, the results confirm the behavioral agency view which predicts a neutralizing impact of project-level governance and monetary incentives on alliance innovation performance.

Monetary incentives in strategic R&D alliances also influence the abnormal stock returns accrued to startups following the announcement of alliances. In other words, our findings suggest that monetary incentives affect a startup's value creation in its strategic alliance with an incumbent firm, i.e. the higher the monetary incentives, the higher the startup firm's abnormal stock return will be following the alliance announcement. On the other hand, we found no significant effects of project-level governance on abnormal stock returns following alliance announcements. This highlights an interesting fact about alliance deals and their valuation. Given that project-level governance has a negative effect on alliance innovation performance, it is surprising that investors do not take this negative effect into account when they consider investing in the startup firm following the alliance announcement. Hence, it appears that the decision-makers in the market overlook the direct negative performance effects of project-level governance when they determine the potential value of alliances to startup firms.

Theoretical contributions

This study makes a number of contributions to the alliance governance literature, the innovation management literature, and agency theory. The findings of this work extend the lines of research on the relation between alliance governance mechanisms and alliance performance. To the best of our knowledge, previous studies in the strategic alliances literature have not examined the relationship between the size of performance-based monetary incentives and alliance performance. Moreover, previous studies that examine the relationship between project-level governance of partner activities and performance do not pay enough attention to the complementarities between project-level governance and monetary incentives. By showing that project-level governance and monetary incentives offset each other in explaining alliance innovation performance and that their total effect will increase the odds of success only marginally, we reveal that these two mechanisms are limited in their effectiveness. This phenomenon occurs because higher monetary incentives and greater project-level governance lead to greater risk aversion of both the startup firms and the incumbents' alliance representatives, thus hampering the development of novel solutions and increasing the odds of alliance terminations before reaching their goals.

Our findings regarding the complementarities between project-level governance and monetary incentives and the negative effect of project-level governance on alliance performance are in contrast with the expectations of the relational view in alliances. Although, we take only the control role of project-level governance into account in our study, alliance representatives play a key role in developing relational governance by building interpersonal trust and cooperation (Hoetker and Mellewigt, 2009; Ring and Van de Ven, 1994). Although it seems that formal role relationships dominate at the alliance formation stage, and only shift minimally in the direction of relational governance. If the shift was present and greater, we would have seen the positive effect of project-level governance on performance.

In addition, the findings of this work advance our understanding of the link between governance and firm performance. Research has demonstrated that startups benefit from engaging in alliances with other firms (Stuart, 2000). However, the firm-level performance implications of governance choices have been overlooked (Aggarwal, Siggelkow, and Singh, Forthcoming). By empirically showing that monetary incentives directly influence firm performance, we address this gap in the literature. Our finding regarding the positive

effect of monetary incentives on a startup's abnormal stock returns following the alliance announcement reveals a key determinant of the performance of a startup firm.

This dissertation also provides empirical contributions to the strategic alliances literature. To conduct our test, we developed measures for project-level governance, monetary incentives, and alliance performance. Our measure for project-level governance takes into account the differences in controllers, i.e., members of core and peripheral committees, alliance managers, and project managers, by assigning weights to each of them. We believe that developing such a measure is necessary because of differences in the control responsibilities of alliance representatives. On the other hand, as we discussed, we used pre-commercialization milestone payments tied to the performance of startups as a measure for monetary incentives in the setting of biopharmaceutical alliances. Furthermore, different from prior studies that measure performance by self-assessment questionnaires, we measure performance by using archival data sources; an approach that we believe results in a more accurate depiction of performance levels.

Moreover, by showing the impacts of project-level governance and monetary incentives on the performance of startup-incumbent, vertical R&D alliances, we make another contribution to the organization of innovation literature. The finding regarding the negative impact of project-level governance on alliance innovation performance is consistent with the literature that discusses dysfunctions of control in innovative task settings (Andrews and Smith, 1996; Burns and Stalker, 1961; Carson, 2007; Ettlie, 1983; Thomas and Velthouse, 1990; Thompson, 1965). Furthermore, this finding is in line with the literature on motivation and creativity which reports the negative impacts of control on intrinsic task motivation, and in turn, on creative performance (Amabile, 1998; Kreps, 1997; Thomas and Velthouse, 1990). Yet, these literature streams have overlooked the importance of monetary incentives in determining the degree of project-level control as well as performance. We found that monetary incentives compensate for performance risks transferred to startups. Furthermore, we showed that monetary incentives, encouraged in part by project-level governance, positively influence performance. Therefore, even though there is a direct and negative effect of control on innovation performance, it indirectly increases performance because it causes increases in the monetary incentives demanded by

startups. By demonstrating these effects, we extended the prior research and provide more insights into the control mechanisms used in innovative task settings.

Finally, this dissertation contributes to agency theory. Although agency theory explains in detail the circumstances that lead to the use of monitoring and monetary incentives to protect the interest of principals, there is limited empirical research that examines how these two mechanisms affect the principals' performance. Contrary to the predictions of the complementarities position, the simultaneous utilization of monetary incentives and project-level governance leads to negligible performance improvements in the context of startup-incumbent R&D alliances. Hence, the behavioral agency model that takes into account the biases and inaccuracies of the performance appraisals made by the principals' controllers, as well as their greater risk aversion under the presence of higher monetary incentives, explains the relationship, between the two governance mechanisms and performance, better. Therefore, our study extends the agency theory research by showing that the behavioral agency view is superior to the complementarities position in explaining the antecedents of alliance innovation performance. Furthermore, the research setting for testing agency theory has been predominantly the corporate governance setting. To the best of our knowledge, our study is the first attempt at contrasting classical and behavioral agency theories in the context of strategic R&D alliances.

