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Master Thesis

A study of the relationship between CEO ownership and the balance between exploration/exploitation in high-tech industries

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Introduction

We have chosen to dedicate our master thesis to study the relationship between CEO stock ownership and the balance between firm exploration/exploitation in high-tech industries. To measure exploitation and exploration we will look at deviation from average patent classifications, 2-5 years post contractual change for CEOs. A lower than average degree of new patent classifications implies incremental changes, hence exploitation; whereas a higher than average degree of new classifications implies radical change, hence exploration. The choice of industries are based on the fact that the propensity to develop new ideas in high-tech industries are related to profitability and the number of patents a company holds is positively associated with sales and stock performance (Chakrabarti, 1990; Griliches, 1990), In general for high-tech industries, about 5% of all raw ideas turns into patent applications. Out of those patent applications 0,6% turns into commercial successes (Stevens & Burley, 1997). This implies an idea-to-commercial success ratio of 0,033% and illustrates the high failure rate involved. Moreover, short-tenured CEOs are found to be better than long-tenured CEOs in the highly dynamical technological situations describing the industries (Wu, Levitas & Priem, 2005), indicating a higher CEO turnover than average for the high-tech industries. As the CEO is driven by self-interest and is the executor of the firm, this will lead to more short-termism, i.e. exploitation, in the industries at the expense of exploration. This follows from the simple fact that returns from exploitation are more predictable and proximate in time (March, 1991), whereas returns from exploration are more uncertain and distant in time (Levinthal & March, 1993). Given the below average CEO tenure in high-tech industries, CEOs that allocates the firm's resources to exploration takes the risk of investing in returns for the CEO successor. We argue that the increased frequency of patent applications and CEO changes relative to normal state makes high-tech industries the best candidate to investigate for distinct patterns. To investigate the relationship, we will dedicate this paper to the following research question:

"To what extent does the degree of CEO stock ownership affect the balance between exploration and exploitation in high-tech industries?"

We argue that CEO stock ownership should have a positive relation to short-term performance, hence an exploitative strategy. By using new patent classifications as a measure for exploration we argue that the two measures should have a negative relation. To answer our research question we have identified one comprehensive hypothesis:

H: *"The degree of CEO stock ownership will have a negative relation to the degree of new patent classifications".*

Literature Review

Exploration and Exploitation

We will utilize the seminal paper "Exploration and Exploitation in Organizational Learning" by J.G. March (1991) as a conceptual foundation for our study. The paper is a study of adaptive processes with the relation between exploration and exploitation as a primary concern. Exploration refers to the exploration of new possibilities and includes i.a. innovation, experimentation, risk-taking and distant search. Exploitation, on the other hand, is the utilization of old certainties and includes i.a. efficiency, implementation, execution and local search. Search is the sampling of opportunities from the pool of technological possibilities (Levinthal & March, 1981). Within this pool the firm can recombine, relocate and manipulate knowledge and the consensus among researchers is that the tracking of this activity is best captured using patent citations (Rosenkopf & Nerkar, 2001; Benner & Tushman, 2002; Katila & Ahuja, 2002). The pool is twofold and consists of familiar knowledge and new knowledge, respectively (Levinthal & March, 1981; Katila & Ahuja, 2002). If the firm utilizes familiar knowledge to solve a problem, the firm is conducting a local search and consequently *exploiting,* and vice versa.

For this study, we reject the view of exploration and exploitation as being two extremes on a continuum that cannot coexist and rather emphasize the orthogonal view where they coexist and the vital factor is the balance between them (Katila & Ahuja, 2002; Lavie & Rosenkopf, 2006; Gupta, Smith & Shalley, 2006; Katila & Chen, 2008). The balance is crucial because excessive exploitation may lead to negative effects such as rigidity and organizational inertia (Volberda, 1996; Van Den Bosch et al., 1999) whereas excessive exploration may have adverse effects on

e.g. efficiency and reliability (Levinthal & March, 1993; Gupta, Smith & Shalley, 2006). Consequently, a firm pursuing an exploitative (explorative) strategy emphasizes exploitation (exploration) but do not neglect exploration (exploration). Derived from this, we embrace the concept of ambidexterity as a mechanism to strike this balance and ambidextrous strategies as a mean to get there (Levinthal, 1997; Lavie & Rosenkopf, 2006). The essential coexistence is nicely pointed out by research claiming that a successful search often combines knowledge that is known to the firm with knowledge that is new to it (March, 1991; Tushman & O'Reilly, 1996; Katila & Ahuja, 2002; Siggelkow & Rivkin, 2005; Katila & Chen, 2008), combining local with distant search and leaving the determining factor of whether the firm has been exploitative or explorative to the respective balance between them.

