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Doctoral Thesis

Title:

Three Essays on Innovation Performance, Aspirations and Strategic Decision Making

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Chapter 1. Introduction

1.1 A premise

My research interests lie at the intersection of Strategy and Innovation. The research I developedduring my doctoral dissertation, the present manuscript, focuses on the understanding of the role that innovative performance plays in influencing strategic decision-making at the organizational and individual level in knowledge intensive contexts. In particular, I have been interested in looking at how organizations and individuals use specific reference points to assess their own performance generating a feedback mechanism that serves as the basis of motivation to engage in change in the patterns of strategic behavior.

What are the main theoretical traditions I refer to when developing my conceptual offerings? What is the empirical heritageI receive from previous research to further interpret my theories? And, indeed, *what are the main desired contributions of my doctoral research proposed in this manuscript?* Finally, *why would my doctoral research be important to the Management community?* These are questions that have certainly been motivating me along the doctoral research process and that have been important "references" to design and write my doctoral dissertation.Despite each section of the main body of the thesis (Chapter 2, Chapter 3 and Chapter 4) will offer detailed answers to these three fundamental questions, in this Introduction chapter, I will provide an initial answer to these questions to theoretically position my doctoral dissertation; in the Conclusions chapter, I will focus more on the contributions of this manuscript.

1.2 A Theoretical Background

In my doctoral dissertation I mainly refer to four fairly interrelated theoretical traditions: Behavioral Theory of the Firm (Cyert and March, 1963), Prospect Theory (Kahneman and

Tversky, 1979), Evolutionary Economics (Nelson and Winter, 1982) and Knowledge-Based View of the firm (Kogut and Zander, 1992; Grant, 1996).

According to Behavioral Theory of the firms (Cyert and March, 1963), organizations are goal-directed systems and use specific reference points (historical and social) to assess their strategies in order to adapt their behavior in response to performance feedbacks. In particular, depending on whether organizational performance is below or above the reference points, organizations initiateproblemistic search and slack search processes as adaptive behavior, which likely generate organizational change. As a direct descendent of the behavioral theory of the firms, Nelson and Winter (1982) formulate an evolutionary theory of the firms, where the concept of "routine" is the basic element of firm behavior, suggesting that stable nature of the routines is triggered by change in response to the performance feedback model. In fact, while routines are stable patterns of behavior (Winter, 1964), organizational routines can be either reinforced or changed depending on the positive or negative outcome of the organizational actions.

While Cyert and March (1963) and Nelson and Winter (1982) generated organizational theories to explain decision-making behavior, similar predictions have also been offered at the individual level. In their Prospect Theory, Kahneman and Tversky (1979) point out the key role of the reference point or target for denying the decision maker's attitude towards risk. In particular, risk taking is affected by the relation between current position and some critical reference points (Kahneman& Tversky1979): individuals change their preferences towards a more risk taking profile when they expect negative outcomes and tend to maintain their preference (risk averse) when they expect positive outcomes.

Therefore, from these three theoretical traditions the organizational and individual strategic decision-making is the result of performance feedbackbased on specific reference points that generate an adaptive behavior. Analyzing these theoretical frameworks in their main assumptions and propositions, I propose at least two possible aspects that might be subject of further conceptual development: performance construct and reference point.

Regarding the performance construct, I develop two main considerations. Firstly, although Cyert and March (1963) suggest that organizations have multiple goals to achieve and each of these goals is reflected in different organizational performances, financial performance has been the most employed so far in performance feedback models. On the one hand, there has been a systematic attempt to operationalize it in different ways (i.e. return of assets, return on equityand return on sales). On the other hand, few attempts have been made to use other types of performance measures than financial. However, most of the wisdom we have from these theories is based on the assumption that performance feedback processes are based on assessment of the financial organizational results. Secondly, financial performance is a broad measure of a firm's overall financial health and it results from the combination of several interrelated activities within the organization. Hence, causal ambiguity of financial performance is less clear when it has to function as an input to assess the nature and location of a problem. But, these current theories suggest organizational adaptive behavior considering a general concept of performance, without necessarily linking the nature of the performance in itself and the subsequent decisional heuristics employed by the decision maker as a response to the feedback. Therefore, *what would the predictions be if considering other theoretical assumptions on the input of the feedback process, such as a different and more accurate performance constructs?*In this regards, my doctoral dissertation is an attempt to offer another goal dimension (i.e. Innovation) as input

forthe performance feedback model. Building on the Knowledge-Based view of the firm (Kogut and Zander, 1992; Grant, 1996), I argue that innovation, as the critical resource to generate competitive advantage (especially in high knowledge intensive industries),is not just an outcome to reach (as for the traditional StrategicManagement theoretical perspective), but itcould be also an input to assess the organizational behavior. In this sense, I offer theoretical arguments on the reasons why innovative performance would suggest revisited predictions on the organizational and individual behavior when employed as input in the performance feedback model for strategic decision-making.

Regarding the reference point, overall, the theoretical traditions mentioned above offer historical and social aspirations levels as reference to assess the performance and calibrate the response. Looking closer to the social reference point, this constructs has been proposed as the performance of the average industry performer; in other words, organizations tend to compare themselves with any other player of the competitive arena, therefore generating decision making processes that reflect an evaluation of their managerial actions and processes in comparison to a smallspecified reference point. Economic and managerial theories suggest that organizations choose a specific social reference when assessing their behavior. In this sense, the response of an organization could be predicted as heterogeneous depending on the reference point associated in the performance assessment process. Therefore, *what would the predictions be if refining the social reference point in a more meaningful way?*

Among others, these are the main questions I will address in my doctoral dissertation in order to attempt to develop new theoretical offerings to the current theories on strategic decision making and performance feedback.

1.3 Main empirical heritage

Since the early 90s, starting from the theoretical foundations of the performance feedback models, a relatively recent and rich empirical tradition emerged within the strategic management community.

Performance feedback models have been applied in the study of several types of organizational strategic changes. Some examples are markets, products launches, and levels of R&D, practices and processes.While each dissertation chapter will offer a review of the most important empirical contributions, HenrichGreve's work deserves some initial special attention. In fact, Greve H. has been probably the most prolific scholar in offering empirical research on the relationship between performance and strategic organizational behavior. Focusing mainly on the shipbuilding and insurance industries, overall his studies tend to confirm the theoretical predictions offered by Cyert and March (1963). In fact, to a large extent,Greve's evidence suggests that: organizations performing below their aspirations have a higher likelihood to change their strategic behavior, in contrast to organizations performing above aspirations that show reluctance to change their pattern of strategic behavior. Building on these main findings, more recent work attempts to enrich his work either examiningnovel strategic changes to explain reactions to performance deviation from aspirations (ex. Shipilov et al., 2011) or offering simulation studies to deeper understand the common theoretical and empirical wisdom on the performance feedback model, organizational change and inertia (ex. Hu et al, 2011; Ethiraj and Levinthal, 2009).

Looking closer to Greve's work and the related more recent empirical developments, I realized that some possibilities exist to both increase understanding on mixed results and directly respond to some specific empirical calls. First of all, most of the empirical research found

stronger results when assessing the relationship between performance and historical aspirations levels than social aspirations levels. These might be explained by the choice of the comparison group for each focal firm when assessing the performance, but also by certain organizational characteristics that influence directly the decision making process. In this latter sense, recently Greve (2011) explores how small and large firms have distinct responses to performance because of differences in risk aversion and internal rigidity. But, it is different to understand how the decision maker compares herself to other organizations. In this sense, little has been done to propose other comparison groups than the average (or median) performer within the industry. Greve (2008) is one of the few exceptions. Using size as the main driver, he offers arguments why insurance companies generate social comparisons with those more similar in size. I believe this could be one of the main sources of the weakness of the results on social aspiration in predicting strategic change (compared to the results on historical comparison). So, one of the empirical questions I deal with in my doctoral dissertation is*what are possible alternative operationalization/adjustments of the reference group for social aspiration level computation?*

Secondly, very little has been done to operationalize differently the organizational goals. Exceptions in this sense are: Greve (2008) proposing organizational growth as an additional goal dimension to financial performance and Gaba and Bhattacharya (2012) looking at how performance deviations of the innovation goal from aspirations predict the choice of externalizing R&D activities via CVC (Corporate Venture Capital) for information technology firms. In this regard, I respond directlyto the research call posed by Greve (2008)"it would be interesting to investigate which goals other than profitability and size affect organizational behaviors" (pp. 490). So, *would innovation be a valid goal that matters for organizational strategic decision-making?*

Thirdly, I believe that part of the explanation of the low predictability power of the social aspiration constructs lies in the level of analysis. In fact, several studies either propose weak or no empirical evidence or combine it with the historical aspiration in order to have a unique aspiration construct, which the firm refers to. I believe these results on social aspiration level might also depend on the level of analysis of previous studies, mainly focused on organizational level. At this level of analysis, the aggregation of different processes to a unique behavior observed from an external standpoint might confound the decision maker to identify the correct reference point when assessing socially its performance. For example, considering two firms within the same industry: are they more comparable when having asimilar strategic position? Or similar size? Or similar market share? Or similar relevant administrative processes (i.e. productive and marketing)? And, in the case of high-tech industries, would R&D expenditure or intensity be a more appropriate dimension to employ in order to get precision in organizational comparability? I believe an organization experiences difficulty observing directly processes (and routines) of other organizations, making this multi-dimensionality in comparison the key confounding factor in assessing precisely a reference group. Moving to the individual level could be a possible alternative approach to increase the explanatory power of the social aspiration construct. In fact, individuals are more likely to observe each other and have simpler heuristics to assess peers within a large group. Social comparison theory also suggests this (Festinger, 1954). Organizational structure also helps individuals to identify themselves in specific group and roles, making easier the identification of the peers. Experience, tenure, organizational roles and other observables increase the ability of the agent to identify the peer group, making more appropriate and accurate the social comparison of the focal individual performance with the reference group. So, another question I attempt to answer with my doctoral dissertation is: *would individual level*

of analysis be a more accurate perspective to assess the predictive power of social aspirations? Chapter 3 and Chapter 4 of my doctoral dissertation are specifically dedicated to this mission.

And finally, at the other extreme of the previous point, I propose to study organizational phenomena at the corporate level. While the previous points suggests that individual level analysis should be considered more consistently, here I also respond to another call of Greve (2008) to move from the study of how performance feedback models predict organizational business strategy to the corporate level. Quoting Greve directly "Are mergers done primarily because of firm experience and availability of good targets, or do firms' aspiration levels for size influence their pursuit?" (pp. 490). In particular, building on a few previous studies (Anand and Singh, 1997; Baum et al., 2005; Iyer and Miller, 2008), Chapter 2 of the here presented doctoral dissertation aims to develop a study, among other research goals, to respond directly to this call.

1.4 Structure of the Doctoral Dissertation

My doctoral dissertation is articulated in three main chapters, which represent three current working papers.

The second chapter of the dissertation examines the conditions under which pharmaceutical firms change their partnering behavior (i.e. alliance and acquisitions portfolio) in response to innovative performance deviations from historical and social reference points. In technology intensive industries, firms use alliances and acquisitions to acquire knowledge from external sources and hence enhance their own innovative abilities and performance. Prior research considers decision-making regarding governance modes to be risky and rational in nature, often ignoring how performance feedback affects decisions on mode choice and the role

of perceived risk associated with different mode choices. Building on assumptions from behavioral theory and evolutionary theories of the firm, I develop a more sophisticated theoretical model of the organizational and technological conditions under which firms are motivated to change their risk taking profile in governance choice routines across time. Previous research on organizational risk-taking focuses on financial performance as the main trigger to generate organizational strategic change. I offer arguments to support the idea that innovative performance complements financial performance in motivating managers of pharmaceutical firms to engage in change of alliance and acquisitions activities, and actually in different ways. Testing a sample of 988 pharmaceutical firms from 1990 to 2006, my results confirm the central idea of the study - that the type of performance (financial or innovative) has a strong influence on the associated feedback loop and subsequent organizational action. When financial performance deviates from aspirations (either above or below), pharmaceutical firms decrease the extent of change in partnering patterns; in contrast, when innovative performance deviates from expectations (either above or below), pharmaceutical firms increase the extent of change in partnering patterns. My results are stronger for aspiration levels based on historical comparisons than those for social comparisons.

The third chapter of the dissertation investigates an inventor's motivation to engage in inter-organizational mobility. In particular, the main research question is "*why do inventors move across organizations?"*Initially, I provide a review of the theoretical and empirical research on employees' mobility in high intensive knowledge industries. In particular, I ask who moves (i.e. motivation to move), where inventors move (i.e. pattern of mobility) and performance implications for the moving inventor. Focusing on the first question (i.e. who moves), Chapter 3 is an exploratory attempt that seeks to build on behavioral and prospect

theory, particularly, on the literature of managerial risk taking in order to explore the motivational influences on individual mobility across firms in the pharmaceutical industry - specifically how performance deviations from specific reference points (aspirations) explain the likelihood of mobility (a risky action). To test my hypotheses, I collected patents for 4,940 inventors (1,431 movers) belonging to the top five global pharmaceutical firms between 1975 and 2008. In line with the theoretical traditions mentioned above, our results suggest that when an inventor performs above her aspiration level (both historical and social), we found support for risk adversity arguments (i.e. less likely to change employer); when an inventor performs below her aspiration levels is more likely to engage in inter-organizational mobility, such as risky action, but only when comparing her performance to the social aspirations (i.e. risk taking profile).

Finally, Chapter 4 builds on the main findings of Chapter 3 and it attempts to offer a more comprehensive model to explain the antecedents of talented employee mobility. Previous research explains inter-organizational mobility as a result of environmental conditions (for example: presence of non-compete agreements), internal and external market labor incentives structures and inventor's technological characteristics. Thus, mobility has been mainly predicted as an event reflecting opportunity/capability arguments coming from the relationship between the employee and the labor or entrepreneurial market. However, so far motivational arguments have received less attention. In fact, we do not have a clear understanding on the sociological underpinnings characterizing mobility, in particular about the inventor's motivational rationales behind the engagement in such risky decision. I build my hypotheses on behavioral and prospect theory, particularly, on the literature on managerial risk taking in order to explore the motivational influences on individual mobility across firms in the pharmaceutical industry -

specifically how performance deviations from specific reference points (aspirations) explain the likelihood of mobility (a risky action). Using the sample mentioned above for Chapter 3, the results of our research confirm and extend previous studies on mobility: firm's incentive structure to retain talented employees and inventors' labor market explain the likelihood of mobility, as well as inventor's performance deviations from social aspiration levels also predict inventor's likelihood of mobility.

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Chapter 2. Aspirations, Performance, and Changes in Partnering Behavior:Evidence from the Pharmaceutical Industry 1990 – 2006

Note on the Chapter 2

The paper is co-authored with Prof. Paul Almeida and Prof. Pedro Parada. The presented dissertation chapter refers to working paper version in January 2012.

The working paper has been awarded as DRUID Conference Working Paper Publication 2011.

In the near future, the paper will be finalized and submitted to Academy of Management Journal.

Abstract

Building on the prior research on aspiration levels and managerial decision making, we examine the conditions under which pharmaceutical firms change their partnering behavior across time. Using insights drawn from behavioral theory and evolutionary theory of the firm, we argue that any change in partnering behavior is considered risky, and is triggered by the gap between actual performance and aspirational performance. Testing a sample of 988 pharmaceutical firms from 1990 to 2006, our results confirm the central idea of the paper - that the type of performance (financial or innovative) has a strong influence on the associated feedback loop and subsequent organizational action. When financial performance deviates from aspirations (either above or below), pharmaceutical firms decrease the extent of change in partnering patterns; in contrast, when innovative performance deviates from expectations (either above or below), pharmaceutical firms increase the extent of change in partnering patterns. Our results are stronger for aspiration levels based on historical comparisons than those for social comparisons.

2.1 Introduction

Behavioral theory offers us an important insight - that past performance influences subsequent decision making in organizations (Cyert and March, 1963; Levitt and March, 1988). This observation has led researchers to investigate the relationship between organizational performance and associated change (Miller and Chen, 1994; Ocasio, 1995). An important idea underlying this stream of research is that it is not just absolute levels of performance that matter but rather, the gap between actual performance and desired performance (aspiration levels). The actions of managers differ depending on whether organizational performance is above or below their aspiration levels. These aspiration levels are determined by historical performance (current performance relative to own previous performance) or social performance (performance relative to peers) (Kahneman and Tversky, 1979; March and Shapira, 1992; Greve, 1998). The conceptual reasoning supporting this research stream calls upon behavioral concepts of problemistic search and slack resources (Cyert and March, 1963) and suggests that organizations adjust their risk preferences in actions whenever performance deviates from aspirations.

In a recent special issue of Organization Science, Argote and Greve (2007) describe current research trends in the behavioral tradition and explain how the building blocks developed by Cyert and March (1963) have become the foundation for theoretical and empirical research in a wide range of fields including organizational learning theory and evolutionary economics. Argote and Greve (2007) suggest that the rich contributions in this field have generated theoretical and empirical puzzles in management studies, in particular around concepts related to performance feedback, risk preferences, and organizational change. In modeling the relationship between these concepts, most studies have adopted the theoretical perspective that organizations grow averse to risk when they perform above their aspiration levels (Bromiley et al., 2001;

Greve, 1998, 2003a, 2003b; Nickel and Rodriguez, 2002), and this results in lower levels of organizational change. However, when performance is below aspiration levels, there is lack of consensus regarding the organization's appetite for risk. While Cyert and March (1963) and Kahneman and Tversky (1979) suggest that under-performance in organizations will result in greater propensities to take risk and hence change, Staw et. al. (1981) expect greater resultant organizational rigidity and risk adverse behavior. Recent studies (Vissa et al., 2010; Baum and Dahlin, 2007; Haleblian et al., 2006) take a more evolutionary point of view and suggest that organizational change is not only an outcome of performance feedback, but also the result of experience effects, learning mechanisms, and the evolution of routines within the organization.

The extant empirical research on aspiration levels provides two main insights. First, organizational change is better predicted when performance is above aspiration levels rather than below, both in terms of magnitude of the effect and its statistical significance (Greve, 2003a; Audia and Greve, 2006). Studies show mixed results when performance is below aspiration levels as regards an organization's risk preferences and likelihood of change. Second, whenever the type of organizational change is very risky (for example launching innovative products), change is more likely when performance is close to aspiration levels – either above or below (Greve, 1998; Greve, 2003a). In order to explain these mixed empirical findings, organizational scholars have turned their attention to the exploration of boundary conditions that affect the extent of organizational change by looking at organizational characteristics (Audia and Greve, 2006), the type of organizational change and the related nature of risk (Greve, 1998), and different performance measures (Greve, 2008). Given the existing theoretical and empirical puzzles, this paper attempts to draw upon concepts from behavioral theory and evolutionary economics to develop a conceptual framework that complements classical performance feedback

models and enrich our understanding of the boundary conditions under which performance predicts risk preferences and organizational change. Specifically, we focus on the how two types of performance - financial and innovative - differentially affect performance feedback and therefore the likelihood of risky change.

Our research studies change in the context of organizational partnering behavior (the choice of alliances and acquisitions). The literature in strategic management has highlighted the risky nature of partnering choices (Dyer et al., 2004; Wang and Zajac, 2007), emphasized that they are associated with routinized organizational decisions (Hayward, 2002) and that they are important, specifically in high-technology industries, to organizational competitiveness (Bierly and Chakrabrati, 1996). This understanding makes the study of decisions related to partnering patterns an appropriate setting in which to observe the relationship between risky organizational actions and performance. Our study observes partnering behavior of pharmaceutical firms from the year 1990 to 2006. Our results confirm the central idea of the paper - that the type of performance (financial or innovative) has a strong influence on the associated feedback loop and subsequent organizational actions. When financial performance deviates from expectations (either above or below), pharmaceutical firms decrease the extent of change in partnering patterns. In contrast, when innovative performance deviates from expectations, pharmaceutical firms increase the extent of change in partnering patterns. Our results are stronger for aspiration levels based on historical comparisons than those for social comparisons.

Our study builds on rich and diverse prior theoretical and empirical research and seeks to extend it in a few important ways. First, we directly test how performance predicts risk preferences when the organizational change is highly risky in nature. As suggested by evolutionary economics, given that organizations are path dependent and establish routines that

heavily influence subsequent action, we argue that risk may not so much refer to the nature of an organizational action, but rather that any organizational action that represents a clear departure from the existing routines will be deemed risky (Nelson and Winter, 1982). Second, we introduce a performance construct not usually associated with this stream of empirical literature, namely innovative performance and contrast it with financial performance. This is important given that most prior studies have only used financial measures of performance, and as Audia and Greve (2006) point out, the results of these studies may well be sensitive to the type of performance being studied and its measurement. Third, we attempt to improve the understanding of the antecedents of risky organizational change. We offer theoretical arguments that combine the behavioral theory of the firm and evolutionary economics to better explain organizational change. Both these frameworks have offered predictions on organizational change, but there is limited research that combines these two perspectives to explain change. Finally, we investigate how performance and aspirations affect organizational change at the corporate level, which is relatively uncommon in previous studies (Greve, 2008). In the next section, we develop our hypotheses regarding the relationship between performance and change in partnering. We then discuss the use of data and describe our methodology. The final section presents the findings and discusses the results, limitations, and extensions of this study.

2.2 Theory and Hypotheses

2.2.1 Performance, Aspiration Levels and Organizational Change

The behavioral theory of the firm has contributed significantly to our understanding of organizational search, the propensity for risk taking, and the likelihood of strategic change (Audia et al., 2000; Bromiley 1991; Greve 1998, 2003b; Miller and Chen, 2004; Park, 2007).

According to this theory, organizational search for new solutions is triggered by a problem. When organizational performance falls below the aspiration levels of the firm, a search for solutions occurs and organizational change becomes more likely. Problemistic search implies that organizational aspiration levels (as regards performance) are formed based on the past experience of the focal organization (*historical* aspiration levels) and those of comparable organizations (*social* aspiration levels). The behavioral view of the firm offers similar predictions when organizational performance is above desired aspiration levels. Performance above aspirations levels provides managers not only with access to additional or lower-cost resources (slack) but also instills confidence in their abilities to pursue promising ideas previously deemed too risky. In this frame, the gap between aspiration levels and performance plays a central role, serving as an impetus for the firm to search for new solutions, increasing the salience of risky organizational choices and subsequently encouraging managers to engage in more risk-seeking behavior that results in organizational change. Figure 1a represents the relationship between performance, aspiration levels, and organizational change derived from Cyert and March's (1963) theory of the firm.