Managerial implications

Several managerial implications emerge from this paper. First, this study provides important insights for the managers of large established firms. These managers should be cautious about the degree of project-level governance that they will exert on their partner. This is not only because intense project-level governance leads to higher monetary incentives and possibly higher future payments to their partners, but it is also likely to have a negative impact on alliance performance. Hence, they must very carefully weigh advantages of control against its disadvantages. Furthermore, they should avoid short-term formal reviews and evaluations, because these managerial actions will inhibit problem-solving ability of their partners. They should allow their partners to make mistakes and not punish them immediately by terminating the partnership on the grounds of possibly biased and fallacious evaluations. This is because without enough opportunities to probe and

search for the "right answer", it is very difficult for a startup to transform its scientific output into a marketable product.

Second, managers of small startup firms must think about the dysfunctions of day-to-day control by incumbents when they negotiate alliance deals. Following the strategy of compensating performance risks posed by over-control through monetary incentives will help them avoid a problematic deal. Furthermore, they should take into account the fact that higher monetary incentives will lead to higher abnormal stock market gains.

Finally, when they conducting value analysis, deal analysts must think about the link between day-to-day governance and performance at both the alliance and firm level. Giving more emphasis to monetary incentives as compared to project-level governance might result in misevaluations of a startup's value creation in its R&D alliance with an incumbent. Therefore, analysts should gather information about the deal structure by analyzing contracts, by asking the alliance management units of incumbents, or by projecting an estimate based on prior deals made by the incumbent partner.

Limitations and Future Research

This study is not without limitations, and we note them as possible future research opportunities. Our research shares the same limitations of any single industry study. While we have no reason to believe that the U.S. pharmaceutical industry is less generalizable than any other setting, similar studies in other industries would be valuable.

We primarily focus on the formal control-based roles and responsibilities of alliance representatives. Even though it helps us in explaining the relationship between project-level governance, monetary incentives, and performance, the roles and responsibilities of alliance representatives are more diverse than modeled here. Previous studies addressed the various informal roles of alliance representatives. For instance, Spekman et al (1998) list seven different roles for alliance managers, among them: vision creation, strategic sponsorship of the partner, advocacy of alliance within the firm, networking to provide resources for the alliance and facilitating the growth of an alliance. These roles are different from the formal control and management roles of alliances used in this study. Likewise, Bamford, Gomes-Casseres, and Robinson (2003) highlight the internal and external championing roles of alliance managers in addition to their role of controlling partner behavior. Although steering committee members and functional committee

members of a partner firm are primarily responsible for the formal control of the alliance that does not mean that they would not do internal and external championing. Therefore, the investigation, from different theoretical perspectives, of the relation between committee members and alliance managers of an incumbent firm and a startup firm during an alliance might present fruitful areas of research that can improve our understanding of alliance governance mechanisms and ultimately alliance performance. Future research may look at how the internal and external championing roles of alliance representatives affect alliance performance from the lenses of a resource dependency perspective. Future studies, that can successfully identify the circumstances under which the alliance representatives of incumbents provide key resources to their partners, would shed light on different aspects of the day-to-day governance of strategic R&D alliances.

We employed agency theory in this dissertation when we investigated the relationship between project-level governance and monetary incentives and their effects on performance. Alternatively, future studies can use stewardship theory or an integrated version of stewardship and agency theories. Stewardship theory challenges the assumptions of agency theory by noting that not all agents are self-interested and motivated by financial rewards. While our research showed that monetary incentives increase alliance innovation performance, it is unclear for us to what extent startups are opportunistic. In practice, we know that startups have stakes in the future of their projects and they know that opportunism will be harmful not only to their partners but also to themselves. Therefore, a better design of monitoring and incentive mechanisms can be achieved if the premises of stewardship theory can be combined with the premises of agency theory.

Research on the relationship between the alliance representatives of an incumbent and its startup partner might further benefit from the theories of corporate governance. Recent research on social influence tactics used in boardrooms (Stern & Westphal, 2010) may help researchers explain different outcomes of project-level governance. We showed here that when a startup faces higher performance risk, because of greater project-level governance, it tends to request higher monetary incentives to compensate its risks. Alternatively, a startup could use social influence tactics to gain political support of some representatives of incumbent firm. One social influence tactic that can be used by a startup

firm is to explicitly or implicitly offer executive management positions in the startup, one of its affiliates, or close collaborators. Knowing that he or she will be an executive director in one of the startup firms, the representative would be less vigilant in its evaluation of alliance outcomes developed by the startup. Hence, social influence tactics may weaken the need for higher monetary incentives in cases where the degree of project-level governance is high.

Our results reveal several downsides in formal management principles and formal governance. Furthermore, we observed, in our sample, that on average more than 50% of R&D alliances were terminated without successful outcomes. These facts cause controversy over the effectiveness of the formal management principles used in innovation alliances as well as the effectiveness of alliances as organizational modes for innovation. Particularly, the industry experts in the US biopharmaceutical industry have been questioning the effectiveness of drug discovery and development models, in particular the formal management principles used by large pharmaceutical firms and the R&D alliances these firms form with small firms to develop new drugs have come under scrutiny. In response, industry experts are suggesting novel industry-level organizational forms to overcome the drawbacks of formalization and alliances in general (Roth and Cuatrecasas, 2010). We believe further research is necessary to compare the innovation rates of internal R&D, external R&D through alliances, and novel forms of external R&D to help industries in designing the most effective industrial organization for innovation.

CHAPTER 5: DISCUSSION & CONCLUSIONS

5.1 KEY FINDINGS

The objective of this dissertation was to demonstrate the antecedents and performance consequences of two overlooked governance mechanisms in the strategic alliances literature. The results indicate, overall, that both project-level governance and performance-based monetary incentives are central to alliance governance in the context of strategic R&D alliances (see Table 5.1 for the summary of findings). Specifically, both of these mechanisms play key roles in explaining alliance performance.

In Chapter 2, we find that, in a setting of vertical and horizontal strategic R&D alliances, project-level governance positively influences performance through its effect on contractual complexity. We argue that this is because of the involvement of alliance representatives in contract design which results in more complete contracts which are robust to both operational problems and the unforeseen circumstances that may arise *ex post*. Thus, we show empirically that the involvement of alliance representatives increases contractual complexity, which in turn positively influences performance.

