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The Effects of CEO Succession Origin and Incentive Structure on Firm Innovation

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ABSTRACT

The Effects of CEO Succession Origin and Incentive Structure on Firm Innovation

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This paper suggests a new perspective on how executive succession is related to R&D and the firm performance by investigating R&D intensity, CEO succession origin (inside/outside), and the proportions of long-term incentives interact with one another to play a decisive role in determining R&D efficiency and subsequent future firm performance. By merging firm data on financial information, executive compensation statistics, and hand-collected CEO biographies and career histories, the study examines the various interaction effects on the main relationship of R&D intensity and future firm performance (ROA). Also, the three-way moderating effects of R&D intensity, inside/outside CEOs, and the proportion of long-term incentives were analyzed. For 223 different CEO succession events of Hi-technology IPO firms from the period of 1993 to 2015, the regressions suggest that future firm performance in ROA after CEO succession takes place is affected by

the interactions of high R&D intensity and high long-term incentive proportions with an inside successor. The results indicated that heavy emphasis on the long-term incentives for executives is responsible for the strong negative relationship between R&D intensity and future firm performance. Additionally, Inside CEOs who engage in a high level of R&D intensity, are associated with acquiring the most expected positive effect on firm performance (ROA). An important finding of this paper is that R&D intensity, long-term incentives proportion, and CEO Origin interact in the way that they influence firm performance derived from R&D. Among Hi-technology firms where there are high levels of R&D intensity, inside CEOs tied to a higher proportion of Long-term incentives had the most positive effect on future firm performance. Insider CEOs can set aside the detrimental effects of R&D spending on firm performance with their specific knowledge about organizational contexts. Also, from the support from the board and stakeholders, Insiders may be more risk-taking in terms of investments in R&D and aligning their interest to the eventual goal of firm innovation.

Keywords : CEO Succession Origin, Executive Compensation, Managerial Human Capital, Strategic Change, R&D, Innovation

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I. INTRODUCTION

Firm growth is dependent on the innovation of organizations. To be competitive in the ever-changing business environment, organizations must come up with the sustainable capability to create innovative results (Miller, Fern, & Cardinal, 2007). If companies seek new motives for prosperity, they will need to exert much effort on activities related to innovation. Innovation can be defined in numerous ways. Madhavan and Grover (1998) depicted innovation as the process to manage knowledge while Brown and Eisenhardt (1995) stated innovation as a vital component for a firm's existence under substantial uncertainties. Nonaka and Takeuchi (1995) viewed innovative companies as knowledge creators who relentlessly engage with novelty. In line with this, how to manage knowledge-based resources efficiently is crucial for organizational success. It is intellectual capital such as human capital, social capital, and organizational capital that influences organizational capabilities to innovate (Subramanlam & Youndt, 2005). Each organization has distinctive ways to handle intellectual capital. In any case, utilization is the key because the competitive knowledge resources that firms have can become obsolete depending on the success of competitors (Balkin, Markman & Gomez-Mejia, 2000). Going further, addressing how to manage the valuable knowledge resources that a firm has require our understandings of what ways a firm's knowledge can be managed and reproduced. We need to look through the two perspectives of organizational learning: exploitation versus exploration (March, 1991).

In the research of Hargadon and Fanelli (2002), the authors suggested the dual aspects of research on knowledge. They viewed that knowledge can be spread out within the organization and be translated into changing routines or redistributing resources. At the same time, knowledge can be utilized to create novel products by exploring and assimilating new knowledge into existing competencies. Most conspicuously, the existing knowledge level determines how much an organization is capable of knowledge creation and assimilation which allows new products to be developed and introduced in the market. This prior knowledge of the firm may reside in the managers and knowledge workers (Smith, Collins, & Clark, 2005). The scholars have discussed that the accumulated knowledge in the firm originates from executives and knowledge workers. Their abilities, skills, experiences, networks, and background information enhance firm capabilities to create new knowledge. Subsequently, this accumulated stock of novel knowledge allows products to be developed. New product developments are a crucial part of creating firm value and making firms more sustainable (Damapour, 1991). Indeed, firms that can manage, develop, and utilize knowledge can produce innovative products. In this regard, research and development are crucial because they can be the source of innovation and sustaining competitive advantage. Great attention has been on finding ways to produce knowledge by transforming inputs into output (Dushnitsky & Lenox, 2005). The authors elaborated that the exploitation of external knowledge plays a key role in terms of innovation. Especially, innovative efforts that are from outside of the firm's boundaries may be in the form of R&D alliances, laboratories operated by the government or university, and others.

Generally speaking, R&D spending can contribute positively to the future performance of firms. However, in the management literature, this preconceived

notion of the expected positive relationship of the R&D investments and subsequent firm performances is regarded as near-sighted reasoning. Perhaps, the steady investments in R&D, which are more beneficial for the stakeholders of the company, resulting in higher R&D productivity which can make the firm more competitive and long-lasting (Kor & Mahoney, 2005; Mudambi & Swift, 2014). But there could be no significant relationship between the R&D and performance due to the uncertain nature of R&D outputs. Besides, depending on who is in charge of R&D, the outcomes may vary greatly.

Strategic leadership is especially important because top managers make decisions that influence the process of innovation (Finkelstein, Hambrick, & Cannella, 1996). Managers have roles regarding how to allocate resources and they can make strategic choices based on the options they have regarding how to expend on R&D. In the end, managers determine how much to spend on research. As Barker and Mueller (2002) found out, managers' traits such as education level, age, and tenure are antecedents of R&D spending. Especially, the CEO is an influential figure of the organization who can direct the firm and make strategic choices for the firm as a whole. In line with this thought, accounting literature focuses on the manager's manipulation of earnings to meet the forecasts of analysts, which lead to changes in R&D expenditure. Among many scholars, Mudambi and Swift (2014) have pointed out that managers may focus on short-term firm performances instead of long-term outcomes that truly create value. The scholars have also noticed the changes in R&D spending is related to firm growth, which changes the common perception that stable R&D leads to firm benefits. To sum up, both R&D spending changes either in static or disruptive form can suggest that firms take on different approaches based on their capacity, situations, and goals that the firm is oriented at.

Choosing the R&D strategy for companies can be explained in terms of the R&D investments in terms of exploitation and exploration (March, 1991). For instance, making most out of the firm's resources and knowledge denote that firm is in the exploitation stage while searching for novel knowledge means that firm is undertaking exploration to seek new value. Because strategic actions to undertake R&D spending for firm innovation may disrupt the firm performance, firms may choose to outsource the innovative inputs. When well-established high-tech firms rely on external knowledge by investing in technology ventures, or R&D alliances, the outcomes from sourcing R&D may be more efficient and deployable in a timely manner as opposed to internal research and development because of low marginal R&D productivity. However, the outsourcing of knowledge may involve adverse selection and hold-up problems which demands the focal firm to develop their ways to research and R&D. Especially in sectors where competition is fierce and imitation of products often takes place, firms need to develop novel ways to maintain a competitive advantage. The internal R&D decision is contingent on the top managers' discretion. Managers can leverage R&D investments in creating sensational products and cutting-edge technologies. However, managers may be opportunistic by investing less in R&D investments and future value creation for the betterment of short-term performances to which the compensation is tied to.

If we understand the nature of how managers can be ambivalent toward engaging in R&D activity, the paramount question to answer is what type of CEOs would be willing to engage more in pro-innovation inputs. Indeed, investments in innovation involve great risks and failure by nature. CEOs who strive for short-term financial performances and seek for status-quo may be reluctant toward pursuing innovation. CEOs who were promoted from within a company know how to deal with the

resources that the firm has but might be in favor of stable operations of businesses in charge. CEOs from outside of the company possess novel knowledge that can change the business operations but may desperately work for creating good financial performances (Shen & Cannella, 2002). Researchers found that the overall trends in R&D productivity continue to decline (Knott, 2017; Cummings & Knott, 2018). They suspect that the trend of the decreasing rate of R&D productivity may be due to an increasing number of outside chief executive officers (CEO) in companies. Outsider executives were often appointed in the hope of turning the situation around (Chen, 2015, Quigley, Hambrick, Misangyi, & Rizzi, 2019), or strategically change the businesses that the company is involved in. To outside CEOs, the investment in R&D could be at the expense of their top priorities such as short-term financial performances. To answer the question of CEOs of different origins and their influence on potential outcomes to a firm, researchers must understand the varying experiences, backgrounds that CEOs have (Harris & Helfat, 1997; Zhang & Rajagopalan, 2010). The relationship between strategic change and firm performance can be moderated by the types of CEOs' who are capable of making changes (Zhang & Rajagopalan, 2004, 2010). Because adjusting R&D expenditure can be viewed as a strategic change that a firm takes, we could view R&D intensity as a firms' willingness to engage in R&D strategy. For firms whose firm performance depends on innovation, selecting CEOs who will pursue activities that will create more innovation outcomes.

This paper's contribution to CEO Succession studies is twofold. The extant literature on executive succession and firm performance in regards to innovation is scantly discussed. How CEOs drive strategic changes in the organization and their influence toward innovation needs to be explored. First, it is crucial to

acknowledge that CEOs enjoy much autonomy and face a wide latitude of choices when making strategic decisions. They are key figures in making decisions for a firm to innovate and thus sets the limit on how much to spend on R&D expenditure. Second, because many companies use incentive plans to make CEOs work on behalf of company stakeholders, it is necessary to revisit the importance of long-term incentive schemes given to the CEO appointed. The long-term incentives are often tied to CEOs to make them think in the long-run, engaging more in research and development activities that have an impact on the future firm performances. Initially, I hypothesize that high long-term incentives moderates the relationship between R&D intensity and firm performance. After controlling for the effect that long-term incentives have on firm performance, the next findings indicate that inside successor CEO is likely to influence more on the future firm performances from the extent of R&D amount taken. However, the insignificant result implied that inside CEOs were not so much regulated by proportions of long-term incentives. In addition, there was a three-way interaction effect suggesting that insiders who are given a high proportion of long-term pay and engaged in high R&D intensive activities contribute positively to future firm performances. I examined the contributions that CEOs make to innovation by observing how much they emphasize R&D expenditure to generate future firm performance (ROA) up to two years after CEOs are appointed (at period *t*) in 223 high-technology companies that are listed in Compustat. High-technology firms were chosen because they are companies that heavily re-invest resources in R&D.

II. LITERATURE REVIEW

Literature on CEO and Innovation

Cummings and Knott (2018) have illustrated the study on CEOs and innovation in the forms of understanding the CEOs and their characteristics (Barker & Mueller, 2002), and using corporate governance that regulates CEO to behave toward innovation. Laverty (1996) have articulated the managerial opportunism in which managers make intertemporal choices on behalf of themselves, thus making suboptimal choices. Cumming and Knott (2018) gives a situation in which stock options with grant and exercise dates are given to CEO to support Laverty's reasoning. Stock option loaded CEO would prefer to maximize the price of stocks by cutting expenses on R&D. Also, I could find an example from confident CEOs who delay their timing of vesting stocks (Malmendier & Tate, 2005). Galasso and Simcoe (2011) elaborated in their research that CEOs tend to not exercise options when they are confident enough that they can earn money and trust their abilities to generate more outcomes in the future.

The latter form of literature on CEOs and Innovation that Cummings & Knott (2018) point out has to do with corporate governance and CEO's behavior. Earnings management practice can take place by adjusting R&D expenses among different time periods to achieve the expectations of analysts. One example could be the incentive structure that links the performance of CEOs to long term performance like innovation. Dechow and Sloan (1991) found that retirement-bound CEOs innovate less in the absence of long-term incentives. Moving further from the notion that CEO's behavior, decisions to enhance firm innovation is

contingent upon the characteristics and situations that the CEO faces, I examine the originality of the CEO and the governing mechanism of their CEO and test whether which type of CEOs do contribute to innovation given numerous contingencies.