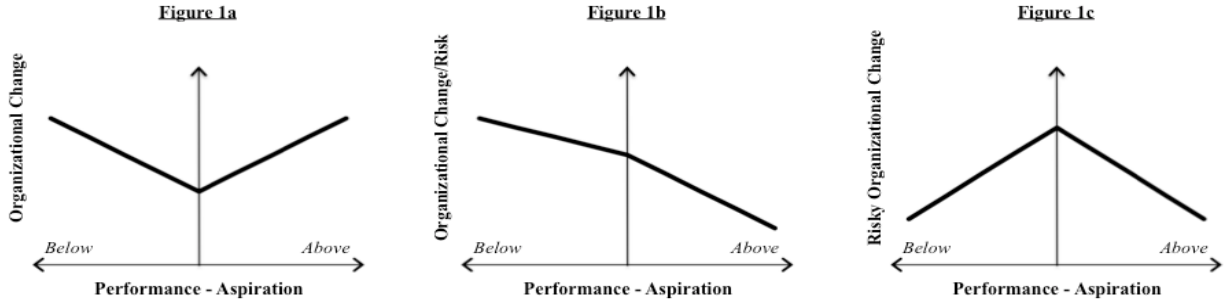
Evolutionary economics and organizational learning can be seen to be the most direct descendants of the behavioral theory of the firm (Argote and Grieve, 2007). One of the important concepts arising from evolutionary economics is that of a routine, which Winter (1964, p. 263) defines as a 'pattern of behavior that is followed repeatedly, but is subject to change if conditions change'. Nelson and Winter (1982) view routines as adapting in response to performance feedback. Actions that result in successful outcomes are positively reinforced and hence lead to persistence in the use of the existing routines, while actions that lead to performance outcomes that are unsuccessful trigger a search for modifications in the existing routine. Routines thus

possess the qualities of both stability and change (Feldman, 2000; Feldman and Pentland, 2003). Such evolutionary predictions on the relationship between performance and organizational change are in line with the functional form presented in Figure 1b (1). Empirical research largely supports the theoretical predictions indicated above. Bromiley et al. (2001) and Nickel and Rodriguez (2002) offer a comprehensive review of the empirical studies on this topic and find broad support for these predictions. Greve (1998), for example, finds that in the radio broadcasting industry, firms increase the likelihood of format change when station performance is below aspiration levels (both historical and social) and decrease the likelihood when performance is above aspiration levels.

When considering more risky forms of organizational change, however, the empirical findings on the relationship between performance, aspiration levels and organizational change are mixed, particularly when performance falls below aspirations. Greve (1998) studying change in format in the radio broadcasting industry finds that, in general, performance below aspiration levels does not have any effect in predicting change. However, by isolating various levels of risky change (in this study, different types of format), he finds for the most risky types of change, there is a decrease in the likelihood of change for performance below aspiration levels. Greve (2003a) finds similar results when studying the relationship between performance and the launch of innovations in the shipbuilding industry. The author shows that while performance above aspirations has an expected negative relationship to the launch of innovations, performance below aspirations has a positive but insignificant effect. These findings suggest that, when organizational change is risky, performance below aspirations generates inertial forces (Hannan and Freeman, 1977) and risk aversion (Staw et al., 1981), which in turn decreases the likelihood

of organizational change. Figure 1c shows the expected relationship between performance and risky organizational change.

Figure 2.1: Most important theoretical reference for the relationship between performance, risk and chance



The results of these studies are related, in part, to the nature of the performance measures (usually financial) employed. As suggested previously by Nickel and Rodriguez (2002), the organizational feedback observed may depend on the type of performance measure. Diversity in performance type can affect the feedback mechanisms that lead to decision-making and, thus, the likelihood of risky change. In this paper, we therefore contrast the patterns of organizational change arising from feedback models related to innovative performance and financial performance for a set of pharmaceutical firms. We focus on change related to partnering behavior (the firms' alliance and acquisition portfolios).

2.2.2Organizational Change: Partnering Behavior

Performance feedback models have been applied in the study of several types of organizational change including changes in strategy, markets, products launches, levels of R&D, practices and processes (Lant et al., 1992; Nohria and Gulati, 1996; Greve, 1998, 2003a, 2003b; Audia et al., 2000; Mezias et al., 2002; Fleming and Bromiley, 2003). Even though a critical

aspect of organizational growth and success is related to partnering behavior (in the form of alliances and acquisitions), and there are several studies that relate the formation of alliances to subsequent performance, there has been less attention paid to explaining how performance changes affect the change in the formation of alliances and acquisitions. Exceptions to this include Anand and Singh (1997) who study when low-performing organizations make acquisitions, Iyer and Miller (2008) who suggest how firm performance feedback matters to the timing of an acquisition, and Baum et al. (2005) who explain how Canadian investment banks accept the risk and uncertainty of non-local inter-organizational partnerships. However, these studies do not look at the portfolio of alliances and acquisitions, or explain specifically how such a portfolio would change given performance feedback. We suggest that behavioral and evolutionary theories of the firm provide an appropriate framework to study this change. First, given the evidence that most acquisitions and alliances fail in generating value and wealth for shareholders (Dyer et al., 2004, Seth, 1990; Doz, 1996), the expansion (and contraction) of organizational boundaries through alliances and acquisitions can be seen as being risky in nature and a viable organizational phenomenon for research purposes. Second, in order to explain the rationale behind strategic choices involving partnering, management scholars have often employed several theoretical perspectives related to rational decision making (for a review see Villalonga and McGahan, 2005). However, Dyer et al. (2004), find that managers seem to have a very limited rationale and basis from which to make choices between the formation of an alliance or an acquisition and suggest that these choices are often reflective of past experiences and path dependent behaviors. We therefore apply insights drawn for behavioral and evolutionary theories to the strategic choices made by firms regarding the choice of partnering behavior. While previous research has focused on the choice between alliances and acquisitions

as opposing options, and has explained under which conditions organizations move from one collaborative mode to another, we are interested in looking at the change in the composition of the entire portfolio of alliances and acquisitions, which represents and defines the overall pattern of organizational partnering behavior.

Hypotheses Development

Previous research on partnering in strategic management literature, for example Villalonga and McGahan (2005), appropriately view different modes of collaboration as embodying varying levels of risk. Often certain forms of alliances, such as licensing, are deemed to be less risky, while acquisitions are seen as more risky. An important insight that may be derived from the behavioral theory of the firm is that the perception of risk in the mind of a manager may not coincide with actual risk. After all, individual managers are boundedly rational (March and Simon, 1958). In the face of uncertainty and complexity, they do not consider, or rationally evaluate, the complete spectrum of choices before them. Rather, when deciding on future approaches and actions, they are heavily influenced by current areas of practice and by historical actions. The resulting individual actions and decisions tend to be in the neighborhood of current practice (since they are seen to be less risky) and are pursued even if they may not be the most attractive in terms of future success. Hence, when faced with a decision about partnering choices, managers are likely to associate current partnering patterns with minimal risk, regardless of whether this is actually the case. In the following paragraphs, building on behavioral theory and evolutionary economics, we suggest that any change in the overall partnering behavior of the organization represents risky action.

Nelson and Winter (1982) point out that organizations, like individuals, are bounded in their rationality and decision processes. Using this lens to explain the evolution of organizations, Nelson and Winter (1982) suggest that firms are path dependent – actions tend to be along well-established and familiar paths. They ascribe this to the formation of routines (organizational skills or habits) within the organization. These routines favor local search processes and make it difficult for the firm to adapt to any changes that are a departure from past practices and trajectories. Hence at the organizational level too, firms are likely to view a continuation of current practice (existing patterns of partnering behavior) as being less risky, and only depart from current practice reluctantly.

Recent studies on alliances and acquisitions (Zollo, 2009; Zollo and Singh, 2004) suggest that, although knowledge about the management of acquisitions and alliances can accumulate in individual managers as well as in groups throughout the organization, it is at the corporate level where organizational routines related to these processes are most likely to form and develop. Hayward (2002) proposes that managers develop standardized and specialized routines to form acquisitions while Zollo et al. (2002) introduce the concept of inter-organizational routines, defined 'as stable patterns of interaction among two firms developed and refined in the course of repeated collaborations'. Routinized actions embody the relationship between two firms and are important since they build across time and, with experience, allow growth in partner specific knowledge and hence contribute to alliance success. An evolutionary perspective (Nelson and Winter, 1982, Feldman, 2000) suggests that behaviors that result in outcomes that are viewed as a success are positively reinforced, making the change in organizational routines less likely. On the other hand, behaviors that lead to outcomes that are considered unsuccessful trigger the search for modifications in the existing routines, making the organizational change more likely.

Therefore, while partnering actions are significantly affected by experience and routinization generating stability and path-dependency in behavior, the interpretation of an organization's performance (successful or unsuccessful) could stimulate possible modifications of existing partnering routines.

As explained earlier in our paper, when risky change is involved, an advanced interpretation of behavioral theory (Greve 1998) suggests that organizational change is most likely when performance is at expected levels. In general, for performance below expectations, evolutionary theory would appear to predict an increased likelihood of change – this is not in line with behavioral expectations for risky change. However, we argue below, that when considering financial performance specifically and the nature of routines linked with partnering behavior, evolutionary theories too would suggest that a decrease in financial performance below expectations would result in maintenance of existing routines and a decreased likelihood of change. First, according to threat-rigidity theory (Staw et al., 1981) organizations respond to financial distress by emphasizing cost reduction, limiting new strategic initiatives and reducing risk taking, and this results in conservative behavior (for a review see Miller and Chen, 2004; Chen and Miller, 2007). Poor performance could bring an organization close to the survival point (March and Shapira, 1987, 1992) where any further failure could threaten the organization's existence. Since establishing (or even dissolving) partnerships or undertaking acquisitions are resource intensive activities, these will not be undertaken lightly in an environment of financial distress. Maintaining existing routines could be seen as more cost effective compared to establishing new ones. Second, since financial performance is a broad measure of organizational performance, the set of factors that influence the performance may be hard to identify or pinpoint, and hence the precise nature or location for any underlying problem and the associated

solution may not be obvious. Similarly, partnerships are complex and the relationship between a particular partnership, or a portfolio of partnerships, and the overall financial performance of the organization is often ambiguous (Haleblian et al., 2006). Behavioral researchers have suggested that under conditions of ambiguity, decision makers depend heavily upon the most recent information to reduce their cognitive burdens and simplify information processing (Hogarth &Einhorn, 1992). When we bring together the conditions of financial distress, causal ambiguity and risky change (partnering patterns) the power of the feedback mechanism is likely to be reduced, and the organization incentives and ability to change routines is likely to diminish. Hence managers can be expected to fall back on reliance of familiar and existing routines, rather than try new approaches. Therefore, we expect that a change in the composition of the portfolio of alliances and acquisitions is most likely when an organization faces financial performance that equals aspirations. In view of these arguments, we propose the following hypotheses:

Hypothesis 1a: For firms performing below their aspiration levels for financial performance, decreases in financial performance are negatively related to the extent of change in organizational partnering behavior.

Hypothesis 1b: For firms performing above their aspiration levels for financial performance, increases in financial performance are negatively related to the extent of change in organizational partnering behavior.

Innovative Performance

Previous literature suggests a positive relationship between alliances and acquisitions and organizational innovative performance (Cloodt et al., 2006). An alliance can contribute to an organization's innovativeness by facilitating access to a partner's knowledge as well by providing opportunities for joint knowledge creation (Grant and Baden-Fuller, 2004) thereby establishing a positive link between strategic alliances and innovative performance (Ahuja, 2000; Stuart, 2000). Acquisitions can be a means to absorb the complete knowledge base of another firm permitting the generation of economies of scale and scope in the use of knowledge (Ahuja and Katila, 2001). Research also suggests that alliances and acquisitions may have a dark side - partners may have conflicting interests and moral hazard behaviors may decrease inter-organizational knowledge transfers (Khanna et al., 1998). In acquisitions, the aggressive pace of integration may disrupt innovative routines of the acquired organization generating a loss in competence or expert manpower and a delay in innovative activities (Puranam et al., 2006; Paruchuri et al., 2006). Most prior studies have sought to examine the effects of collaborative mechanisms on innovation. In this paper, our emphasis is on how deviations in innovative performance from aspiration levels affect subsequent partnering actions. We do not seek to study whether levels of innovative performance result in a decrease or increase of alliances and acquisitions, but rather whether innovative performance above and below aspiration levels results in a change in the approach to partnering as captured by the change in the portfolio of partnering choices (alliances and acquisitions). Scholars interested in how performance affects organizational decision making have called for measures of performance beyond financial performance (Audia and Greve, 2006; Greve, 2008) to predict organizational change. Innovation performance is a strong candidate for study given its importance in high technology industries where it is often closely related to organizational success.

Innovation and financial performance differ in important ways with respect to the feedback mechanisms they generate. They differ in terms of the breadth of organizational entities that influence them and in the extent of causal ambiguity related to performance levels. As argued previously, financial performance is a broad measure of a firm's overall financial health. It results from the combination of several interrelated activities within the organization including incoming and outgoing logistics, operations, sales, marketing, and manufacturing. All these activities individually and interactively influence financial performance and this makes it hard to identify and isolate the effects of any given activity on financial performance. Hence, causal ambiguity of financial performance (above or below expectations) is significant and the appropriate strength and direction of any resultant managerial action is less clear. Innovative performance, on the other hand, reflects the results of an organization's effort to generate innovation, and is heavily dependent on, and identified with, the Research and Development (R&D) function of an organization (Hagedoorn and Cloodt, 2003). The focus on the R&D function suggests a more direct managerial interpretation of cause and effect. The decreased causal ambiguity for innovative performance suggests a decrease in uncertainty and perception of risk for the decision maker and a corresponding decrease in inertia in organizational action.

The contrast between financial and innovative performance is even more evident when we specifically consider situations where performance is below or above aspiration levels. March and Shapira (1992) show that when financial performance is below the desired level, the decision maker's attention moves from one considering aspirations to that of the survival point (the performance level below which the organization may not be able to survive). Innovative performance below expectations, on the other hand, is less affected by survival considerations. A drop in the number of patents in a particular year may have long-term survival considerations but

is unlikely to impinge on the short term viability of the organization (given the time lags involved in product design, development, manufacturing and sales) and hence the decision making associated with poor performance is not likely to be influenced by survival considerations, and hence may be less risk averse. Financial performance is also observed by, and impacts, a large number of stakeholders inside and outside the organization. The broad set of stakeholders may be affected by poor performance and may therefore want to influence the subsequent decisions about the way forward. Multiple interests and inputs into the decision making process, increase the likelihood of decisions made will reflect a compromise amongst stakeholders ensuring solutions that are relatively risk averse and close to current practice (Coff, 1999). For innovative performance, the stakeholders are more local to the R&D department and, perhaps, the top management of the organization. The fewer and less diverse set of stakeholders will permit corrective decisions and actions that are more risky than would be prudent when considering financial performance.

When performance is above aspiration levels, innovative performance also differs from financial performance. Financial resources in excess of expected ones, generates competition among stakeholders for rent appropriation. Organizational units compete with each other to increase their budgets and investors exercise pressure to transform slack resources to dividends. The competition for resources creates internal pressure resulting in conflicts and can produce inertia in decision making and an aversion to external investment, especially if risky. Innovation above expected levels does not result in a similar competition for additional innovations generated since this does not necessarily result in excess resources – especially in the short run.

We have argued that given important differences between innovative and financial performance, there will be less organizational inertia associated with innovative performance. So

how do changes in innovative performance (above or below aspirations) affect choices in partnering behavior? Since in high technology industries, innovative performance is linked to partnering behavior, altering partnering behavior (to acquire external knowledge) can be seen as an approach to adjust this outcome. A fall in innovative performance below aspiration levels would generate an increase in internal R&D investments and external knowledge sourcing (alliances and acquisitions) based on the problemistic search argumentation (Cyert and March, 1963). From an evolutionary perspective, partnering routines generating outcomes that are seen as unsuccessful would activate a search for modification of (Nelson and Winter, 1982; Gavetti et al, 2007), or repairing of (Feldman, 2000) existing routines, leading to organizational change. As regards external knowledge sources, innovative performance below aspirations suggests that current partnering behavior may not be satisfying expectations in knowledge sourcing, and such a discrepancy is likely to generate a change in the alliance and acquisition portfolio. One possibility is that organizations might reduce partnering activities since they perceive them as not contributing overall innovative performance. Another possibility is that organizations might increase partnering activities in order to increase the external knowledge needed to reach expected innovation levels. Finally, organizations may change the relative weightage of alliances and acquisitions in the portfolio (from more acquisitive to more collaborative, or vice versa) to search for an optimal set of knowledge inputs. In every case, innovative performance below aspiration levels stimulates a search for external knowledge through collaborative activities that complements internal knowledge, through the modification of the existing alliance and acquisition portfolio.

Hypothesis 2a: For firms performing below their aspiration levels for innovative performance, decreases in innovative performance are positively related to the extent of change in organizational partnering behavior.

Kogut and Zander (1992) suggest that knowledge is both an input and output of innovation. Therefore innovation performance above aspirations would result in an increase in knowledge available for subsequent innovation. This is in line with Penrose (1959) who suggests that excess resources explain organizational growth and innovation. Pitelis (2007), while examining the similarities between Penrose's and Cyert and March's views of organizations, suggests that these theories are largely in alignment when it comes to the effects of slack or excess resources on growth and innovation. Both theories support the idea that excess (or slack resources) would lead to organizational search and hence serve to further increase innovation. Innovative performance, often measured in terms of weighted patent counts, affects a firm's ability to both exchange and absorb knowledge (Cohen and Levinthal, 1990) and therefore relates to the ability to conduct collaborative (Lane and Lubatkin, 1998) and acquisitive activities (Ahuja and Katila, 2001). A firm with strong innovative performance can be seen as a repository of new and useful knowledge, and can therefore be viewed as an attractive potential partner or, perhaps, as having a greater capacity to acquire new knowledge through acquisition. Innovating beyond expectations can lead to a new set of opportunities for alliances and acquisitions for a firm, presenting the firm with additional choices and therefore increasing the chance that the firm will alter its partnering portfolio. Hence, we predict that:

Hypothesis 2b: For firm above their aspiration levels for innovative performance, increases in innovative performance are positively related to the extent of change in organizational partnering behavior.

2.3 Data and Methodology

Our sample consists of 988 publicly traded U.S. firms that had a total of 2,380 acquisitions and 2,864 alliances between 1990 and 2006. Our analysis is confined to the pharmaceutical industry identified by the SIC codes 2833, 2834, 2835 and 2836. We also examined the NAICS codes relevant to the pharmaceutical industry (325 and 5417) to ensure that our sample did not include standalone biotechnology and chemical firms. Given the importance of innovation (OECD, 1997; Cloodt et al., 2006), and the prevalence of alliances and acquisitions, the pharmaceutical industry is a good empirical setting to study performance feedback models and change in partnering behavior.

Our data on acquisitions and alliances are drawn from the SDC Platinum database recognized as one of the most comprehensive databases of its kind (Schilling, 2009). Patent data are obtained from the United States Patent and Trademark Office (USPTO). For this database we use the most updated version available on the National Bureau of Economic Research (NBER) website, which contains information for patents up to 2006. Firm-level data are obtained from the Compustat Global Fundamental Annual dataset (Standard & Poor's), which provides data for publicly traded companies and their subsidiaries. These three databases have been commonly used in previous studies of firm partnering choices (Villalonga and McGahan, 2005; Iyer and Miller, 2008; Wang and Zajac, 2007) and in performance feedback studies (Chen and Miller, 2007) (2).

Dependent variable.The dependent variable measures the change in partnering behavior between year *t* and year *t-1*. For each firm-year, we generate a column vector with two components (i) a = the number of alliances and (ii) b = the number of acquisitions formed by the organization in the given year. This vector represents the partnering profile of the organization in a particular year. In order to compute the change in partnering patterns between year *t* and *t-1*, we measure the Euclidian distance between the two vectors.

$$PBC_{it} = \sqrt{\left(a_{i,t} - a_{i,t-1}\right)^2 + \left(b_{i,t} - b_{i,t-1}\right)^2},$$

where PBC (Partnering Behavior Change) is the extent of change in the pattern of partnering behavior of organization *i* from year *t-1* to year *t*. Our formulation of the dependent variable is similar to studies that capture technological distance across firms (Ahuja, 2000; Rosenkopf and Almeida, 2003). This operationalization of the dependent variable captures both quantitative and qualitative changes in partnering behavior across time. Quantitative changes, such as an increase or decrease in alliances and/or acquisitions will increase the magnitude of the dependent variable and qualitative changes, such as a shift in the partnering emphasis from alliances to acquisitions and vice versa will also increase the magnitude of the dependent variable.

Independent variables. In our study we examine two types of performance, financial and innovative. Following previous studies on performance feedback models and organizational change (Greve, 2003a, Greve 2003b), financial performance is measured using the traditional accounting measure of return on assets (ROA) (3). Recent studies of firm boundary choice under

behavioral assumptions have identified ROA as a good measure of firm performance (Iyer and Miller, 2008). For innovative performance (IP) we use the count of granted patents for the firm. Patents are an appropriate indicator of innovative performance in high-technology sectors (Hagedoorn and Cloodt, 2003), and are an important source of technological advantage in the pharmaceutical industry (Levin et al., 1987). Previous studies of partnering choices have widely used patent counts as a measure of innovative performance (Cloodt et al., 2006).

For both the performance measures, we follow Greve (1998, 2003a, 2003b) in generating the measures for historical and social aspiration level variables. We generate historical aspiration levels by taking an exponentially weighted average of past values on the performance variable (Levinthal and March 1981). The formula for historical aspiration levels is:

$$A_{i,t} = \alpha * A_{i,t-1} + (1-\alpha) * P_{i,t-1}$$

In this specification of historical performance aspiration level, $A_{i,\,t}$ is the aspiration level for firm *i* in time *t*. $P_{i,\,t-1}$ is the actual performance of firm *i* in time *t-1*. *Alpha* is the weight given to the most recent aspiration level. In order to assess the appropriate value of *alpha*, we estimate models with different values of alpha varying from 0.1 to 0.9 with increments of 0.1 (Greve, 2003a) and identify the value of *alpha* corresponding to the best log-likelihood value. Following this procedure we find that Financial Performance (ROA) had an *alpha* of 0.5 and Innovative Performance (IP) had an *alpha* of 0.2. For social aspiration levels, we attempted to identify the appropriate reference group for a particular firm. We assume (as did Greve 2008) that firms will identify with, and compare themselves to, other firms of a similar size. We hence divided our sample firms into two groups by size (measured as log of employees) depending on whether they were below or above the median in terms of size in that year. We then computed the difference

between the firm's performance in period *t* and the median performance of the appropriate reference group (bigger firms or smaller firms) in the industry in period *t-1*.

$$Social_{i,t} = P_{i,t} - P_{j,t-1,s}$$

where $Social_{it}$ for firm *i* in time *t* is the difference between the performance of firm *i* in year *t* and the performance of the firm *j* in year *t-1*, where *j* is the median industry performer in the same size category. In our model, *s* is 1 when the firm is large, 0 otherwise.