Measure of exploration and exploitation in previous literature

Patents have been extensively used for measuring exploitation and exploration in previous studies. Stuart and Podolny (1996) measured the amount of inventions for a firm that had shared antecedents with a competing firm in the Japanese semiconductor industry. They used this as a measure for local search and to find out how technological capabilities evolved in a cluster of innovative firms. Rosenkopf and Nerkar (2001) studied the optical disk industry to find the most utilized form of exploration, divided in local, radical, internal boundary-spanning and external boundary-spanning exploration. In order to quantify this, they used the technical subclasses of patents and categorized them in their four categories. Katila and Ahuja (2002) and Forti and Toschi studied the global robotics industry and technology companies, respectively. They both utilized companies' prior art patent citations to measure the depth (exploitation) and the scope (exploration) of the search. The depth measure captures how deeply a firm utilized its existing knowledge and is quantified by counting how often each element in the current domain has occurred previously in the chosen period.

$$Depth \ = \ \frac{\text{Repetition count}}{\text{Total items}}$$

The scope measures captures how widely a firm explored by counting how many new elements there are in the current domain.

$$Scope \;\; = \frac{\text{New item}}{\text{Total items}}$$

The choice of patents as data source is similarly explained and defended in all the studies. Patents, by its very nature, begins with a problem and ends with a solution (Walker, 1995) and is therefore an accurate measure of how firms conduct their search activities over time. Second, patent data provides a detailed and consistent chronology of search (Almeida, Song & Grant, 2002). Utilized knowledge is cited over time and, because of legal reasons, accurate (Walker, 1995). Moreover, Forti and Toschi utilized patent measures because it was particularly appropriate for their study when testing hypotheses that involved learning and knowledge creation. To discover distinct learning sources, they looked at the further development of existing patents where each citation was an indicator of adaptation to context derived from learning. To adjust for different patent propensities across industries all the aforementioned studies focused on particular high-tech industries or high-tech industries as a whole, where patents is deemed as an important appropriability mechanism (Arundel & Kabla, 1998; Grupp, Schwitalla, Schmoch & Granberg, 1990).

Forti and Toschi sat the period to 5 years in the past from the focal year contentiously because organizational memory in high-tech companies has been found to be limited. Acquired knowledge depreciates significantly and loses its distinct value within c.5 years (Argote, 1999). This contentious decision was not made in the other aforementioned studies, which utilized previous studies' data or had a period of 10 years.

Agency theory

Modern companies are usually not run by the founder and owner of the firm, but rather run by managers hired by the board of directors to run the firm on behalf of the shareholders. This type of interaction is referred to as a principal agent relationship. Defined as a relationship in which one or more person(s) (principals) engage another person (agent) to perform some service on their behalf which involves delegating some decision making authority to the agent (Jensen & Meckling, 1976). However, challenges arise when ownership and

control is separated, as both the agent and principal are assumed to be motivated primarily by self-interest (Barnea, Haugen & Sanbet, 1985; Bromwich, 1992; Chowdhury, 2004). Divergence in the principals' interests can however be limited by establishing appropriate incentives for the agent, and by incurring monitoring costs designed to limit opportunistic behavior by the agent (Hill & Jones, 1992). Such monitoring costs relates to the principals' attempts to monitor or restrict the actions of the agent, to ensure behavior that maximize the shareholders' value. On the other hand, we have bonding costs, which is incurred by the agent. Costs related to contractual obligations that limit or restrict the agent's activity. Lastly, there is the subject of residual losses, meaning the costs incurred from divergent principal and agent interests despite the use of monitoring and bonding. The sum of the principal's monitoring expenditures, the agent's bonding expenditures, and any remaining residual loss are defined as agency costs, a measure to align the principal and agent's incentives (Hill & Jones, 1992).