Literature on CEO Succession

Appointing new top executives implies that the organization is keen on turning things around, or trying new strategies for the betterment of the organization in the future (Berns & Klarner, 2017). In light of this, selecting top executives is an important strategic change that board members consider seriously. The Board of Directors meticulously plan the succession events and seek out seemingly the best fit for the job. The succession event is both a disruptive process and an opportunity to adapt to value-enhancing future outcomes (Berns & Klarner, 2017; Schepker, Kim, Patel, Thatcher, and Campion, 2017). The disruptive view states that firm performances may decline due to the cost of appointing new CEO (Boeker, 1992). Those who support the adoptive view posits that new appointments give chance to align the strategy and resources according to the outside environments (Shen and Cho, 2005; Schepker et al., 2017).

The attempt to appoint CEOs from within the organization or from the outside of a firm's boundaries is an important issue because the succeeding CEO's origin impacts the subsequent firm performances differently. While inside succession may suggest that organization maintains the current strategic decision makings, outside succession may be due to situations linked to turnaround, or other strategic changes. For instance, companies with low performance are likely to hire new CEOs from outside (Dalton & Kesner, 1985). Because managers are evaluated and assessed

based on the performance of the firm in charge, they avoid taking a huge risk that may be detrimental to the company and themselves.

III. HYPOTHESIS DEVELOPMENT

High-technology firms face fierce competition and for them to survive in the ever-changing business environments. continuous efforts are needed to engage in innovation and the creation of new value. Balkin et al. (2000) have integrated the resource-based view with the agency-based view stating that top executives in the high-tech firms need to be tied to a compensation scheme that accordingly pays them. The authors have elaborated on the types of the incentive plan, namely short- and long-term pay, and the importance of the distinct structures that award the top executive for her efforts to keep up the innovation in an organization. Perhaps rewards could induce transformation to take place within the company and core competencies to be developed for sustaining advantage. However, although competitive advantage in high-tech firms is derived from technological innovation, designing a proper incentive structure for managers to engage in innovation is relatively unstudied (Balkin et al., 2000, Makri, Lane, Gomez-Mejia, 2006).

The notion that innovation is crucial for firms to formulate competitive advantage aligns with the resource-based view that valuable, rare, inimitable, and non-substitutable resources that organizations possess is key to maintaining successful businesses (Barney, 1991). To understand the organizations' rationale and drivers of performances, analyzing the antecedents, or the decision-making of firms must be studied in-depth. In light of this, Chief Executive Officers (CEOs) are worth

studying for, as they are the most influential figure in the top management. One of the distinct characteristics of CEOs is their originality, characterized by top executives who possess a different background and human capital. Depending on situations, executives store tacit knowledge through learnings they accumulate over the course of their career (Sturman, Walsh & Cheramie, 2008).

Murphy and Zabojnik (2007) stated that the outside CEOs became popular with the expectations that outsiders possess general human capital such as leadership, and strategic planning (Sturman et al., 2008), which benefits the overall company. Cummings and Knott (2018) point out that appointing a manager with general skills may indicate that the firm does not have an influential figure who possesses context-specific capabilities, leading to a little contribution to innovative performances. Given that strategy on research and developments hinges on the governance and appointment of CEOs (Barker & Muller, 2002), the top manager can be a decisive figure who can bring the organizational innovation to take place.

While the CEO characteristics and its outcomes on organizations vary depending on the industry (Rajagopalan & Datta, 1996), this paper examines a specific sector, the hi-technology industry because technology-intensive firms are directly affected by the spending levels of R&D and the utilization of knowledge asset being created due to the R&D activity. Borrowing from the classification of hi-tech industries defined from the Industry Classification Codes (Kile and Phillips, 2009), this paper considers the very firms in the hi-tech sector, where R&D expenditure is one of the most important factors that determine future firm performances and innovation.

R&D and Firm Performances

The high-technology sector is one of the most influential industries that has become the major source of employment and productivity growth (Makri et al., 2006). R&D spending is pivotal to understanding how a firm is oriented toward inventing new products, processes, and future firm performances. Research and Development intensity or technological intensity may be depicted as a proxy for managerial discretion, or the multiple courses of action that CEOs have to consider (Hambrick & Finkelstein, 1987) at the industry level. R&D intensity impacts not only the CEO's pay (Henderson & Fredrickson, 1996) but also firm performances (Barkema, Geroski & Schwalbach, 1997). In this paper, R&D intensity is central to understanding the degree to which uncertain decisions are made for the sake of long-term innovation, which may not actually occur despite the exerted effort (Baysinger, Kosni & Turk, 1991; Lim, 2015). CEOs are executors of R&D activity, deciding on how to allocate resources regarding innovation. (Balkin et al, 2000). However, as R&D investments are risky and bear huge costs to companies, CEOs are reluctant to increase the R&D spending in uncertain objectives. In fact, the duration for R&D spending to actual output may take a long time, making executives hesitate when short-term performances are their top priority. The driver for such a phenomenon to happen, sensible R&D investments in the core part of the business is inevitable. Especially, in the context of high-technology companies, deploying the right R&D strategy is a crucial aspect in making a firm prosperous. Therefore, high-tech companies need someone who can maneuver the company well under dynamic situations where core technologies, skills are constantly updated, and new methods are being adopted.

Driving CEOs to undertake R&D spending demands a governance mechanism that can make top executives work on promoting long-term innovation. However, a manager's opportunistic behavior is one source of the main problem in corporate governance. The agency-based view suggests a prescription for handling principal-agent problems by providing managers relevant incentives (Jensen & Meckling, 1976). Specifically, managers are tied to criteria that induce them to work on behalf of the expected results of the firm and stakeholders. Sanders and Hambrick (2007) made a point that stock options are extensively used as a mechanism that promotes the risk-taking behaviors of executives. The scholars have discussed whether stock options work in the right way because such an incentive plan determines the subsequent behavior of managers. Taking a behavioral agency theory into account, CEOs will be motivated to R&D activities when they are given incentive structures that provide more income when stock options are exercised. This is different from stock ownership because there is no downside risk involved with options. Without the risk of losing value, executives can voluntarily engage in risky projects with R&D investments (Wu & Tu, 2007). Stock options are useful in making managers undertake R&D because options granted have to be exercised to have a market value (Sanders, 2001). Also, scholars have debated on the stock options and their effect on the manager's decision makings with long-term orientation (Sanders & Hambrick 2007; Wu & Tu, 2007). According to Sanders and Hambrick (2007), managerial risk-taking can be categorized into amounts of bet involved, variance (dispersion) of expected outcomes, and the probability of big losses. The authors confirmed that implementing stock option is a remedy for problems such as shirking behavior, short-term orientation, and risk-avoidance (Jensen & Murphy, 1990). Furthermore, the effects of stock options granted to CEOs who have an

investment were examined. From the three different managerial risks (Sanders & Hambrick, 2007) are explained above, the size of investments that executives make will increase because of the motivating nature of stock options. Also, because the stock options trigger managers to take initiatives that bring outcomes of high dispersion, the firm may undertake huge R&D investments or engage in activities that require creativity and innovation. However, the authors also pointed out the negative side of the option-loaded executive who is motivated by stock options to take more risks but incur negative performances costly for an organization. Sanders (2001) also found that stock options may trigger CEOs to invest in wrongful risk-taking of acquiring businesses. Another key measure for executives' long-term pay is restricted stock, which has become increasingly popular in the pay-for-performance linkages (Irving, Landsman, & Lindsey, 2011; Lim, 2015). This could be an incentive plan for executives that also provides an opportunity to align interests. Lim (2015) has investigated that executive compensation and the risk taken by the firm with regards to restricted stock and R&D spending. Nonetheless, there are suspicions that whether restricted stocks are an effective incentive scheme that provides good alignment of a manager's interests with that of a company (Hou, Lovett, and Rasheed, 2020). In fact, Devers, McNamara, Wiseman, and Arrfelt (2008) elaborated that restricted stocks are associated with lowered strategic risk from the behavioral agency perspectives.

In the end, we could assume that stock options or restricted stocks both cause managers to engage in risk-taking but might incur a negative impact on firm performance. If CEOs are compensated based on a mixture of a high level of stock options, and/or a high level of restricted stocks, CEOs may show risk-averse behavior and subsequently invest heavily in R&D, which may elicit unexpected

outcomes. In return, the company may exhibit extreme financial performances that affect the firm negatively. Thus, the interaction between a high level of stock options and restricted stocks and a high level of R&D spending could exacerbate firm performance extremely, bringing huge losses than huge wins. A detrimental relationship was expected as follows. When executives are option-loaded, and restricted stock-granted, it is likely that those CEOs will engage in intensified R&D spending (R&D intensity).

Therefore, I hypothesize,

Hypothesis 1: There will be a joint effect between the high level of R&D intensity and high level of Long-term incentive proportion, when matched, it will have the most detrimental effect on Future firm performance.

Upper Echelons Theory and Resource Dependence Theory

One relevant concept that explains the CEO behavior and firm performance is the upper echelons theory. Upper echelons theory suggests that the strategic decision making of top executives is based not only on rational analysis but also on the idiosyncratic preferences that can stem from individual characteristics and backgrounds (Hambrick & Mason, 1984; Hambrick, 2007). The main assumption of the upper-echelons theory is that executives make strategic choices upon their past experiences, perspectives, and personalities (Hambrick & Mason, 1984). This concept is based on the idea that top managers pave their way based on their perspectives and disposition (Hambrick, 2007). Hambrick and Mason (1984)

articulate that the demography of the top management team is an influential framework that constitutes the amount of organizational performance and value creation. They also argue that the characters of upper echelons determine strategic decisions of top managers (e.g., CEO, TMT members) and subsequent outcomes. Indeed, the perspectives open up room for understanding whether executives with educational backgrounds, career paths, functional knowledge affect organizations. Barker and Mueller (2002) articulated that CEO characteristics such as age, tenure, and a science-related college degree is relevant to creating innovation. Therefore, the age and tenure of a CEO are the two main characteristics because they not only alter executives' attitude toward their commitment but also their need for financial and career security. For this paper, I focus on the CEO origin, which determines whether the CEO is from inside or outside of the company.

Another important concept is resource dependence theory. The theory posits that an organization can lessen environmental dependence through executive succession (Pfeffer & Salancik, 1978). In this vein, firms with poor performance may be due to the misalignment between the environment and the decision makings of the firm (Hilman, Withers, & Collins, 2009; Pfeffer & Salancik, 1978). Appointing the CEO who can deal with organizational problems may align the firm's behavior to the environments that they are dependent on (Hilman et al., 2009). In terms of CEO Succession, Harrison, Torres, and Kukalis (1988) found that when firms are contingent on the environment that they belong to, there is a higher chance of replacing executives. In addition, firms with poor performances tend to have short-tenured CEOs especially under economic difficulties or unstable situations (Guthrie, Grimm, & Smith, 1991). Dalton and Kesner (1983) mention that the size of the organization and the succession of potential CEOs who is appointed internally or

from external sources. From the point of resource dependence theory, managers in big firms have the power to govern managerial decisions which shows an inclination to hire a CEO from the inside. The intriguing aspect Dalton and Kesner (1985) found was that companies that had an average level of performance tend to select outside CEOs. This contradicts with the other findings that firms in a critical situation tend to appoint outsiders who can turn the situation around (Schwartz and Menon, 1985; Chen, 2015). In regards to types of managers and innovation, an explanation is needed for whom to hire when companies want more innovation to take place.