As in previous similar studies, (Audia and Greve, 2006; Greve, 2003a), to estimate whether the effect of performance on change in partnering activity differs according to whether the performance is above or below the aspiration level, we specify performance as a spline function (Greene, 1993). Therefore, for each performance type (ROA and IP) we create two variables for both historical and social aspiration levels. First we compute the difference between performance and aspiration, as:

$$D_{i,t,a,p} = P_{i,t,p} - A_{i,t,a,p}$$

where $D_{i,t,a,p}$ is the discrepancy for the firm *i* in time *t* relative to aspiration *a* (historical or social) between the $P_{i,t,p}$, which is the performance *p* (financial or innovative) of the firm *i* in time *t*, and $A_{i,t,a,p}$, which is the aspiration *a* (historical or social) for the performance *p* (financial or innovative) for the firm *i* in time *t*. From *D* we generate two variables called $Above_{i,t,a,p}$ and $Below_{i,t,a,p}$ formalized as:

$$Above_{i,t,a,p} = \begin{cases} D_{i,t,a,p} \\ 0 \end{cases}$$

where $Above_{i,t,a,p}$ equals $D_{i,t,a,p}$ when $D_{i,t,a,p}$ is positive, and 0 otherwise.

$$Below_{i,t,a,p} = \begin{cases} D_{i,t,a,p} \\ 0 \end{cases}$$

where $Below_{i,t,a,p}$ equals $D_{i,t,a,p}$ when $D_{i,t,a,p}$ is negative, and 0 otherwise.

Therefore, for each performance type we have 2 independent variables for historical aspiration levels (above and below) and two independent variables for social aspiration levels (above and below). In general, we use aspirations in *t* to generate discrepancy in *t+1*, which in turn predicts partnering behavior change in *t+2*. Therefore, we allow for a one year lag between the generation of the performance feedback and the subsequent organizational change.

Control variables.In order to take into account alternative explanations for explaining partnering behavior, we introduce control variables into our model. The resource based view of the firm highlights the role of firm's technological and marketing resources (especially in high-technology sectors) in making partnering choices to build complementarities and synergies. We therefore introduce *R&D Intensity* (the ratio of R&D expenditures to sales), and *Marketing Intensity* (the ratio of the sum of marketing, selling, general, administrative expenses to sales) to the model. The variable *Resources* is the sum of the two resource variables (4). From an

organizational learning perspective, the value generated by an acquisition or an alliance depends on the capabilities, which the firm develops through repeated experience with these governance forms (Hayward, 2002). Thus, we use *Alliance Experience* and *Acquisitions Experience*, asthe average number of alliances (or acquisitions) in the previous 3 years as controls. To control for *Size*, we use the log of the number of employees. Size has, after all, been confirmed as an important organizational characteristic in firm risk taking studies (Audia and Greve, 2006) and in partnering choice studies (Villalonga and McGahan, 2005). Finally, we control for growth opportunities that encourage partnering behavior by incorporating *Net Income* and *Intangible Assets* (trademarks, patents, and property rights) (Iyer and Miller, 2008).

Model. In this study, the dependent variable Partnering Behavior Change (PBC) captures the difference between the organization's portfolio of alliances and acquisitions in *t* and *t-1* as explained previously. The independent variable is the difference between performance and its aspirations in *t*, where the aspiration in *t* is a linear combination of aspiration and the performance in *t-1*, either historical or social (as explained earlier). By definition our dependent and independent variables are differences across time, so we specify our estimation model as pooled ordinary least squares (POLS) using the first-difference method (Wooldridge, 2002). As in a fixed-effect model the first-differencing transformation eliminates unobserved effects and holds the same assumptions of consistency as in the fixed-effects method. Unlike in fixed-effects, the first-difference estimator does not assume homoskedasticity and no serial correlations in the error term, which implies that all the reported statistics from the POLS are asymptotically valid (Wooldridge, 2002). Therefore:

$$\Delta Y_{i,t} = \Delta X_{i,t}\beta + \Delta C_{i,t} + \Delta U_{i,t}$$

where $\Delta Y_{i,t}$ is the change in organizational partnering behavior by firm i in year t ($\Delta Y_{i,t}=Y_{i,t}-Y_{i,t-1}$), ΔX_{it} is the difference between performance and aspiration levels ($\Delta X_{i,t}=X_{i,t}-X_{i,t-1}$), $\Delta C_{i,t}$ is the vector of control variables affecting $Y_{i,t}$ and $\Delta U_{i,t}$ is the error term. Intuitively, the FD specification implies that we focus on the effect of any variation in performance on the variation in the change in partnering behavior, rather than the level of the dependent and independent variables. The interpretation of the estimates is exactly the same as FE model (Wooldridge, 2002). In addition, we adjust the standard errors for intra-group correlation and control for robustness of the estimator. We analyze the data using STATA SE 11.0.

2.4Results

Table 1 presents the correlation matrix and table 2 presents the results of the regressions. Model 1 includes the control variables, model 2 adds the variables based on financial performance, and model 3 includes variables based on innovative performance. Models 4 to 8 show the results of the sensitivity analyses (a) by adjusting the time lag used (model 4 and 5), (b) combining both independent variables (model 6) and (c) using alternative estimation models (model 7 and 8).

Table 2.1: Descriptive Statistics and Correlation Matrix

	Obvs	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Partnering Behavior Change	8.694	0,39	0,69	1,00																
(2) Partnering Behavior Change (1	7.733	0.40	0.70	0,53	1,00															
(3) Partnering Behavior Change	9.950	0,37	0,48	0,89	0,50	1,00														
(4) Above$_{Historical, Financial}$	5.137	0.10	0,19	-0,09	-0,08	-0,11	1,00													
(5) Below$_{Historical, Financial}$	9.870	-0,04	0,15	0,05	0,05	0,06	0,22	1,00												
(6) Above$_{Social, Financial}$	7.792	0.10	0,14	0,03	0,02	0,03	0,09	0,18	1,00											
(7) Below$_{Social, Financial}$	7.792	-0,19	0,32	0,10	0,09	0,07	0,10	0,41	0,45	1,00										
(8) Above$_{Historical, Innovative}$	6.915	0,91	3,17	0,07	0,08	0,08	-0,06	0,03	0,00	0,05	1,00									
(9) Below$_{Historical, Innovative}$	9.902	-0,37	1,63	-0,09	-0,06	-0,06	0,04	0,01	0,00	-0,04	0,08	1,00								
(10) Above$_{Social, Innovative}$	6.946	0,85	3,54	0,06	0,06	0,08	-0,04	0,02	0,00	0,04	0,54	-0,24	1,00							
(11) Below$_{Social, Innovative}$	6.964	-3.90	5,21	-0,12	-0,14	-0,11	0,13	-0,05	0,03	-0,11	0,12	-0,04	0,19	1,00						
(12) Size	7.012	88,93	1.683	0,09	0,06	0,04	-0,02	0,00	0,03	0,03	0,01	-0,03	-0,01	0,01	1,00					
(13) Resources	6.772	-0.20	11,53	-0,02	-0,01	-0,01	-0,09	-0,06	-0,03	-0,02	0,01	-0,01	0,01	0,00	0,00	1,00				
(14) Alliance Experience	8.962	-0.00	0,38	0,12	0,03	0,10	0,00	0,01	-0,01	0,00	-0,04	0,03	-0,01	-0,02	-0,01	-0,03	1,00			
(15) Acquisition Experience	8.962	0,01	0,29	0,17	0,05	0,14	0,00	0,01	0,01	0,03	0,01	0,00	0,01	-0,01	0,01	0,00	0,14	1,00		
(16) Net Income	8.259	9.758	#####	0,02	0,03	0,02	-0,01	0,02	0,04	0,02	0,07	-0,05	0,06	0,00	-0,14	-0,01	-0,02	-0,03	1,00	
(17) Intangible Assets	5.831	-0.00	0,42	0,05	-0,01	0,03	-0,02	-0,01	0,00	0,02	0,01	-0,01	0,00	-0,02	0,07	0,11	0,01	0,06	-0,05	1,00

Coefficients greater in magnitude than 0.04 are significant at the 0.05 level

Notes: Number of obvervations per variable is not costant given the missing values. This difference is reflected also in N of the sample for each model. However, our results are r

Hypotheses 1a and 1b suggest that any increase in the discrepancy between financial performance and the aspiration levels results in a decrease in the extent of change in partnering behavior. In model 2, the regression coefficient associated with performance above historical aspirations is negative and statistically significant (-.475, $p<0.001$), while the coefficient for performance below historical aspirations is positive and significant (.448, $p<0.001$). Therefore Hypotheses 1a and 1b are supported suggesting that organizations are most likely to change their partnering behavior when their financial performance equals the expectations based on historical performance patterns (Figure 2a). Following previous studies (Greve 2003a, 2003b) we perform the Wald test of the difference of coefficients to explore whether the magnitude of partnering

behavior change is different for above and below aspirations. The results of the Wald test (F=0.81) suggest that there is no statistically significant difference between the magnitudes of the two effects. Our results for social aspiration levels variables (associated with financial performance) show that while performance below expectations based on social aspirations is positive and significant (.230, $p<0.001$), performance above social aspirations has a negative coefficient but is not statistically significant. Overall our findings for financial performance, above and below aspirations, are as expected and reinforce past findings of empirical research on performance and risky organizational change.

Hypotheses 2a and 2b suggest that the increase in the discrepancy between actual innovative performance and aspirations results in an increase in the extent of change in partnering behavior. The coefficient for performance above historical aspirations is positive and statistically significant (.033, $p<0.001$), while coefficient for performance below historical aspirations is negative and significant (-.028, $p<0.001$). Our findings support Hypotheses 2a and 2b and suggest that the greater the difference between innovative performance and the organizations aspirations (either below or above), the greater the change in partnering behavior (Figure 2b). Results of the Wald test of the difference of coefficients (F=0.54) suggest there is no difference in the magnitudes of the coefficients when Pharmaceutical firms' innovative performance is above or below historical aspiration levels. The results for the variables considering social aspirations resemble those for historical aspiration levels; while performance below social aspirations supports hypothesis 2b (-.019, $p<0.001$), performance above social aspirations has a positive coefficient, as predicted, but is not statistically significant. Overall our findings for innovative performance suggest that any deviation from aspirational performance activates problemistic or slack search, which results in greater risk taking and change. This

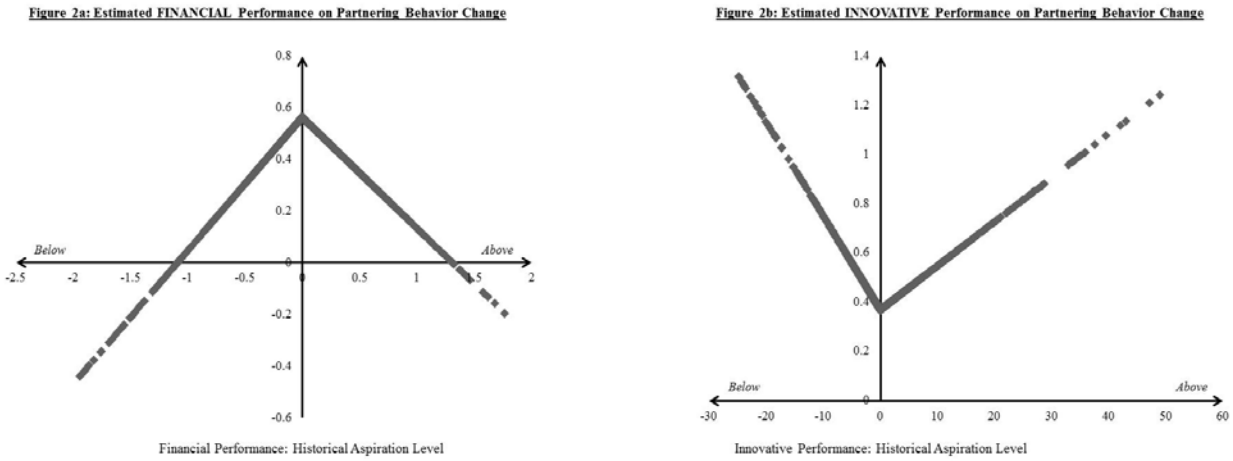
finding is in line with Cyert and March's (1963) original ideas on performance feedback and organizational change. Overall, the fit of our models improved significantly (model 2 adjusted r^2 =.105 and model 3 adjusted r^2 =.128) with the addition of our independent variables.

Table 2.2: Model in first difference for Partnering Behavior Change

	Main Models			Sensitivity Analysis Models				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
$Above_{Historical, Financial}$		-0.47***		-0.34***		-0.19*	-0.94***	
		(0.083)		(0.107)		(0.084)	(0.209)	
$Below_{Historical, Financial}$		0.44***		0.42***		0.32**	1.08***	
		(0.096)		(0.113)		(0.105)	(0.288)	
$Above_{Social, Financial}$		-0.08		-0.08		-0.02	-0.17	
		(0.137)		(0.138)		(0.132)	(0.249)	
$Below_{Social, Financial}$		0.23***		0.22**		0.10	0.40**	
		(0.070)		(0.082)		(0.077)	(0.150)	
$Above_{Historical, Innovative}$			0.03***		0.02*	0.03**		0.06***
			(0.007)		(0.007)	(0.009)		(0.013)
$Below_{Historical, Innovative}$			-0.02***		-0.02*	-0.03**		-0.06***
			(0.007)		(0.010)	(0.009)		(0.013)
$Above_{Social, Innovative}$			0.02		0.00	0.00		0.01
			(0.004)		(0.006)	(0.006)		(0.008)
$Below_{Social, Innovative}$			-0.01***		-0.02***	-0.01***		-0.03***
			(0.003)		(0.003)	(0.003)		(0.005)
Size	0.00***	0.00***	-0.00	0.00*	0.00*	-0.00	0.00**	0.00
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Resources	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Alliance Experience	0.11	0.12+	0.30***	-0.05	-0.30	0.31***	0.12*	0.34***
	(0.073)	(0.071)	(0.067)	(0.051)	(0.057)	(0.067)	(0.061)	(0.097)
Acquisition Experience	0.24**	0.24**	0.44***	0.05	0.16*	0.32***	0.41***	0.68***
	(0.081)	(0.079)	(0.102)	(0.071)	(0.102)	(0.097)	(0.075)	(0.118)
Net Income	0.00**	0.00*	0.00	0.00*	0.00	0.00	0.00*	0.00
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangible Assets	0.06+	0.06*	0.07**	-0.04	-0.03	0.00	0.12*	0.11+
	(0.000)	(0.032)	(0.030)	(0.033)	(0.030)	(0.000)	(0.060)	(0.060)
Costant	0.71***	0.80***	0.53***	0.87***	0.59***	0.56***	-0.15	-0.85***
		(0.081)	(0.073)	(0.083)	(0.073)	(0.087)	(0.104)	(0.091)
Years Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood-ratio test vs. model 1		85.78***	105.04***					
Degrees of freedom		4	4					
Likelihood-ratio test vs. model 2						47.01***		
Degrees of freedom						4		
Likelihood-ratio test vs. model 3						19.82***		
Degrees of freedom						4		
Log-Likelihood							-1.829,71	-1.903,19
N	2.627	2.627	2.824	2.343	2.626	1.898	2.894	3,091
Number of Cluster (firm)	413	413	598	394	559	379	425	619
R-squared	0,08	0.10	0.13	0.07	0.09	0,13	0.07	0,08
F (or Wald Chi2 for model 7 and model 8)	5.86***	9.47***	11.53***	5.61***	6.59***	7.98***	190.99***	229.12***

Notes. One-tailed test for hypothesized effects; two-tailed tests otherwise.
+p<0.10, *p<0.05, **p<0.01, ***p<0.001
Robust standar errors are in parentheses

Figure 2.2: Estimated effect of Performance on Partnering Behavior Change



In table 2 we report results also for three different sensitivity analyses. In our initial models (2 and 3), we use the difference between performance in time *t* and aspiration levels in time *t* as the predictor for change in period *t+1*. The assumption here is that a change in partnering behavior takes one year to get reflected in the performance feedback mechanism and the associated change adopted by the organization. We also allow for an additional time between performance and change by observing the change in period *t+2*. Model 4 shows how the discrepancy between actual financial performance and its aspiration in time period *t* predicts change in partnering behavior in *t+2*. Our results do not change and the coefficients maintain their direction and statistical significance. The results also hold for both historical and social aspiration levels. In model 5, we apply the time lag *t + 2* to the model using innovative performance. As was the case for financial performance, our results do not change in any significant manner. Model 6 shows the regression results after combining the independent variables from models 2 and 3. By combining the independent variables, we are taking into consideration the effect of both types of performance together in explaining the variation in the phenomenon of interest. Model 6 shows a better fit to data in comparison to model 2 (LR=47.01)

and model 3 (LR=19.82) and confirms our initial findings supporting our hypotheses. Finally, we consider the likelihood of change instead of the extent of change, as in previous studies on organizational change (Greve, 1998, 2003a), to see whether our results may be affected by the choice of the estimation procedure (model 7 and model 8). In order to do that, we create the variable *Partnering Behavior Change Binary* (*PBCB*) equal to 1 when *Partnering Behavior Change* (*P.B.C.*) is greater than 0, and 0 otherwise. Estimating the models for *P.B.C.B.* using a Probit estimator, we observe similar results as with the pooled OLS regressions.

2.5 Discussion and Conclusions

Our study examines how the gap between aspiration levels and actual performance explains the changes in partnering patterns of pharmaceutical firms for the period 1990 to 2006. Our results confirm the central idea of the paper - that the type of performance (financial or innovative) has a strong influence on the associated feedback and subsequent organizational action. When financial performance deviates from expectations (either above or below), pharmaceutical firms decrease the extent of change in partnering patterns; in contrast, when innovative performance deviates from expectations (either above or below), pharmaceutical firms increase the extent of change in partnering patterns. Our results are stronger for aspiration levels based on historical comparisons than those for social comparisons.

Our study suggests that the type of performance being observed is important. While any deviation of financial performance from its aspirations generates risk adversity, which is reflected in less change, a deviation from expectation of innovative performance increases the extent of change in partnering behavior for the firms being studied. In other words, our results suggest that risk profile in decision-making, as captured by the change in partnering routines, has

different patterns depending on the type of performance used to activate the behavioral feedback mechanisms. Hence the relationship between performance, risk and organizational change is explained not only by whether performance is above and below aspirations (as has been the focus of most previous studies), but also by the type of performance that triggers the feedback mechanism and the change. Our results, in fact, suggest that for pharmaceutical firms, performance above or below expectations leads to similar patterns of risk taking (for both innovative and financial performance), but these patterns of decision-making are significantly different when considering different performance types (financial and innovative).

Though our research attempts to extend and incorporate new ideas to the literature on performance aspiration levels and organizational change, it also in many ways reinforces existing perspectives. Greve (1998, 2003a) has previously shown that financial performance (measured as ROA) does not explain risky organizational change in the manner that problemistic search would suggest. Instead the papers found support for inertial argumentation and risk aversion. Building on this platform, our study provides the conceptual basis for this finding and confirms the empirical findings in a new setting. Our research is also an attempt to directly answer the call for more research that improves our understanding of the role of various types of goals (other than profitability) and related performance measures (other than financial performance) in predicting risky organizational change (Greve, 2008). By using innovative performance as a predictor of organizational change in our performance feedback model, our findings suggest that the decision maker's interpretation of each performance construct has different implications for firm risk-taking behavior. In this vein, we shed light on what can be viewed as the local character of performance and its related feedback mechanisms. In other words, while a goal belongs to the organization as a whole, the related performance feedback mechanisms might reside only in a

part of the organization, and more specifically in those parts involved closely to the input-output process that is reflected by the performance. This local nature of goals affects the level of causal ambiguity related to the feedback mechanism and thus the level of uncertainty of the subsequent decision-making process.

This paper attempts, perhaps more fully than before, to incorporate and synthesize insights from evolutionary economics in order to sharpen the perspective on the relationship between performance, risk taking and organizational change. One of the primary insights from evolutionary economics is incorporated into our dependent variable – that any departure from existing practice is viewed as being essentially risky from a managerial decision-making perspective. Borrowing from Nelson and Winter's (1982) concepts as path dependency, routines, stability and change, we attempt to build a more comprehensive approach to behavioral strategic decision-making, presenting risk as any departure from current behavioral practice (specifically applied to the idea of change of partnering routines). Along this theoretical tradition, we view risk as a perception in the mind of the managers, who are considered boundedly rational and path dependent in their decision-making. Where the insights from evolutionary economics play an important role is in highlighting how hard it is for individuals and organizations to change behavior patterns, regardless of the likelihood of success related to the change. By looking at risky change as a departure from routinized strategic actions related to alliances and acquisitions and by using a performance feedback model perspective, we incorporate behavioral concepts and thinking to both the independent variables and the dependent variable – thus embedding our research more completely in behavioral theory.

From the perspective of the strategic management literature on partnering choices, our findings are in line with previous studies that suggest that partnering decisions are risky in nature

(Villalonga and McGahan, 2005; Wang and Zajac, 2007), and also with studies attempting to uncover behavioral explanations behind partnering choices (Iyer and Miller, 2008). At the same time, our study seeks to enrich the understanding of the rationale behind partnering choices and risk taking in strategic decision-making by emphasizing the role of bounded rationality and routinization in the associated processes. The literature on alliances and acquisitions has largely relied on rational assumptions related to resource-based, transaction cost-based and agency-based theories in explaining corporate managerial decision making. This study attempts to add to the overall understanding on partnering choices showing how evolutionary and behavioral assumptions can explain variation in risk taking of corporate level decision making. Thus this study helps complete the picture of influences on decisions related to alliances and acquisitions.

Building on the literature on alliances, acquisitions, and innovation we confirm the strength of the relationship between innovative performance and partnering choices that is seen as a key determinant of competitive advantage in high-tech industries (Bierly and Chakrabrati, 1996). We look at how innovative performance affects the extent of change in partnering choices. Here innovative performance is not seen as an outcome of strategic decision making, but rather as a driver for strategic decision making in the minds of managers. Thus, our study presents innovative performance in a different light; not only as an output of the innovation process but also as input for the firm's decision making process.

Our study has some implications for managers. Managers should recognize that decision making in areas of strategic importance could often be influenced by expectations in performance rather than by other more rational characteristics such as the level of resources, the competitive environment involved, or the strategic probabilities of success associated with these

actions. We do not suggest that building on behavioral considerations in decision making is either efficient or inefficient. We merely suggest that managerial awareness of the salience of

expectations regarding performance (especially those influenced by historical performance) on subsequent decision making, will enhance the sophistication of the choices they make. Managers should therefore explore the basis of their decision-making processes and be aware of the implications. While we do not have any normative claims to offer, we do believe managers should bear in their mind the performance implications in their strategic decision making, in particular when engaging in partnering choices.

By building on previous research in behavioral theory, we hope to make several contributions. First, we contrast the feedback effects of different types of performance. Second, we attempt to develop and directly test theoretical arguments on how performance feedback models predict risky forms of organizational change. Third, we apply performance feedback models to better understand changes in partnering routines. While collaborations are seen as important strategic tool (Villalonga and McGahan, 2005), there has been relatively little research that explains partnering patterns taking into account behavioral insights. Fourth, we bring into focus an important measure of performance - innovative performance. In high technology industries, innovative performance is central to firm success and therefore it is important to understand how it affects firm decision making. By studying innovative performance, we shed light on how different performance measures affect risk taking behavior in contrasting ways. Finally, we study performance feedback models on partnering behavior change in the pharmaceutical industry, which is a new empirical setting in which to test behavioral assumptions.