Several previous studies have examined the relationship between the use of control mechanisms and their effect on the agency costs. Suggesting various ways to overcome the agency problem and reduce the costs involved. For instance, it is argued that managerial shareholdings can reduce and mitigate agency costs (Jensen & Meckling, 1976; Agrawal & Knoeber, 1996; Ang et al., 2000; Chow, 1982; Fleming et al., 2005; O'Sullivan, 2000). Jensen and Meckling's (1976) approach to the agency problem differed from most of the previous literature, focusing almost exclusively on the normative aspect of the agency relationship; how to structure the contractual relationship between the principal and agent, including compensation incentives. Agency costs of equity arise from the direct expropriation of funds by the managers, consumption of excessive perquisites, shirking, sub-optimal investment and entrenching activities. Thus, earlier studies suggest that managers are encouraged to own the organizations' share to motivate management monitoring (Agrawal & Knoeber, 1996; Fleming et al., 2005). Under which our study will primarily revolve around the subject of managerial ownership as a compensation incentive to align the shareholders and the CEOs' self-interests.

Managerial ownership

The CEO is considered to be the most important agent of a firm's principals (Mintzberg, 1983). Providing the CEO with stock ownership in the firm is argued to align the manager's self-interest with the principal's (shareholder) and reduce agency cost (Jensen & Meckling, 1976).

Jensen and Meckling´s study suggested that the higher the portion of stock ownership, the more responsible the manager is to increase the value of the firm. Scholars of original agency theory argue that the equity agency cost is zero when the manager owns 100 per cent of the organization, and that there is a positive relationship between equity agency costs and the separation of ownership and control. However, as the manager's equity ownership falls below 100 per cent, the equity ownership becomes relatively dispersed. Hence, the manager has a greater incentive for shrinking or the consumption of excessive perquisites (Jensen & Meckling, 1976; Fleming et al.,2005). Farrer and Ramsay (1998) argue that the manager only bear a portion of the expenses when the value of the firm decrease. Hence suggesting that a lower managerial equity holding is associated with lower incentive and effort to maximize the shareholder's utility. Chow (1982) argue that such circumstances also increase the manager's incentive to falsify financial disclosures, as disclosures may be utilized by shareholders in setting managers' remuneration.

Friend and Lang (1986) emphasize that conflict among the stakeholders decrease as managerial ownership increase, hence less cost associated with the agency problem (Jensen & Meckling, 1976). The reason being that insiders have a greater incentive to protect the shareholders interest, and therefore need less monitoring (Vafeas, 1999). Jensen and Meckling (1976) claim in their study that a larger portion of equity owned by insiders leads to increased firm value, as agency cost is reduced and interest are realigned. Hence a reduced need for intensive auditing, as managers are less likely to deliberately mislead themselves (O'Sullivan, 2000). Berger et al. (1997) argue that managers with high stock ownership have a greater incentive to make value maximizing decisions about capital structure. Consequently, holding common stocks motivates managers, as their voting rights increase their influence on the firm's general policy (De Angelo & De Angelo, 1985).

However, several studies on agency cost and managerial stock ownership provide contradictory or mixed findings, arguing that managerial stock ownership does not serve as an impediment for agency cost (Singh & Davidson, 2003). Implying that the relationship between managerial ownership and agency cost is inconclusive. Abdullah (2006) argue that non-executive' interests are associated negatively with financial distress, effectively increasing the incentive to monitor management. While Florackis (2008) found that managerial ownership encourages better use of assets in the companies' revenue generation. Both McKnight and Weir (2009) and Yang et al.'s (2008) studies support this notion, providing evidence of reduced agency cost in UK and Taiwanese companies, as a result of high managerial ownership. However, several studies find that managerial ownership is non-linearly related to agency cost and firm value (Morck et al., 1988; Bhabra, 2007; Benson & Davidson, 2009; Jelinek & Stuerke, 2009). Bhabra (2007) found a curvilinear relationship of managerial ownership and firm value, while Benson and Davidson (2009) found a significant inverted u-shaped relationship. Supporting Morck et. al.'s (1988) study, who found a significantly positive relationship between firm value and ownership when ownership was between zero and 5 per cent, and a significantly negative relationship when ownership was between 5 to 25 percent.

Furthermore, it is suggested that manager-owned organizations may be excessively risk averse (Fama & Jensen, 1983). Hence leading to under-investment in risky project, and motivate managers to pursue safe strategies (Loh & Venkatraman, 1993). However, in the absence of manager ownership, shareholders tend to discount the value of their initial investment, thus lowering the managerial compensation (Francis & Wilson, 1988). Hence managers have a greater incentive to choose a higher quality audit to increase their compensation (Jensen & Meckling, 1976; Firth & Smith, 1992).