Managerial Resources: Human Capital of the Executives

Human capital is defined as the knowledge, skills, abilities and other attributes (KSAO) held by people at work and developed from training, prior education, and experiences. It can be regarded as an intangible resource leading to higher firm performances that lead to competitive advantage (Becker, 1962; Hitt, Bierman, Shimizu, & Kochhar, 2001). Human capital specificity is about an individual's knowledge, skills, and experience that are unique enough to create rents for the organization (Hatch & Dyer, 2004; Hitt et al., 2001; Wang & Barney, 2006). Human capital is hard to replicate because of its unique traits of scarce nature, specialty, and hidden knowledge (Coff, 1997). Usually, human capital in an organization brings economic rents. Including the seminal work of Human capital theory, many scholarly articles have said that human capital brings competitive advantage for firms (Becker, 1962). Especially, specific knowledge is very important for being competitive.

Human capital also resides in managers. Managers possess skills that are beneficial to the organization.

Managerial resources are skills of managers that lead to economic rents of firms (Castanias & Helfat, 2001). More specifically, managerial Human capital is the KSAOs (Knowledge, Skills, Abilities, Other characteristics) that are valuable, rare, inimitable, and non-substitutable as the resource-based view states. As Barney (1991) suggests, human capital can be a source of competitive advantage. Bailey and Helfat (2003) defined managerial human capital as knowledge, skills, and assets that managers accumulate from their past tenure working in different positions. The human capital of executives is developed over the course of tenure at the workplace through managing companies and by taking roles and responsibilities to increase the shareholder wealth and to turn the company around which may be reflected in the career history of top managers.

Developing further from Becker's classification (1976) of general skills and knowledge of specificity, Castanias, and Helfat (1991) categorized CEO's skills and knowledge into firm-specific, industry-specific, and general knowledge. General knowledge is something that can be leveraged in any industry and firm. For the case of executives, general knowledge can be leadership, insight, decision-making. Industry-specific human capital is the knowledge that can be utilized within the same or similar industry such as specific perspectives, understandings of certain technology, markets, or regulations. The other knowledge of specificity is firm-specific Human capital which is personal knowledge and innate abilities that are only applicable to the firm the person belongs to. Examples are tacit knowledge, organizational culture, and relationships (Bailey & Helfat, 2003; Castanias & Helfat, 1991).

The basic concept of human capital theory implies that as transferability increases, specificity decreases (Harris & Helfat, 1997). Depending on the transferability of human assets that managers possess, managerial human capital can be sorted into different levels. Harris and Helfat (1997) have explained the compensating schemes for managers with specific knowledge in accordance with the fit to the firm. Research is unclear on the implications of human capital specificity and transferability on the executive-level labor market and its associated value by hiring firms. Because executives hired from the outside have huge opportunity costs from giving up their valuable human capital at their old firms, they will be compensated more than those who stayed at current firms (Brett and Stroh, 1997). Some literature suggests that firms would provide greater compensation to executives who possess higher levels of transferable human capital (Harris & Helfat, 1997). The human capital being transferred and compensated for is usually for their general human capital which is transferrable to other organizations. In contrast, specific human capital is difficult to be utilized to others. It is because the specific type of knowledge pertaining to a particular firm may not be valuable to others in the market.

Because the human capital of the CEO has different levels of knowledge depending on the degree of transferability and specificity, which knowledge is most critical to a firm differs. When the value is unique enough to firm, the managerial human capital can be considered as a decisive factor that leads to competitive advantage because CEO's human capital is hard to be imitated (Barney, 1991; Castanias and Helfat, 1991). The main benefits for hiring individuals from other competitors or similar industries may be regarded as acquiring knowledge that is competitor specific such as projects, business plans, or instructions on how to get

the job done. Especially for the executives, their social capital and networks can also make the firm able to utilize the inter-related connections to readily acquire resources and to subsequent firm success. In line with the notion of hiring others from competitors, executives hired from within the same industry can be beneficial for firms in the developmental stages or eager for expansion through merger and acquisition. Also, to turn things around for firms experiencing sudden shock or loss in their operations.

CEO Origins: External Hire, Internal Promotion

One of the extinct traits that researchers need to investigate is CEO origin and their influence on firm performances. Outside CEOs are externally hired from the CEO market, whereas inside CEOs are internally promoted within / hired from the ILM. The top executives can be either hired from the outside or appointed from the insiders who are from the promotions within the company. Outsiders lack expertise and experiences which is reflected in low R&D productivity, especially outsiders are from the high R&D intensity firms. Regarding this, Cummings and Knott (2018) revealed that R&D productivity decays during the outside CEOs' appointments in their study. This finding holds when they control the regression model with the size and other fixed effects. Past research says that outsiders have a lack of expertise, remote experiences especially when they are appointed in high R&D intensity firms (Cummings & Knott, 2018; Balsmeier and Buchwald, 2014).

On the other hand, insiders have specific knowledge to contribute more to innovation. Outside CEOs exhibit lower R&D Productivity than firms with internal CEOs (Cummings & Knott, 2018). Outside CEOs bring extreme results and

appointing outsiders may be risky for firms (Quigley et al., 2019). Hired employees or outsiders with novelty also need time to make their knowledge internalized to the organization (Singh and Agrawal, 2011). Inside CEOs have asset specificity for innovation and they have internalized the organization's processes (Cummings & Knott, 2018; Singh and Agrawal, 2011). Context-specific skills important dynamic capabilities of managers that influences firm Innovation (Helfat & Martin, 2015) Hiring inside CEOs may have benefits because insiders may be more loyal to the company and have internal knowledge or relationships within the company that can be utilized (Howard, 2001, Harris & Helfat, 1997 from Cummings & Knott's 2018 article). However, Cummings & Knott (2018) have pointed out the decreasing rates of R&D productivity may be due to increasing rates of Outside CEOs being appointed. Murphy and Zabojnik (2007) stated that the outside CEOs became popular with the expectations that outsiders possess general human capital which benefits the overall company. According to Quigley et al. (2019), outside CEOs bring extreme results and thus are a risky business for the board of directors who is in charge of appointing the right manager who brings firm performances. The extreme performance outcomes may be due to outsiders' attention on short-term performances or lack of experience and decision makings of her/his own interests in the newly appointed organizations. In the related story, the human capital theory says that outsiders possess general knowledge and lack domain expertise which can be a hindrance to bringing innovative results. On the other hand, Inside CEOs may be different because they possess firm-specific knowledge. Insiders know how and where to invest in order to generate R&D productivity and innovation results.

Innovation scholars have documented the value of hiring managers who can contribute to building human capital (Rao & Drazin, 2002). In this regard, hiring an

appropriate manager is upon managerial and professional executives in companies because they can contribute to acquiring the firm's objectives such as in technology and operations. (Kimberly & Evanisko, 1981). Indeed, hiring is very important for innovation because newcomers hold the knowledge of novelty that can contribute to creating human capital (Wang and Zatzick, 2019). Learning-by hiring or acquiring knowledge by hiring newcomers can benefit the firm. Singh and Agrawal (2011) argued that "learning by hiring" implies that while the novelty of knowledge or perspectives from hiring new employees may benefit the company in general, but when the knowledge is internalized, it takes some time to have the internalization to take place in the organization. They argue that the knowledge transfers between the newly hired and currently employed can happen with some time framework because and incumbents take time (Singh & Agrawal, 2011).

An important issue in the succession literature is relay succession where an internal candidate is going through adaptation and learning stages to be a CEO (Zhang and Rajagopalan, 2004). From the relay successions, firms have the opportunity to learn about the candidate from the perspectives of managerial abilities and interpersonal relationships. Especially, during times of strategic change, hiring outsiders may be a disruptive process that alters routines (Ocasio, 1999). To conclude, insider CEOs are keener on innovation and understand how to turn R&D efforts into outcomes. Because insiders seem to handle R&D expenditure efficiently, I hypothesize that inside CEOs with a high level of R&D expenditure (or High R&D intensity) is related to acquiring positive effects on future firm performance (ROA) than outside CEOs.

Hypothesis 2: There will be a joint effect between the matched high level of R&D intensity and CEO Origin; When Inside CEOs engage in a high level of R&D intensity, they will have the most positive effect on Future firm performance.

CEO Incentives and Agency Based View

From the seminal work by Jensen and Meckling (1976) managers (or agents) behave in a way that maximizes their utilities, not investors' (or principals') utilities. Therefore, compensating executives are crucial for principals who need to induce/monitor managers to act on behalf of investors. Human capital at the top manager level deals with competitions among firms to hire CEOs with transferrable human capital and companies would provide charming compensation in order to make a valuable human asset to join the company. An important thing to note is that skillful executives may exhibit shirking behavior if they are not compensated for the efforts they put in. As Zajac (1990) states, executives have to be satisfied with their pay in order to perform at the superior level. Castanias and Helfat (1991, 2001) introduced the concept of managerial rents where the authors discussed the industry-specific human capital. Industry-specific human capital refers to human capital that is highly related to a firm's industry, which is only meaningful when utilized within the specific industry. Industry-related knowledge is within a broad range of human capital, from specific human capital to transferable human capital. Thus, I agree with Castanias and Helfat (2001) that human capital specificity is an issue of degree, and although the discussions regarding the definition of industry-specific human capital have varied, we employ the theoretical framework proposed by Castanias and Helfat (2001) to examine the

degree of specificity against the degree of transferability of human capital. Managers will generate rent when they have incentives to earn rewards for the rent earned (Castanias & Helfat, 2001).

In terms of compensating executives, there are five basic components to which the top managers could receive: salary, short-term bonuses, long-term incentives, benefits, and perquisites. Examples of long-term incentives are stock options and restricted stocks. They are the types of incentive schemes that induce managers to work for the future. At the same time, companies can monitor the top manager whether she is pursuing long-term innovation. Because innovative outcomes are future-oriented results that need time to achieve, the usage of long-term incentives can align the interests of CEOs to the interests of the innovation-seeking firms.

Past research tells that top executives in high-technology companies should be rewarded for sustaining the firms' capability to innovate. To reduce this agency problem, firms rely on long-term incentives to promote self-monitoring in Top management (Balkin et al., 2000). In reality, many CEO compensation contracts are of long-term performance pay which is around 40 percent of the total compensation (Milkovich, Newman, & Cole, 2007).

CEO and Long-term Incentives

Our focus is on Long-term Incentives because pay tied to long-term compensation can induce managers to work on behalf of future innovative outcomes. Cummings et al (2018) noted that numerous forms of corporate governance influence the CEO’s behavior. In this vein, long-term incentives are the mechanism through which managers work toward enhancing a firm’s R&D efficiency, or performance

through R&D activities. Without a proper incentive structure provided to the managers, alignment of the CEO's interests to the firm's goals would not take place. According to Tauber and Levy (2002), long-term pay is given to make executives work on behalf of the shareholders and to enhance firm performance. Also, the long-term incentives are to prevent CEOs to leave before they acquire monetary incentives from exercising stock options or liquidate restricted stocks. Fong (2010), in his paper, found that CEO who is relatively under-payed is related to a shrinking R&D spending in low R&D intensive firms, while CEO underpayment is associated with increases in R&D spending in high R&D intensive industries. Fong's study provides clues that pay can change the behavior of CEOs that can bring innovation to the firm. Indeed, from the principal-agent perspective, aligning the pay with long-term performances can drive CEO to pursue innovation. When the CEO pay is tied to the long-term performances, the top managers, regardless of who they are in terms of originality (inside/outside), will contribute to more innovation being created.