Our study has certain limitations which also point to possible avenues for future research. First, our analysis is limited to the global pharmaceutical industry. While the pharmaceutical industry is similar to other high technology industries in terms of the importance of innovation and collaborations, we cannot generalize our findings, and the implications thereof, to other technology and science intensive industries. Future research should examine the relationship between financial and innovative performance and changes in partnering behavior in other high-technology industries. Second, we examine only one type of dependent variable to capture the idea of risky change at the organizational level. There is an opportunity to further understand how performance feedback models can provide insight to managerial actions related to other variables of strategic importance. Third, as suggested by previous studies, innovative performance is a multi-indicator construct. While patents are a good measure of innovative performance and have been commonly used to measure innovativeness, future studies using innovative performance in feedback models should consider other measures including R&D expenditure and new product introductions. Fourth, our study only partially addresses the call from management scholars to explore additional performance goals in predicting organizational change. While we have used measures of both financial and innovative performance, we do not explore the relationship between the two. Future studies may explore the interaction between these two performance variables.

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Footnotes

(1) The literature on individual risk-taking (Kahneman and Tversky, 1979) and organizational risk-taking (Bowman, 1982; March and Shapira, 1987) also suggests risk aversion when performance is above aspirations and risk taking when it is below aspiration levels.

(2) For the creation of our final database, the matching of the three databases is a critical issue. In order to match USPTO data with COMPUSTAT data we followed the procedure suggested by NBER (Bessen, 2009). After this first match, we matched this resulting database with the SDC database using CUSIP numbers as the identifier of each firm. The resultant final sample has 9,950 firm-year combinations.

(3) Studies have also used return of equity (ROE) as a measure for financial performance (Audia and Greve, 2006). Our findings for ROE resemble those for ROA but with slightly weaker effects.

(4) We use the Resource variable in our regressions, though the results are the same if we use the variables R&D Intensity and Marketing Intensity separately.

Chapter 3: Inventor's Performance, Aspirations And The Likelihood Of Inter-Organizational Mobility

Note on the Chapter 3

The Chapter 3 relates to the working paper *"Performance, Aspirations, and the Likelihood of Inventor Mobility"*. The version of the working paper used to build this chapter refers to May 2012.

The working paper has been awarded as Academy of Management (AOM) Conference 2012 Best Paper Proceedings for the TIM Division and as DRUID Conference Working Paper Publication 2012.

In the near future, the paper will be finalized and submitted to either Research Policy or Industrial and Corporate Change.

Abstract

Building on previous and current research of employees' mobility, Chapter 3 proposes three main research questions representing my present and future research agenda on mobility of inventors. In particular, I ask *who* moves (i.e. motivation to move), *where* inventors move (i.e. pattern of mobility) and *performance implications* for the moving inventor. While recent contributions opened new ways to explore more in depth such questions, I believe that these are still fundamental questions associated with mobility that are begging further theoretical and empirical analysis. In particular, the study proposed in Chapter 3 is an exploratory attempt that seeks to build on behavioral and prospect theory, particularly, on the literature of managerial risk taking in order to explore the motivational influences on individual mobility across firms in the pharmaceutical industry - specifically how performance deviations from specific reference points (aspirations) explain the likelihood of mobility (a risky action). In line with the theoretical traditions mentioned above, our results suggest that: when an inventor performs above her aspiration level (both historical and social), we found support for risk adversity arguments (i.e. less likely to change employer); when an inventor performs below her aspiration levels is more likely to engage in inter-organizational mobility, such as risky action, but only when comparing her performance to the social aspirations (i.e. risk taking profile).

3.1 Introduction to the relationship between knowledge and mobility

Since Arrow's (1962) work on the link between labor mobility and knowledge spillovers, the implications of inter-organizational mobility have received extensive attention by organizational and strategic management scholars. In previous management studies, the focus has been mainly on the use of hiring from other firms as a mechanism for acquiring knowledge or learning (Levin et al., 1987). Song et al. (2003) suggest that learning-by-hiring can be useful when hired engineers are used for exploring technologically distant knowledge (rather than for reinforcing existing firm expertise) and also for extending the hiring firm's geographic reach. Rosenkopf and Almeida (2003) find that mobility is associated with inter-firm knowledge flows (regardless of geographic proximity). And, Almeida et al. (2003) suggest that, for start-ups, the motivation and ability of learning-by-hiring decreases with organizational growth. These studies have two features in common. Firstly, they look at the implications of mobility from the recipient's perspective, therefore analyzing the effects of mobility on the hiring firm. Secondly, they focus mainly on the knowledge transfer looking at how the hired employee's human capital affects the knowledge base of the recipient firm.

Building on this early work, recent studies on mobility have attempted to develop a more comprehensive understanding of the implications of inter-organizational mobility on firm performance and exploring the boundary conditions under which employees' mobility generates strategic consequences. Somaya et al. (2008) draw on social capital theory and look at the differences of mobility between competitors and potential allies. In particular, they find that the movement of employees both to and from clients may enhance firm performance, whereas only inward mobility from competitors benefits recipient firms. Corredoira and Rosenkopf (2010) explore the effect of mobility on knowledge transfers to firms that lose these employees. In

particular, they find that semiconductor firms losing employees are more likely to subsequently cite patents of firms hiring these employees, suggesting that mobility-driven knowledge flows are bidirectional. Dokko and Rosenkopf (2010) suggest that mobility affects a recipient firm's social capital when the hired employee has rich and non-redundant social capital. At the same time, the mobility event is not a loss for the 'donor' firm as long as there is a change in the firm's business strategy. Taken together, these more recent studies propose a complementary view to previous studies on mobility, suggesting two main points: first, mobility generates bidirectional knowledge flows and there are implications for both the 'donor' and recipient firm; second, social capital implications of mobility need to be further explored (from a gain/loss perspective), just as it has been done for human capital associated with mobile employees.

Other studies draw more attention to the organizational performance implications of mobility. Aime et al. (2010), for example, suggest that mobility of key employees is stable across organizations, while the competitive advantage (presented as measure of performance) they generate is not. Therefore, mobility has implications for both the 'donor' and the recipient firms' competitive advantage and the related industry dynamics. Moreover, Agarwal et al. (2009) study how a firm's reputation for toughness in patent enforcement affects the spillovers via inventor mobility. They suggest that a firm's litigiousness significantly reduces spillovers otherwise anticipated from departures of employee inventors, particularly when the hiring organizations are entrepreneurial ventures.

This literature review on inter-organizational mobility offers the image of a research field in which economic and managerial discussion is still developing. I believe that there are still fundamental questions associated with mobility that are begging further analysis, which constitute the main pillars of my research agenda.

First, most prior literature has considered mobility as an exogenous event and has paid little attention to the antecedents of mobility. Therefore, an important question on the table is, "*which environmental, firm and inventor characteristics do predict mobility?"*. Some exceptions that have thrown some light on this question are Marx et al. (2009), who study how the non-compete agreement policy in Michigan approved in 1985 affects the likelihood of employees' mobility, Palomeras and Melero (2010) who examine how inventor's knowledge characteristics stimulate mobility, and Campbell et al. (2011), who suggest that employees with higher earnings are less likely to leave relative to employees with lower earnings. These studies propose arguments based on the opportunities that the (labor) market offers to employees as conditions for and consequences of inter-organizational mobility. In addition, they look at how the employee's capabilities can fit such market opportunities. Thus, mobility has been mainly predicted as an event reflecting opportunity/capability arguments coming from the relationship between the employee and the labor or entrepreneurial market. However, so far motivational arguments have received less attention. In other words, *what are the employee's intrinsic motivations to move?* What are the antecedents related to the employee's (technological) characteristics that predict mobility? In this vein, scholars still do not know much. Therefore, the first objective of my research agenda, as well as the core aim of this chapter, is to build on these prior studies and advance the understanding of the *likelihood* of the inter-organizational mobility event.

A second aspect that has been less considered by the mobility literature is the patterns of mobility or *where* employees go, given that they have moved. Almeida and Kogut (1999) suggest that institutions and labor networks vary by region and constrain or incentivize engineers' mobility, therefore explaining why knowledge spillovers generated by mobility are

regionally localized. More recently, Bidwell and Briscoe (2010) propose that workers' mobility is more likely from large firms to small firms, and from firms in which high levels of training is provided at early career stages to firms that demand associated skills in later career stages. Campbell et al. (2011) suggest that employees are more likely to create a new venture than joining another firm when they show high ability to appropriate and transfer the source firm's complementary assets and possess high relative bargaining power in terms of value creation. Besides these exceptions, the *patterns* of mobility (industrial and geographical) are relatively unexplored. Therefore, the second objective of my research agenda is to answer the question *"what factors explain the direction (geographic, industrial and organizational) of mobile individuals?"*

Finally, a third aspect of mobility that has been less studied is the performance of the inventor once she moved. In other words, it is still unclear whether the mobile inventor increases or decreases her own individual and firm performance. An attempt to explore the productivity-mobility relationship has been Hoisl (2007), in which the author analyses the causality between inventor's productivity (i.e. patent count) and inventor's mobility. The findings suggest that where a move increases productivity, an increase in productivity decreases the probability to observe a move. Lately, Singh and Agrawal (2011) propose a difference-in-difference empirical strategy to test the "learning-by-hiring" hypotheses previously proposed by Song et al. (2003). Studying citations' patterns between the source and the recipient firms, their results offer the idea that the role of the recruit (i.e. inventor moved) does not diminish over time, but keeps the same importance, suggesting, "exploiting-by-hiring" rather than "learning-by-learning". Therefore, while inventor's performance implications are receiving more attention from economics and management of innovation scholars, to the best of my knowledge, there is a void in studies that

explicitly addresses this issue. Therefore, the third main research question of my research agenda is *"How does mobility affect the innovative performance of a mobile inventor?"*

These three broad research questions represent the main building blocks of my research agenda on mobility of inventors. In this chapter, in particular, I will offer theoretical and empirical arguments on the inventor's motivation to engage in an inter-organizational move, therefore contributing to the understanding of the mobility's antecedents. In summary, looking at mobility as a risky choice for the inventor, I will build on the literature of managerial risk taking (Cyert and March, 1963; Kahneman and Tversky, 1979; March and Shapira, 1987) to explain how performance's deviations from specific reference points explain the likelihood of mobility events as a reflection of different risk profiles.

3.2 Theory and Hypotheses

3.2.1 Performance, aspirations and risk

The behavioral theory of the firm has contributed significantly to my understanding of organizational search, the propensity for risk taking, and the likelihood of strategic change (Audia et al., 2000; Bromiley 1991; Greve 1998, 2003b; Miller and Chen, 2004; Park, 2007). According to this theory, search processes for new solutions are triggered by a problem. When organizational performance falls below the aspiration levels of the firm, a search for solutions occurs and organizational change becomes more likely. Problemistic search implies that aspiration levels (as regards performance) are formed based on the past experience (historical aspiration levels) and those of comparable peers (social aspiration levels). The behavioral view offers similar predictions when performance is above desired aspiration levels. Performance

above aspirations levels provides agents not only with access to additional or lower-cost resources (slack) but also instills confidence in their abilities to pursue promising ideas previously deemed too risky. In this frame, the gap between aspiration levels and performance plays a central role, serving as an impetus to search for new solutions, increasing the salience of risky choices and subsequently encouraging managers to engage in more risk-seeking behavior that results in forms of change.

Evolutionary economics and organizational learning can be seen to be the most direct descendants of the behavioral theory (Argote and Greve, 2007). One of the important concepts arising from evolutionary economics is that of a routine, which Winter (1964, p. 263) defines as a 'pattern of behavior that is followed repeatedly, but is subject to change if conditions change'. Nelson and Winter (1982) view routines as adapting in response to performance feedback. Actions that result in successful outcomes are positively reinforced and hence lead to persistence in the use of the existing routines, while actions that lead to performance outcomes that are unsuccessful trigger a search for modifications to the existing routine. Routines thus possess the qualities of both stability and change (Feldman, 2000; Feldman and Pentland, 2003). Empirical research largely supports the theoretical predictions indicated above. Bromiley et al. (2001) and Nickel and Rodriguez (2002) offer a comprehensive review of the empirical studies on this topic and find broad support for these predictions.

This framework has been applied mainly to organizational level studies (Greve, 1998; 2003a; 2003b; 2008). However, similar predictions are also rooted in the tradition of individual and managerial risk taking (Kahneman and Tversky, 1979; March and Shapira, 1987). One of the main propositions of prospect theory points out the key role of the reference point or target for denying the decision maker’s attitude towards risk. When the expected results of an alternative

are “good” — that is to say, they are higher than the target level — the decision maker shows a risk-averse attitude. When the expected results are “bad” — lower than the target level — the decision maker will be risk seeking (Nickel and Rodriguez, 2002). In short, risk taking is affected by the relation between current position and some critical reference points (Kahneman and Tversky1979). Similar arguments are offered by Shapira and March (1987); in their work on individual managerial risk taking, they suggest that risk is context specific and individuals use reference points in order to evaluate their performance and adjust their risk preferences for further action.

3.2.2 Inter-organizational mobility as risk

Therefore, there is a consistent shared framework between individuals and organizations in explaining the risk taking profile as a function of the deviations of the observed performance and from related aspirational reference points. Now, the question is *“how does such a framework relate to a mobility event?”* In other words, *“how do deviations of inventor’s performance from related aspirations explain mobility events?”*

Current research on inter-firm mobility describes it as an action involving risk. In particular, moving from one organization to another involves inventor’s routines distress and disruption at different levels. Nelson and Winter (1982) and Cyert and March (1963) elaborated on a dual routine perspective, where organizational behavior stems from two sets of hierarchically ordered routines: a set of operational routines that control day-to-day actions, and a set of meta-routines that govern operational routines. Higher-order routines govern the use, combination, or recalibration of lower order ones (Nelson and Winter 1982). Therefore, higher-order routines are inherently social and success of replication hinges on retention of their

integrity (Wezel et al., 2006). While the source firm does not necessarily face the risk of experiencing severe disruption in routines given the departure of one employee, the moving employee is not automatically obvious to transfer and replicate high order routines. In particular, this argument is more salient when considering employees dedicated to innovative activities (i.e. inventors or scientists). In fact, as suggest by Kogut and Zander (1992), innovation and knowledge creation are socially constructed activities, so preserving and replicating these routines is critical if not done through existing patterns of interaction among those actors usually involved (Nelson and Winter, 1982). Arguing from a social capital perspective, recent studies have corroborated empirically these theoretical implications of mobility as risky event in terms of disruption of innovative routines for the moving inventor (Agrawal et al. 2004; Ganco, 2009).

Combining the previous frameworks on individual and managerial risk taking with the idea that mobility represents a risky event considering the related inventor's disruption of routines involved, especially when looking at knowledge creation activities, I offer hypotheses for the prediction of the mobility event as a reflection of an inventor's risk profile given the performance deviations from specific reference points, both historical and social.

3.2.3 Inventor's performance vs. historical aspirations

When an inventor performs above her historical aspirations (i.e. performance is better than the performance in the previous period of time), she does not have the motivation to engage in risky actions, such as mobility. When the expected results of an alternative are "good" — that is to say, they are higher than the target level — the decision maker shows a risk-averse attitude. So, the better the inventor's productivity (i.e. count of patents), the less likely to observe a move of the focal inventor. Similar results on the productivity-mobility relationship have been found in

recent studies by Hoisl (2007), although the author looks at level of performance on not variation over time from period to another. In fact, I am interested in how the performance's deviations from aspirations affect the probability of moving, and not the performance in itself. In a similar vein, Campell et al. (2011) argue that there is a negative relationship between higher earnings and the likelihood of mobility events. In their studies they equate earnings to ability (i.e. better performing), therefore concluding that those employees more capable are less likely to move.

Hypothesis 1a: For inventors performing above their historical aspiration levels, increases in innovative performance are negatively related to the likelihood of mobility.

When an inventor performs below her historical aspirations (i.e. performance is worse than the performance in the previous period of time), she does have the motivation to engage in risky actions, such as mobility. When the expected results are "bad" — lower than the target level — the decision maker will be risk seeking. While previous studies do explore the relationship between inventor's productivity and mobility events, and it consistently turns out to be negative, to the best of my knowledge there is no previous study looking at this relationship isolating the effect on performance when it is above or below reference points. So, mobility literature does not really provide insights on the situation in which the inventor is below its aspirations. But, I offer two arguments. First, the inventor might feel that her innovative routines are not productively working. Given the organization and context specificity of the innovation routines (Kogut and Zander, 1992; Wezel et al., 2006), the inventor might attribute her "failure" status to such contextual factors and therefore attributing to mobility the idea of potential solution for such *problemistic* situation. Second, inventors with low performance, actually lower

than aspirations, might signal to the current employers a not sufficient level of ability, making their positive rewarding carrier path in that specific organization less likely. Therefore, an inventor experiencing negative performance discrepancies form aspirations is likely to be at risk of mobility, such as risky option.

Hypothesis 1b: For inventors performing below their historical aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility.

3.2.4 Reference target for social aspiration formation: the role of inventor's co-authors

Recently, social capital implications of mobility have been receiving more attention, just as it has been done for human capital associated with mobile employees (Corredoira and Rosenkopf, 2010; Dokko and Rosenkopf, 2010; Somaya et al., 2008). While knowledge resides in individuals (Grant, 1996), innovation is a social constructed process (Kogut and Zander, 1992) and it is developed through the combination of individual and organizational routines (Nelson and Winter, 1982). Therefore, there is an increasing interest in the understanding of how the employee's group of reference plays a role as boundary condition to explain strategic consequences of mobility events. However, most of these studies have looked at how the social capital of the moving employee explains variation in phenomena at the firm level, such as recipient firm's performance (for example bidirectional knowledge flows). Less work has been done on the inventor-social capital relationship in terms of mobility implications at the individual level, and in particular for the moving employee. An example, in this vein, is Azoulay et al.

(2010) estimating the magnitude of spillovers generated by academic "superstars" who died prematurely and unexpectedly, thus providing an exogenous source of variation in the structure of their collaborators' co-authorship networks. Results of this study suggest that on average, the co-authors decline in their quality-adjusted publication rates. In my study, I am rather interested in the other direction of the relationship of the inventor with her co-authors. In other words, *how the co-authors affect the inventor, and specifically her likelihood on mobility?*

3.2.5 Inventor's performance vs. social aspirations

Considering the cohort of each inventor's co-authors as the reference group, I can assess the focal inventor's performance in terms of comparison to the main reference group. As suggested by Kahneman and Tversky (1979) and Cyert and March (1963), current performance is evaluated using the peer group performance as reference point (along with historical). So, when an inventor's performance is above the performance of her co-authors (social aspiration level), the focal inventor assesses her performance as success, therefore being less motivated in and avoiding incurring in risky profile action. Given the context-specificity of the performance evaluation, mobility is a less likely event given the potential opportunity offered internally by the source firm. Actually, for each inventor I expect a strong positive relationship between being above her historical aspiration (performing better than the previous period) and being above the social aspiration group (performing better than the group of coauthor), reflecting a positive pattern of patenting behavior. Therefore, also as suggested by previous studies, mobility event for top performer is less likely to observe (Campbell et al., 2011; Hoisl, 2007).

When considering the situation in which the inventor is performing below her social aspiration, similar arguments apply as for the performance below historical aspirations, therefore

making mobility a more likely event for inventors performing below their social aspirations. Firstly, performing below the reference group could pose the inventor in a lower bargaining position with the current employer, as suggested by Campbell et al. (2011). Secondly, the group of co-authors might not recognize the value of the focal inventor anymore, therefore making less likely further collaborations, generating a potential isolation effects in the related network. Therefore, the inventor might perceived the risk related to a mobility event costs as lower if compared to the incurring consequential costs of sticking in a situation in which her performance is recognized as not as valuable as her peer group.

The idea that top performers are less likely to engage in mobility and low performers are more likely to move has been lately offered also by Carnahan et al. (2012). Arguing that the compensation dispersion of the firm compared to the competitors affect the rent appropriation of the employees and the related hazard of mobility, the authors explored the heterogeneity in mobility and entrepreneurial decisions. More specifically, the Carnahan et al. (2012) find that individuals with extreme high performance are less likely to leave firms that offer higher compensation dispersion than competitors, however, if they do leave these employers, they are more likely to create new ventures. In contrast, employees with extreme low performance are more likely to leave firms with more compensation dispersion than competitors, and these individuals are less likely to engage in new venture creation (Carnahan et al., 2012).

In the light of arguments offered above, I offer the following hypotheses for the relationship between the difference between the inventor's performance and the social aspiration level, and the likelihood mobility:

Hypothesis 2a: For inventors performing above their social aspiration levels, increases in innovative performance are negatively related to the likelihood of mobility.

Hypothesis 2b: For inventors performing below their social aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility.

3.3 Methodology

3.3.1 Data

I build my sample using the database publicly provided by The Institute for Quantitative Social Science at Harvard University (I.Q.S.S.). Lai et al. (2009) developed a project to combine in a set of unique databases the patents and inventors' data previously offered by difference data sources, such as NBER and USPTO. The resulting set of databases provides data on each patent published between 1975 and 2008 in USPTO, along with the list of inventors per each patent and related geographical and affiliation information (1). Recent studies on mobility have been empirically developed using such data source (Marx et al., 2009).

From the database I extract the patents and inventors information for five of the top global pharmaceutical firms, being: Pfizer Inc., GlaxoSmithKline Plc., Merck & Co. Inc., and Bristol-Myers Squibb, Novartis AG. I focus on pharmaceutical firms because of the importance of innovation for this industry (OECD, 1997; Cloodt et al., 2006) and given that inter-firm mobility of engineers is especially intense in high-tech industries (Almeida and Kogut 1999). The five firms selected to build my sample sum up to the 45% of market share in the pharmaceutical industry, making my sample fairly representative of the industrial dynamics.

To build my sample I take the following steps for each of the five pharmaceutical firms. First, combining the company information available on the database CorpTech and the company official reports, I studied the corporate dynamics involved in each of the companies from their existence date, in particular looking at acquisitions, mergers, joint venture and alliances activities. The objective is to have a more conservative estimation of mobility events, avoiding codifying an inter-mobility event that is in fact an intra-mobility event. Second, I use the I.Q.S.S. database to identify each patent whose assignee is the company or any related subsidiary from 1975 to 2008. Before doing this, I keep only patents with the following characteristics: single assignee, utility type and non-university. Third, using the patents generated in step two, I list any inventor who has published at least one patent with the focal company. As result, I obtain a list of inventors with the related published patents in each year. Fourth, from this list I generated two sets of inventors: those having as assignee only the focal firm (therefore, no moving inventors); those having some patenting activity in the focal firm and subsequently in another firms (moving inventor). From the "moving inventor" lists I exclude: 1) those inventors in which there is the overlapping patent application year between the focal firm and the non-focal firm 2) those inventors with one patent in between several focal firm patents, and vice-versa 3) those inventors having only unidentified assignee. This procedure of identification of inventors as it has been done in previous studies of mobility of inventors (Hoisl, 2007; Palomeras and Melero, 2010). Following all these steps, I generate a sample of 4,940 inventors for the five pharmaceutical firms, who applied for a total of 61,281 patents from the 1975 to 2008. I identify 1,431 moving inventors that represent the 29% of the inventors.