In Chapter 3, we find that there is a positive reciprocal relationship between project-level governance and performance-based monetary incentives in the context of vertical R&D alliances. In Chapter 4, we show that that project-level governance decreases the odds of successful product development. Therefore, we showed that strict governance by the incumbent's alliance representatives, which is partly triggered by higher monetary incentives, is likely to cause alliances without successful development outcomes. On the other hand, monetary incentives increase the odds of successful product development. In R&D alliances, where incumbents offer relatively higher monetary incentives to startups, it is more likely that marketable products can be developed. These findings indicate that the innovative performance of a partnership is positively associated with monetary incentives, while it is negatively associated with the project-level governance of daily activities by the incumbent partner.

Table 5. 1 Summary of findings

Chapters	Key Findings	Secondary Findings
Chapter 2	1) Negative reciprocal relationship between project-level governance and equity, 2) Positive reciprocal relationship between project-level governance and contractual complexity, 3) Stage at signing determines the degree of project-level governance. Late stage deals have greater project-level governance. 4) Contractual complexity, encouraged in part by project-level governance, positively affects alliance innovation performance.	1) Alliance technical scope is a key determinant of contractual complexity. 2) Stage at signing influences both equity and alliance performance. Late stage deals are more likely to have equity investments and more likely to develop marketable products.
Chapter 3	Positive reciprocal relation between project-level governance and monetary incentives in vertical R&D alliances between startups and incumbents. Greater project-level governance by incumbents increases the required degree of monetary incentives offered to startups, and vice versa.	Year effects and alliance technical scope determine the magnitude of monetary incentives in vertical R&D alliances between startups and incumbents.
Chapter 4	1) Monetary incentives have positive impacts on both alliance innovation performance and abnormal returns. 2) Project-level governance has a negative effect on alliance innovation performance and no effect on abnormal stock returns following alliance announcements. Hence, given the positive reciprocal relation of project level-governance and monetary incentives, their interactive effect on alliance innovation performance is neutralizing.	1) Late stage alliances are more likely to have positive alliance outcomes. 2) Likewise, committed payments from incumbents to startups at the onset of R&D alliances, i.e. upfront cash payments and equity investments, increase the likelihood of success. 3) Cross-border alliances are more likely to be successful than nation-level alliances. 4) Even though these factors impact alliance innovation performance, none of them influences abnormal returns.

Monetary incentives of strategic R&D alliances also determine the abnormal stock returns of startups following alliance announcements. We found a direct positive effect of

monetary incentive on abnormal stock returns. In other words, our findings suggest that monetary incentives positively influence a startup's value creation in its strategic alliance with an incumbent firm. On the other hand, we found no significant effects of project-level governance on abnormal stock returns following alliance announcements. Despite its insignificance, the effect of project-level governance on abnormal stock returns was negative. These findings highlight an interesting fact about alliance deals and their valuation: given that project-level governance has a negative effect on alliance innovation performance, it is surprising that investors do not take this negative effect into account when they make their investment decisions following alliance announcements. Hence, it appears that the market imperfectly judges the relationship between the governance and value creation potential of an alliance.

This dissertation also reveals several other antecedents to startup-incumbent R&D alliance performance. Payments committed by incumbents for startups have a marginally significant and positive effect on alliance performance. Furthermore, the stage at signing is an important determinant of whether any marketable product could be developed in an alliance. Late stage alliances have higher chances for developing marketable products than early stage alliances. Our results also show that cross-border deals have relatively higher chances of being successful than nation-level deals, although the coefficient was marginally significant. Different from our expectations, we found no significant effects of prior deals, i.e. partner-specific alliance experience, on performance.

Finally, the results of this dissertation provide important insights into the antecedents of project-level governance and monetary incentives. In Chapters 2 and 3, we show that the degree of project-level governance hinges upon the presence of other governance mechanisms. More importantly, project-level governance is not only influenced by other governance mechanisms, but also influences them. Our results show that there is a positive bi-directional relationship between project-level governance and contractual complexity. Similarly, project-level governance and monetary incentives complement each other. Yet, the relationship between project-level governance and equity is one of substitution, i.e. greater project-level governance eliminates the need for equity investments, and vice versa.

We also identified several exogenous antecedents of project-level governance and monetary incentives. We find that the stage at signing of an R&D alliance affects project-level governance. Late stage deals have relatively greater project-level governance than early stage deals. Our results show that the technical scope of the alliance determines monetary incentives. Incumbents are willing to offer higher monetary incentives to startups for which the alliances have broad rather than narrow scopes.

5.2 THEORETICAL CONTRIBUTIONS

Strategic alliances literature

This dissertation makes a number of contributions to the alliance governance literature, the innovation management literature, and agency theory. First, this work extends the research on the determinants of alliance governance modes and the relationship between alliance governance mechanisms and alliance performance. Previous studies have primarily focused on the determinants of governance mechanisms including formal ones such as equity investments (Gulati, 1995; Gulati and Sing 1998; Oxley 1997; Pisano 1989) and contractual complexity (Reuer and Arino, 2007) as well as informal ones such as trust (Das and Teng, 2001, Puranam and Vanneste, 2009, Ring and Van de Ven, 1994). Although these studies provide important insights into circumstances under which firms form equity joint ventures instead of non-equity contractual alliances, craft detailed instead of incomplete contracts and use trust-based instead of formal governance, little attention is paid to the factors that determine the degree of project-level governance by alliance representatives and the size of monetary incentives offered by one partner to the other.

The literature points out the use of committee members and boundary spanners to control and coordinate alliance activities (Child, Faulkner, and Tallman 2005; Gerwin and Ferris, 2004), and in general to govern alliance assets (Hoetker and Mellewigt, 2009); however, empirical tests to identify the determinants of the day-to-day governance are scarce. Our finding that late-stage alliances have greater project-level governance than early-stage alliances is consistent with studies that emphasize the control and monitoring functions of committee members and alliance managers (Child, Faulkner, and Tallman 2005; Gerwin and Ferris, 2004, Mayer and Teece, 2008). Additionally and consistent with Gerwin and Ferris (2004), the global alliance governance structure, i.e. equity vs.

contractual, affects the need for micro-level governance. Complementary to their substitution view, we show that the relationship also exists in the opposite direction: greater project-level governance eliminates the need for macro-level governance mechanisms.