Addressing the match between CEO's strategic action toward pursuing innovation and their long-term incentive proportions, insiders can efficiently utilize the stock of knowledge held by the top management. Insiders tend to be more risk-seeking not only because they are tied to a high proportion of long-term incentives (a motivating mechanism) but because of their strong support from the board members and many stakeholders of the incumbent company that seeks innovation. In sum, the most positive effect takes place when insiders engage in high-level of R&D intensity are coupled with high long-term incentives.

Therefore, I hypothesize,

Hypothesis 3: There will be a joint effect between the proportion of Long-term incentive and CEO Origin; When Inside CEOs receive a high level of long-term incentive proportions, they will have the most positive effect on Future firm performance.

Lastly, I propose that by controlling the effects from the above Hypothesis 1,2, and 3, I could also examine the three-way interaction of R&D intensity, Long-term incentive proportions, and CEO origin. Specifically, I test that Inside CEOs with high proportions in long-term incentives will exhibit better firm performance than that of outside CEOs. Therefore, I hypothesize,

Hypothesis 4: The most positive effect will take place when Inside CEOs are matched with a high level of long-term incentive proportions and engaged with a high level of R&D intensity.

IV. METHOD

Sample and Data collection

In order to test the Hypothesis, I gathered two main panel datasets from Wharton Research Data Services (WRDS) for the years 1992-2017. To sort out hi-technology industry companies within the firm data, I used industry classification codes as suggested by Kile & Phillips (2009). For the company's financial and accounting information, Compustat was used and Information regarding executives from companies came from Execucomp. The dataset starts from 1992 because the

Securities and Exchange Commission (SEC) required to disclose the executive pay beginning the very year. The two unique datasets were merged and linked by company identifier *gvkey* and respective fiscal years (*fyear*). The third data consists of whether a CEO is from outside or inside, the CEO's firm tenure, and the CEO's age at the time of succession. To create the third dataset, I hand-collected the CEO information from websites such as Bloomberg, the wall street transcript, archival interviews, and articles. To check the reliability of the information, social network services such as LinkedIn was examined for more accurate dates. In addition, Securities and Exchange Commission reports were searched in the process. Because determining Inside CEOs required meticulous examination, news articles or company released information was heavily relied on due to the complicated career history of some executives and company status changes from the merge and acquisitions or company name changes, etc. Also, some CEOs had differences in their elected date and assumed date, which made it difficult when manipulating the CEO origin variable. Especially for companies gone through the acquisition of another company, there were cases where their CEOs were appointed from the acquired company with the same industry, which this study considers the very CEOs as insiders. Missing information regarding the CEO's job tenure may be due to reasons such as CEOs hired from subsidiaries, or name changes of a company when an influential figure turns the company around by increasing efficiency or leads to initial public offering (not necessarily CEOs at the time of name change). There were also cases of undergoing trials for insider trading, accounting fraud. Regarding criminal activities of CEOs, I postulate that the decision-makings of those executives may be on behalf of their own interests, rather than the better being of shareholders, which in turn makes the performance of those firms not

relevant for this study. Thus, those firms were deleted. My final sample consists of 223 CEO-succession event observations which were associated with 223 different companies, covering years from 1993~2015.

Dependent Variables

Future Firm Performances. The variable for future firm performances was operationalized as Return on Assets (ROA), which was collected from the COMPUSTAT. I examined the firm performance in terms of the moving averages, measuring periods from $t+1$ and $t+2$ and averaging them. Other independent variables are either in period t or $t+1$. This approach also does not violate the issues of reverse causality.

Independent Variables

R&D intensity. R&D intensity was measured by dividing total R&D expenditure by sales (Baysinger & Hoskisson, 1989; Osborn & Baughn, 1990). R&D intensity will be used as a measure that shows the management's efforts or CEO's degree of investments in the innovation. Scholars have pointed out that Baysinger and Hoskisson (1989) measures R&D intensity in the form of reported R&D spending divided by sales revenue in thousand dollars. R&D intensity is low for firms with big size and high for small, hi-tech firms. Other researchers have used R&D intensity as a predictor for the firm's exploration and investments into innovation (Greve, 2003; Li, Maggitti, Smith, Tesluk & Katila, 2013). The notion of absorptive capacity by Cohen and Levinthal (1990) is highly correlated with firm R&D activity that leads to more learning and innovative efforts, indicating that there are knowledge spillovers not visible which should be controlled (Morck &

Yeung, 1991; Su and Tsang, 2015). According to Xu, Zhou, and Du (2019), R&D intensity demonstrate efforts from the firm to organize long-term capabilities to innovation.

Inside CEOs. One of the key measures for the paper is the indicator variable which represents the originality and background of the CEOs. Operationalizing the variable of Inside CEO was conducted using the firm tenure of the CEOs. If a CEO's tenure at the firm, that is the duration of her/his time as a non-CEO at the very firm the person became CEO, is less than two years (730 days or less), then Inside CEOs=0. If the CEO tenure is more than two years, then Inside CEOs=1. This categorization was adopted from Cummings & Knott (2018) and Quigley et al. (2019).

The proportion of Long-term Incentives. This main independent variable is the proportion of Long-term incentives that CEOs receive out of the total payments (total direct compensations) that includes base pay, bonuses, and other components. Specifically, total pay in the model consists of fixed base salary and variable portions such as bonus (short-term), restricted stock granted, options awarded based on Black and Scholes' (1973) option-pricing model, calculated in the succession year when the options are granted. Long term incentives were calculated by adding stock options awarded and restricted stocks granted. The proportion of Long-term incentives was calculated by dividing Long-term incentives (stock options awarded + restricted stocks granted) by the total amount of CEO pay.

Control Variables

CEO Age. In this paper, I look into another aspect of the upper echelons view

which is the age of the executives. Organizations need new hires because the newly employed personnel can drive the change in the firm where incumbent people are molded into the old perspectives and practices. This could be a hindrance in terms of driving changes in the organization. Executives with long tenure could withhold creative managerial attempts in order to settle with the current firm's performances (Finkelstein and Hambrick, 1990). However, evidence on the relationship between age and risk propensity has been mixed in the literature, with some claiming a positive relationship while others claiming a negative relationship. In this context, young CEOs tend to perform better in the labor market than old CEOs and hence may be less resistant to takeovers. On the other hand, old CEOs do not have many work years remaining and the impact of takeovers on future income may not be significant.

CEO Firm Tenure. One of the two variables as a controlling mechanism that represents the effects under the upper echelon theory is the tenure years as a chief executive. This variable is defined as how long executives worked as a CEO. Barker and Muller (2002) found that executives' impact on the R&D spending decisions depends on the length of CEO tenured years, making the effect on the CEO's spending behavior of R&D increase with the long-tenured years. This means that CEOs over time can make R&D spending based on their own preferences.

Firm Age. Firm age was constructed by calculating the years after the firm's initial public offering. This was to control for the tendency of firms becoming rigid or complacent to change or innovate. Some research suggests that companies tend to exploit their existing technological competencies rather than explore new and unfamiliar technologies (Sørensen & Stuart, 2000).

Firm Size. I controlled for the effect of firm size in terms of the total number of employees in the company. Firm size is the main control variable for our analysis because the size of innovation or innovative activity depends on the size of the firm. It can have both positive and negative effects (Tecce, 1992). Some scholars point out that there exist diseconomies of scale regarding research and development because as the firm size gets bigger, the firm is likely to become complacent on investing efforts on the innovation (Hambrick & MacMillan, 1985; Mansfield, 1968).

Past Firm performances. To control for the past firm performances, the past 2 years of average return on assets (ROA) is used. Past Firm performance was measured as return on assets (ROA), and this accounting performance represents traditional short-term firm performance in the management research. Past performance impacts future results.

Financial leverage. To control the extent to which firms leverage debts, I used the ratio of total debt to total assets (Miller & Bromiley, 1990).

Year Effects. To control for time-variant effects, year dummies were constructed and controlled in all equations.

Method for measuring the models

The main purpose of this study is on testing the models of whether R&D intensity, CEO origin, and long-term incentives proportions have an impact on the firm's future performances (ROA). The model specification is described below. I employed the ordinary least squares regression analysis to investigate the relationship of the R&D intensity and proportion of the CEO's long-term payment

to the future firm performance. The basic model specification below is the basic equation (Equation 1) to be used in the hypothesis developments.

Future Firm Performance $_{t+1,t+2}$ =

f **(Proportion of Long-term Incentives** $_{t,t+1}$**, Inside CEOs** $_{t}$**, CEO Age** $_{t}$**, CEO Firm Tenure** $_{t}$**, Firm Age** $_{t}$ **, Firm Size** $_{t}$**, Past Firm Performances** $_{t-1,t}$**, Financial Leverage** $_{t,t+1}$**, R&D Intensity** $_{t,t+1}$**, Year Effects)**

(1)

To test the moderating effects (Hypothesis 1) (in Model 2) of long-term incentive pay on the relationship of R&D intensity and innovation, I use the below equation:

Future Firm Performance $_{t+1,t+2}$ =

f **(Proportion of Long-term Incentives** $_{t,t+1}$**, Inside CEOs** $_{t}$**, CEO Age** $_{t}$**, CEO Firm Tenure** $_{t}$**, Firm Age** $_{t}$ **, Firm Size** $_{t}$**, Past Firm Performances** $_{t-1,t}$**, Financial Leverage** $_{t,t+1}$**, R&D Intensity** $_{t,t+1}$**, R&D Intensity X Proportion of Long-term Incentives, Year Effects)**

(2)

After controlling for the R&D intensity X Proportion of Long-term Incentives interaction term in Equation (2), the second moderating effect of R&D intensity and CEO succession origin (Inside/Outside CEOs) is tested in Hypothesis 2 (in Model 3).

Future Firm Performance $_{t+1,t+2}$ =

f **(Proportion of Long-term Incentives** $_{t,t+1}$**, Inside CEOs** $_{t}$**, CEO Age** $_{t}$**, CEO Firm Tenure** $_{t}$**, Firm Age** $_{t}$ **, Firm Size** $_{t}$**, Past Firm Performances** $_{t-1,t}$**, Financial Leverage** $_{t,t+1}$**, R&D intensity** $_{t,t+1}$**, R&D Intensity X Proportion of Long-term Incentives, R&D Intensity X Inside CEO, Year Effects)**

(3)

In the same fashion, the moderating effects of the proportion of long-term incentive pay and CEO succession origin (Inside/Outside CEOs) are tested (Hypothesis 3) (in Model 4) after controlling for the R&D intensity X Proportion of Long-term Incentives interaction term in the Equation (2).

Future Firm Performance $_{t+1,t+2}$ =

f **(Proportion of Long-term Incentives** $_{t,t+1}$**, Inside CEOs** $_{t}$**, CEO Age** $_{t}$**, CEO Firm Tenure** $_{t}$**, Firm Age** $_{t}$ **, Firm Size** $_{t}$**, Past Firm Performances** $_{t-1,t}$**, Financial Leverage** $_{t,t+1}$**, R&D Intensity** $_{t,t+1}$**, R&D Intensity X Proportion of Long-term Incentives, R&D Intensity X Inside CEO, Proportion of Long-term Incentives X Inside CEO, Year Effects)**

(4)

Finally, the three-way interaction terms of Inside CEO X R&D intensity X Proportion of Long-term Incentives are tested in Hypothesis 4 (in Model 5).