Using patents to track mobility present some challenges and limitations, as acknowledged in previous studies (Palomeras and Melero, 2010; Marx et al., 2009). Nonetheless, previous

research has shown patent data as viable to track inventor mobility (Almeida and Kogut 1999, Song et al. 2003; Trajtenberg et al. 2006).

3.3.2 Variables

Dependent variable. My dependent variable is employee mobility, which is a dummy variable coded 1 if an inventor's employer changed in the subsequent period, and 0 otherwise (i.e. when the inventor is at risk to move). The move assumed to happen at the midpoint between the last patent in the focal firm and the first patent in the non-focal firm.

Independent variables. My independent variables are the discrepancies of the inventor's innovative performance from her aspiration levels (historical and social). For innovative performance, I use the count of granted patents for the firm. Patents are an appropriate indicator of innovative performance in high-technology sectors (Hagedoorn and Cloodt, 2003), and are an important source of technological advantage in the pharmaceutical industry (Levin et al., 1987). For the performance measures, I follow previous work of Greve (1998, 2003a, 2003b) in generating the measures for historical and social aspiration level variables. I generate historical aspiration levels by taking an exponentially weighted average of past values on the performance variable (Levinthal and March 1981). The formula for historical aspiration levels is:

$$A_{i,t} = \alpha * A_{i,t-1} + (1-\alpha) * P_{i,t-1}$$

In this specification of historical performance aspiration level, $A_{i,t}$ is the aspiration level for inventor i in time t. $P_{i,\,t-1}$ is the actual performance of inventor i in time t-1. Alpha is the

weight given to the most recent aspiration level. In order to assess the appropriate value of alpha, I estimate models with different values of alpha varying from 0.1 to 0.9 with increments of 0.1 (Greve, 2003a) and identify the value of alpha corresponding to the best log-likelihood value. Following this procedure I find that innovative performance had an alpha of 0.2. For social aspiration levels, I attempted to identify the appropriate reference group for a particular firm. As suggested by previous work on inventors and the related peer group (Azoulay et al., 2010), the group of co-authors is a viable reference group for each focal inventor. I build the co-authors cohort for each inventor in each year. From the year in which the focal inventor patents with another inventor, the latter is included in the group of co-authors of reference, but not before. Therefore, following the logic above, I compute the mean of the performance of the inventor's co-authors in each year. Finally, I compute the difference between the inventor's performance in period t and the mean of the suggested reference group in period t (2).

$$Social_{i,t} = P_{i,t} - P_{j,t}$$

where $Social_{it}$ for inventor i in time t is the difference between the performance of firm i in year t and the performance of the inventor j in year t-1, where j is the average performer in the group of co-authors.

As in previous similar studies using the aspiration constructs , (Audia and Greve, 2006; Greve, 2003a), to estimate whether the effect of innovative performance on the likelihood of mobility differs according to whether the performance is above or below the aspiration level, I specify performance as a spline function (Greene, 1993). Therefore, I create two variables for

both historical and social aspiration levels. First I compute the difference between performance and aspiration, as:

$$D_{i,t,a} = P_{i,t} - A_{i,t,a}$$

where $D_{i,t,a}$ is the discrepancy for the inventor *i* in time *t* relative to aspiration a (historical or social) between the $P_{i,t,}$ which is the performance of the inventor i in time *t*, and $A_{i,t,a}$, which is the aspiration a (historical or social) for the inventor i in time *t*. From *D* I generate two variables called $Above_{i,t,a}$ and $Below_{i,t,a}$ formalized as:

$$Above_{i,t,a} = \begin{cases} D_{i,t,a} \\ 0 \end{cases}$$

where $Above_{i,t,a}$ equals $D_{i,t,a}$ when $D_{i,t,a}$ is positive, and 0 otherwise.

$$Below_{i,t,a} = \begin{cases} D_{i,t,a} \\ 0 \end{cases}$$

where $Below_{i,t,a}$ equals $D_{i,t,a}$ when $D_{i,t,a}$ is negative, and 0 otherwise.

Therefore, I have two independent variables for historical aspiration levels (above and below) and two independent variables for social aspiration levels (above and below). For historical comparison, I use aspirations in t to generate discrepancy in *t+1*, which in turn predicts the likelihood of mobility in *t+2*. Therefore, I allow for a one-year lag between the generation of the performance feedback and the subsequent mobility event (3).

Controls. In order to control for alternative explanations for the likelihood on mobility suggested by previous studies (Singh and Agarwal, 2011; Campbell et al., 2011; Palomeras and Melero, 2010; Marx et al., 2009, Hoisl, 2007), I use a set of control variables. *Complementarity* is the mean number of co-inventors per patent in the inventor's set of patents. *Quality* is the sum of the forward citations received by the inventors on each patent adjusted (standardized) by the industry mean of forward citations in the specific technological category of the focal patent in the reference year. *Dispersion* is the standard deviation of the forward citation received by the inventor on her set of patents in a specific year. *Self-Citation* is the mean percentage of self-citations that an inventor receives in her set of patents. *Tenure* is the difference in years between each year and the application year of the first applied patent. *Gender* is a dummy variable coded 1 if male, and 0 otherwise. *Tech Dummies* are generated for the 18 most relevant technological classes in which the firms sampled patent. On average, these technological categories represent 70% of the patents for each firm. *Year Dummies* are introduced into the model to capture time trend effects.

3.3.3 Model

In my analysis I estimate the hazard rate that an inventor in my sample changes the employers. For each inventor I construct the patenting life, which is a series of patents applied in each period. Since I can observe the inventor only when she files a patent, an inventor is at risk every time she applies for a patent. Structuring my data as such, my sample is characterized by censored (nonmoving) and non-censored inventors (moving). For both the censored and

uncensored individuals I do not know whether the inventor moves or stays, therefore the last period does not contribute as a valid observation (4).

The functional form of my baseline hazard is assumed to be a logarithm in order to take into account the decreasing marginal moving hazard rate over time. Given the dichotomous nature of my dependent variable, the estimation model I use is a probit random effect specification in order to take into account for individual unobserved variation caused by inventor-specific characteristics omitted in the model (Jenkins, 2005). The empirical strategy I adopted has been validated in recent similar studies on inventors' mobility (Palomeras & Melero, 2010).

3.4 Results

Table 3.1 shows descriptive statistics and correlation coefficients. Table 3.2 shows the marginal effects computed at the mean. Model 1-3 show results of the probit marginal effects. Model 1 show the marginal effects for the main effects specification; Model 2 is specified only with

control variables; and Model 3 is the full model specification. For the interpretation of the results I focus on the marginal effects estimates of Model 3 (marginal effects at the mean of each variable in the full model specification).

Table 3.1: Descriptive Statistics and Correlation Matrix

	Obvs	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Mobility	24,016	0.04	0.20	1.00												
(2) Above (Historical)	30,779	1.17	2.48	-0.05	1.00											
(3) Below (Historical)	31,961	-0.38	1.08	0.00	0.17	1.00										
(4) Above (Social)	31,961	0.71	1.87	-0.06	0.53	0.01	1.00									
(5) Below (Social)	31,961	-0.60	0.62	-0.08	0.22	0.03	0.37	1.00								
(6) Quality	31,961	5.54	9.52	0.02	0.07	0.05	0.02	-0.01	1.00							
(7) Dispersion	31,961	1.32	3.6	0.03	0.10	0.07	0.14	0.11	0.32	1.00						
(8) Self Citations	31,961	0.05	0.15	-0.04	0.02	-0.03	0.05	0.03	0.06	0.08	1.00					
(9) Complementarity	31,961	3.88	2.60	-0.02	-0.03	-0.04	-0.02	0.00	-0.09	-0.04	0.02	1.00				
(10) Previous mobility	31,961	0.32	0.18	0.17	0.00	0.01	-0.01	0.01	0.02	0.00	-0.03	-0.02	1.00			
(11) Tenure	29,323	9.12	6.61	0.01	0.28	0.11	0.15	0.08	0.18	0.07	0.03	0.15	0.06	1.00		
(12) Tenure (squared)	29,373	176.97	160.8	0.00	-0.20	-0.08	-0.10	-0.05	-0.16	-0.08	-0.03	0.12	0.06	0.95	1.00	
(13) Gender	31,961	0.92	0.26	0.00	0.00	0.01	0.01	0.00	0.01	0.02	0.01	0.10	0.03	0.05	0.05	1.00

Coefficients greater in magnitude than 0.02 are significant at the 0.05 level

Notes: number of observations per variable is not constant given the missing values. However, our results are not affected by this differences

Control variables show results overall consistent with previous studies' findings on mobility. *Complementarity* is negative and significant. *Quality* is positive and significant. *Dispersion* is negative and significant, and *Self-Citations* are negative and significant (Palomeras and Melero, 2010), *Tenure* is positive and significant while *Gender* is not significant (Campbell at al., 2011; Singh and Agrawal, 2011). For *Tenure* I test a non-linear relationship, and I found that the relationship between tenure and likelihood of mobility is an inverted U-shape: inventors in the pharmaceutical firms in my sample are more likely to move when they are in the middle of their carrier as scientist.

Table 3.2: Probit Model Random Effects for Prediction of Mobility: Marginal Effects at the mean

	Marginal Effect Models		
	Model 1	**Model 2**	**Model 3**
Above (Historical)	- 0.003*** (0.000)		- 0.002*** (0.000)
Below (Historical)	0.002 (0.001)		0.001 (0.001)
Above (Social)	- 0.007*** (0.001)		- 0.007*** (0.001)
Below (Social)	- 0.012*** (0.002)		- 0.011*** (0.002)
Quality		0.00*** (0.000)	0.00* (0.000)
Dispersion		- 0.002*** (0.000)	- 0.001*** (0.000)
Self Citations		- 0.061*** (0.011)	- 0.053*** (0.010)
Complementarity		- 0.002*** (0.000)	- 0.001** (0.000)
Previous mobility		0.072*** (0.011)	0.073*** (0.011)
Tenure		0.006*** (0.001)	0.003*** (0.000)
Tenure (squared)		- 0.000*** (0.000)	- 0.000*** (0.000)
Gender		0.07 (0.075)	0.005 (0.005)
Year dummies	Yes	Yes	Yes
Technology dummies	Yes	Yes	Yes
N	21,995	21,995	21,995
Number of Clusters (inventors)	3,629	3,629	3,629
Wald Chi2	164.78***	153.45***	242.47***

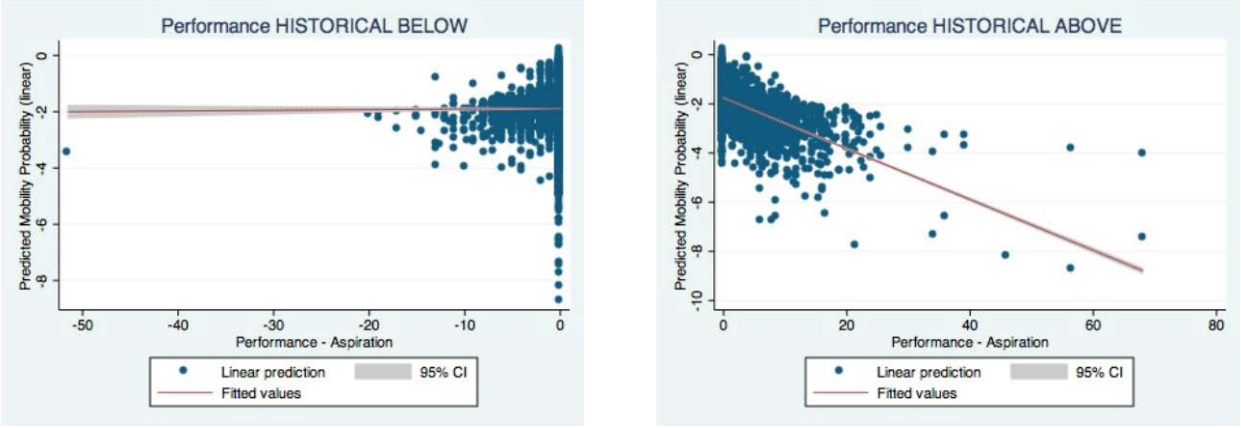
Notes. One-tailed test for hypothesized effects

+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Hypotheses 1a suggests that increases in innovative performance of those inventors performing above their historical aspiration levels are negatively related to the likelihood of

mobility. The marginal effect in Model 3 is negative and significant, suggesting that increases in inventor's innovative performance (i.e. patent count) result in decreasing in the probability of mobility. Thus, an increase of 10% from the mean would decrease the probability of mobility, on average, by 0.02%. This result suggests risk aversion individual behavior, as predicted. Therefore, my hypothesis 1a is supported. Hypothesis 1b suggests that for inventors performing below their historical aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility. I cannot draw any conclusion since the coefficient is not significantly different from zero; so, hypothesis 1b is not supported. Figure 3.1 shows the marginal effects plot of the variable Above (historical) and Below (historical) on the likelihood of inventor's inter-organizational mobility.

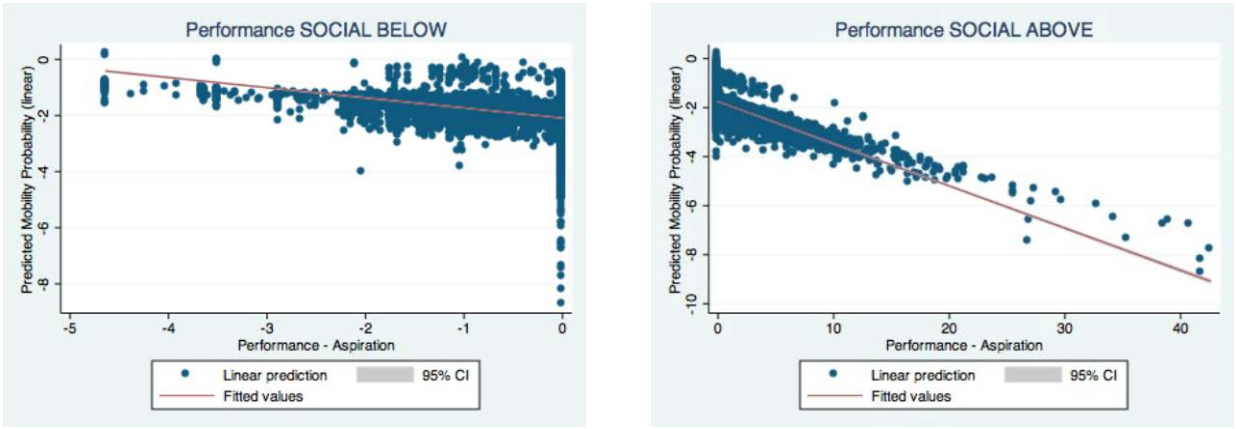
Figure 3.1: Marginal Effect of Performance vs. Historical Aspirations



Looking at results for social aspiration variables, results are as follows. Hypothesis 2a suggests that for inventors performing above their social aspiration levels, increases in innovative performance are negatively related to the likelihood of mobility. Results in the model 3 show that an increase in inventor's performance of 10% from the mean in comparison to her

co-authors' performance, on average, would decrease the probability of mobility by 0.07% (statistically significant). Therefore, my hypothesis 2a is supported. The hypothesis 2b suggests that for inventors performing below their social aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility. The marginal effect in Model 3 in negative and significant, suggesting that decreases in inventor's innovative performance (i.e. patent count) in comparison to her co-authors' performance would result in increasing in the probability of mobility. Thus, a decrease of 10% from the mean would increase the probability of mobility, on average, by 0.11%. This result suggests that when an inventor is performing below her reference group she would show risk taking individual behavior, as suggested by my theory. Therefore, my hypothesis 2b is supported. Figure 3.2 shows the marginal effects plot of the variable Above (social) and Below (social).

Figure 3.2: Marginal Effect of Performance vs. Social Aspirations



Overall, my results suggest that mobility is less likely when the inventor's performance is above aspiration levels, both historical and social. Instead, a mobility event is more likely when

the inventor's performance is below the average performance of her group of co-authors. Table 3.3 shows a summary of the results for hypotheses and controls.

Table 3.3: Summary of the results

	Direction	Significance	Hypotheses	Mean	Effect
Above (Historical)	Negative	Yes	**H1 SUPPORTED**	1.17	**-0.02%**
Below (Historical)	Positive	No	H2 NOT SUPPORTED	-0.38	-
Above (Social)	Negative	Yes	**H3 SUPPORTED**	0.71	**- 0.07%**
Below (Social)	Negative	Yes	**H3 SUPPORTED**	-0.60	**- 0.11%**
Quality	Positive	Yes			
Dispersion	Negative	Yes			
Self Citations	Negative	Yes			
Complementarity	Negative	Yes			
Previous mobility	Positive	Yes			
Tenure	Positive	Yes			
Tenure (squared)	Negative	Yes			
Gender	Positive	No			

3.5 Contributions and Conclusions

The current chapter is the first offering of a broader research project that seeks to better understand the causes and effects of the inter-organizational mobility of inventors. This chapter

is exploratory in nature and seeks to build on behavioral and prospect theory, particularly, on the literature of managerial risk taking (Cyert and March, 1963; Kahneman and Tversky, 1979; March and Shapira, 1987). The chapter intends to explore the motivational influences on individual mobility across firms in the pharmaceutical industry - specifically how performance deviations from specific reference points (aspirations) explain the likelihood of mobility (a risky action).

My hypotheses suggest that any performance deviations above aspiration levels, both historical and social, would decrease the likelihood of an inventor's inter-organizational mobility. Results support mainly my hypotheses; in other words, when an inventor performs above his or her aspirations, the likelihood of mobility decreases, therefore showing an individual risk-averse profile. No statistical evidence can be drawn for the performance below aspirations, while evidences have been found the performance below social aspirations. In fact, as hypothesized, when an inventor shows decreases in her performance in comparison to the social reference (i.e. group of co-authors), she is more likely to move. My results appear to be in alignment with the original prospect theory predictions on risk taking for individuals performing below their aspirations (Kahneman and Tversky, 1979), especially when considering the performance compared to the "relevant others", such as co-inventors in my case, and on risk adversity when considering the performance above their aspirations (historical and social).

My study developed in this chapter presents the following contributions. Firstly, considering the prediction of the likelihood of mobility, it should be noted that inventor performance has been least considered as an antecedent of mobility. Building on Trajtenberg (2005) and Trajtenberg et al. (2006), Hoisl (2007) suggests that while a move increases productivity, an increase in productivity decreases the probability of observing a move.

Similarly, Palomeras and Melero (2010) suggest that the higher the quality of an inventor's set of knowledge, the more likely to observe a move. Such studies, while important contributions, have focused on the inventor's performance in absolute terms. It is hard to interpret the meaning of performance of each inventor, and in particular at which level of performance mobility is most likely. A very recent exception, in this sense, is Carnahan et al. (2012), in which the authors look at likelihood of mobility of extreme performers. My study, building on the aspiration level concepts, tries to improve the interpretation of the performance measure and its implications in terms of inventor's mobility. To the best of my knowledge, there is no prior study that explicitly addresses this issue. Secondly, previous studies have focus more on the capability and market opportunity arguments to explain the likelihood of mobility (Campbell et al., 2011; Palomeras and Melero, 2010). While these two dimensions are important to explain inter-organizational mobility, the inventor's intrinsic motivation to move has been so far less consider. Looking at the difference between performance and its aspirations, I propose a model in which the inventor is motivated to risk taking or risk adverse behavior, such as mobility. Finally, I try to further develop the construct of social aspiration level. In organizational level studies such construct has been approximated to the average or median performance - of an industry. Recently Greve (2008) propose a refinement of the construct looking at those firms of the same size to build the reference group for the focal firm. Along this line of reasoning, I build the social comparison group as the set of co-authors for each focal inventor, taking into account the social nature of the innovative activities. Further research should consider also other social comparison group, such as the median focal inventor firm performance or any geographical or technological specification of the peer group.

3.6 Limitations

This study is not free of limitations. I acknowledge the following two areas of improvements characterizing the current study. Firstly, I do not have access to salary data of the inventors I collected. The lack of information on salary hinders the possibility to make realistic assumptions on the following inventor's unobservables: ability, internal bargaining power, status, and compensation's expectations on any potential new employers. These aspects might significantly shape the inventor's hazard to engage in an inter-organizational mobility event. Within the strategic human capital community, few studies have been able to either access or directly collect data on the salary. Campbell et al. (2011) and Carnahan et al. (2012) are expectations in this sense. However, their empirical settings are based on U.S. lawyers, therefore using non-inventors data. In fact, the vast majority of studies based on inventors' mobility using patents data do not have access to salary data, even when they combined the patents data with survey empirical strategy (Hoisl, 2007). Therefore, while not having the salary information might threat some assumptions behind my study, within the inventors' mobility community studying high knowledge-intensive industry, such as pharmaceuticals, is currently a standard limitation. Along this line of reasoning, future research should make a greater effort to collect data on the salary of the inventors, or at least on the compensation and rewarding policies of the firms employed in the sample for the analysis. The second limitation of my current study presented in this chapter is the relatively low magnitude of the main effects hypothesized in the theory. In fact, such low magnitude might raise some questions about the economic relevance of both the research questions and the proposed mechanisms. In other words, inventor's performance-based variables might not have a strong predictive effect on inventor's inter-organizational mobility. However, this is apparently not only a characteristic of my study but a

consistent finding in comparable research, such as Palomeras and Melero (2010). Perhaps these results lie on the performance construct and its usual proposed measurement, such as patents count. Future research needs to consider alternative performance measurements in order to better capture the established relationship between performance and inter-organizational mobility providing more meaningful measures. In this sense, qualitative approaches might be extremely useful to uncover what is the inventor's performance for both the individual and the organization and, thus, better assessing how this affects her decision making process, such as mobility events.

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Footnotes

(1) For more detailed information about the databases creation process refer to http://dvn.iq.harvard.edu/dvn/dv/patent and specifically to the document available online “The careers and co-authorship network of U.S. patent-holders, since 1975”, in which Lai and colleagues offer explanation on the disambiguation of the original source data.

(2) I assume that the inventor can observe when her co-authors apply for a new patent. This assumption relies on the findings that information flows informally and quickly in network of

inventors. In addition, since I look at application year of patens, the nature of the data is to be public and quickly available in their information, in particular, on the website of USPTO.

(3) For social aspiration, I compute the discrepancy in t (both performance and aspirations are in period t), but mobility event is still predicted with one-year lag.

(4) The last observation for non-censored individuals is the first patent filed for the new employer, while for censored individuals is the last patent filed in the focal firm. Both these cases do not contribute as observations in the sample.

Chapter 4: A Behavioral Perspective On Inventors' Mobility. The Case Of Pharmaceutical Industry

Note on the Chapter 4

The Chapter 4 is based on the paper *"A Behavioral Perspective On Inventors' Mobility. The Case Of Pharmaceutical Industry"*, co-authored with Prof. Paul Almeida.