Our findings regarding the complementarities between project-level governance and monetary incentives and the negative effect of project-level governance on alliance performance are in contrast with the expectations of a relational view in alliances. Although, we solely take into account the control role of project-level governance in our work, previous studies note that alliance representatives play key roles in developing relational governance by building interpersonal trust and cooperation (Hoetker and Mellewigt, 2009; Ring and Van de Ven, 1994). Yet, it seems that formal role relationships are dominant at the alliance formation stage, and later on, they are less likely to transform into a relational governance approach. If it was the case, we would expect to see a positive effect of project-level governance on performance and a reduction in the requested monetary incentives.

This dissertation also contributes to the stream of strategic alliances literature germane to inter-organizational contracting processes. Argyres and Mayer (2007) discuss that the managers and technical personnel of a firm function as the repositories of the firm's contract capabilities. They suggest that these personnel play crucial roles in designing contractual terms primarily pertaining to *ex ante* specification of contingencies and operational problems. Likewise, Bamford, Gomes-Casseres, and Robinson (2003) and Slowinski and Sagal (2003) contend that alliance representatives responsible for the day-to-day management of alliances can improve alliance performance when they provide input at the contract negotiation and design stages. Consistent with these ideas, our work demonstrates that indeed greater project-level governance increases contractual detail, which in turn positively affects the performance.

Our findings regarding (1) the complementarities between project-level governance and monetary incentives in the context of startup-incumbent R&D alliances, and (2) the complementarities between project-level governance and contractual complexity and (3) the substitution effects between project-level governance and equity in the broader context of strategic R&D alliances contribute to previous research on the inter-relationships of

alliance control mechanisms. While the existing literature primarily investigated whether formal and informal governance mechanisms complement or substitute each other (Agarwal, Croson and Mahoney, 2010; Argyres, Bercovitz, and Mayer, 2007; Hoetker and Mellewigt, 2009; Poppo and Zenger, 2002; Ryall and Sampson, 2009), we concentrated on the relation between project-level governance and the other formal control mechanisms. Hence, we extend the debate on the relationship between formal and informal governance mechanisms by investigating the relationships between governance mechanisms with similar degrees of formalization.

Revealing the antecedents and consequences of monetary incentives is one of the most important contributions of this study to the strategic alliances literature. To best of our knowledge, this dissertation is the first to show the antecedents and consequences of the magnitude of pay-for-performance schemes in the context of strategic R&D alliances. Until now, investigations on monetary incentives have been limited and more importantly researchers have never distinguished between performance-based payments, such as milestone payments, and committed payments, such as upfront cash payments and equity investments. In this dissertation, we identified milestone-based payments offered to startups and consequently conducted a finer-grained analysis of them.

Our results demonstrate the importance od distinguishing performance-based payments from committed payments. First, the drivers of performance-based payments and committed payments are different. As previous studies have shown, the magnitude of committed payments is determined by the relative bargaining power of partnering parties, and the quality of technology brought by startup firm to the alliance, i.e., a function of the stage at signing and hold-up problems determined by the license exclusivity and the magnitude of irreversible and specialized investments in alliances (Higgins, 2007; Sakakibara, 2010). Typically, an incumbent and a startup negotiate how much the incumbent will pay for the license, for the reimbursement of the previous research expenses incurred by the startup and for the purchase of a share in the startups by taking into account the factors described above. In contrast, monetary incentives primarily depend on the performance risk faced by startup firms. Our results suggest that startup firms estimate their future performance risks, particularly those resulting from the strict day-to-day governance by the incumbent, when they negotiate milestone-based payments.

Second, the performance effects of milestone-based payments and committed payments differ in their significances and effect sizes. Performance-based payments have a slightly greater impact on performance, i.e. the odds ratio is 2.85 for monetary incentives and 2.80 for committed payments, and the coefficient is statistically more significant. Nevertheless, committed payments have only a direct and positive effect on performance, while monetary incentives have a positive direct and negative indirect effect on performance. Therefore, the presence of positive effects confirms the ideas of those against the transaction cost economics view of irreversible commitments. These opponents of TCE theory do not view initial investments to an alliance as a source of hold-up problems. For instance, Madhok and Tallmann (1998) argue that irreversible commitments by a firm in an alliance can also be perceived as a mechanism for a firm to give positive signals to its partners on its commitment; thus generating commitment and cooperation between partners, both of which are necessary for alliance success and survival. Their suggestion is different from TCE, because TCE does not focus on value maximizing. It instead focuses on the minimization of transaction costs. By revealing that early irreversible commitments by incumbents in R&D alliances are positively related to alliance success, our research provides more insights into R&D alliance deals than previous research that analyzed deals by combining committed payments and milestone-based payments under the 'deal size' construct such as Higgins (2007) and Adegbasan and Higgins (2011).

In addition, the findings of this work advance our understanding of the link between governance and firm performance. Research has demonstrated that startups benefit from engaging in alliances with other firms (Stuart, 2000). However, the firm-level performance implications of governance choices have been overlooked (Aggarwal, Siggelkow, and Singh, Forthcoming). By empirically showing that monetary incentives directly influence firm performance, we address this gap in the literature. Our finding regarding the positive effect of monetary incentives on a startup's abnormal stock returns reveals the importance of revenues generated in alliances in terms of a startup firm's market value.

This dissertation also provides empirical contributions to the strategic alliances literature. To conduct our test, we developed measures for project-level governance, monetary incentives, and alliance performance. Our measure for project-level governance takes into account the differences in control levels of committee members, alliance

managers and project managers by assigning weights to each of them. We believe that developing such a measure is necessary because of the differences in control responsibilities of alliance representatives. On the other hand, as we discussed, we used pre-commercialization milestone payments tied to the performance of startups as a measure for monetary incentives in the setting of bio-pharma alliances. Furthermore, forming contrast to prior studies that measure performance by self-assessment questionnaires, we measured it by using archival data sources, resulting in a more accurate depiction of performance levels.