Future Firm Performance $_{t+1,t+2}$ =

f **(Proportion of Long-term Incentives** $_{t,t+1}$**, Inside CEOs** $_{t}$**, CEO Age** $_{t}$**, CEO Firm Tenure** $_{t}$**, Firm Age** $_{t}$ **, Firm Size** $_{t}$**, Past Firm Performances** $_{t-1,t}$**, Financial Leverage** $_{t,t+1}$**, R&D intensity** $_{t,t+1}$**, R&D Intensity X Proportion of Long-term Incentives, R&D Intensity X Inside CEO, Proportion of Long-term Incentives X Inside CEO, R&D Intensity X Proportion of Long-term Incentives X Inside CEO, Year Effects)**

(5)

Data analysis

The final data for the analysis is an unbalanced dataset that consists of 223 CEO succession events in High-technology firms from the year 1993 to 2015. To test the

hypothesis, the ordinary least square (OLS) regression method was selected to analyze the pooled cross-sectional time-series data. Initially, one of the main variables called Inside CEOs were set at period *t*, when the succession took place. The dependent variable was constructed by averaging two periods at *t+1* and *t+2*. Other predictor variables including the proportion of long-term incentives were calculated by averaging period *t* and *t+1* (lagged the dependent variables by one average year). Some variables such as past firm performances (in ROA) is average of period *t-2* and *t-1*, to represent true past before the succession event happened.

Breusch and Pagan Lagrangian multiplier test for random effects was conducted to decide between pooled OLS and the random-effects model. The pooled OLS regression was chosen to be the model because the results for both models showed a p-value of nearly 0.000, thus proving that pooled OLS estimation is more efficient for this paper.

V. RESULTS

Descriptive statistics of means, standard deviations of variables in this study are presented in Table 1. Table 2 reports the regressions of different specifications of the hypotheses in the paper. Model 1 is the basic set of ordinary least squares regressions without any interaction terms. In particular, for this paper, there exists a negative relationship between R&D intensity and the future firm performances measured in ROA. In Model 2, the coefficient of R&D intensity and the proportion of Long-term incentives interaction term was negative and significant ($b=-0.179$, $p<0.001$). Especially in Model 2, the variable R&D intensity became insignificant, suggesting that when R&D intensity is coupled with a high proportion of long-term

incentives, the interaction effect takes away the negative trend shown in the relationship between R&D intensity and future firm performances (Model 1). Thus, Hypothesis 1 was supported. In Model 3, the coefficient of the interaction term (Inside CEOs and R&D intensity) was positive and significant ($b=0.114$, $p<0.001$), supporting Hypothesis 2. This result suggests that after controlling for the negativity from the interaction of R&D intensity and the proportion of long-term incentives, the other interaction term of R&D intensity and Inside CEOs show a positive effect. Model 4, the coefficient of the interaction term (Inside CEOs and Proportion of Long-term incentives) was not significant (Hypothesis 3 not supported). Lastly, in Model 5, the result indicated that there exists a three-way interaction that was positive and significant at $b=0.296$ and $p<0.001$. (Hypothesis 4 supported).

Insert Table 1 & Table 2 about here.

In Hypothesis 1, I examined the interaction effects of R&D intensity and Long-term incentives proportions relative to the total direct compensation. It showed that depending on the proportions of long-term incentives, the effects on future firm performance varies. For low proportions of long-term incentives, the effects of R&D intensity on future firm performance is not significant. However, the effects between high proportions of long-term incentives and future firm performance exhibit a negative relationship. Specifically, under the situation of low R&D intensity, the higher future firm performance gets when there is a heavy emphasis

toward long-term incentives given to CEOs. However, when the R&D intensity is high, future firm performance is lower when CEOs are tied to a bigger portion of long-term incentives. However, the future firm performance level is more or less similar regardless of long-term incentives proportions. Figure 1 illustrates the findings in Hypothesis 1.

Insert Figure 1 about here.

Taking into account the findings in Hypothesis 1, I controlled the interaction effects of R&D intensity and Long-term incentives proportion when testing Hypothesis 2. Therefore, the regression equation for Hypothesis 2 included both interaction terms from Hypothesis 1 and R&D intensity X Proportion of Long-term Incentives. As a result, the association between R&D intensity and future firm performance (ROA) differed depending on the origin of CEOs (Inside/Outside). When the R&D intensity is low, outsiders were better off in terms of making a high return on assets. Most importantly, as the R&D intensity increases, the relationship between R&D intensity and future firm performances is negative but becomes positive for Insiders. Figure 2 shows the results explained.

Insert Figure 2 about here.

Hypothesis 3 was not significant. To further illustrate the relationship between CEO origin and CEO's long-term incentives, a three-way interaction term was constructed for further analysis. To interpret the effects in Hypothesis 4, a three-way interaction was tested. When a high proportion of long-term incentive was given to Inside CEOs, the relationship between R&D intensity and future firm performance becomes stronger (more for Inside CEOs than Outside CEOs). Figure 3 is the graph for Hypothesis 4. To view how the relationship differs on CEO origin, Figure 4 is drawn separately. The graph tells that the firm performance when an outsider CEO is appointed changes greatly according to the long-term incentives tied to them. By looking at the fluctuations (how steep the angles are relative to the different levels of long-term incentive proportions), we can tell that insiders are less sensitive to change in incentive proportions.

Insert Figure 3 & Figure 4 about here.

VI. CONCLUSION & DISCUSSION

This paper suggests a new perspective on how CEO succession origin (insider/outsider), R&D intensity, and proportions of long-term incentives interact with one another to play a decisive role in determining R&D efficiency and subsequent future firm performance. Results suggest that the future firm performance, as defined as subsequent two periods of firm performance after CEO succession takes place, is affected by the combination of variables: high R&D

intensity and a high proportion of Long-term incentives (1), high R&D intensity, and CEO Origin (being an Insider) (2), and the three-way interactions: high R&D intensity, being an insider, and high level of long term incentive proportions (3).

Before analyzing further, we see a surprising observation that long-term incentives are responsible for the strong negative relationship between R&D intensity and future firm performance in ROA (Refer to the regression result presented in model 1). Indeed, stock options or restricted stocks both cause managers to engage in risk-taking which can bring a negative impact on firm performance. When CEOs are tied to a high level of stock options, and a high level of restricted stocks, CEOs may show risk-seeking behavior such as investing in research and developments. Because R&D investments are a form of strategic change, such decisions can bring negative consequences of low future firm performance (or low ROA).

The analysis of the Hypothesis tested is as follows. First, stock options or restricted stock granted cause managers to engage in risk-taking but might have a negative impact on firm performance. Interaction between a high level of stock options and a high level of R&D spending exacerbates performance, bringing more big losses than big wins. So the detrimental relationship was shown when CEOs engage in high R&D spending (high R&D intensity). Because the negative effect was extremely strong, I controlled the interaction term from Hypothesis 1 in analyzing further regressions for Hypothesis 2,3,4.

Second, the data confirmed that insider CEOs who engage in a high level of R&D intensity are associated with acquiring the most expected positive effect on firm performance (ROA). This positive relationship is shown when the negative impact of the long-term incentive scheme given to CEOs associated with R&D intensity is

controlled. Insiders are efficient at handling R&D expenditure and they know how to balance the R&D expenditure. Presumably, they possess firm-specific knowledge on how to manage the absorptive capacity of the firm in charge. Also in regards to translating R&D efforts into future firm performances, insiders are well-positioned because they understand the organizational contexts in which his/her firm operates. Inside CEOs are going through relay successions, In the end, CEOs are responsible for how much to invest in R&D. Prior research indicates that fluctuations in R&D spending are exhibited as the firms trying to develop commercialized products. Depending on the level of R&D utilization, the degree to which the firm is going to develop products, or change the processes differs. An increase in R&D spending may mean that a firm is starting new R&D related activities (Greve, 2003). Therefore, the shift in the level of R&D spending we observed in Table 3 can be interpreted as the high-technology firms in our analysis sought to move from exploitation to exploration or vice versa. Inside CEOs heavily increased R&D more rapidly than those of firms who hired outsider CEOs. Table 3 shows the statistics for CEO Succession events (either Inside or Outside) and the amount of R&D expenditure around the period *t* when the succession happened. The trend we see from Table 3 indicates that firms that hired Insiders engaged in initial exploitation from R&D and subsequently moved on increasing the R&D spending (moving from exploitation to exploration).

Besides, the degree to which they engage in R&D is high for those firms that appointed Insider CEO was high in the first place. This may mean that when firms are keen on investing in R&D and improve performance thru innovation, they tend to appoint insiders. Firms that showed a high level of R&D intensity before the succession (period *t-2*, *t-1*) seem to be investing heavily in R&D before the

succession event took place at period *t*. They are likely to hire Inside CEOs to continue with the firm's strategy toward intensive R&D. In the table, we see that those firms with Inside CEO succession exhibit a high level of R&D intensity that keeps improving even after the succession event at period *t*.

Insert Table 3 about here.

However, the expected relationship between the Insider CEOs matched with high-level long-term incentive proportions did not show any significance (Hypothesis 3). To further investigate the insignificant result, I examined a three-way interaction effect with the two moderating variables. An important finding of this paper is that R&D intensity, Long-term incentives proportion, and CEO Origin interact in the way that they influence firm performance. Among hi-technology firms where there are high levels of R&D intensity, inside CEOs tied to a higher proportion of Long-term incentives had the most positive effect on future firm performance. This can be interpreted as follows. A high proportion of Long-term incentives given to Inside CEOs work as a mechanism that makes insiders utilize R&D most efficiently to partially offset the strong adverse effect coming from R&D and a high ratio of long-term incentives. Other research in the past did not observe a legitimate relationship between R&D and long-term incentives (Lerner and Wulf, 2007). However, in this paper, we can partially conclude that inside CEOs react to incentives and become efficient in terms of making a firm performance out of heavy R&D investments. They should be compensated appropriately in order to do

show such behavior.

On average, inside CEOs were given a higher proportion of long-term incentives than outsiders (Table 4). This could motivate insiders to align their interests to the firm's long-term oriented goals or innovation. On the other hand, outside CEOs may desire their incentive to be less structured with a higher level of long-term incentives. From Table 4, we see that after period *t*, the proportion of long-term incentives for outsiders were dropped. Because outsiders are risk-averse in terms of pursuing innovation, they will want to re-negotiate in the second year and lower the long-term incentives in their composition. Also, outsiders are short-term oriented. They may want to prove their worth by improving well-observed financial-, short-term performances rather than uncertain and risky projects which may worsen the short-term outcomes.

Insert Table 4 about here.

In regards to the firm's decision to internalize R&D to pursue innovation, appointing insiders may be more appropriate to achieve the R&D productivity and subsequent innovation outcomes. In the case of the internal executive succession, it may be the case that the insider has accumulated firm-specific knowledge that enables inside CEOs to efficiently utilize the current firm's state of absorptive capacity. They seem to be aware of whether they are capable of creating firm value out of R&D spent. Besides, inside CEOs undergo a relay succession process in which the potential executives learn about the roles and problems in advance. This

very process helps CEOs to understand organizational contexts and the priority goals that a firm has. Also, one should notice that inside CEO candidates have been chosen to represent the company. Thus, the insiders have developed interpersonal relationships and relational support from the board and other stakeholders within the current firm. As a result, inside CEOs have the relevant knowledge and a supportive climate that makes more positive firm outcomes than their counterparts from the outside. It seems that insiders can set aside the detrimental effects of R&D spending on firm performance and also be more risk-taking in terms of aligning their interest to the firm's eventual goal of innovation. In addition, other findings indicate that risk-seeking CEO's strategic actions are more strongly influenced by performance-based pay, proving that high emphasis on long-term incentives can induce insiders who tend to be risk-seeking to bring more positive return from the asset. Also, insiders understand the organizational contexts and have strong supports from the board members and stakeholders which can make them pursue R&D activities without strong resistance.