Several studies suggest that a high managerial ownership stake leads to higher valuation and superior firm performance (McConnell & Servaes, 1990; Kim, Lee & Francis, 1988; Oswald & Jahera, 1991; Hudson, Jahera & Lloyd, 1992). However, some research also argue that a high degree of CEO stock ownership motivates forecast precision, which to a large extent implies short-term or

artificial firm performance (Cheng, Luo & Yue, 2013). The question if this superior firm performance is short-term, long term or a house of cards is however still up for debate.

<div align="center">Measure of managerial ownership in previous literature</div>

Kim and Lu (2011) utilized two measures of CEO ownership in their paper investigating the relationship between CEO ownership and firm valuation. The first measure for ownership aggregates stocks and options, whereas their second measure only includes stocks. The first mentioned is calculated as:

$$\frac{\text{The number of stocks and the delta of all stock options held by a CEO}}{\text{The number of all outstanding stocks } + \text{ the delta of all outstanding stock option}}$$

Their delta calculation follows Core and Guay's (2002) methodology. The second measure is simply the percentage stock ownership held by the CEO. The limitation of this measure is that it does not provide a complete picture of the incentives involved in the CEO's decision making. On the other hand, the strength of this measure is that it gives a more accurate picture of a CEO's voting rights than the measure that includes options. Options do not give voting rights until exercised and thus represent a hypothetical scenario rather than an actual scenario. The choice between the two measures is thus a trade-off between capturing all the incentives involved and an accurate picture of the decision power held by the CEO. Put simply, these are the two types of measurements for managerial ownership that dominates previous literature. However, the level of detailedness in the treatment of stocks and options vary. Coles, Lemmon and Meschke (2012) splits options into existing and newly granted, which again is split into exercisable and unexercisable. With differing underlying assumptions for each class of options they calculate effective ownership. Short and Keasey (1999) and DeAngelo and DeAngelo (1985) simply uses stocks as measurement, but DeAngelo and DeAngelo even includes stocks owned by relatives to calculate the proper CEO ownership.

Methodology

We will conduct a deductive study of managerial ownerships relative to firms' exploration and exploitation. Developing an hypothesis based on the existing

theoretical consideration, which will be confirmed or disconfirmed through statistical inference (Bryman & Bell, 2015).).We will utilize positivist and objectivist ontology, taking a controlled and structured approach to the research, without subjective interpretations (Bryman & Bell, 2015). Pursuing a quantitative research strategy, emphasizing quantification in the collection and analysis of data, where the statistical data determine the end result.

Research Method

We will use a quantitative research method, based on the utilization of secondary data regarding CEO stock ownership, as well as change in patents of US high-tech companies. To retrieve data related to CEO stock ownership we will use the Bloomberg Terminal, accompanied by Compustat. Data regarding patents will be acquired by utilizing USPTO, and other patent databases if adequate. The size of the sample will only be limited by our chosen data sources, giving us a vast sample size that minimizes sampling error (Bryman & Bell, 2015). The chosen period and length of period is not determined yet and will be decided in consultation with our Thesis supervisor.

Research Design

We will utilize a cross sectional research design, as we seek to identify variations in different cases (Bryman & Bell, 2015). The content of analysis will be systematically collected at a single point in time, and standardized into a consistent benchmark to measure variation. However, we recognize that it may be difficult to establish causal relation from the resulting data, as data is collected at a single point in time.

In order to analyse our data we will conduct a multiple, linear regression model using degree of new classifications with respect to patents as a dependent variable (Y) of the constant term ($\beta 0$), the independent variable of CEO stock ownership (X) and the error term (εi). To control for industries, idiosyncratic features, CEO and contractual characteristics we will use dummy variables.

Variables

Measure of exploitation and exploration

Exploitation and exploration will, in our study, be measured as conducted in the studies of Katila and Ahuja (2008) and Forti and Toschi, amongst others. The decision is made on the basis of what we deem to be the consensus among researchers, consequently increasing the legitimacy of our study. This implies that exploration and exploitation will be measured as:

$$Exploration \ = \ \frac{\text{New patent classifications}}{\text{Total patent classifications}} = (1 - Exploitation)$$

$$Exploiation \ = \ \frac{\text{New patent classifications}}{\text{Total patent classifications}} = (1 - Exploration)$$

The distinction between new and existing patent classifications is made because they derive from different knowledge sources. The creation of a new product can be a further development of something already known, i.e. local search and exploitation, or it can come as a result of new knowledge acquisition, i.e. distant search and exploration. We can therefore draw the conclusion that R&D expenditure or R&D intensity is not a proper measure for exploration, as the measures most likely include the utilization of not only exploration, but also exploitation.