Innovation management literature

By identifying micro-level governance mechanisms stemming from project-level organization, we contribute to the literature on the organization of innovation. This literature has extensively studied the organization of new product development projects, within the context of a single firm (see the meta analysis paper of Gerwin and Barrowman (2002) for an extensive review). Although some research on the organization of single firm new product development has involved the relations of firms with external agents during product development (Ancona and Caldwell, 1992), the research was still from the perspective of a focal firm. Nevertheless, a literature on the organization of collaborative innovation projects, between two or more firms, has recently emerged as a consequence of the prevalence of inter-firm R&D alliances (Carson, 2007; Gerwin and Ferris, 2004; Tiwana, 2008; Van den Ende, Jaspers and Gerwin, 2008). By examining the interplay between micro-level governance of an alliance determined by its project organization and its macro-level governance, we bridged different levels of governance and in turn advanced the bourgeoning literature on the organization of inter-firm development projects.

Moreover, by showing the impacts of project-level governance and monetary incentives on the performance of startup-incumbent vertical R&D alliances, we make another contribution to the organization of innovation literature. The finding regarding the negative impact of project-level governance on alliance innovation performance is consistent with the literature that discusses dysfunctions of control in innovative task settings (Andrews and Smith, 1996; Burns and Stalker, 1961; Carson, 2007; Ettlie, 1983; Thomas and Velthouse, 1990; Thompson, 1965). Furthermore, it is in line with the

literature on motivation and creativity which reports negative impacts of control on intrinsic task motivation, and in turn, on creative performance (Amabile, 1998; Kreps, 1997; Thomas and Velthouse, 1990). Yet, these studies have overlooked the magnitude of monetary incentives. We found that monetary incentives compensate for the performance risks transferred to startups. Furthermore, we showed that monetary incentives, encouraged in part by project-level governance, positively influence performance. Therefore, even though there is a direct and negative effect of control on innovation performance, this effect can be compensated by monetary incentives offered to startups. By demonstrating this, we extended prior research and provided a deeper insight into the control mechanisms used in innovative task settings.

Agency theory

Finally, this dissertation contributes to agency theory. There is a growing controversy among agency theorists over the relationship between monitoring and monetary incentives, particularly in the corporate governance setting. There are currently two opposing positions on the relationship: 1) a substitution position, and 2) a complementarities position. Proponents of the substitution position argue that when appropriate levels of monetary incentives are offered to agents, there is less need for a principal's monitoring, and vice versa (Rediker and Seth, 1995; Zajac and Westphal, 1994). On the other hand, proponents of the complementarities view argue that monitoring and monetary incentives complement each other (Hoskisson, Castleton and Withers, 2009; Milgrom and Roberts, 1992; Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997). One of the basic arguments is that the higher the control, the more performance risks are transferred to agents, which in turn leads to requests for higher monetary incentives by them. However, over-incentivizing increases the need for control (Hoskisson, Castleton, and Withers, 2009). Another argument is that if effort and outcome relationships are not well understood in a principal-agency setting, monitoring and incentives are likely to operate as complements (Milgrom and Roberts, 1992; Rutherford, Buchholtz, and Brown, 2007; Tosi, Katz, and Gomez-Mejia, 1997). As mentioned, the empirical setting of the previous studies on this controversial issue has been corporate governance, particularly CEO compensation. We contribute to this debate by extending research to the strategic

R&D alliance setting and showing that monitoring and monetary incentives complement each other in this novel setting.

5.3 PRACTICAL IMPLICATIONS

Several managerial implications emerge from this dissertation. As can be seen in Table 5.2, these implications can be grouped under four headings. First, managers, in general, should be aware of the contract design roles of alliance representatives, because their input is key to the formulation of contractual details and ultimately to the final performance of strategic R&D alliances. Furthermore, managers should take into account the complementarities and substitutions between different governance mechanisms when they design the governance structure of R&D alliances. The presence of two governance mechanism that substitute each other might be counter-productive. Likewise, the absence of one of the two complementary governance mechanisms might prevent the effective implementation of the present governance mechanism. For instance, monetary incentives will lose their effectiveness under the absence of necessary *ex post* monitoring mechanisms, such as committee members and alliance managers.

Second, this study provides important insights for the managers of large established firms. They should be cautious about the degree of project-level governance they exert on their partner in their strategic R&D alliances. This is not only because strict project-level governance leads to higher monetary incentives and possible higher future payments to their partners, but it is also because strict governance negatively impacts alliance innovation performance. Furthermore, they should avoid short-sighted controls through formal reviews and evaluations because these managerial actions will inhibit the problem-solving ability of their partners. If the incumbent wants to facilitate the transformation of their partners' scientific output of into marketable products, then they should allow their partners to make mistakes and not immediately punish them by terminating the partnership without allowing the startup to probe and search for the "right answer".

Third, managers of small startup firms must take into account the possible dysfunctions of day-to-day control by incumbents when they negotiate alliance deals. By invoking the strategy of compensating for performance risks, caused by over-control, through the use of monetary incentives the startup can avoid a problematic deal. Furthermore, they should

consider the fact that higher monetary incentives will lead to higher abnormal stock market gains for the startup.