VII. LIMITATIONS & FUTURE RESEARCH

The finding of this paper contributes to the CEO succession literature that Inside CEOs most efficiently manage R&D and subsequently influence firm performance positively. This paper is not without limitations for the following reasons. In this analysis, I have not considered different types of successors based on numerous important factors such as their past work-experiences at former firms, industry backgrounds, and education level. Especially, the CEOs in the dataset were not categorized inside/outside based on whether the executive had experience in a

similar industry. Harris and Helfat (1997) have narrowed down external executives with respect to which industry the CEO is from. I posit that outside CEOs with industry-specific knowledge would have a different set of skills and experiences as opposed to those CEOs with general knowledge and skills related to management. If the CEOs were categorized carefully based on the different hierarchies of the firm's human capital, the result might show different trends.

In terms of constructing the CEO variable, it is still not sure whether inside CEOs should be defined as an executive who has two years or more tenure at the firms they became CEOs. There are different articles on how to construct the CEO origin variables. In addition, because the Inside CEO variable was calculated based on CEO's tenure at the firm, there exists representation issues. For instance, if a CEO just founded a company, her tenure at the very firm is zero, which falsely tells that the CEO is an outsider. Therefore, to prevent in which CEO is a founder owns family businesses and has become CEO after acquisition happened. Although I have meticulously tracked the 223 different CEO's biographies, there could be other issues involved in categorizing the CEO types.

We also have to take other contextual factors into account. Zhang and Rajagopalan (2010) have found that there is a curvilinear relationship between strategic change and firm performance. The sample firms in the analysis showed a strong negative relationship between strategic change (R&D intensity) and firm performance. It could be high-tech industries where the negative relationship is pronounced. If we look into other sectors, we may end up with different conclusions.

To strengthen the arguments made in this paper, further analysis is needed to check the robustness of the results. In the future, we can test the hypothesis using

different firm performance variables such as Tobin's Q or future stock prices. Also, we can try to measure how the R&D intensive efforts taken by CEO directly impact the firm innovation measures such as patent counts.

Lastly, this paper needs to control for other possible confounding factors that affect the main relationship articulated in this paper. In the future, the study may be conducted using other statistical methodology such as propensity score matching.

TABLES & FIGURES

TABLE 1
Descriptive Statistics and Correlations

	Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	ROA *t*	0.05	0.16	-1.45	0.84	1															
2	ROA *t+1,t+2*	0.03	0.21	-2.38	0.37	0.74	1														
3	ROA *t-2,t-1*	0.02	0.22	-2.52	0.29	0.37	0.45	1													
4	PLTI *t*	0.30	0.35	0.00	0.99	-0.09	-0.07	0.03	1												
5	PLTI *t+1*	0.24	0.33	0.00	0.97	-0.02	0.01	0.06	0.55	1											
6	PLTI *t,t+1*	0.27	0.30	0.00	0.96	-0.06	-0.04	0.05	0.89	0.87	1										
7	Inside CEO *t*	0.62	0.49	0.00	1.00	0.13	0.12	0.12	0.00	0.04	0.02	1									
8	CEO Age *t (in years)*	52.2	6.1	38.0	70.0	0.01	-0.05	0.11	-0.01	-0.06	-0.04	-0.02	1								
9	CEO's Firm Tenure *t (in days)*	3,298	3,746	0	14,730	0.14	0.14	0.08	-0.01	0.07	0.04	0.68	0.13	1							
10	Firm Age *t (in years)*	14.1	5.2	5	26	0.13	0.07	0.13	-0.50	-0.56	-0.60	0.13	0.10	0.07	1						
11	Firm Size *t* (log)	8.34	1.81	2.57	12.68	0.19	0.31	0.24	0.02	0.07	0.05	0.15	0.05	0.33	0.09	1					
12	Financial Leverage *t*	0.36	0.20	0.04	1.69	-0.12	0.05	-0.05	0.04	0.08	0.07	-0.02	0.04	0.05	-0.13	0.29	1				
13	Financial Leverage *t,t+1* (log)	-1.17	0.59	-3.11	0.30	-0.16	0.02	-0.01	0.04	0.07	0.06	-0.03	0.07	0.03	-0.10	0.37	0.87	1			
14	R&D Intensity *t*	0.20	0.79	0.00	8.66	-0.58	-0.71	-0.21	0.12	0.02	0.08	-0.03	0.06	-0.05	-0.08	-0.27	-0.16	-0.18	1		
15	R&D Intensity *t+1*	0.18	0.71	0.00	10.25	-0.66	-0.83	-0.19	0.11	0.00	0.07	-0.08	0.08	-0.07	-0.03	-0.27	-0.14	-0.08	0.85	1	
16	R&D Intensity *t,t+1* (log)	-2.35	0.98	-6.42	2.22	-0.33	-0.41	-0.25	0.13	0.06	0.11	-0.13	0.01	-0.12	-0.05	-0.31	-0.20	-0.24	0.51	0.47	1

Notes: The Level of analysis is the organization. The sample size is 223 CEOs/Firms. PLTI = Proportion of Long-term Incentives, ROA= Firm Performance, the dependent variable measured in terms of Return on Asset (ROA). The dependent variable (Firm Performance at *t+1,t+2* was measured by averaging Firm Performance at *t+1* and *t+2*. Independent variable Proportion of Long-term Incentives was measured at t and t+1. Inside CEO was measured at t, which denotes the succession event that happened at t. Past firm performance variable was measured at *t-2* and *t-1*. Other variables are measured at either t or the average of *t* and *t+1*. Variables such as Inside CEOs are measured at *t*, when the succession event took place.

TABLE 2

REGRESSION RESULTS FOR HYPOTHESIS

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Prop. Long-term Incentives *t, t+1* [VP]	0.072	-0.282*	-0.256*	-0.279*	-0.690***
	(0.074)	(0.112)	(0.108)	(0.119)	(0.174)
Inside CEO *t* [IN]	-0.001	-0.008	0.247***	-0.006	0.072
	(0.035)	(0.034)	(0.067)	(0.040)	(0.089)
CEO Age *t*	-0.004	-0.004	-0.004	-0.004	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
CEO Firm Tenure *t*	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm Age *t*	-0.005	-0.005	-0.004	-0.005	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm Size *t* (log)	0.020*	0.015	0.009	0.015	0.008
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Past Firm Perform. *t-2, t-1*	0.264***	0.282***	0.247***	0.282***	0.285***
	(0.064)	(0.062)	(0.060)	(0.062)	(0.059)
Financial Leverage *t, t+1*	-0.039	-0.035	-0.031	-0.036	-0.025
	(0.024)	(0.023)	(0.022)	(0.024)	(0.022)
R&D intensity *t,t+1* (log) [RD]	-0.066***	-0.021	-0.107***	-0.021	-0.046
	(0.014)	(0.017)	(0.026)	(0.017)	(0.031)
RD X VP		-0.179***	-0.160***	-0.179***	-0.361***
		(0.044)	(0.042)	(0.044)	(0.073)
IN X RD			0.114***		0.032
			(0.026)		(0.036)
IN X VP				-0.006	0.618**
				(0.085)	(0.210)
RD X IN X VP					0.296***
					(0.088)
Year Effects?	YES	YES	YES	YES	YES
Constant	-0.083	0.081	-0.056	0.081	0.092
	(0.175)	(0.173)	(0.169)	(0.174)	(0.170)
Observations	223	223	223	223	223
R-squared	0.404	0.451	0.500	0.451	0.529

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

RD: R&D intensity, **VP:** Prop. Long-term Incentives, **IN:** Inside CEO

TABLE 3

R&D Expenditure of the Sample Firms around the time of CEO Succession event (Period *t*)

R&D expenditure (in Million $)	*t-2*	*t-1*	*t*	*t+1*	*t+2*
Outside CEO	357	349	369	383	405
%△ (percentage change)		-2.2	5.7	3.8	5.7
Inside CEO	764	791	799	933	901
%△ (percentage change)		3.5	1	16.8	-3.4

Notes: The sample size is 223 firms. Period *t* is where the successsion happened. Newly appointed CEO is directly responsible for period *t, t+1, t+2* .

TABLE 4

CEO Compensation Information after the Succession event (Period *t*)

		t	*t+1*	*t+2*
Outside CEO	**Total CEO Incentives**	4,459	3,677	4,548
	Long-term Incentives in Amount	2,758	1,925	2,753
	Long term Incentive Proportions (%)	27%	20%	20%
Inside CEO	**Total CEO Incentives**	4,599	5,193	5,008
	Long-term Incentives in Amount	2,746	3,310	3,102
	Long term Incentive Proportions (%)	29%	25%	25%

Notes: The sample size is 223 CEOs. (Inside CEOs=141, Outside CEOs=92)
The monetary terms are in (Thousands $)

