

When Does a CEO's Risk Propensity Drive Exploration in Product Development?

Dovev Lavie
Department of Management and Technology
Bocconi University
Via G. Roentgen 1
20136 Milano, Italy
Tel: (+39) 02 5836 2646
E-mail: dovev.lavie@unibocconi.it

Patricia Klarner
Department of Strategy & Innovation
Vienna University of Economics and Business (WU)
Welthandelsplatz 1
1020 Vienna, Austria
Tel: (+43) 1 31336 4537
Email: pklarner@wu.ac.at

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ABSTRACT

We advance research on the managerial antecedents of exploration by studying personal, organizational, and environmental conditions under which a CEO's risk propensity shapes a firm's tendency to explore in product development. Our panel data analysis of 219 firms in the pre-packaged software industry reveals that when a CEO is risk prone, the CEO's ability to drive exploration increases with the CEO's power in the firm, which manifests in tenure, duality, and insider origin. Counter to expectations, however, the firm's accumulated exploration experience does not reinforce but rather attenuates the effect of the CEO's risk propensity on exploration. We attribute this to firms' quest for balance between exploration and exploitation, and the need to counter the CEO's risk propensity when exploration becomes excessive. Finally, we find that competitive pressure in the firm's product market reinforces the ability of a CEO who is more risk prone to garner support for further exploration. Our study advances a dynamic perspective that relates the heterogeneity in firms' exploration tendencies to the behavioral inclinations of their CEOs.

INTRODUCTION

When does a CEO's risk propensity drive a firm's tendency to explore in its product development initiatives? In its purest form, exploration involves relying on new knowledge, whereas exploitation entails refining and leveraging existing knowledge (Levinthal and March 1993). Scholars have offered an elaborate discussion of these activities and the tradeoffs between them (e.g., Lavie et al., 2010). The notion of exploration and exploitation has been studied in various contexts, ranging from product development to alliances and acquisitions (e.g., Stettner and Lavie, 2014). Here we focus on exploration in product development (e.g., Katila and Ahuja, 2002). Prior research has often sought to explain heterogeneity in firms' exploration tendencies. More recently, scholars have begun studying what drives changes in such tendencies within a given firm. They have examined the managerial antecedents of exploration and exploitation, underscoring the role of executives in directing exploration efforts, while alluding to related constructs. For instance, they have demonstrated that executives' search for knowledge contributes to new product development (Li et al. 2013), while seeking advice supports exploratory innovation (Alexiev et al. 2010). Exploratory innovation is also promoted by creative leadership that nurtures social and human capital and fosters inspiration (Jansen, Vera, and Crossan, 2009; Makri and Scandura 2010). This research reveals that exploration is facilitated by managerial attention to and provision of support in the form of communication structure, organizational functions, and management systems and procedures (Khanagha et al. 2017). The focus on within-firm variation in exploration tendencies is essential, because unlike studies that explain variation across firms, the former stream of research can offer guidance to managers who wish to directly influence the exploration tendency of their firm. Hence, extant research relates a firm's tendency to explore to the executives' observed managerial initiatives and actions (what they do).

We complement this research stream by relating the firm's tendency to explore to a CEO's risk propensity, i.e., to an inherent behavioral inclination that underlies executives' actions (who they are). Unlike risk taking, which entails managerial action, risk propensity is an attitude toward risk, i.e., a relatively stable behavioral inclination to take or avoid risk, which may not necessarily manifest in organizational outcomes (Sitkin and Weingart 1995). Scholars have studied CEO risk propensity using proxies such as obtaining a

private pilot license (Cain and McKeon 2016) and exposure to early-life disasters (Bernile et al. 2017). But beyond the question of construct validity, these studies focus on the implications for financial leverage and acquisitions rather than for a firm's exploration tendency. We use content analysis to introduce a novel approach for capturing a CEO's risk propensity and examine how such propensity drives a firm's transition from exploitation to exploration in product development.