Table 5. 2 Summary of implications for practice

Audience	Practical Implications
Managers of firms engaged in R&D alliances (in general)	Use alliance representatives not only for the *ex post* control of strategic R&D alliances but also for designing contracts, because their early involvement in contracting and deal-making improves alliance performance. (Chapter 2) Awareness of the complementarities or substitutions between micro-level and macro-level, as well as *ex ante* and *ex post* governance mechanisms. (Chapter 2,3,4)
Managers of incumbents engaged in vertical R&D alliances with startups	Strict day-to-day governance by an incumbent will cause not only negative performance effects on alliance innovation performance, but also higher monetary incentives and consequently higher payments from the incumbent to the partner. (Chapters 3and 4) Think twice before terminating an alliance after vigilant evaluation of failed test results by alliance committees. Do not forget that development activities involve significant amounts of trial-and-error. (Chapter 4)
Managers of startups engaged in vertical R&D alliances with incumbents	Do not forget to bargain for monetary incentives by considering the degree to which the startup firm will be exposed to day-to-to governance by the incumbent partner. (Chapter 3) Think about the relation between monetary incentives offered to the startup firm by the incumbent partner and abnormal stock returns following the alliance announcement. The higher the monetary incentives, the higher the abnormal stock returns will be. (Chapter 4)
Alliance deal analysts	Take into account organizational choices that determine the degree of project-level governance by incumbents when determining the value creation potential of the strategic alliance for the startup firm. (Chapter 4) Request information about partners' choice over formal alliance representation roles, if the partners have not disclosed the transaction to the public. This information is relatively less confidential than other types of information in alliance contracts, leading to a high chance of availability. Alternatively, look at prior deals of the incumbent firm, and try to estimate how it organizes the day-to-day control of partnerships. (Chapter 4)

Finally, deal analysts must think about the link between day-to-day governance and performance when they conduct value analysis. Giving more emphasis to monetary incentives compared to project-level governance might result in the wrong prediction of a startup's value creation in its R&D alliance with an incumbent. Therefore, analysts should

gather information about deal structure from contracts, and if not possible, from asking alliance management units or projecting an estimate based on prior deals of the incumbent partner.

5.4 LIMITATIONS AND FUTURE RESEARCH

This dissertation is not without limitations, and we note them as possible future research opportunities. Our research shares the same limitations of any single industry study. While we have no reason to believe that the U.S. pharmaceutical industry is less generalizable than any other setting, similar studies in other industries would be valuable.

Throughout this dissertation, we focus primarily on the formal control-based roles and responsibilities of alliance representatives. Even though this choice helps us in explaining the relationship between project-level governance and other formal mechanisms and in showing the impact of project-level governance on performance, the roles and responsibilities of alliance representatives might be more diverse in practice than modeled here. Previous studies have addressed various, less formal roles of alliance representatives. For instance, Spekman et al (1998) list seven different roles for alliance managers. Among them, vision creation, strategic sponsorship of the partner, advocacy of the alliance within the firm, networking to provide resources for the alliance and facilitating the growth of an alliance; these roles are different from formal alliance control roles that we depicted in this dissertation. Likewise, Bamford, Gomes-Casseres, and Robinson (2003) note the internal and external championing roles of alliance managers in addition to their role of controlling partner behavior. Although steering committee members and functional committee members of a partnering firm are primarily responsible for formal control of the alliance, that does not mean that they would not also engage in internal and external championing. Therefore, the investigation of the relationships between alliance representatives of an incumbent firm and a startup firm during an alliance, from different theoretical perspectives, might represent fruitful areas of research that can improve our understanding of alliance governance mechanisms and ultimately alliance performance. Future research may look at how the internal and external championing roles of alliance representatives affect alliance performance from a resource dependency perspective. Future studies that can successfully identify the circumstances in which the alliance representatives of

incumbents provide key resources to their partners will shed light on different aspects of the day-to-day governance of strategic R&D alliances.

We could not investigate partners' decision regarding which partner will chair the committees. Having the right to chair meetings may moderate the effect of project-level governance on monetary incentives and performance. We noticed from the alliance contracts that one partner may appoint its representative as the single chairman, both partners may appoint their representatives as chairmen or the partners may opt for a rotating chairman option. Future research may investigate how this choice affects other governance mechanisms and performance.

Different decision-making styles used in these committees require further research. When gathering data from alliance contracts, we realized that partners included terms that assign decision-making rights to a single party, if that party possesses the necessary knowledge to make decisions. In other words, although joint committees typically operate under a consensual decision-making principle, in some special cases they delegate the authority to a single party that has the relevant expertise in the domain of the decision. Future studies can compare the effectiveness of this decision-making style with more traditional consensus-based decision making styles.

When we examined the relation between project-level governance and contractual complexity, we measured contractual complexity as the number of pages in an alliance contract. Finer-grained measures might be used to better understand the nature of the relationship between the two mechanisms. Future research might examine which clauses are added to the contract when greater project-level governance takes place, and to what degree project-level governance becomes stricter depending on the presence of specific clauses in a contract.

We employed agency theory in this dissertation when we investigated the relationship between project-level governance and performance-based monetary incentives and their effects on performance. Alternatively, future studies can integrate agency theory with other theories to explain the link between the two governance mechanisms and performance. Indeed, previous studies integrated agency theory with other paradigms in the context of corporate governance to explain CEO pay (Barkema & Gomez-Mejia, 1998, Jensen & Murphy, 1990). The strategic alliances literature can also benefit from this approach.

Stewardship theory can be an appropriate candidate, because it challenges the assumptions of agency theory by noting that not all agents are self-interested and motivated by financial rewards (Davis, Schoorman, and Donaldson, 1997). While our research showed that monetary incentives increase alliance innovation performance, it is unclear to what extent startups are opportunistic. In practice, it might be the case that startups have less of a tendency to act opportunistically because they have stakes in the future of their projects and they know that opportunism will not only be harmful to their partners, but also to them. Therefore, a better design of monitoring and incentive mechanisms can be achieved if the premise of stewardship theory can be combined with the premise of agency theory.

The bourgeoning literature on the relationship between alliance representatives of an incumbent and its startup partner might benefit further from the theories tested in the corporate governance setting. Recent research on social influence tactics used in boardrooms (Stern & Westphal, 2010) may help researchers explain the different outcomes of project-level governance. While we showed, in this dissertation, that when a startup faces higher performance risk, because of greater project-level governance, it tends to request higher monetary incentives to compensate its risks. Alternatively, it can use social influence tactics to gain the political support of some representatives at the incumbent firm. One social influence tactic that can be used by a startup firm is to explicitly or implicitly offer executive management positions in the startup or at one of its affiliates or close collaborators. Knowing that he or she will be an executive director in one of the startup firms, the representative would be less vigilant in its evaluation of alliance outcomes developed by the startup. Hence, social influence tactics may weaken the need for higher monetary incentives in cases for which the degree of project-level governance is high.