FIGURE 1

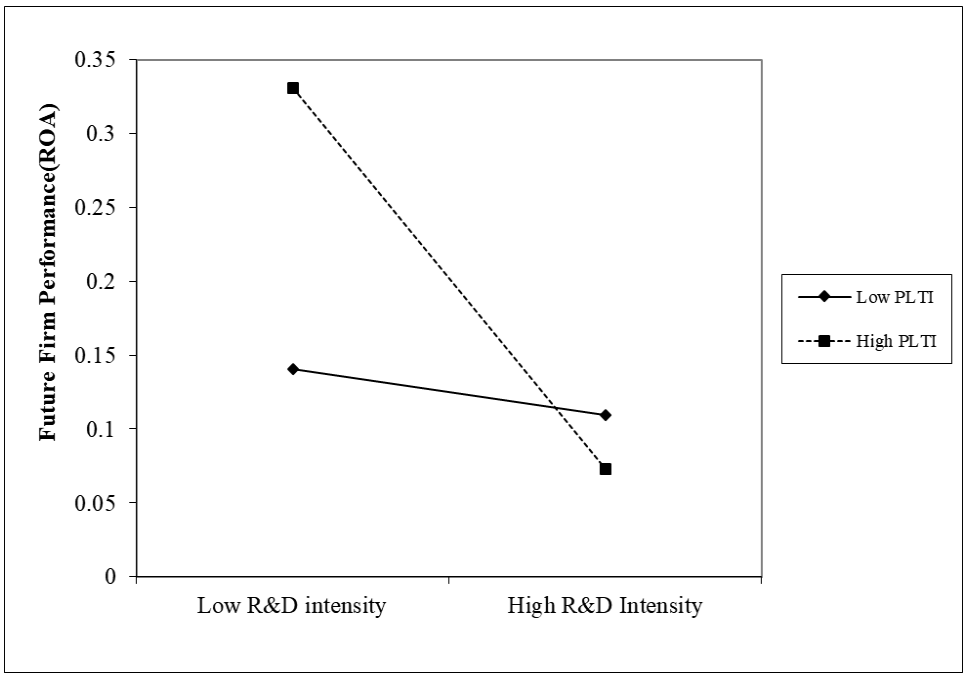


FIGURE 2

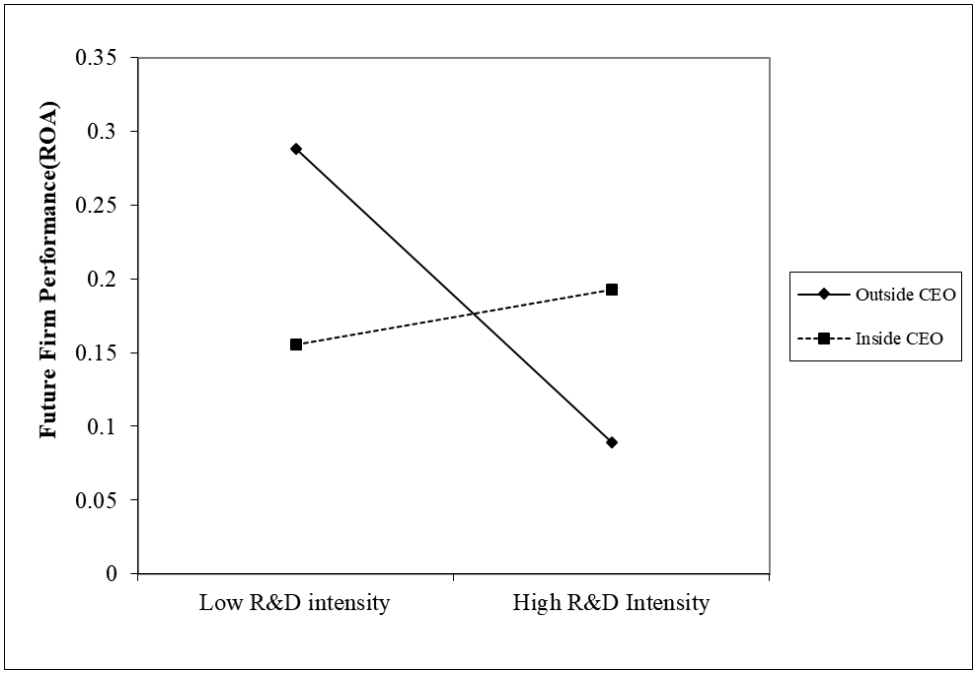


FIGURE 3

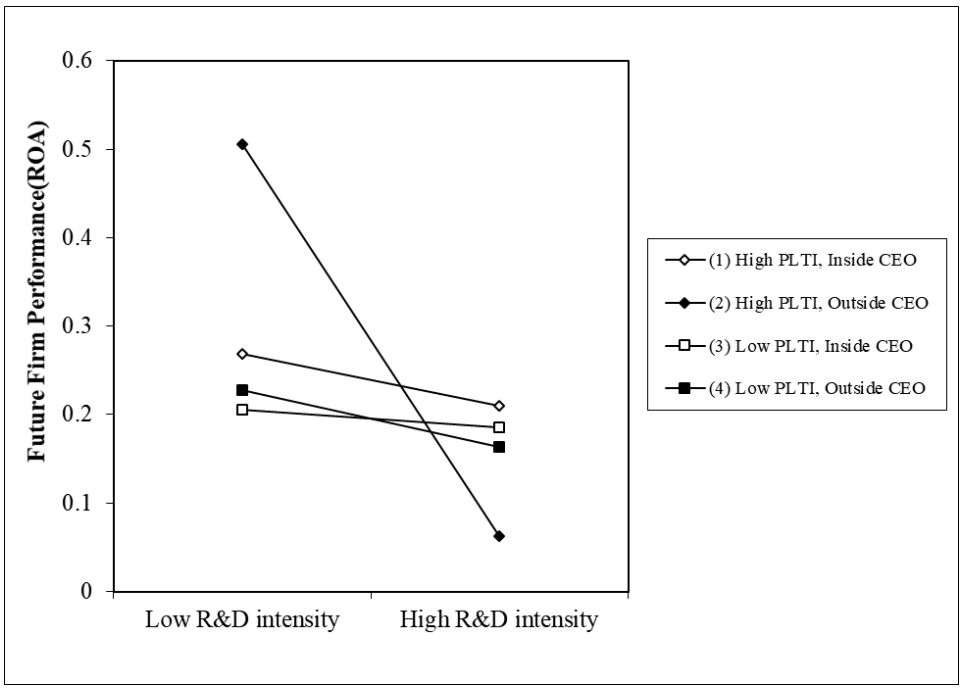
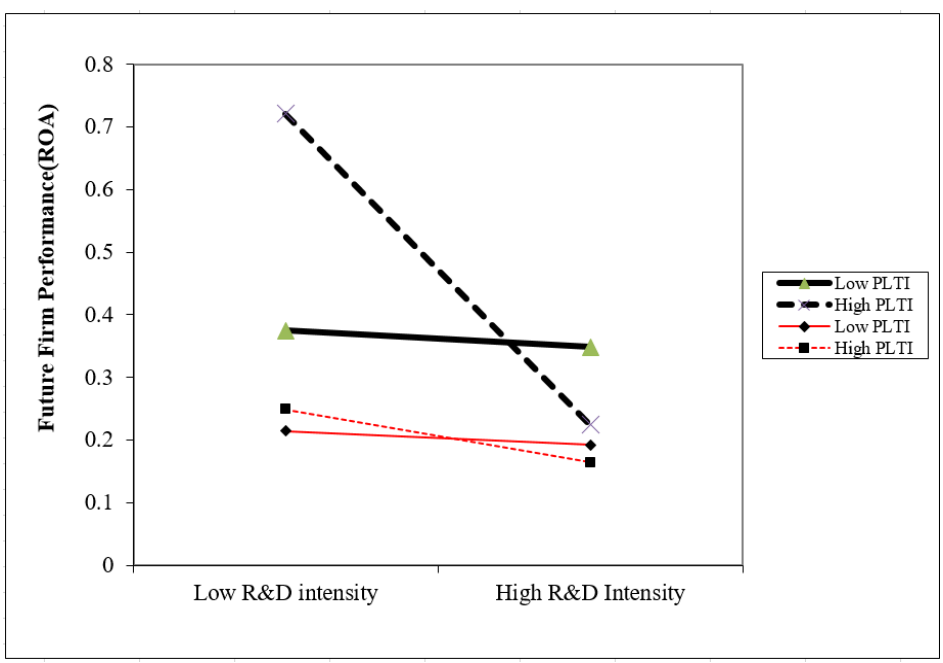


FIGURE 4



Note: Inside CEO in thin lines, Outside CEO in thick lines

REFERENCES

Bailey, E. E., & Helfat, C. E. (2003). External management succession, human capital, and firm performance: An integrative analysis. *Managerial and Decision Economics*, *24*(4), 347-369.

Balkin, D. B., Markman, G. D., & Gomez-Mejia, L. R. (2000). Is CEO pay in high-technology firms related to innovation? *Academy of Management Journal*, 43(6), 1118-1129.

Balsmeier, B., Buchwald, A., & Stiebale, J. (2014). Outside directors on the board and innovative firm performance. *Research Policy*, 43(10), 1800-1815.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.

Barker III, V. L., & Mueller, G. C. (2002). CEO characteristics and firm R&D spending. *Management Science*, *48*(6), 782-801.

Barkema, H., Geroski, P., & Schwalbach, J. (1997). Managerial compensation, strategy and firm performance. *International Journal of Industrial Organization*, 413-416.

Baysinger, B., & Hoskisson, R. E. (1989). Diversification strategy and R&D intensity in multiproduct firms. *Academy of Management Journal*, *32*(2), 310-332.

Baysinger, B. D., Kosnik, R., & Turk, T. A. (1991). Effects ownership structure. *Academy of Management Journal*, 34.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy*, *70*(5, Part 2), 9-49.

Berns, K. V., & Klarner, P. (2017). A review of the CEO succession literature and a future research program. *Academy of Management Perspectives*, 31(2), 83-108.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, 81(3), 637-654.

Boeker, W. (1992). Power and managerial dismissal: Scapegoating at the top. *Administrative*

Science Quarterly, 400-421.

Brett, J. M., & Stroh, L. K. (1997). Jumping ship: Who benefits from an external labor market career strategy?. *Journal of Applied Psychology*, 82(3), 331.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review*, 20(2), 343-378.

Castanias, R. P., & Helfat, C. E. (1991). Managerial resources and rents. *Journal of Management*, *17*(1), 155-171.

Castanias, R. P., & Helfat, C. E. (2001). The managerial rents model: Theory and empirical analysis. *Journal of Management*, *27*(6), 661-678.

Chen, G. (2015). Initial compensation of new CEOs hired in turnaround situations. *Strategic Management Journal*, 36(12), 1895-1917.

Coff, R. W. (1997). Human assets and management dilemmas: Coping with hazards on the road to resource-based theory. *Academy of Management Review*, *22*(2), 374-402.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 128-152.

Cummings, T., & Knott, A. M. (2018). Outside CEOs and innovation. *Strategic Management Journal*, *39*(8), 2095-2119.

Dalton, D. R., & Kesner, I. F. (1983). Inside/outside succession and organizational size: The pragmatics of executive replacement. *Academy of Management Journal*, *26*(4), 736-742.

Dalton, D. R., & Kesner, I. F. (1985). Organizational performance as an antecedent of inside/outside chief executive succession: An empirical assessment. *Academy of Management Journal*, *28*(4), 749-762.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3), 555-590.

Dechow, P. M., & Sloan, R. G. (1991). Executive incentives and the horizon problem: An

empirical investigation. *Journal of Accounting and Economics*, 14(1), 51-89.

Devers, C. E., McNamara, G., Wiseman, R. M., & Arrfelt, M. (2008). Moving closer to the action: Examining compensation design effects on firm risk. *Organization Science*, 19(4), 548-566.

Dushnitsky, G., & Lenox, M. J. (2005). When do firms undertake R&D by investing in new ventures?. *Strategic Management Journal*, 26(10), 947-965.

Finkelstein, S., & Hambrick, D. C. (1990). Top-management-team tenure and organizational outcomes: The moderating role of managerial discretion. *Administrative Science Quarterly*, 484-503.

Finkelstein, S., Hambrick, D., & Cannella, A. A. (1996). Strategic leadership. St. Paul: West Educational Publishing.

Fong, E. A. (2010). Relative CEO underpayment and CEO behaviour towards R&D spending. *Journal of Management Studies*, *47*(6), 1095-1122.

Galasso, A., & Simcoe, T. S. (2011). CEO overconfidence and innovation. *Management Science*, 57(8), 1469-1484.

Greve, H. R. (2003). A behavioral theory of R&D expenditures and innovations: Evidence from shipbuilding. *Academy of Management Journal*, *46*(6), 685-702.

Guthrie, J. P., Grimm, C. M., & Smith, K. G. (1991). Environmental change and management staffing: An empirical study. *Journal of Management*, 17(4), 735-748.

Hambrick, D. C. (2007). Upper echelons theory: An update. *Academy of Management Review*, 32; 334-343.

Hambrick, D. C., & Finkelstein, S. (1987). Managerial discretion: A bridge between polar views of organizational outcomes. *Research in Organizational Behavior*.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of management review*, *9*(2), 193-206.

Hambrick, D. C., & Macmillan, I. C. (1985). Efficiency of product R&D in business units: The role of strategic context. *Academy of Management Journal*, *28*(3), 527-547.

Hargadon, A., & Fanelli, A. (2002). Action and possibility: Reconciling dual perspectives of knowledge in organizations. *Organization Science*, 13(3), 290-302.

Harris, D., & Helfat, C. (1997). Specificity of CEO human capital and compensation. *Strategic Management Journal*, 18(11), 895–920.

Harrison, J. R., Torres, D. L., & Kukalis, S. (1988). The changing of the guard: Turnover and structural change in the top-management positions. *Administrative Science Quarterly*, 211-232.

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, 25(12), 1155-1178.

Helfat, C. E., & Martin, J. A. (2015). Dynamic managerial capabilities: Review and assessment of managerial impact on strategic change. *Journal of Management*, 41(5), 1281-1312.