Although the inclinations of other executives may be of interest, the CEO's role is the most crucial and pivotal in strategic decision-making (Hambrick and Mason 1984; Carpenter et al. 2004; Herrmann and Nadkarni 2014; Gupta et al. 2019). Indeed, organizational structures, objectives, procedures, and culture that guide a firm's strategic decisions reflect the personality of the CEO as the most dominant change agent, who exerts disproportionate influence on the firm's decisions (Hambrick 2007; Finkelstein et al. 2009). Studies have examined the roles of CEOs in driving exploration versus exploitation (e.g., Cao et al. 2010, 2015), but only a few considered the role of the CEO's risk propensity as a driver of the firm's tendency to explore. Some scholars have examined the implications of executives' risk propensity for innovation. In particular, Kraiczy et al. (2015) find that a CEO's willingness to invest in high-risk projects and adopt a bold, aggressive posture under uncertainty is related to innovativeness of the product portfolio in small family firms, with a stronger association observed for firms with earlier family generations and a weaker association for firms with greater ownership stake of family top managers. In another study based on a survey of manufacturing firms, Gilley et al. (2002) report a positive association between the top management team's perceived risk taking and their firm's innovation performance, with this association becoming weaker in dynamic environments. Finally, Ling et al. (2008) find that top management teams' shared preference for risky opportunities relates positively to corporate entrepreneurship. These studies imply a positive association between CEOs' risk propensity and exploration in product development, although some of the studies focus on risk taking, and they all rely on contemporaneous surveys issued in small to medium-sized firms. We extend this research by studying the conditions under which this association holds in public firms operating in a dynamic industry.

Our baseline argument is that a CEO's risk propensity prompts risk taking that can drive a firm's

tendency to increase exploration in product development. We proceed by considering how personal, organizational, and environmental characteristics influence managerial discretion (Wangrow et al. 2015) and thus set boundary conditions to this effect. Specifically, we conjecture that the CEO's power, as manifested in tenure, duality, and origin (Shen and Cannella 2002; Zhang and Rajagopalan 2003), reinforces the effect of risk propensity by fostering support for risk taking. We also predict that the firm's exploration experience reinforces this effect by furnishing supportive routines for exploration. Finally, we expect that competitive pressure in the firm's product market prompts risk taking and thus reinforces the effect of the CEO's risk propensity on exploration in product development. These hypotheses underscore the tension between the CEO's risk preferences and various constraints on the CEO's discretion. Using data on 219 pre-packaged software firms during 1990–2001, we find support for most of our hypotheses. Contrary to expectations, however, we find that the firm's exploration experience attenuates the effect of the CEO's risk propensity, a finding that we ascribe to the firm's attempt to balance past exploration with a transition toward exploitation. Interestingly, our findings reveal that a firm led by an outside CEO or one who does not hold the board chairperson position is likely to transition toward exploitation in product development despite its CEO's risk proneness. These findings point to the challenges that CEOs face when seeking to advocate exploration in their firms per their risk propensity.

Our study contributes to research on exploration and exploitation by shedding light on an often-overlooked driver of a firm's tendency to explore, while complementing research on the environmental and organizational antecedents of exploration (e.g., Lavie et al. 2010). Whereas scholars have inferred that a CEO's risk propensity can prompt exploration, we demonstrate that it does so only under strict conditions relating to the CEO's power and the firm's exploration experience and competitive environment. The CEO's inclinations may be countervailed when the CEO lacks tenure, is an outsider, or does not hold the board chairperson position, as well as when the firm has already exhausted its exploration efforts. By studying factors that affect a firm's transition between exploration and exploitation, we depart from a static perspective on the merits of balancing exploration and exploitation and advance a dynamic view that reveals how such balance may be reached or disrupted over time (Luger et al. 2018; Kang and Kim 2020). Finally,

we inform research on firms' exploration tendencies by underscoring the nuanced role of the CEO's risk propensity in explaining when a firm explores more under given industry conditions. In so doing, we leverage rich longitudinal archival data and introduce advanced methods for measuring risk propensity and exploration in product development. Our original dictionary and content analysis for measuring a CEO's disposition can also contribute to research in corporate strategy.