In December 2012, the paper has been submitted to Journal Of Management (JOM) for the special issue on Strategic Human Capital. The paper has been offered with a Revise-and-Resubmit (R&R) status. Therefore, the version used to build this chapter refers to December 2012.

Due to the current R&R status at JOM and the general policies of the journal mentioned above, it is requested to contact the authors before circulating the paper. Following the usual academic behavior code in these situations, no circulating the paper without authors' permission is the policy recommended by the authors.

Abstract

The Chapter 4 attempts to answer to the questions *"why do inventors move?"* Recent studies propose answer to this fundamental question focusing mainly either on incentives structure in inventor's contracts (i.e. internal labor market) or external labor market opportunities. These perspectives consider the agent as rational in her labor decision-making process, able to optimize at the best employer-employee fit and to maximize the rent appropriation of her current (and future) employment situation. However, we believe that these theoretical economic traditions present a partial representation of why talented employees engage in inter-organizational mobility. In fact, we do not have a clear understanding on the sociological underpinnings characterizing mobility, in particular about the inventor's motivational rationales behind the engagement in such risky decision. Therefore, the Chapter 4 is an attempt that seeks to offer a more comprehensive model to explain the antecedents of inter-organizational mobility. Building on behavioral and prospect theory, particularly, on the literature of managerial risk taking, Chapter 4 mainly aims to explore and to bring attention to the motivational influences on individual mobility across firms in the pharmaceutical industry - specifically how performance deviations from specific reference points (social aspirations) explain the likelihood of mobility (a risky action). The results of our research confirm and extend previous studies on mobility: along with firm's incentive structure to retain talented employees and inventors' labor market explain the likelihood of mobility, inventor's performance deviations from social aspiration levels also predict inventor's likelihood of mobility. In particular, as predicted by our theory, inventors performing above social aspirations show a risk- averse profile (less likely to move), and inventors performing below social aspirations show a risk-taking profile (more likely to move).

4.1 Introduction

In knowledge intensive industries human capital is a strategic asset critical for competition (Coff, 1997). According to knowledge-based view, knowledge is embedded in individuals (Grant, 1996) and it is socially combined in routines that generate innovative activities (Nelson & Winter, 1982; Kogut & Zander, 1992). More precisely, the tacit component of knowledge, which is highly embedded in individuals, is the source of the competitive advantage. Therefore, strategic management scholars have paid a lot of attention to the mobility of talented employee and its strategic implications for firm performance (Campbell et. 2011; Corredoira & Rosenkopf 2010; Aime et al., 2010; Somaya et al., 2008), focusing mainly on the idea that mobility is an important mechanism to transfer valuable knowledge from one firm to another.

Building on the pioneer works of Arrow's (1962) and (Levin et al., 1987) on the link between labor mobility and knowledge spillovers, management scholars have developed several studies on the use of hiring from other firms as a mean for acquiring knowledge or learning (Song et al., 2003; Rosenkopf & Almeida, 2003, Singh & Agrawal, 2011) and on the boundary conditions under which spillovers exist and generate effects for the firm's performance (Agrawal et al. 2006; Agarwal et al. 2009; Corredoira & Rosenkopf 2010)

While the research mentioned above certifies a significant understanding of the effects generate by employees' mobility, less it has been done to explain the antecedents of mobility, so addressing the question "why do talented employees move?" Research developed to answer to this question can be structured in three streams. The first stream relates to the internal labor market dynamics. Labor economist focused mainly on the design of optimal contracts for talented people, looking at mobility mainly driven by mismatch of incentives and wage level

system (Jovanovic, 1979; Topel & Ward, 1992). More recently, other studies (Campbell et al., 2011; Gambardella et al., 2009; Marx et al., 2009) proposed a mix between monetary and non-monetary incentives designed in the employment contracts to increase the likelihood to retain the most talented employees. The second stream relates to the external labor market. Most of this work has been developed on the firm-inventor fit logic, so to which extend the recipient firm can extract value out of the moving inventor's knowledge base. An example is Palomeras & Melero (2010), where the authors looked at how the characteristics of the inventor's knowledge stimulate mobility. Finally, a third stream of research looks at how performance affects the likelihood of mobility. These studies suggested that employee's performance affects the internal bargaining with the current employer for the rent appropriation out of the innovative activity and it represents a signal to the external market as being a valuable resource (Hoisl, 2007).

While these three streams of research offer compelling arguments on the antecedents of mobility, we believe that the general picture still needs to be completed. In fact, most of these studies assume the firm's standpoint as main perspective in arguing how an employer could be actively effective in both retaining and attracting talented profiles. However, little has been said from the individuals' perspective. In addition, inventors are described as rational agents focused on maximizing rents, therefore responding strongly to incentives and market opportunities, almost neglecting the motivational aspects of the individuals to engage in a move. These motivational aspects are interesting to understand considering that inter-organizational mobility entails some risks for the individuals, such as potential loss of social capital, temporary disruption of innovative routines and, in general, environmental switching costs that are not necessarily and certainly offset by the potential benefits related to the move. So, these

characteristics of the mobility make this event risky in nature, bringing into discussion individual aspects of the inventors in their decision making process.

The objective of this study is, thus, to bring into the equation of mobility the risk aspect of such event, answering the question "why an inventor should be motivated to engage in such a risky action?" In other words, we aim to complete the picture on the antecedents of mobility looking at, along with internal and external market explanations, the inventor's individual motivation to move across organizations.

In particular, we will offer theoretical and empirical arguments on the inventor's motivation to engage in an inter-organizational mobility. Looking at mobility as a risky choice for the inventor, we will build on the literature of managerial risk taking (Cyert & March, 1963; Kahneman & Tversky, 1979; March & Shapira, 1987) to explain how performance's deviations from specific reference points explain the likelihood of mobility events as a reflection of different risk profiles. In order to do so, we will focus on the sociological underpinnings of mobility and innovation in general. Firstly, we will use the group of co-authors as main reference for the inventor to assess her own performance, reflecting the social and interactive nature of the innovative activities. We will try to explain why and how the inventor's performance deviations from the cohort of co-authors explain the individual likelihood to move. Secondly, we will explore the role played by the informal collaborations (i.e. scientific publications) in adjusting the performance's interpretation, and therefore the rationales, of the individual behind her choice to move.

4.2 Theory and Hypotheses

4.2.1 Internal Labor Market

Although scholars have paid more attention to implications of inter-organizational mobility than its antecedents, scholars from sociology, psychology, economics and management have sought to understand rationales behind the employee mobility (Granovetter, 1973; March and Simon, 1958).

One of the most contributing tradition is this research has been the studies on internal labor market. In fact, labor economists extensively studied the mechanisms underlying employees' mobility looking at how contracts can reflect an optimal incentives' system to retain the most talented employees (Pakes & Nitzan 1982, Anton and Yao 1995). Within this tradition, wage adjustments and productivity-based rewarding schemes have been mainly adopted as drivers for mobility (Topel & Ward, 1992; Jovanovic, 1979).

Moving from this basis, recently scholars developed more sophisticated models to better describe the dynamics related to the internal labor market regarding mobility, in particular in high-intensive knowledge contexts, under the assumption that firms experience disutility when a talented employee walks out. Considering the complex nature of innovation, which is the result of a combination of specific complementary assets (Teece, 1986), and the value/rent appropriation issue in innovative activities between firms and inventors, current research offers conceptual and empirical work to deepen the understanding on how firms should design and enforce their contract to improve retention of key employees/inventors.

Marx et al. (2009), for example, study how the non-compete agreements policy in Michigan approved in 1985 affects the likelihood of employees' mobility. In fact, firms, if allowed by the competition law in the region in which they operate, can incorporate this specific contract's feature that prevents the moving employees to disclose trade secrets and, in general, sensitive information that, if appropriated by competitors, would erode the competitive position

of the source firm. Their results suggest that the enforcement of non-competes attenuates mobility, and non-compete enforcement decreases mobility more sharply for inventors with firm-specific skills and for those who specialize in narrow technical fields (Marx et al., 2009).

Gambardella et al. (2009) develop a conceptual framework in which they model an optimal contract to deal with the asymmetric information about the employee's ability and the non-contractible output of the skilled employee. In their model they suggest that job autonomy of the employee (i.e. delegation - time and resources to carry out research) can be defined in the contract in order to decrease the hazard of mobility. Gambardella and colleagues (2009) propose that inventors need complementary asset to develop their innovative activities; therefore, they would have less incentive to leave if the firm provides more assets available to them. In addition, following Stern (2004), giving to the inventors the decision about the degree of autonomy in the contract (for example, deciding the employee's autonomy about where and when to publish, or the topics or direction of her research projects) would decrease the hazard of a move.

Along a similar line of reasoning, Campbell et al. (2011) argue that skilled employees are more able than non-skilled employees to appropriate rent vis-à-vis with the firm out of the economic activities. Firms can both optimize the fit of their complementary assets to employees' core knowledge and offer pecuniary and non-pecuniary benefits in order to retain their key employees. In this sense, considering high-performing employees having enhanced ability to appropriate value and thus gain high earnings, firms can regulate internal labor market designing contracts for their inventors that minimize their likelihood to move (Campbell et al., 2011).

These recent studies present a scenario in which salary is not the most important driver for the employer-employee relationship as suggested originally by labor economists. But, their results suggest that firms, leveraging two main aspects, can regulate internal labor market

designing contracts for their inventors that minimize their likelihood to move. The first is to increase the access to complementary assets for inventors. In a co-specialized production system, such as innovation is, each agent involved in the production wants to maximize the appropriation of the rent and value of the productive process. Increasing the share of rent appropriation via the provision of more complementary assets, the firms can successfully retain their most talented employees. The second is delegation. Considering the employer-employees conflict in developing innovative activities that are valuable for the firm and for the inventor (which usually is a trade-off given the possible mismatch in incentives), delegating more time and resources to generate more interesting research for the inventors could increase their private benefits, which in turn decreases the chance of observing a move.

In the light of these arguments on the internal labor market for inventors, we state the following hypotheses:

H1. Increases in the firm's research intensity are negatively related to the likelihood of inventor's mobility.

H2. Increases in the delegation provided to the inventors to develop their own research are negatively related to the likelihood of inventor's mobility.

4.2.2 External Labor Market

Labor economists suggest that mobility can be seen as a result of an optimal matching process among R&D-intensive firms where employees, if free to move, are allocated where their value is maximized (Kim & Marskhe, 2005). In other words, the recipient firm can better use the

human capital embedded in the moving individual than source firm. Following a similar technological firm-employee argument, scholars show how firms use hiring as a mechanism to learn from other firms, especially leveraging knowledge and capabilities of inventors coming from distant technological and geographical areas (Song et el., 2003; Rosenkopf & Almeida, 2003). This idea has been the strong conceptual basis for several further studies on whether and how firms can appropriate value out of the transferred human capital, which in turn have been showed to affect positively the firm performance via knowledge spillovers (Singh & Agrawal, 2011; Corredoira & Rosenkopf, 2010; Somaya et al., 2008).

Therefore, mobility can be seen as a function of potential recipient firms willing to acquire external knowledge such as input for their learning strategy. This firm's learning necessity generates a market for inventors that face the opportunity to leave their current organization to move into a new firm where they might get a better firm-employee fit, in particular in terms of complementary assets. This dynamic, thus, suggests two fundamental questions: What is the value of a moving inventor for a potential recipient firm? And, how can the recipient firm extract value from the in-coming inventor?

Regarding the first question, Palomeras & Melero (2010) study how the inventors' technological and knowledge characteristics are valued in the market for inventors. In particular, they show that the quality of the innovation that inventors generate makes them more likely to receive job market opportunities from other firms. Their idea relies on the assumptions that inventors with a strong and high-quality knowledge basis are more likely to be a valuable option for future innovations. In addition, high-quality inventors are able to better capture complementarities in resources and capabilities from collaborations in other organizational contexts and with other collaborators. Therefore, better quality in the knowledge basis of the

inventors generates incentives to firms to attract those inventors, making more likely to observe mobility events in the industry.

Although an inventor can signal quality to the firms in an industry making them more likely to hire her, it would be still unclear whether the firm will be able to appropriate the value out the hired inventors. Wezel et al. (2006) suggest that moving employees can replicate routines related to innovation when such routines are not necessarily "higher order" routines (Nelson and Winter, 1982; Cyert & March, 1963), which involve usually multiple actors. Therefore, while an inventor can been seen as a valuable individual when considering her knowledge basis, such value could be a function of an interactive innovative production process among several individuals (not moving), thus reducing the chance of knowledge appropriation of the recipient firm. Similar arguments are offered in Palomeras & Melero (2010), where they argue that the interdependences and routines developed during the innovation process can make impossible to fully exploit the knowledge held by an individual inventor without hiring her group of co-inventors (p. 884), making less likely the individual move to an alternative employer. In fact, innovative is a social complex activity that combines different individual knowledge bases; the individuals might organize the process following a division of labor by competences and capabilities. While the final result could be a valuable innovation, the single individual might have specialized in one part of this successful process, making her value lower in any other alternative use out of the current employer (or group). In this sense, high complementarities in innovative activities, intended as high division of labor, would reduce the external value of an inventor and the chance to get job market opportunities from other firms, which implies a lower likelihood on inventor's inter-organizational mobility.

H3. Increases in the quality of an inventor's knowledge basis are positively related to the likelihood of inventor's mobility.

H4. Increases in the complementarity associated to the inventor's knowledge basis are negatively related to the likelihood of inventor's mobility.

4.2.3 Individual motivation for mobility: a behavioral hypothesis

The behavioral theory of the firm has significantly contributed to our understanding of organizational search, the propensity for risk taking, and the likelihood of strategic change (Audia et al., 2000; Bromiley 1991; Greve 1998, 2003b; Miller & Chen, 2004; Park, 2007). According to this theory, organizations assess their performance using specific reference points, which refer either to their historical performance (historical aspirations) or to the performance of a group of reference (social aspirations). Using these references as aspirations, they interpret their performance as above or below such reference points, subsequently engaging in further actions as learning effect of the performance feedback process.

Evolutionary economics and organizational learning can be seen to be the most direct descendants of the behavioral theory (Argote & Greve, 2007). One of the important concepts arising from evolutionary economics is that of a routine, which Winter (1964, p. 263) defines as a 'pattern of behavior that is followed repeatedly, is subject to change if conditions change'. Nelson & Winter (1982) view routines as adapting in response to performance feedback. Actions that result in successful outcomes are positively reinforced and hence lead to persistence in the use of the existing routines, while actions that lead to performance outcomes that are unsuccessful trigger a search for modifications to the existing routine. Routines, thus, possess the

qualities of both stability and change (Feldman, 2000; Feldman & Pentland, 2003). Empirical research largely supports the theoretical predictions indicated above. Bromiley et al. (2001) and Nickel & Rodriguez (2002) offer a comprehensive review of the empirical studies on this topic and find broad support for these predictions.

This framework has been applied mainly to organizational level studies (Greve, 1998; 2003a; 2003b; 2008). However, similar predictions are also rooted in the tradition of individual and managerial risk taking (Kahneman & Tversky, 1979; March & Shapira, 1987). One of the main propositions of prospect theory points out the key role of the reference point or target for denying the decision maker's attitude towards risk. When the expected results of an alternative are "good" — that is to say, they are higher than the target level — the decision maker shows a risk-averse attitude. When the expected results are "bad" — lower than the target level — the decision maker will be risk seeking (Nickel & Rodriguez, 2002). In short, risk taking is affected by the relation between current position and some critical reference points (Kahneman & Tversky1979). Similar arguments are offered by Shapira & March (1987); in their work on individual managerial risk taking, they suggest that risk is context specific and individuals use reference points in order to evaluate their performance and adjust their risk preferences for further action.

Therefore, there is a consistent shared framework between individuals and organizations in explaining the risk taking profile as a function of the deviations of the observed performance and from related aspirational reference points. Now, the question is "how does such a framework relate to a mobility event?" In other words, "how do deviations of inventor's performance from related aspirations explain mobility events?"

Current research on inter-firm mobility describes it as an action involving risk. In particular, moving from one organization to another involves inventor's routines distress and disruption at different levels. Nelson & Winter (1982) & Cyert and March (1963) elaborated on a dual routine perspective, where organizational behavior stems from two sets of hierarchically ordered routines: a set of operational routines that control day-to-day actions, and a set of meta-routines that govern operational routines. Higher-order routines govern the use, combination, or recalibration of lower order ones (Nelson & Winter 1982). Therefore, higher-order routines are inherently social and success of replication hinges on retention of their integrity (Wezel et al., 2006). While the source firm does not necessarily face the risk of experiencing severe disruption in routines given the departure of one employee, the moving employee is not automatically obvious to transfer and replicate high order routines. In particular, this argument is more salient when considering employees dedicated to innovative activities (i.e. inventors or scientists). In fact, as suggest by Kogut & Zander (1992), innovation and knowledge creation are socially constructed activities, so preserving and replicating these routines is critical if not done through existing patterns of interaction among those actors usually involved (Nelson & Winter, 1982). Arguing from a social capital perspective, recent studies have corroborated empirically these theoretical implications of mobility as risky event in terms of disruption of innovative routines for the moving inventors (Agrawal et al. 2004; Ganco, 2009).

Combining the previous frameworks on individual and managerial risk taking with the idea that mobility represents a risky event considering the related inventor's disruption of routines involved, especially when looking at knowledge creation activities, we offer hypotheses for the prediction of the mobility event as a reflection of an inventor's risk profile given the performance deviations from specific reference points.

In particular, we focus on the social aspiration levels. In fact, recently, social capital implications of mobility have been receiving more attention, just as it has been done for human capital associated with mobile employees (Corredoira & Rosenkopf, 2010; Dokko & Rosenkopf, 2010; Somaya et al., 2008). While knowledge resides in individuals (Grant, 1996), innovation is a socially constructed process (Kogut & Zander, 1992) and it is developed through the combination of individual and organizational routines (Nelson & Winter, 1982). Therefore, there is an increasing interest in the understanding of how the employee's group of reference plays a role as boundary condition to explain strategic consequences of mobility events. However, most of these studies have looked at how the social capital of the moving employee explains variation in phenomena at the firm level, such as recipient firm's performance (for example bidirectional knowledge flows). Less work has been done on the inventor-social capital relationship in terms of mobility implications at the individual level, and in particular for the moving employee. An example, in this vein, is Azoulay et al. (2010) estimating the magnitude of spillovers generated by academic "superstars" who died prematurely and unexpectedly, thus providing an exogenous source of variation in the structure of their collaborators' co-authorship networks. Results of this study suggest that on average, the co-authors decline in their quality-adjusted publication rates. In our study, we are rather interested in the other direction of the relationship of the inventor with her co-authors. In other words, "how the co-authors affect the inventor, and specifically her likelihood on mobility?"

Considering the cohort of each inventor's co-authors as the reference group, we can assess the focal inventor's performance in terms of comparison to the main reference group. As suggested by Kahneman & Tversky (1979) and Cyert & March (1963), current performance is evaluated using the peer group performance as reference point (along with historical). So, when

an inventor's performance is above the performance of her co-authors (social aspiration level), the focal inventor assesses her performance as success, therefore being less motivated in and avoiding incurring in risky profile action. Given the context-specificity of the performance evaluation, mobility is a less likely event given the potential opportunity offered internally by the source firm. In general, we expect a strong positive relationship between being above the social aspiration group (performing better than the group of coauthors) and the individual innovative performance level, reflecting a positive pattern of patenting behavior. Therefore, also as suggested by previous studies, mobility event for top performer is less likely to be observed (Campbell et al., 2011; Hoisl, 2007).

When considering the situation in which the inventor is performing below her social aspiration, we offer the following argument to explain her likelihood of mobility. Firstly, performing below the reference group could pose the inventor in a lower bargaining position with the current employer, as suggested by Campbell et al. (2011). Secondly, the group of co-authors might not recognize the value of the focal inventor anymore, therefore making less likely further collaborations, generating a potential isolation effects in the related network. Therefore, the inventor might perceive the risk related to a mobility event costs as lower if compared to the incurring consequential costs of sticking in a situation in which her performance is recognized as not as valuable as her peer group. In the light of these arguments, we offer the following hypotheses for the relationship between the difference between the inventor's performance and the social aspiration level, and the likelihood mobility:

H5. For inventors performing above their social aspiration levels, increases in innovative performance are negatively related to the likelihood of mobility.

H6. For inventors performing below their social aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility.

4.2.4 The Role of Information Collaboration

The inventors' output of their research activity is mainly twofold: patents and scientific publications. In particular, publications are the results of collaborations among individuals belonging also to different organizations, including universities and communities of practice (Gittelman, 2006, 2003; Zucker et al., 2002). Recent empirical research on biotech firms show how these collaborations can be, as the classical other knowledge sourcing mechanisms (for example alliances), an important mean to improve both scientists' research output (Cockburn & Henderson, 1998) and the firm's innovative performance (Almeida et al., 2012).

This research poses that informal collaborations are critical for the individual and organizational performance, providing access to valuable knowledge and stimulating the overall firm's R&D effort to innovate. However, while this organizational boundary spanning mechanism affects innovative performance, we still do not fully understand how informal collaborations can function as bridges on the external job market, generating job opportunities, therefore affecting the individual hazard of mobility.

Building on the labor economists and sociologists work on how job network affect job search and inter-organizational mobility (Granovetter, 1995), recent work (Nakajima et al., 2010) shows how collaboration networks are important to optimize the employer-employee match, dealing successfully with the "lemons" issue related to hiring process (Akerlof, 1970). The authors use inventors' research collaboration networks as a channel for job information flows. As

a consequence: networked individuals can access a greater set of information about job opportunities than non-networked individuals; firms can lower the information asymmetries on the quality of the potential new employee increasing the likelihood of getting an optimal match with the prospective new hire. Along with these results, they also find that an inventor using the research collaborations' network also experiences an increase in performance post-mobility, confirming even strongly the hypothesis that research collaborations have an effect on both the likelihood of mobility and the post-mobility performance.

In the light of these findings, we offer the following hypotheses on the moderating role of inventor's informal collaboration on the relationship between performance's deviation from social reference group and the likelihood of mobility.

H7. For inventors performing above their social aspiration levels, the decreasing likelihood of mobility is reduced by the number of informal collaborations.

H8. For inventors performing below their social aspiration levels, the increasing likelihood of mobility is augmented by the number of informal collaborations.

4.3 Methodology

4.3.1 Data and Sample

We build our sample combing three sources, which reflect the three types of data we employ in our study: patents, scientific publications and firm data.

For the patent data, we use the database publicly provided by The Institute for Quantitative Social Science at Harvard University (I.Q.S.S.). Lai et al. (2009) developed a

project to combine in a set of unique databases the patents and inventors' data previously offered by difference data sources, such as The National Bureau of Economic Research (NBER) and United State Patent and Trademark Office (USPTO). The resulting set of databases provides data on each patent published between 1975 and 2008 in USPTO, along with the list of inventors per each patent and related geographical and affiliation information (1). Recent studies on inventors' mobility have been empirically developed using such data source (Marx et al., 2009).