Henderson, A. D., & Fredrickson, J. W. (1996). Information-processing demands as a determinant of CEO compensation. *Academy of Management Journal*, 39(3), 575-606.

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource dependence theory: A review. *Journal of Management*, *35*(6), 1404-1427.

Hitt, M. A., Bierman, L., Shimizu, K., & Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Academy of Management Journal*, 44(1), 13-28.

Hou, W., Lovett, S., & Rasheed, A. (2020). Stock option pay versus restricted stock: A comparative analysis of their impact on managerial risk-taking and performance extremeness. *Strategic Organization*, 18(2), 301-329.

Howard, A. (2001). Identifying, assessing, and selecting senior leaders. The nature of organizational leadership: *Understanding the performance imperatives confronting today's*

leaders, 305-346.

Irving, J. H., Landsman, W. R., & Lindsey, B. P. (2011). The valuation differences between stock option and restricted stock grants for US firms. *Journal of Business Finance & Accounting*, 38(3-4), 395-412.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305-360.

Jensen, M. C., & Murphy, K. J. (1990). Performance pay and top-management incentives. *Journal of Political Economy*, 98(2), 225-264.

Kile, C. O., & Phillips, M. E. (2009). Using industry classification codes to sample high-technology firms: Analysis and recommendations. *Journal of Accounting, Auditing & Finance*, 24(1), 35-58.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management Journal*, *24*(4), 689-713.

Knott, A. M. (2017). Is R&D Getting Harder, or Are Companies Just Getting Worse At It. *Harvard Business Review*, 7(2).

Kor, Y. Y., & Mahoney, J. T. (2005). How dynamics, management, and governance of resource deployments influence firm-level performance. *Strategic Management Journal*, 26(5), 489-496.

Laverty, K. J. (1996). Economic "short-termism": The debate, the unresolved issues, and the implications for management practice and research. *Academy of Management Review*, 21(3), 825-860.

Lerner, J., & Wulf, J. (2007). Innovation and incentives: Evidence from corporate R&D. *The Review of Economics and Statistics*, 89(4), 634-644.

Li, Q., Maggitti, P. G., Smith, K. G., Tesluk, P. E., & Katila, R. (2013). Top management

attention to innovation: The role of search selection and intensity in new product introductions. *Academy of Management Journal*, *56*(3), 893-916.

Lim, E. N. (2015). The role of reference point in CEO restricted stock and its impact on R&D intensity in high-technology firms. *Strategic Management Journal*, *36*(6), 872-889.

Madhavan, R., & Grover, R. (1998). From embedded knowledge to embodied knowledge: New product development as knowledge management. *Journal of Marketing*, 62(4), 1-12.

Makri, M., Lane, P. J., & Gomez-Mejia, L. R. (2006). CEO incentives, innovation, and performance in technology-intensive firms: a reconciliation of outcome and behavior-based incentive schemes. *Strategic Management Journal*, 27(11), 1057-1080.

Malmendier, U., & Tate, G. (2005). CEO overconfidence and corporate investment. *The Journal of Finance*, 60(6), 2661-2700.

Mansfield, E. (1968). Industrial research and technological innovation; an econometric analysis. New York: Norton

Morck, R., & Yeung, B. (1991). Why investors value multinationality. *Journal of Business*, 165-187.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71-87.

Miller, K. D., & Bromiley, P. (1990). Strategic risk and corporate performance: An analysis of alternative risk measures. *Academy of Management Journal*, 33(4), 756-779.

Miller, D. J., Fern, M. J., & Cardinal, L. B. (2007). The use of knowledge for technological innovation within diversified firms. *Academy of Management Journal*, 50(2), 307-325.

Milkovich GT, Newman JM, Cole N. 2007. Compensation. McGraw-Hill Ryerson: Toronto, Ontario,Canada.

Mudambi, R., & Swift, T. (2014). Knowing when to leap: Transitioning between exploitative and explorative R&D. *Strategic Management Journal*, 35(1), 126-145.

Murphy, K. J., & Zabojnik, J. (2007). Managerial capital and the market for CEOs. *Available at SSRN 984376*.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford university press.

Ocasio, W. (1999). Institutionalized action and corporate governance: The reliance on rules of CEO succession. *Administrative Science Quarterly*, *44*(2), 384-416.

Osborn, R. N., & Baughn, C. C. (1990). Forms of interorganizational governance for multinational alliances. *Academy of Management Journal*, *33*(3), 503-519.

Pfeffer, J., & Salancik, G. R. (1978). *The external control of organizations: A resource dependence perspective*. New York: Harper & Row.

Quigley, T. J., Hambrick, D. C., Misangyi, V. F., & Rizzi, G. A. (2019). CEO selection as risk-taking: A new vantage on the debate about the consequences of insiders versus outsiders. *Strategic Management Journal*, *40*(9), 1453-1470.

Rajagopalan, N., & Datta, D. K. (1996). CEO characteristics: does industry matter?. *Academy of Management Journal*, 39(1), 197-215.

Rao, H., & Drazin, R. (2002). Overcoming resource constraints on product innovation by recruiting talent from rivals: A study of the mutual fund industry, 1986–1994. *Academy of Management Journal*, *45*(3), 491-507.

Sanders, W. G. (2001). Behavioral responses of CEOs to stock ownership and stock option pay. *Academy of Management journal*, *44*(3), 477-492.

Sanders, W. G., & Hambrick, D. C. (2007). Swinging for the fences: The effects of CEO stock options on company risk taking and performance. *Academy of Management Journal*, *50*(5), 1055-1078.

Schepker, D. J., Kim, Y., Patel, P. C., Thatcher, S. M., & Campion, M. C. (2017). CEO succession, strategic change, and post-succession performance: A meta-analysis. *The*

Leadership Quarterly, 28(6), 701-720.

Schwartz, K. B., & Menon, K. (1985). Executive succession in failing firms. *Academy of Management Journal*, 28(3), 680-686.

Shen, W., & Cannella, A. A. (2002). Revisiting the performance consequences of CEO succession: The impacts of successor type, post succession senior executive turnover, and departing CEO tenure. *Academy of Management Journal*, 45(4), 717–733.

Shen, W., & Cho, T. S. (2005). Exploring involuntary executive turnover through a managerial discretion framework. *Academy of Management Review*, 30(4), 843-854

Singh, J., & Agrawal, A. (2011). Recruiting for ideas: How firms exploit the prior inventions of new hires. *Management Science*, *57*(1), 129-150.

Smith, K. G., Collins, C. J., & Clark, K. D. (2005). Existing knowledge, knowledge creation capability, and the rate of new product introduction in high-technology firms. *Academy of Management Journal*, 48(2), 346-357.

Sørensen, J. B., & Stuart, T. E. (2000). Aging, obsolescence, and organizational innovation. *Administrative Science Quarterly*, *45*(1), 81-112.

Sturman, M. C., Walsh, K., & Cheramie, R. A. (2008). The value of human capital specificity versus transferability. *Journal of Management*, 34(2), 290-316.

Su, W., & Tsang, E. W. (2015). Product diversification and financial performance: The moderating role of secondary stakeholders. *Academy of Management Journal*, *58*(4), 1128-1148.

Subramaniam, M., & Youndt, M. A. (2005). The influence of intellectual capital on the types of innovative capabilities. *Academy of Management Journal*, 48(3), 450-463.

Tauber, Y. D., & Levy, D. R. (Eds.). (2002). Executive compensation. BNA Books.

Teece, D. J. (1992). Competition, cooperation, and innovation: Organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behavior &*

Organization, *18*(1), 1-25.

Wang, H. C., & Barney, J. B. (2006). Employee incentives to make firm-specific investments: Implications for resource-based theories of corporate diversification. *Academy of Management Review*, 31(2), 466-476.

Wang, T., & Zatzick, C. D. (2019). Human capital acquisition and organizational innovation: a temporal perspective. *Academy of Management Journal*, *62*(1), 99-116.

Wu, J., & Tu, R. (2007). CEO stock option pay and R&D spending: a behavioral agency explanation. *Journal of Business Research*, 60(5), 482-492.

Xu, D., Zhou, K. Z., & Du, F. (2019). Deviant versus aspirational risk taking: The effects of performance feedback on bribery expenditure and R&D intensity. *Academy of Management Journal*, *62*(4), 1226-1251.

Zajac, E. J. (1990). CEO selection, succession, compensation and firm performance: A theoretical integration and empirical analysis. *Strategic Management Journal*, *11*(3), 217-230.

Zhang, Y., & Rajagopalan, N. (2004). When the known devil is better than an unknown god: An empirical study of the antecedents and consequences of relay CEO successions. *Academy of Management Journal*, 47(4), 483-500.

Zhang, Y., & Rajagopalan, N. (2010). Once an outsider, always an outsider? CEO origin, strategic change, and firm performance. *Strategic Management Journal*, 31(3), 334-346.

국 문 초 록

내부승진/외부고용 최고경영자 승계와 임금구조가 기업 혁신에 미치는 영향

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본 논문은 R&D 집중도(R&D intensity)와 최고경영자 승계 유형(내부승진/외부고용)과 최고경영자에게 주어지는 장기적 보상의 비율이 서로 상호작용하여 기업의 R&D 효율성을 높이는 과정을 설명하며 궁극적으로 기업의 미래 성과에 미치는 영향을 규명한다. 이를 위해 기업의 재무성과, 경영진 보상 정보와 경영진의 생애 및 경력에 관한 자료를 수집하고 R&D 집중도와 기업의 미래 성과(ROA)의 관계를 조절하는 다양한 상호작용 효과들을 살펴보았다. 추가적으로 R&D 집중도, 내부승진/외부고용 경영자와 장기적 경영자 보상 비율 간의 삼원 상호작용 효과(three-way interaction effect) 분석 또한 시행하였다. 고기술산업군에 속한 미국 223개의 IPO 기업을 대상으로 1993~2015년 사이의 경영자 승계가 일어난 시점들을 연구한 결과, 기업의 미래 성과는 R&D 집중도가 높고, 높은 비율의 장기적 보상을 받는 내부승진한 경영자가 선임되었을 시 유의미한 성과를 나타내었다. 구체적으로, R&D 집중도와 기업의 미래 성과 간의 강하고 유의미한 부(-)의 관계는 경영자에게 주어지는 높은 비율의 장기적인 보상으로 인한 것으로 판명되었다. 또한, 내부승진된 경영자가 R&D 투자에 높은 수준으로 집중하는 경우, 기업의 미래 성과에 가장 긍정적인 효과를

미치는 것으로 나타났다. 주요한 시사점으로는 R&D 집중도, 경영자의 장기적 보상의 비율과 경영진 승계가 서로 상호작용하여 기업의 성과에 영향을 미친다는 것이다. 따라서 R&D 집중도가 높은 고기술기업에서 높은 비율의 장기적 보상을 받는 내부승진한 경영자는 기업의 미래 성과에 가장 긍정적인 효과를 가져다 준다고 볼 수 있다. 이는 내부승진한 경영자가 조직 맥락을 이해하는 기업 특유적 (firm-specific) 지식을 가지고 있기에 R&D 투자를 보다 효율적으로 관리하는 것에 기인한다고 볼 수 있다. 이에 더하여, 내부승진한 경영자는 기업 이사회와 이해관계자들의 지지로 인해 외부고용된 경영진보다 기업의 장기적인 목표인 혁신을 위해 더욱 위험을 감수하는 성향을 보이는 것으로 설명할 수 있다.

주요어 : 경영자 승계 유형, 경영자 보상, 경영자 인적 자본, 전략적 변화, R&D, 기업 혁신

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