Our results reveal both upsides and downsides of formal management principles. On the one hand, monetary incentives positively influence alliance innovation performance. On the other hand, project-level governance negatively influences alliance innovation performance. Furthermore, we observed in our sample that on average more than 50% of R&D alliances were terminated without successful outcomes. These facts cause controversy over the effectiveness of formal management principles used in innovation

alliances as well as the effectiveness of alliances as an organizational mode of innovation. Particularly, the experts of the US biopharmaceutical industry have long been questioning the effectiveness of the drug R&D models; in particular the formal management principles used by large pharmaceutical firms and the R&D alliances these firms form with small firms to develop new drugs. As a result, these biopharmaceutical experts have been offering novel industry-level organizational forms to overcome the drawbacks of formalization and alliances in general (Roth and Cuatrecasas, 2010). We believe that further research is necessary to compare the innovation rates of internal R&D, external R&D through alliances, and novel forms of external R&D to help firms find effective ways to organize for innovation.

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SUMMARY

Alliances are collaborative agreements between two or more independent firms to achieve various strategic purposes. In the R&D context, firms engage in strategic alliances to jointly develop new technologies and products. In these inter-organizational relationships, alliance governance plays a central role in determining alliance performance, because it aligns the partners' incentives. Prior research examined the influence of different forms of alliance mechanisms on alliance and firm-level performance. Yet, few studies have examined the antecedents and performance outcomes of two of these different governance mechanisms: 1) day-to-day project-level governance by firms' alliance representatives and 2) performance-based monetary incentives.

The potential upsides of these two governance mechanisms are that they mitigate moral hazard and adverse selection problems faced by the partners. On the other hand, the potential downsides are that they can result in over-control or biased-control, both of which might negatively affect innovation performance, particularly that of the partner responsible for developing the innovation. Hence, managers face a challenge when they decide on the extent to which they should use these two governance mechanisms in R&D alliances. In order to address this challenge, we examine the antecedents of these governance mechanisms, the relationship between them, and their impacts on alliance and firm-level performance in the U.S. biotechnology setting.

In Chapter 2, we discuss the three main roles of project-level governance: 1) contract design, 2) contract enforcement, and 3) contract adaptation. The tests on a sample of 316 strategic R&D alliances of US-based biotechnology firms with established pharmaceutical firms as well as other biotechnology firms reveal that project-level governance complements contractual complexity and substitutes equity in the context of strategic R&D alliances. Furthermore, the results show that late stage alliance deals have greater project-level governance than early stage alliance deals. Finally, the findings demonstrate that higher contractual complexity, encouraged in part by greater project-level governance, has a positive impact on alliance innovation performance.

In Chapter 3, in contrast to the second chapter, we focus solely on startup-incumbent alliances, i.e. those between biotechnology firms and pharmaceutical firms. We aim to explain the relationship between project-level governance exercised on startups by the

controllers appointed by the incumbents and performance-based monetary incentives offered by incumbents to startups. By drawing upon two competing positions in agency theory, i.e. the substitution and complementarities positions, we develop two alternative hypotheses. The tests on a sample of 220 strategic R&D alliances show that there is a positive reciprocal relationship between project-level governance and performance-based monetary incentives in the context of startup-incumbent strategic R&D alliances.

In Chapter 4, we examine performance outcomes of project-level governance and performance-based monetary incentives in the same setting as Chapter 3. The results show that monetary incentives have direct positive effects on alliance innovation performance and startups' abnormal stock returns following alliance announcements. On the other hand, project-level governance performed by the controllers appointed by the incumbents has a negative effect on alliance innovation performance, and has no significant effect on the startups' abnormal stock returns following alliance announcements. Hence, the results suggest that project-level governance and monetary incentives offset each others' effects on alliance innovation performance in the context of startup-incumbent alliances. An implication of this finding is that offering greater monetary incentives to startups has only a minimal positive effect on development success, if the incumbents simultaneously opt for intense project-level governance. Hence, the results support behavioral agency theory which predicts that project-level governance increases risk aversion of startups, and, in turn, reduce alliance innovation performance. Moreover, we extend the literature on innovation management by showing that under higher performance-based payments, the negative effects of control were offset.

The findings of this dissertation make noteworthy contributions to the alliance governance and innovation management literatures as well as to agency theory. Furthermore, this thesis has important practical implications for managers who are responsible for designing governance structures for R&D alliances. Finally, deal analysts and investors can benefit from the findings of this study.

SAMENVATTING

Allianties zijn samenwerkingsverbanden tussen twee of meer onafhankelijke ondernemingen om bepaalde strategische doelen te verwezenlijken. In de R&D context nemen ondernemingen deel in strategische allianties om gezamenlijk nieuwe technologieën en producten te ontwikkelen. In deze inter-organisatorische relaties heeft de besturing van de alliantie een belangrijk effect op de alliantieprestaties, aangezien het de partners informatie verschaft over elkaars activiteiten en de incentives van de partners met elkaar in lijn brengt. Eerder onderzoek heeft de invloed van verschillende alliantiemechanismen onderzocht op alliantie- en ondernemingsniveau. Weinig onderzoekers hebben de antecedenten en effecten op prestaties van twee besturingsmechanismen onderzocht: 1) besturing van de alliantie op projectniveau, en 2) op prestaties gebaseerde financiële beloningen.

De potentiële positieve kanten van deze twee besturingsmechanismen zijn dat ze de partners informatie verschaffen over elkaars activiteiten en de beloonde partij stimuleren om de juiste prestaties te leveren (en daarmee het 'moral hazard' en 'adverse selection' problemen verminderen). Aan de andere kant is het potentiële nadeel dat ze kunnen resulteren in over-controle of subjectieve controle, welke beide een negatieve invloed kunnen hebben op de prestaties van de alliantie, en meer in het bijzonder op de partner die verantwoordelijk is voor de ontwikkeling van de innovatie. Managers staan voor de uitdaging te beslissen in welke mate zij gebruikmaken van deze twee besturingsmechanismen in R&D allianties. In dit proefschrift worden daarom de antecedenten van deze twee besturingsmechanismen, de relaties ertussen, en hun impact op de prestaties van de alliantie en van de ondernemingen onderzocht.