From this database we extract the patents and inventors information for five of the top global pharmaceutical firms, being: Pfizer Inc., GlaxoSmithKline Plc., Merck & Co. Inc., and Bristol-Myers Squibb, Novartis AG. We focus on pharmaceutical firms because of the importance of innovation for this industry (Organization for Economic Co-operation and Development - OECD, 1997; Cloodt et al., 2006) and given that inter-firm mobility of engineers is especially intense in high-tech industries (Almeida & Kogut 1999). The five firms selected to build our sample sum up to the 45% of market share in the pharmaceutical industry, making our sample fairly representative of the industrial dynamics.

To build our sample we take the following steps for each of the five pharmaceutical firms. First, combining the company information available on the database CorpTech and the company official reports, we studied the corporate dynamics involved in each of the companies from their existence date, in particular looking at acquisitions, mergers, joint venture and alliances activities. The objective is to have a more conservative estimation of mobility events, avoiding codifying an inter-organizational mobility event that is in fact an intra-organizational mobility event. Second, we use the I.Q.S.S. database to identify each patent whose assignee is the company or any related subsidiary from 1975 to 2008. Before doing this, we keep only patents with the following characteristics: single assignee, utility type and non-university. Third,

using the patents generated in step two, we list any inventor who has published at least one patent with the focal company. As result, we obtain a list of inventors with the related published patents in each year. Fourth, from this list we generate two sets of inventors: those having as assignee only the focal firm (therefore, no moving inventors); those having some patenting activity in the focal firm and subsequently in another firms (moving inventor). From the "moving inventor" lists we exclude: 1) those inventors in which there is the overlapping patent application year between the focal firm and the non-focal firm 2) those inventors with one patent in between several focal firm patents, and vice-versa 3) those inventors having only unidentified assignee. This procedure of identification of inventors as it has been done in previous studies of mobility of inventors (Hoisl, 2007; Palomeras & Melero, 2010). Following all these steps, we generate a sample of 4,940 inventors for the five pharmaceutical firms, who applied for a total of 61,281 patents from the 1975 to 2008. We identify 1,431 moving inventors that represent the 29% of the inventors. Using patents to track mobility present some challenges and limitations, as acknowledged in previous studies (Palomeras & Melero, 2010; Marx et al., 2009). Nonetheless, previous research has shown patent data as viable to track inventor mobility (Almeida & Kogut 1999, Song et al. 2003; Trajtenberg et al. 2006).

For scientific publications, we collected data from the database Thomson-ISI Web of Science. Each inventor can participate to scientific research projects, therefore being among the authors of journal publications, which are collected in the Web of Science database. From this database we collected publications for each inventor identified in our sample. For each inventor, we use the name and last name as main keyword for the search of each inventor's publications. To avoid ambiguous author-article association (2), we combine the inventors' information with the name of any employer's name listed in her patenting track (3). We collected 13,359

publications (almost 5 publications per author on average). From this database we collected the following information: author's name, author' affiliation(s), keywords, publication year, number of times cited, number of times citing. This database has been extensively used in innovation in general and similar studies (Hess & Rothaermel, 2007).

Finally, we collect data at firm level on R&D Expenditure and Sales from Compustat Global Fundamental Annual dataset (Standard & Poor's).

Combining these three different sources, we build a final sample of 2,887 inventors from the above-mentioned top five pharmaceutical firms, which applied for 42,277 patents from 1975 to 2007. The rate of inter-organizational mobility in our sample is 21.3% (615 moving inventors).

4.3.2 Empirical Strategy

In our analysis we estimate the hazard rate that an inventor in our sample changes the employers. For each inventor we construct the patenting life, which is a series of patents applied in each period. Since we can observe the inventor only when she files a patent, an inventor is at risk every time she applies for a patent. Structuring our data as such, our sample is characterized by censored (nonmoving) and non-censored inventors (moving). For both the censored and uncensored individuals we do not know whether the inventor moves or stays, therefore the last period does not contribute as a valid observation (4).

The functional form of our baseline hazard is assumed to be a logarithm in order to take into account the decreasing marginal moving hazard rate over time. Given the dichotomous nature of our dependent variable, the estimation model we use is a probit random effect specification in order to take into account for individual unobserved variation caused by

inventor-specific characteristics omitted in the model (Jenkins, 2005). The empirical strategy we adopted has been validated in recent similar studies on inventors' mobility (Palomeras & Melero, 2010).

4.3.3 Variables

Dependent variable. Our dependent variable is employee mobility, which is a dummy variable coded 1 if an inventor's employer changed in the subsequent period, and 0 otherwise (i.e. when the inventor is at risk to move). The move is assumed to happen at the midpoint between the last patent in the focal firm and the first patent in the non-focal firm. This operationalization of our dependent variable follows from the preferred estimation procedure and it has been applied in similar recent studies (Palomeras & Melero, 2010).

Independent variables. We look at mobility as a function of internal labor market forces, external labor market forces and individual motivations.

To capture the effect of the internal labor market forces on the likelihood of mobility, we use two constructs offered from Gambardella et al. (2009) in their formal model on how firms can retain their key employees. Firstly, *Research Intensity* is calculated as the ratio between firm's R&D expenditures and sales. This variable measures to which extent the firm provides the inventors with assets to generate innovative activities. In fact, R&D activities involve significantly expensive machineries and equipment that improve the quality and the possibilities of the research activities, which reflect a non-monetary reward for the inventors (Campbell et al., 2011). Secondly, we calculated the *Delegation* as the inventor's number of ISI Web of Science published scientific articles in every period. Stern (2004) suggests that leaving research

autonomy (such as time and research topic decision power) to inventors lowers their propensity to move.

In order to explain how external labor market forces explain the likelihood of mobility, we look at the two inventor's characteristics: how valuable the inventor's knowledge is outside her current employer and how the inventor's knowledge can be appropriated by any potential new employer (i.e. recipient firm in the case of a move). Therefore, *Quality* is the sum of forward citations received by the inventor on each patent adjusted (standardized) by the industry mean of forward citations in the specific technological category of the focal patent in the reference year. While forward citations are a standard measure for knowledge quality and economic value generation for the firm (Palomeras & Melero, 2010; Hall et al., 2005), we do refine it looking at the citations only coming from outside the focal patent's assignee (5). In this way, we believe we can better capture the value assigned to the inventor's knowledge by the external environment (6). The second measure for the external market labor is *Complementarity*, which is the mean number of co-inventors per patent in the inventor's set of patents in each year. Previous studies suggest this as a valid measure for firm's appropriability over the inventor's knowledge assets (Palomeras & Melero, 2010, Ahuja, 2007).

For the individual inventor's motivation to engage in a move, our variables are the discrepancies of the inventor's innovative performance from her social aspiration levels. For innovative performance, we use the count of applied patents by each inventor. Patents are an appropriate indicator of innovative performance in high-technology sectors (Hagedoorn & Cloodt, 2003), and are an important source of technological advantage in the pharmaceutical industry (Levin et al., 1987). For the performance measures, we follow previous work of Greve (1998, 2003a, 2003b) in generating the measures for social aspiration level variables. As

suggested by previous work on inventors and the related peer group (Azoulay et al., 2010), the group of co-authors is a viable reference group for each focal inventor. We build the co-authors cohort for each inventor in each year. From the year in which the focal inventor patents with another inventor, such co-author is included in the group of co-authors of reference, but not before. Therefore, following the logic above, we compute the mean of the performance of the inventor's co-authors in each year. Finally, we compute the difference between the inventor's performance in period *t* and the mean of the suggested reference group in period *t* (7).

$$Social_{i,t} = P_{i,t} - P_{j,t}$$

where $Social_{i,t}$ for inventor *i* in time *t* is the difference between the performance of inventor *i* in year *t* and the performance of the inventor *j* in year *t*, where *j* is the average performance in the group of co-authors (8).

As in previous similar studies using the aspiration constructs, (Audia & Greve, 2006; Greve, 2003a), to estimate whether the effect of innovative performance on the likelihood of mobility differs according to whether the performance is above or below the aspiration level, we specify performance as a spline function (Greene, 1993). Therefore, we create two variables for the social aspiration level construct, *Above* and *Below*, defined as:

$$Above_{i.t} = \begin{cases} 0, & Social_{i.t} < 0 \\ Social_{i,t}, & Social_{i,t} > 0 \end{cases}$$

$$Below_{i.t} = \begin{cases} Social_{i,t}, & Social_{i.t} < 0 \\ 0, & Social_{i,t} > 0 \end{cases}$$

Therefore, *Above* has only positive values, while *Below* has only negative values (9). For our social aspiration variables, we compute the discrepancy in t (both performance and aspirations are in period *t*), but mobility event is predicted with one-year lag.

Finally, we compute the variable *Informal Collaborations*. Looking at each publication per inventor, we check the number of organizations (firms, research centers, universities, etc.) reported as institutions in which the publication's authors belong to. From this list, we compute the average number of institutions involved in each inventor's scientific publication every year (10). Looking at its distribution, we observe that authors affiliated to only one institution published 75% of the articles. Therefore, we decide to operationalize the *Informal Collaborations* variable as a dummy equal 1 if the authors are affiliated to more than one institution, and 0 otherwise. With this variable we aim to measure the exposure of an inventor to other firms, therefore, giving her the chance of getting information and possibilities of job opportunities (Nakajima et al., 2010), which in turns would increase the likelihood of mobility.

Control variables. In order to control for alternative explanations for the likelihood of mobility suggested by previous studies (Singh & Agarwal, 2011; Campbell et al., 2011; Palomeras & Melero, 2010; Marx et al., 2009, Hoisl, 2007), we use a set of control variables. *Dispersion* is the standard deviation of the forward citations received by the inventor on her set of patents in a specific year. *Self-Citation* is the mean percentage of self-citations that an inventor receives in her set of patents. *Tenure* is the difference in years between each year and the application year of the first applied patent (11). *Previous Mobility* has been shown to affect positively future mobility (Palomeras & Melero, 2010). *Area* is a dummy variable coded 1 if the

inventor is located in a region where her employer has a strong presence of R&D facilities, and 0 otherwise. Almeida & Kogut (1999) suggest that regional characteristics affect the inventor's mobility rate. Each pharmaceutical firm in our sample has a main R&D site where each of the other firms has only a marginal presence. In addition, unlike Silicon Valley for semiconductor industry, pharmaceutical firms tend to not position their R&D facilities in areas in which there might be a high concentration of other competitors. *Tech Dummies* are generated for the most relevant technological classes in which the firms sampled patent. On average, these technological categories represent 70% of the patents for each firm. *Year* variable is introduced into the model to capture time trend effects. Finally, in order to capture specific firm unobserved characteristics, *Firm Dummies* are generated for the five pharmaceutical firms analyzed in our study to take into account specific firm effects.

4.4 Results

Table 4.1 shows descriptive statistics and correlation coefficients. Table 4.2 shows the coefficient estimates and Table 4.3 shows marginal effects computed at the mean. Model 1 is specified only with control variables; in the subsequent four models we enter independently the internal labor market variables (Model 2), external labor market variables (Model 3) and the individual motivation variables (Model 4). Model 5 is the full model. For the interpretation of the results we focus on the marginal effects estimates of Model 5 (marginal effects at the mean of each variable in the full model specification). Finally, the last two model test the interaction between the *Informal Collaborations* variable and respectively the *Above* (Model 6, performance above aspirations) and *Below* variables (Model 7, performance below aspirations).

Table 4.1: Descriptive Statistics and Correlation Matrix

	Obs	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Mobility	17,294	0.04	0.19	1.00													
(2) Above	21,458	3.47	1.23	0.06	1.00												
(3) Below	21,458	-1.29	0.16	-0.05	0.45	1.00											
(4) Research Intensity	21,458	6.40	1.26	-0.03	-0.03	0.07	1.00										
(5) Delegation	31,458	1.24	0.25	-0.04	0.10	0.08	0.16	1.00									
(6) Quality	21,458	2.00	0.91	-0.01	0.32	0.23	-0.20	-0.00	1.00								
(7) Complementarity	21,458	1.90	0.91	-0.02	0.02	0.08	0.36	0.10	-0.12	1.00							
(8) Publishing Institutions	21,458	0.08	0.27	-0.00	0.06	0.05	0.09	0.49	-0.03	0.07	1.00						
(9) Dispersion	21,458	1.33	0.44	-0.05	0.40	0.51	-0.09	0.07	0.60	-0.03	0.01	1.00					
(10) Self-Citations	21,458	1.12	0.05	-0.04	0.10	0.07	-0.02	0.02	0.02	0.01	-0.02	0.12	1.00				
(11) Tenure	21,458	2.34	0.57	0.03	0.02	0.14	0.23	0.07	-0.22	0.20	0.05	-0.06	-0.02	1.00			
(12) Tenure (squared)	21,458	5.81	2.64	0.02	0.01	0.13	0.26	0.06	-0.23	0.20	0.05	-0.07	-0.03	0.99	1.00		
(13) Area	21,458	0.69	0.46	-0.02	0.03	-0.00	0.01	0.01	0.04	-0.08	-0.03	0.04	0.03	0.13	0.14	1.00	
(14) Previous mobility	21,458	0.01	0.10	0.09	0.00	-0.00	-0.02	-0.03	0.04	-0.01	-0.01	0.01	-0.02	0.07	0.07	-0.02	1.00

Coefficients greater in magnitude than 0.02 are significant at the 0.05 level

Notes: number of observations for the *Mobility* variable different given the missing values generated by its truncation.

Thus, let's consider Table 4.3 for the interpretation of the results. Control variables show results overall consistent with previous studies' findings on mobility (Campbell et al., 2011; Singh and Agrawal, 2011; Palomeras & Melero, 2010). *Self-Citations* are negative but not significant. *Tenure* is positive and significant; we test a non-linear relationship, and we found that the relationship between tenure and likelihood of mobility is an inverted U- shape: inventors in the pharmaceutical firms in our sample are more likely to move when they are in the middle of their carrier as scientist. As suggested by labor economist, *Previous Mobility* is positive and significant. Controlling for potential regional effects, *Area* suggests that when an inventor is employed in R&D sites located where the firm develops most of its innovative activities is less likely to move.

The first two hypotheses test the effect of how effectively firms can design contracts to retain their employees. Hypothesis 1 suggests that increases in *Research Intensity* (i.e. R&D

expenditure over Sales ratio) are negatively related to the likelihood of inventor's mobility. Results in Model 5 show that an increase of 10% from the mean (6.3 to 7) significantly decreases the likelihood of mobility, on average, by 0.04%. Therefore, Hypothesis 1 is supported. The second construct we employ to test the strength of the internal labor market is *Delegation*, as the inventor's number of published articles. The coefficient is negative and significant (z=-4.09), suggesting that increasing the average autonomy assigned to the inventors for the scientific research activities by 10% turns out in a decrease in the likelihood of mobility (-0.23%). Taken together these results validate the importance of the internal market labor and the related firm-inventor agreement structure to manage retention of inventors. Our results are in line with the prediction of the formal model on retention of talented employees proposed by Gambardella et al. (2009).

Hypotheses 3 and 4 test how the external market for inventors affects the individual decision to move. *Quality* coefficient is positive and highly significant (z=2.28), suggesting that an increase of 10% from the mean in the citations received by an inventor's patent increases her likelihood of mobility by 0.03%. Therefore, Hypothesis 3, suggesting a positive association between inventor's knowledge quality and inventor's mobility, is supported. However, nothing we can say on the *Complementarity* effect. In fact, the coefficient is not significant (z=-1.20), suggesting that in our data we did not find a story related to the division of labor in innovation and the subsequent appropriability issue related to recipient firm. So, Hypothesis 4 is not supported. Overall, our results confirm (in part) the findings of previous studies suggesting that the quality of the inventor's knowledge is important to generate attractiveness from the external labor market for inventors (Palomeras & Melero, 2010).

Looking at results for social aspiration variable, results are as follows. Hypothesis 5 suggests that for inventors performing above their social aspiration levels, increases in innovative performance are negatively related to the likelihood of mobility. Results in the Model 5 show that an increase in inventor's performance of 10% from the mean in comparison to her co-authors' performance, on average, would decrease the probability of mobility by 0.10% (statistically significant). Therefore, our hypothesis 5 is supported. The hypothesis 6 suggests that for inventors performing below their social aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility. The marginal effect of the variable *Below* is negative and significant, suggesting that decreases in inventor's innovative performance (i.e. patent count) in comparison to her co-authors' performance would result in increasing in the probability of mobility. Thus, a decrease of 10% from the mean would increase the probability of mobility, on average, by 0.33%. This result suggests that when an inventor is performing below her reference group she would show risk taking individual behavior, as suggested by our theory. Therefore, our hypothesis 6 is supported.

Table 4.2: Probit Model (random effects) for Prediction of Mobility – Coefficient Estimates

	Coefficients Models						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Above				-0.17*** (0.034)	-0.18*** (0.034)	-0.19*** (0.042)	-0.18*** (0.037)
Below				-0.62*** (0.152)	-0.59*** (0.153)	-0.45** (0.148)	-0.48** (0.150)
Research Intensity		-0.07** (0.022)			-0.08** (0.023)	-0.09*** (0.019)	-0.09*** (0.019)
Delegation		-0.45*** (0.098)			-0.41*** (0.100)	-0.41*** (0.106)	-0.41*** (0.106)
Quality			0.05+ (0.028)		0.06* (0.026)	0.05+ (0.025)	0.05+ (0.025)
Complementarity			-0.13+ (0.076)		-0.88 (0.073)	-0.12+ (0.071)	-0.12+ (0.071)
Informal Collaborations	-0.02 (0.077)	0.17* (0.084)	-0.03 (0.073)	-0.00 (0.072)	0.18* (0.085)	-0.04 (0.253)	-0.73 (0.620)
Dispersion	-0.34*** (0.056)	-0.32*** (0.050)	-0.38*** (0.060)	-0.04 (0.060)	0.10 (0.065)	-0.13* (0.066)	-0.13* (0.066)
Self-Citations	-2.36*** (0.544)	-2.35*** (0.500)	-2.23*** (0.530)	-2.02*** (0.490)	-2.05*** (0.495)	-2.19*** (0.593)	-2.18*** (0.593)
Tenure	3.78*** (0.451)	3.54*** (0.340)	3.56*** (0.470)	3.68*** (0.343)	3.69*** (0.344)	3.64*** (0.300)	3.64*** (0.300)
Tenure (squared)	-0.78*** (0.089)	-0.74*** (0.074)	-0.74*** (0.090)	-0.77*** (0.075)	-0.77*** (0.075)	-0.76*** (0.070)	-0.76*** (0.070)
Area	-0.10* (0.048)	-0.09* (0.042)	-0.11* (0.044)	-0.09* (0.042)	-0.09* (0.043)	-0.07+ (0.042)	-0.07+ (0.042)
Previous mobility	1.06*** (0.165)	0.99*** (0.132)	1.00*** (0.161)	1.01*** (0.133)	-0.97*** (0.134)	-0.99*** (0.075)	-0.99*** (0.075)
Above x Publishing Institutions						-0.04*** (0.253)	
Below x Publishing Institutions						0.07*** (0.071)	0.42 (0.475)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Technology Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Costant	9.49*** (6.520)	-6.95*** (7.444)	2.93*** (6.540)	1.37*** (6.012)	-21.34*** (8.129)	-0.18*** (7.043)	-0.18** (7.043)
N	17,294	17,294	17,294	17,294	17,294	17,294	17,294
Number of Clusters (inventors)	2,887	2,887	2,887	2,887	2,887	2,887	2,887
Wald Chi2	182.08***	345.27***	187.44***	360.76***	392.19***	559.51***	558.08***

Notes. One-tailed test for effects in Hypothesis 5 and Hypothesis 6

+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table 4.3: Probit Model (random effects) for Prediction of Mobility – Marginal Effects at the mean

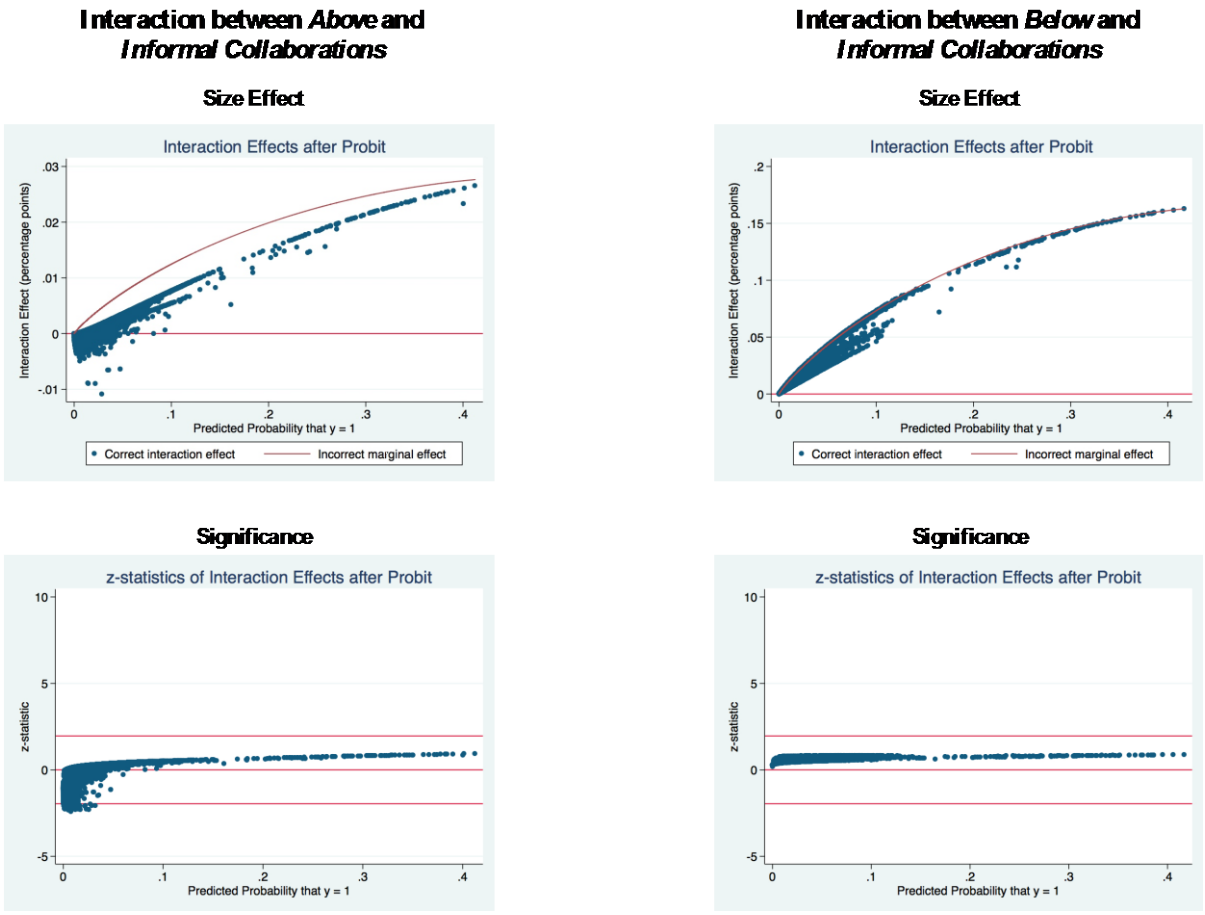
	Marginal Effects Models						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Above				-0.01***	-0.01***	-0.01***	-0.01***
				(0.002)	(0.018)	(0.002)	(0.002)
Below				-0.04	0.03	0.03**	0.03**
				(0.009)	(0.009)	(0.009)	(0.009)
Research Intensity		-0.00***			-0.05***	-0.00***	-0.00***
		(0.001)			(0.001)	(0.001)	(0.001)
Delegation		-0.03***			-0.02***	-0.02***	-0.02***
		(0.006)			(0.006)	(0.006)	(0.006)
Quality			0.00***		0.00***	0.00+	0.00+
			(0.002)		(0.001)	(0.001)	(0.001)
Complementarity			-0.01		-0.05	-0.02+	-0.02+
			(0.005)		(0.004)	(0.004)	(0.004)
Informal Collaborations	-0.00***	-0.01***	-0.00***	-0.00***	0.01	-0.00	0.04
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.015)	(0.037)
Dispersion	-0.02***	-0.02***	-0.02***	-0.00***	-0.06***	-0.00*	-0.00*
	(0.004)	(0.003)	(0.006)	(0.003)	(0.004)	(0.003)	(0.004)
Self-Citations	-0.12***	-0.15***	-0.13***	-0.12***	-0.12***	-0.13***	-0.13***
	(0.034)	(0.031)	(0.037)	(0.029)	(0.028)	(0.035)	(0.035)
Tenure	0.20	0.22	0.21	0.22	0.21	0.21***	0.21***
	(0.030)	(0.020)	(0.034)	(0.019)	(0.020)	(0.018)	(0.018)
Tenure (squared)	-0.04***	-0.05***	-0.05***	-0.05***	-0.04***	-0.05***	-0.05***
	(0.007)	(0.004)	(0.008)	(0.004)	(0.004)	(0.005)	(0.005)
Above x Publishing Institutions						0.00	
						(0.004)	
Below x Publishing Institutions							0.02
							(0.028)

