Paper to be presented at the DRUID 2012

on

June 19 to June 21

at

CBS, Copenhagen, Denmark,

A Behavioral Perspective on Inventors? Mobility: The Case of Pharmaceutical Industry

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Abstract
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Jelcodes:L10,M51

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January 10. 2012

Key Words: Aspiration levels, inventors' mobility, patents, coauthors

Abstract

Building on existing research on employee mobility, this paper investigates an inventor's motivation to move and seeks to answer the question of which inventors move. This paper builds 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). Our results suggest that when the inventor is performing above her aspiration levels (both historical and social), she is less likely to engage in mobility. For an inventor performing below her aspiration level, we found support for risk taking actions (i.e. more mobility) only for social aspiration levels. Thus mobility is most likely when inventors perform below their social aspiration levels.

Motivation and Research Questions

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. We believe that there are still fundamental questions associated with mobility that are begging further analysis. 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 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, we still do not know much. Therefore, the first objective of this paper 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 our 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 our knowledge, there is no study that explicitly addresses this issue. Therefore, the third research question of our paper is "How does mobility affect the *innovative performance* of a mobile inventor?"

These three research questions represent the main pillars of our research agenda on mobility of inventors. In this paper, in particular, we will offer theoretical and empirical arguments on the inventor's motivation to engage in an inter-organizational move. Looking at mobility as a risky choice for the inventor, we 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.

Theory and Hypotheses

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, 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.

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, 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, both historical and social.

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, we are 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 our 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, we 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.

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 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 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 we 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. 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:

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.

Methodology

Data. We build our 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 we extract the patents and inventors information for five of the top global pharmaceutical firms, being: Pfizer Inc., GlaxoSmithKline Plc., Merck & Co. Inc., Bristol-Myers Squibb, Novartis AG. We 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 our sample sum up to the 45% of market share in the pharmaceutical industry, making our sample fairly representative of the industrial dynamics.

[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.

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-mobility event that is in fact an intra-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 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 an 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 and 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 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).

Variables. *Dependent variable*. Our dependent variable is employee mobility, which is a dummy variable coded 1 if an inventor's employer changed since the previous year and 0 otherwise. 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. Our independent variables are the discrepancies of the inventor's innovative performance from her aspiration levels (historical and social). For innovative performance, 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). For the performance measures, we follow previous work of 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 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, 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 innovative performance had an alpha of 0.2. For social aspiration levels, we 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. We 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, 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[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, we specify performance as a spline function (Greene, 1993). Therefore, we create two variables for both historical and social aspiration levels. First we compute the difference between performance and aspiration, as:

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

[2] 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. In addition, since we 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.

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 we 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, we 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, we use aspirations in t to generate discrepancy in t+1, which in turn predicts the likelihood of mobility in t+2. Therefore, we 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), we 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

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

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[4]. *Previous Mobility* has been shown to affect positively future mobility (Palomeras and Melero, 2010). *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.

Model. Given the dichotomous nature of our dependent variable, we estimate 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).

Results

Table 1 shows descriptive statistics and correlation coefficients. Table 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 we focus on the marginal effects estimates of Model 3 (marginal effects at the mean of each variable in the full model specification).

[4] We specify Tenure also in a squared term.

TABLE 1

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 but not significant, and *Self Citation* are negative and significant (Palomeras and Melero, 2010), *Tenure* is positive and significant while *Gender* is negative and not significant (Campbell at al., 2011; Singh and Agrawal, 2011). For *Tenure* 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.

TABLE 2

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 3.2%. This result suggests risk aversion individual behavior, as predicted. Therefore, our hypothesis 1a is supported. Hypothesis 1b suggest that for inventors performing below their historical aspiration levels, decreases in innovative performance are positively related to the likelihood of mobility. We cannot draw any conclusion since the coefficient is not significantly different from zero; so, hypothesis 1b is not supported.

Looking at results for social aspiration variable, 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 3.5% (statistically significant). Therefore, our 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 14%. 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 2b is supported.

Overall, our results suggest that mobility is less likely when the inventor´s performance is above aspirations 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-author.

Conclusions and Discussions

The current paper 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 paper 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 paper 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 hypotheses suggest that any performance deviations below aspiration levels, both historical and social, would increase the likelihood of an inventor's inter-organizational mobility. Results support mainly our 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. Our results appear to be in alignment with the original prospect theory predictions on risk taking for individuals performing above their aspirations (Kahneman and Tversky, 1979), especially when considering the performance compared to the "relevant others", such as co-inventors in our case.

Our study 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. 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 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, we propose a model in which the inventor is motivated to risk taking or risk adverse behavior, such as mobility. 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. 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.

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Table 1: Descriptive Statistics

	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)	29,323	126.97	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. This difference is reflected also in N of the sample for each model. However, our results are not affected by this differences.

Table 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)	- 0.05*** (0.011)		- 0.04*** (0.011)
Below (Historical)	0.02 (0.016)		0.02 (0.016)
Above (Social)	- 0.12*** (0.022)		- 0.11*** (0.022)
Below (Social)	- 0.18*** (0.023)		- 0.17*** (0.027)
Quality		0.00*** (0.001)	0.00* (0.001)
Dispersion		- 0.03*** (0.005)	- 0.02*** (0.005)
Self Citations		- 0.90*** (0.149)	- 0.82*** (0.143)
Complementarity		- 0.03*** (0.007)	- 0.02** (0.007)
Previous mobility		1.07*** (0.158)	1.14*** (0.154)
Tenure		0.08*** (0.014)	0.05*** (0.014)
Tenure (squared)		- 0.03*** (0.007)	- 0.00*** (0.000)
Gender		0.07 (0.075)	0.08 (0.071)
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