THEORY AND HYPOTHESES

Exploration and exploitation can be pursued in various modes and domains (Lavie et al. 2010; Stettner and Lavie 2014). Here, we study exploration and exploitation by means of product development via the firm's internal organization (Cao et al. 2009; Danneels and Sethi 2011). Product development entails searching for and incorporating existing and new knowledge elements (Katila and Ahuja 2002; Li et al. 2013; Maggitti et al. 2013), thus offering a useful context for studying exploration and exploitation. Exploration and exploitation can be conceptualized as contradictory activities that rest at two ends of a continuum, with firms engaging in both activities to different extents (Sidhu et al. 2007; Simsek et al. 2009). This concept is in line with studies noting that resource allocation tradeoffs, conflicting routines, and specialization create tradeoffs between exploration and exploitation (Lavie and Rosenkopf 2006; March 1991) and with research relating to the transitivity and relativity of exploration and exploitation at the organizational level (Gupta et al. 2006; Lavie et al. 2010; Luger et al. 2018). In studying firms' tendencies to explore versus exploit, scholars have noted that firms adapt to their environments (Kraatz and Zajac 2001), e.g., environmental dynamism renders established knowledge obsolete (Sorensen and Stuart 2000) while encouraging search for new knowledge (Sidhu et al. 2004). Although various organizational factors can explain a firm's tendency to explore (Lavie et al. 2010), part of it can be attributed to the firm's CEO.

CEOs lead strategic changes in their firms (Greiner and Bhambri 1989; Pol and Nadkarni 2014), screen their firms' environment, identify the need for change, make the decision to change, and monitor the change process (Schein 1992). New products serve as a "primary mechanism through which firms adapt to changing environmental conditions" (Nadkarni and Chen 2014: 1810). Hence, CEOs may influence decisions to develop new products (Li et al. 2013), even though they are typically not directly involved in their design in

established publicly traded firms. The CEO acts as a change agent who influences the search for and development of new knowledge, and guides and motivates product development teams.

Individuals' risk propensity has been conceptualized as a relatively stable dispositional attribute (Rowe 1977; Fischhoff et al. 1981)—persistent and enduring, yet can change slightly over the course of a lifetime with accumulated personal experience (Sitkin and Weingart 1995; Bernile et al. 2017). Specifically, “risk propensity is defined as an individual’s current tendency to take or avoid risks. It is conceptualized as an individual trait that can change over time and thus is an emergent property of the decision maker” (Sitkin and Weingart, 1995:1575). Thus, risk propensity is more malleable than dispositional traits (e.g., narcissism) but more stable than transient states (e.g., moods) (Gamache et al. 2015). This conceptualization of risk propensity is in line with research in psychology that acknowledges that individuals' risk propensity can change over time due to aging, new experiences, or traumatic events.

CEOs' risk propensities vary (MacCrimmon and Wehrung 1990) and range from risk aversion to risk proneness (Fiegenbaum and Thomas 1988; Bromiley et al. 2001). Such variance can take place over the course of a CEO's career. In turn, this risk propensity can influence managerial behavior (Brockhaus 1980; Sitkin and Weingart 1995; Gilley et al. 2002). The notion of risk propensity refers to a behavioral inclination, whereas risk taking refers to actual actions resulting from that behavior. March (1991) tied risk taking to exploration but did not allude to behavioral inclinations that underlie risk taking. We study a CEO's risk propensity as a behavioral inclination. Our baseline argument is that a CEO's risk propensity can drive exploration in product development.

Specifically, given the inherent risk of exploration, a CEO's risk proneness is more likely to facilitate exploration than risk aversion. Whereas exploration is seen as challenging, overly risky, or infeasible when the CEO is risk averse, the CEO tends to perceive it positively and be undeterred from taking bold and aggressive actions when the CEO is risk prone. Hence, despite the extensive effort and uncertainty surrounding new product initiatives, a CEO's risk proneness is expected to facilitate the firm's exploration in product development. This expectation is in line with prior research relating the risk taken by executives to entrepreneurship and innovation (Gilley et al. 2002; Ling et al. 2008; Kraiczy et al. 2015). In turn, we

expect a CEO's risk aversion to make the CEO refrain from taking risks and instead facilitate exploitation in product development. Underscoring exploitation entails reinforcing activities based on existing knowledge that elicit incremental modifications in product design rather than developing completely new products. In sum, at any level of exploration, a firm's tendency to increase its exploration efforts can be associated with the CEO's risk propensity.

Proposition: A firm's tendency to explore in product development is related to its CEO's risk propensity, so that the more risk prone the CEO, the more the firm will transition from exploitation to exploration.