In hoofdstuk 2 bespreken we de drie algemene functies van besturing van allianties op projectniveau: 1) het ontwerp van de contracten, (2) het toezien op de naleving van de contracten, en 3) de aanpassing van de contracten. Het onderzoek uit dit hoofdstuk, gebaseerd op een steekproef van 316 strategische R&D allianties tussen biotechnologie ondernemingen gevestigd in de Verenigde Staten en farmaceutische ondernemingen, laat zien dat besturing op projectniveau complementair is aan contractuele complexiteit en een vervanging vormt van het investeren in het partnerbedrijf als geheel. Bovendien laten de resultaten zien dat alliantie-deals in een laat stadium een sterkere besturing op

projectniveau hebben dan deals in een vroeg stadium. Ten slotte laten de resultaten zien dat grotere contractuele complexiteit, deels aangemoedigd door sterkere besturing op projectniveau, een positieve impact heeft op de innovatieprestaties van een alliantie.

In hoofdstuk 3 richten wij ons, in tegenstelling tot in hoofdstuk 2, enkel op allianties tussen start-ups en gevestigde ondernemingen, dat wil zeggen, allianties tussen biotechnologie ondernemingen en farmaceutische ondernemingen. We willen hiermee de relatie verklaren tussen enerzijds besturing op projectniveau van projecten uitgevoerd door start-ups door managers die zijn aangesteld door de gevestigde onderneming, en anderzijds de prestatie-gebaseerde financiële beloningen door die gevestigde ondernemingen aan de start-ups. Door gebruik te maken van twee concurrerende posities in de agency theorie, namelijk de substitutie- en complementariteitsposities, hebben wij twee alternatieve hypotheses ontwikkeld. Een toets op een steekproef van 220 strategische R&D allianties laat zien dat er een positieve wederkerige relatie bestaat tussen besturing op projectniveau en prestatie-gebaseerde financiële beloningen in R&D allianties tussen start-ups en gevestigde ondernemingen.

In hoofdstuk 4 onderzoeken we de effecten van besturing op projectniveau en van prestatiegebaseerde financiële beloningen op de prestaties van de alliantie in dezelfde setting als in hoofdstuk 3. De resultaten laten zien dat financiële beloningen een direct positief effect hebben op de prestaties van een alliantie en op de beurskoersen van start-ups in vergelijking met de markt na de aankondiging van de alliantie. Aan de andere kant heeft besturing op projectniveau door de gevestigde ondernemingen een negatief effect op de prestaties van de alliantie en heeft geen significant effect op de beurskoers van startups als gevolg van de aankondiging door de alliantie. De resultaten suggereren dat de besturing op projectniveau en financiële beloningen elkaar compenseren wat betreft de effecten op prestaties van allianties tussen start-ups en gevestigde ondernemingen. Een implicatie van deze bevinding is dat het aanbieden van grote financiële beloningen aan start-ups slechts een klein positief effect heeft op de prestaties, omdat de gevestigde partij gewoonlijk gelijktijdig kiest voor intensieve besturing op projectniveau. De resultaten ondersteunen de ‘behavioral agency theory’, welke voorspelt dat besturing op projectniveau de risicoaversie van start-ups verhoogt, wat op zijn beurt de prestaties van allianties vermindert. Bovendien dragen we bij aan de literatuur op het gebied van innovatiemanagement door te laten zien

dat hoge prestatiegebaseerde beloningen de negatieve effecten van controle kunnen compenseren.

De bevindingen in dit proefschrift vormen een belangwekkende bijdrage aan de alliantie-governance en innovatiemanagement literatuur, maar ook aan de agency theorie. Verder heeft deze thesis belangrijke praktische implicaties voor managers die verantwoordelijk zijn voor het ontwerpen van besturingsstructuren voor R&D allianties. Tot slot kunnen ‘deal analisten’ en beleggers profiteren van de bevindingen in dit onderzoek.

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Mahmut N. Ozdemir was born on November 9th 1981 in Ankara, Turkey. He completed most of his education in Turkey. He holds a B.S. in Industrial Engineering from Bilkent University, Ankara, where he graduated with high honors. He also holds double MSc degrees in Management and Industrial Engineering from Sabanci University, Istanbul. He joined to Rotterdam School of Management, Erasmus University in 2006 and worked there for 5.5 years. In 2011, he will join to Koc University, Istanbul, as assistant professor of strategy and management.

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PROJECT-LEVEL GOVERNANCE, MONETARY INCENTIVES AND PERFORMANCE IN STRATEGIC R&D ALLIANCES

A growing number of firms rely on strategic R&D alliances to develop new products. In these alliances, firms use various kinds of governance mechanisms for incentive alignment. Project-level governance, i.e., the daily control of alliance activities by firms' alliance representatives such as steering committee members, alliance managers, and project managers, and performance-based monetary incentives, i.e., potential payments tied to the performance of partners, are two governance mechanisms, increasingly used in practice yet overlooked in the strategic alliances literature. In this dissertation, I examine the antecedents and performance outcomes of these two governance mechanisms in the biopharmaceutical industry setting.

The results of this dissertation suggest that project-level governance and monetary incentives offset each others' effects on alliance innovation performance in the context of startup-incumbent alliances. In other words, offering greater monetary incentives to startups has minimal positive effect on the development success, if incumbents exercise intense project-level governance by their controllers at the same time. On the other hand, the results suggest that greater monetary incentives result in higher abnormal stock returns to startup firms following alliance announcements. I also find that greater project-level governance positively influences the contractual detail, which in turn increases the likelihood of development success. Finally, I reveal several other exogenous and endogenous antecedents of both governance mechanisms.

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