Measure of managerial ownership

As of today, we are leaning against the decision to measure managerial ownership simply as the percentage of shares held by the CEO, that is:

$$Degree \ of \ CEO \ ownership \ = \ \frac{\text{Shares held by CEO}}{\text{Total outstanding shares}}$$

The arguments for this is of time-saving and simplifying reasons. Before we make our final decision we need to check whether options constitute an abnormal share of total CEO ownership in high-tech industries. Further, the availability of such data must be measured against the value of including such data. The final decision will be made in consultation with our Thesis supervisor.

CEO

The dependent variable (X) in our study will be the degree of CEO ownership. CEOs with less than 2 years in tenure will be weeded out by a dummy variable which takes the form of zero. This is to ensure that the incurred exploration stems for the reigning CEO and not the precursor. Further we will check that our findings are valid for every level of ownership by running the regression for 20 quantiles, beginning with 0-5% and concluding with 95-100%. This will conducted by eliminating 19 quantiles at the time with dummy variables. This is to rule out the relationship Morck et. al.'s (1988) found in their study of the relationship between firm value and ownership. They found that there was a positive relationship at 0-5% ownership and a negative relationship between 5% and 25% ownership, that is an inverted U-shaped relationship.

Moreover, we will add a dummy variable for the sex of the CEO to see if there are any pronounced differences between male and females, and also investigate whether the age of the CEO has any clear impact. It is likely that an older CEO has more ownership and lower risk tolerance, which may affect R&D, and consequently the firm's growth opportunities (Kim & Lu, 2011). Related to this, we are also evaluating whether tenure should be more closely examined.

Firm

First and foremost, we will control whether the size of the company has any major implications for the balance between exploration and exploitation. This stems from the fact that learning tends to crowd out exploration (Levinthal & March, 1993; Sorensen & Stuart, 2000; Ahuja & Katila, 2004). As firms grow in size and conduct more searches, they will conduct relatively more local searches. This is a contentious decision where reliability and efficiency is deemed more important than variation (Katila & Chen, 2008).

Correlated with the size of the company, we will control for the age of the company. Younger firms may have more growth opportunities, invest more in R&D, and have CEOs with larger ownership (Kim & Lu, 2011). Kim & Lu also proposed to check whether the financial leverage of the firm could have an impact. This is because it may affect the firm's willingness to conduct more expensive searches, i.e. distant

searches. Related to this, the proportional level between tangible and intangible assets may also be a determining factor for the exploration/exploitation balance in a firm. Kim & Lu stated that firms with fewer tangible assets typically conduct more research, have less operating profits and younger CEOs.

Industry

As of today, we have chosen to look at high-tech industries as a whole. This follows from the hypothesis that the patent propensity is somewhat the same, but this is an element that will have to be confirmed. Our regression will contain dummy variables for every sub industry that is a part of the grander term high-tech industries. This is to see whether there are any large outliers that manipulate the aggregate results.

Project management and timeline

Two Master of Science in Business students at BI Norwegian Business School will conduct the research. In addition, Professor Sasson will serve as Thesis supervisor, providing guidance and insights that will further enhance the quality of the study.

We have created a Gantt chart to ensure steady progression and commitment to the project. The Gantt chart is chosen because it enables minor adjustment throughout the course of the project so that we avoid the traps of path dependency (Bryman & Bell, 2011).

We have just completed the first phase of the project, with the preparation of the master thesis proposal. The subsequent phases are not completely distinct, but somewhat overlapping. They are chronologically ranked after what we plan to be the superior focus in the respective period. The second phase will be dedicated to refining the research question, complete the project timeline and finalize the research design and method. Thereafter, we will continue our modest start on the literature review. The phase will begin by incorporating feedback on the literature review from the master thesis proposal. This will be a continuous phase throughout the project and will be subject to constant improvement. In March, we will begin the data treatment, with following training in the respective programs included. The project will be concluded by the drafting and finalization of the master thesis.

Throughout the project we will have weekly meetings internally and monthly meetings with our supervisor to ensure that we are on track and heading in the right direction.

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