Notes. One-tailed test for hypothesized effects
+p<0.10, *p<0.05, **p<0.01, ***p<0.001

Overall, our analysis presents inventor's inter-organizational mobility as the results of a combination of factors such as individual response to retention incentives, external labor market opportunities and individual motivation reflecting the risk profile of each inventor when comparing her performance to the one of the reference group. All these three aspects contribute to explain the inventor's likelihood of mobility. In Hypotheses 7 and 8 we attempt to uncover

possible sociological underpinnings related to the mobility choice, in particular looking at the network of collaborations for scientific publications. Looking at Model 5 (no interaction terms) the indicator *Informal Collaborations* is positive and significant. This result suggests that if the number of different organization the inventor gets exposed to, when publishing scientific articles, is greater that two, then she is more likely to move. We would, thus, expect that the decreasing likelihood of mobility for inventors performing above the aspiration level would be offset by the effect of the scientific collaborations network structure (Hypothesis 7), in particular the number of organizations involved in the publications. In the same vein, we would expect that such network would increase the already increasing likelihood of inventors performing below their aspirations level (Hypothesis 8). In order to interpret results of the interaction terms we apply the methodology suggested by Norton et al. (2004) for interactions in probit models. However, as shown in Figure 4.1, we do not find any significant effects in these interactions terms. In other words, while collaborating with multiple institutions increases the likelihood of mobility per se, there is no impact on the intrinsic motivation of each inventor to move given the risk profile generated by the performance deviations from the social aspirations. We will argue more in the next section the possible interpretation of the results.

Figure 4.1: Interaction between Above/Below and Information Collaborations



4.5 Conclusions and Discussion

The current chapter is the second offering of a broader research project that seeks to better understand the causes and effects of the inter-organizational mobility of inventors. This chapter is exploratory in nature and seeks to build on behavioral and prospect theory, particularly, on the literature of managerial risk taking (Cyert & March, 1963; Kahneman & Tversky, 1979; March & Shapira, 1987). The chapter primarily intends to explore the motivational influences on individual mobility across firms in the pharmaceutical industry -

specifically how performance deviations from specific reference points (aspirations) explain the likelihood of mobility (a risky action).

Our main hypotheses (5 and 6) suggest that performance deviations above aspiration levels (i.e. inventor's co-authors average performance) would decrease the likelihood of an inventor's inter-organizational mobility, while the performance deviations below would increase it. Results support mainly our hypotheses; in other words, when an inventor performs above her aspirations, the likelihood of mobility decreases, therefore showing an individual risk-averse profile (Hypothesis 5). Instead, when an inventor performs below her aspirations, the likelihood of mobility increases, therefore showing an individual risk-taking profile (Hypothesis 6). Our results appear to be in alignment with the original prospect theory predictions on risk taking for individuals performing below their aspirations and risk aversion for individuals performing above their aspirations (Kahneman & Tversky, 1979), especially when considering the performance compared to the "relevant others", such as co-inventors in our case.

However, we find no significant results for the role played by the scientific collaborations network of our inventors. Building on recent empirical evidence on the importance of inventor's scientific collaborations network for job search and optimal match (Nakajima et al., 2010) and recalling the importance on personal connections (i.e. network ties) for job search theorized by sociologists (Granovetter, 1995), we explore the possible sociological underpinnings characterizing the inter-organizational mobility of inventors. While we observe that a great exposure to multiple organizations when publishing scientific articles increases the inventor's likelihood to move, we do not find any support for our hypotheses exploring whether this affect the motivation to move for individuals performing above or below their co-authors.

Overall, take all together, our results present the following picture. Firstly, they confirm the previous idea that firms can effectively design contracts able to present an optimal structure of incentives to retain inventors, and that external markets for inventors are able to capture the quality of the inventor's knowledge offering competitive job offers to attract those profiles. Secondly, they suggest that inter-organizational mobility is also a function of personal risk profile's preferences representing the motivational aspect to engage in mobility event given performance assessment in comparison to the inventors' social reference point. However, this last results pointing to the more sociological aspect of decision such as mobility, classically explain by rational theoretical framework, are only partially confirmed when moving the analysis into the net of relationships of the inventors.

Our study presents the following contributions. Firstly, considering the prediction of the likelihood of mobility, it should be noted that inventor's performance has been least considered as an antecedent of mobility. Building on Trajtenberg (2005) and Trajtenberg et al. (2006), Hoisl (2007) suggests that while a move increases productivity, an increase in productivity decreases the probability of observing a move. Such studies, while important contributions, have focused on the inventor's performance in absolute terms. It is hard to interpret the meaning of performance of each inventor, and in particular at which level of performance mobility is most likely. Our studies, building on the aspiration level concepts, try to improve the interpretation of the performance measure and its implications in terms of inventor's mobility. To the best of our knowledge, there is no prior study that explicitly addresses this issue. Secondly, previous studies have focus more on the capability and internal/external market opportunities arguments to explain the likelihood of mobility (Campbell et al., 2011; Palomeras & Melero, 2010; Gambardella et al., 2009). While these dimensions are important to explain inter-organizational

mobility, the inventor's intrinsic motivation to move has been so far less considered. Looking at the difference between performance and its aspirations, we propose a model in which the inventor is motivated to risk taking or risk adverse behaviors, such as mobility. Thirdly, previous research on mobility has studied these different theoretical perspectives independently. In other words, while empirically controlling for different theories, previous studies offered theoretical contributions mainly focused on one aspect of why inventors move. To the best of our knowledge, our study is the first attempt to build a comprehensive model to explain the likelihood of inventors' mobility. Fourthly, it offers an empirical test for the Gambardella et al. (2009) model of inventors' retention. While labor economists studied extensively how to optimize employees' retention, Gambardella and colleagues (2009) propose a formal model to design contracts specific to key employees involved in highly knowledge-intensive activities, such as inventors are. To the best of our knowledge, ours is the first attempt to test empirically and directly this model. Fifthly, our study makes a clear call to bring more into consideration the sociological components of inventors' mobility. And we do in two ways. The first is looking at network of scientific collaborations (in particular to the collaborating institutions); we attempt to uncover how the structure of the inventor's relationships and the exposure to social dynamics, such as collaboration with other institutions, can generate opportunity to improve the inventor's social capital, emerging key driver to explain mobility related events (Dokko & Rosenkopf, 2010; Somaya et al. 2008). The second way is to deepen the social understanding and interpretation of innovation activities. Considering the group of co-authors as reference group is, in other words, as acknowledging the idea that knowledge is embedded in individuals (Grant, 1996) but it's fundamentally a social interactive routine (Nelson & Winter, 1982). Finally, we try to further develop the construct of social aspiration level. In organizational level studies such

construct has been approximated to the average or median performance - of an industry. Recently Greve (2008) propose a refinement of the construct looking at those firms of the same size to build the reference group for the focal firm. Along this line of reasoning, we build the social comparison group as the set of co-authors for each focal inventor, taking into account the social nature of the innovative activities. In addition, we also consider other specifications of the social comparison construct, such as the median focal inventor performance of the firm, the cluster and the industry. The refinement of the social aspiration group is indeed of crucial important for behavioral research, at both individual and organizational levels.

As any other studies, also our study is not free of limitations. In the attempt to deal with issues related to data reliability of patents and programming to mobility codification, our data are collected from a small pool of firms (the top five global pharmaceutical companies) (12). These firms present patenting policies, resource endowment, scientific research publishing policy, training program and other innovation-related characteristics that make them very different from the other player in the industry. Therefore, our results specifically reflect how leading firms in the global pharmaceutical industry are able to manage the retention and the acquisitions of human capital, and how individuals are motivated to engage in risky actions such as mobility. When considering minor (and smaller in size) players in the industry, their firms and individual characteristics (see the example listed above), our results might show a different story on antecedents of mobility. Despite of this, our sample is already a significant improvement in terms of external validity in comparison to those pioneering studies of its kind (Palomeras &Melero, 2010). Therefore, future studies should consider exploring antecedents of mobility also for other types of firms, for example small-size players. Another limitation refers to the characteristics of the scientific publications in our data. In fact, while the average number of co-authors per

publications is 8.5, the number of institutions collaborating together on a publication is on average 1.3. These data suggest that in pharmaceutical industry scientific collaborations are mainly developed by groups of inventors belonging to the same firm. In this sense, our data are only partially an ideal empirical setting to test the effect of how scientific collaborations can serve as a bridge to external environment and related job opportunity, as suggested by the theory. This might be also why we do not find significant moderating effects when interacted with performance discrepancies. So, future research needs to explore other industries in which informal collaboration for scientific research production is more characterized by greater multiple-firms collaborative patterns.

In conclusion, our study offers a conceptual development and an empirical test for a comprehensive model of the antecedents of inter-organizational mobility of inventors. Along with classical economic views on employees' mobility (incentives structure and labor market opportunity), our theory suggests that individual motivations and sociological inventors' characteristics are important driver to explain mobility, opening the debate on how individual behavioral aspects (as decision making based on performance feedback models) can contribute to the understanding of interesting and relevant phenomena for the innovation and strategy community, such as mobility is.

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Footnotes

(1) For more detailed information about the databases creation process refer to http://dvn.iq.harvard.edu/dvn/dv/patent and specifically to the document available online “The careers and co-authorship network of U.S. patent-holders, since 1975.” in which Lai and colleagues offer explanation on the disambiguation of the original source data.

(2) It is possible to find cases in which two inventors have the same name and last name, but they belong to different firms.

(3) An inventor might show multiple affiliations along her patenting trajectory; and this is for the following reason. In the case of an acquisition, the inventor might show different affiliation in her scientific publications, but in fact she never changed firm (corporate dynamics effect). Given

the intensive acquisitions activity in the pharmaceutical industry, this has been something necessary to deal with.

(4) The last observation for non-censored individuals is the first patent filed for the new employer, while for censored individuals is the last patent filed in the focal firm. Both these cases do not contribute as observations in the sample.

(5) Forward citations come from two main different sources: citations from other patents applied by the focal employer (self-citations) and citations from patents assigned to other firms. Since we aim to capture how the external environment values the inventor's knowledge, our Quality variable is the difference between the total number of forward citations and the forward self-citations.

(6) Alternatively, we could use the forward citations received in the scientific publications. Anecdotic evidence (interviews conducted with R&D managers and HR department responsible) suggests that the quality of the scientific publications is important information for the market for inventors to assess the value of an inventor. In fact, models running with this variable replicate results of patents forward citations. Therefore, given severe issues related to multicollinearity, we opted to leave out this variable.

(7) We assume that the inventor can observe when her co-authors apply for a new patent. This assumption relies on the findings that information flows informally and quickly in network of inventors. Since we look at application year of patents, the nature of the data is to be public and quickly available in their information, in particular, on the website of USPTO.

(8) We specify the reference group also considering other possible criteria, such as the average performance in the industry, in the cluster of top pharmaceutical firms and within the firm. Analysis shows similar results.

(9) We exclude from the Above and Below intervals any value of Social that takes zero value. Applying this conservative approach on the difference between performance and aspiration, we leave out 56 zero values not assigned either to the Above or Below variables. Any assignment combination of the 56 zero values to these variables does not change our results.

(10) Notice that when two or more R&D sites of the same firm collaborate together in a scientific publication, we consider as 1 the number of organization publishing the article.

(11) We specify Tenure also as a squared term in order to potentially explain possible personal and professional dynamics related to late stage career. Firstly, more tenured inventors are more likely to develop personal situations (i.e. family or other environmental attachments) that increase the costs related to a move. In addition, more tenured inventors might receive internal career rewards, such as promotion to managerial position, which usually go along with higher salary. Finally, tenure generates a firm-specific value of the inventors, decreasing their optional value in any other future employers. All these arguments together suggest us to specify Tenure in a functional form able to capture these non-linear effects over the likelihood of mobility.

(12) In the mobility literature, when considering how to build the sample (in terms of inventors' and firms' number), there is a trade-off between the use of programs to codify mobility and the entity of a related Type II error in such codification.

Chapter 5: Conclusions

5.1 From the dissertation

In my doctoral dissertation I have been interested in looking at how organizations and individuals use specific reference points to assess their own performance generating a feedback mechanism that serves as the basis for the motivation to engage in change in the patterns of strategic behavior. These research interests have been articulated in three main essays, Chapter 2, Chapter 3 and Chapter 4. While each chapter offers in details its main conclusions and contributions in reference to the management community they are positioned into, in this Conclusion Chapter, I attempt to offer the answers to the overall conceptual questions that motivated the writing of the present doctoral dissertation.

An initial question I posed is *"what would the predictions be if considering other theoretical assumptions on the input of the feedback process, such as a different and more accurate performance constructs?* In this sense, my doctoral dissertation offers diversity in results depending on the level of the analysis. In Chapter 2, I found that the type of performance being observed is important. In fact, when financial performance deviates from expectations (either above or below), pharmaceutical firms decrease the extent of change in partnering patterns; in contrast, when innovative performance deviates from expectations (either above or below), pharmaceutical firms increase the extent of change in partnering patterns. So, this organizational level study suggests that different goals pursued at the same time generate different strategic behavior in organizations because of the different nature of the performance measures in which they are reflected, and specifically considering how each performance measure serves and contributes to the success of the firm as a whole. In other words, while I acknowledge that organizations are goal driven and that profitability has a doubtless centrality in the mindset of the managers, my results suggest that different performances stimulate different

decision-making heuristics, at least at the corporate level when a pharmaceutical firm has to decide on its strategic partnering profile. However, at the individual level my results suggest that innovative performance predicts risky behavior (i.e. the inventor's hazard rate to engage in a mobility event) as expected by the main predictions of the Prospect Theory: risk-taking behavior for inventors performing below aspirations (i.e. more likely to move) and risk adverse behavior for inventors performing above aspirations (i.e. less likely to move). And these are the main results both in Chapter 3 and in Chapter 4. This diversity in results can be explained by the different motivations behind the interpretation of the innovative performance for organizations and individuals. In fact, inventors, are directly associated to their innovative performance, which is their most direct assessment measure both for themselves, for their employer firm and for the colleagues working with them. This clear causal-effect logic between performance and its implications stimulates the decision-making process as expected by individual decision making theories. For organizations, instead, the performance-implications logic is less clear: the multi-dimensionality of goals and related performances might even generate a "portfolio" perspective on the different organizational goals that might affect spuriously the relationship between performance deviation from aspirations and risk profiles.

So, *innovation is a valid goal that matters for organizational and individual strategic decision-making*; in each chapter, I propose arguments mainly supported by the empirical tests on the conceptual importance of other performance measures in order to capture the diversity in the decision maker heuristics. But, as one of the main research interest of my dissertation intends, *different level of analysis (i.e. organizational vs. individual) reveal different strategic behaviors* as a response to innovative performance feedback models.

A second important research question I posed is *what would the predictions be if refining the social reference point in a more meaningful way?* Or more in general, *what are possible alternative operationalization/adjustments of the reference group for social aspiration level computation?* In Chapter 2, I followed a current emerging practice in behavioral strategy, which is refining the social reference group using firm characteristics, such as size. But, I believe it is in Chapter 3 and Chapter 4 where the most of the answer to these questions comes through. Looking at the group of co-authors for each inventor, I attempted to connect conceptually the mechanisms behind the definition of reference group in performance social comparison with the nature of the innovation activities. More precisely, building on the idea that knowledge is embedded in individuals but its application and combination happens in organized group, my results suggest that individual risk behavior is strongly predicted when a more meaningful reference point is set. And this is actually confirmed also in the results of Chapter 2, where pharmaceutical firms do not seem to be particularly triggered in their risk behavior by social comparison, as in previous similar studies. I believe that, at the organizational level, Chapter 2 confirms the need to keep on exploring continuous refinements of the reference group; but, my results suggest that it is the individual level where more precision is gained with the direct implication to improve the estimation procedures and assessment of relationships between performance attainments and risk behavior. Perhaps the combination of a more meaningful reference group (considering the innovation activities) with a more important focus on the individual level of analysis might represent a new fruitful research direction in order to better design the performance feedback models. In this sense, “individual level” does not necessarily mean individuals, but I refer to unit of analysis in which the mechanisms of goal definitions and

the relationship with the related performance measures is more clearly defined and characterized by a stronger causality mechanism.

Finally, I summarize the overall contributions of my doctoral dissertation in three main aspects. Firstly, I give a primary importance to innovative performance as a strong and valid alternative to financial performance in the feedback process for strategic decision-making. This is actually even more salient in the empirical context, pharmaceutical industry, in which Innovation is an extremely critical organizational goal. Acknowledging the multiple goal nature of the organizations and the centrality of Innovation in the current economies, I believe my doctoral dissertation contributes to increase the saliency around this performance measure and its relationship with strategic decision-making. Secondly, moving the discussion on performance feedback mechanisms more towards individual level presents benefits in the precision of the conceptualization and the estimation of the performance feedback loops. At the individual level, especially when considering innovation activities, I propose that performance feedbacks are more direct and more interpretable to the decision maker, therefore strengthening the related predictive power on risk profile. And, thirdly, my doctoral dissertation offers improvements in the understanding of how decision makers set their reference group in order to interpret their performance. Arguing from the socially constructed nature of innovation and complementing with a qualitative approach (i.e. interviews), I explore the meaningfulness of the reference group for the inventors in pharmaceutical firms offering the group of co-authors as a strong peer group for the prediction of individual risk taking.

In conclusion, in my doctoral dissertation I attempt to better understand, and therefore offer to the academic management community, how organizations and individuals learn from

their past actions and decide on subsequent strategic decision-making as a response to performance interpretation necessary to improve performance and gather competitive success.

5.2 Future Research

Looking ahead, I plan to extend my doctoral research generating a research agenda based on the following two main lines of research.

The first research line relates to the inventor's inter-organizational mobility research, and it is articulated in four projects.

In the first project I aim to explore more deeply the relationship between inventor's group composition and inventors' mobility. Thanks to current established relationships with the managers of the R&D Departments of the leading Spanish pharmaceutical company, I intend to examine the group composition for inventors dedicated to the Research activities and to relate the group characteristics (both organizational, such as the role occupied, and individual, such as each inventor's characteristics) to performance measures at a multiple level of analysis (individual, group and firm). In this sense, mobility could be considered as an outcome of innovative policies implemented in the company for the management of the general innovation process or, more specifically, of the management of the most talented employees. In this project, I plan to implement initially a qualitative approach to observe the working group, understanding better the internal interactive dynamics for innovation creation, and subsequently collecting data via survey and archival HR data to move into a more quantitative design.

In the second project I will analyze how the intra-organizational network characteristics affect the productivity patterns post-mobility event, both at individual and organizational level.

In particular, looking at the structure of the network of the moving inventor pre and post mobility, I will analyze the opportunistic (positive effect) and restrictive (negative effect) role that the inventor's intra-organizational network can play in the post-mobility period on innovative performance. While the intra-organizational network has been proven to be a fundamental predictor of innovative performance at both organizational and individual level, so far, its characteristics have been significantly less considered when associated to mobility study.

In the third project I intend to compare inter-organizational mobility with other forms of inventors' mobility, such as corporate spinouts. Recent studies suggest that inventors moving into spinouts become more technologically innovative generating benefits for the parent company. In the same vein, research on inter-organizational mobility suggests that source firm (firm from which the inventor moves) benefits from the move receiving back economic value (for example: citation flows). While very similar in the de-socialization and organizational code disruption mechanisms, spinouts and inter-organizational mobility represents different strategic implications for and potential trade-off for the definition of the R&D strategy and its decentralization, and the retention policy for talents. Therefore, the objective of the project would be exploring the differences between these two similar types of inventor mobility events and under which conditions they generate similar benefits to the parent/source firms.

Finally, in the fourth project I move my research scope to the mobility of academics. Recently, there has been an increasing interest in the implications of mobility of academics for research-based institutions, such as universities and research centers. In particular, more attention has been paid to how such mobility for top scientists affect the generation of extremely valuable inventions and how mobility explains the knowledge flows and collaboration patterns among research institutions. Despite such initial results, I believe that there are still fundamental

questions associated with mobility that are begging further analysis, especially if bridging the classical inventor's inter-organizational mobility literature with the emerging field of academics mobility. In order to develop this specific research line, I'm developing a unique database of 2,500 UK scientists coming from bioscience research fields. In order to get the individual information I'm coding each scientist's CV in order to get personal, educational and professional information to be further merged with publications data. So far, the database counts 221 fully coded scientists.

In the second research line, I will further develop the results of my first dissertation's chapter on the role of innovative performance in performance feedback models for strategic change. As suggested by previous studies, innovative performance is a multi-indicator construct. While patents are a good measure of innovative performance and have been commonly used to measure innovativeness, I intend to consider other measures of innovative performance including R&D expenditure and new product introductions. This is especially valid in the pharmaceutical industry where the organization of the projects 'pipelinein different approval phases is as important as the development of thepatenting activity to generate economic value.