Whereas the implications of a CEO's risk propensity seem straightforward, we suggest that the CEO's ability to influence the firm's tendency to explore versus exploit in line with that propensity depends on the CEO's managerial discretion, i.e., the latitude of action. This discretion derives from environmental, organizational, and individual sources (Hambrick and Finkelstein, 1987; Wangrow et al. 2015), which reinforce the CEO's ability to take risks and instigate change in the firm.

Prior research has alluded to the role of the CEO in providing the impetus, guidance, incentives, and organizational systems that support risk taking and experimentation in the firm (Jansen et al. 2016). However, when taking risk, the CEO also needs managerial discretion and the support of internal stakeholders such as board members, top management, and employees (Greve and Mitsuhashi 2007; Simsek 2007) in order to create an organizational context that supports the firm's transition from exploitation to exploration or vice versa. In particular, the extent to which the CEO's risk propensity translates to exploration in product development depends on the CEO's ability to influence risk taking in the firm by exerting power (Pfeffer and Salancik 1978; Wangrow et al. 2015). This power derives from three sources: the CEO's tenure, duality, and origin (Shen and Cannella 2002; Zhang and Rajagopalan 2003).

First, a CEO's tenure defines the amount of time the individual has spent in the firm's CEO position since being appointed as the CEO. Prior research has studied the direct effect of the CEO's tenure on exploration (e.g., Finkelstein and Hambrick 1990; Wu et al. 2005; Cho and Kim 2017), but not how tenure moderates the relationship between a CEO's risk propensity and exploration. We contend that the CEO is unlikely to successfully gather the required organizational support to transition between exploration and

exploitation soon after the appointment. Rather, the support for the CEO's initiatives is likely to emerge gradually during the CEO's tenure. Following their appointment, CEOs need to establish their legitimacy, build coalitions with influential organizational members, and gather political support for organizational change (Greiner and Bhambri 1989; Hambrick and Fukutomi 1991). Some members of the top management team may be committed to the CEO's predecessor or may still perceive themselves as candidates for the CEO's position, and are thus unlikely to cooperate (Hambrick 1995). Middle managers may have vested interests in established strategies and processes that facilitate exploration or exploitation. Even frontline employees who are concerned about losing their jobs or influence as a result of changes instigated by a new CEO may resist exploration or exploitation. Early in their tenure, CEOs are therefore likely to face resistance to their efforts to infuse exploration or to foster exploitation per their risk propensity. But with tenure, as the CEO becomes familiar with the firm's organization, culture, inner workings, and operations (Alderfer 1986), the CEO gains relevant expertise (Mintzberg 1983), which bestows expert power. Moreover, the CEO builds internal networks and coalitions that provide political support for risk-taking initiatives. Over the course of tenure, the CEO also gains experience working with the board (Bebchuk and Fried 2006) and develops relationships with directors (Macey 2008), which further contributes to the CEO's power and influence (Hambrick and Fukutomi 1991; Shen and Cannella 2002).

Besides political support, changing the firm's tendency to explore requires adaptation of organizational processes that enable the firm to implement new policies in line with the CEO's risk propensity (Goodstein and Boeker 1991; Amburgey et al. 1993; Weick and Quinn 1999). In particular, to foster exploration, a CEO who is more risk prone needs to persuade the firm's units to adopt new routines associated with exploration, thus amending some processes while unlearning others (Makri and Scandura 2010). Corresponding changes are needed when the CEO seeks greater exploitation. Regardless of the direction of transition between exploration and exploitation, underlying this organizational change is the reconfiguration of the firm's capabilities per the CEO's risk propensity. Organizational capabilities and processes are path dependent and sticky (Szulanski 2003), especially with respect to exploitation, which is self-reinforcing and inertial (Lavie and Rosenkopf 2006). Hence, during tenure, a CEO who is more risk prone would need to invest much time

before being able to successfully extend the firm's tendency to explore. This was perhaps the case when Steve Jobs became Apple's CEO in 1997. Even though he knew the firm from his previous post at Apple, Jobs had to restructure the firm, terminate ongoing projects such as Newton and OpenDoc, and dismiss key employees before he could initiate a sequence of innovative new projects. Over time, the sentiment toward Jobs changed from fear to admiration (Burke and Elkind 2008; Petriglieri 2011). Hence, as their length of tenure increases, CEOs can overcome organizational hurdles and, in line with their risk propensity, foster either more or less exploration in their firms' product development efforts.

Second, CEO duality provides the CEO with power to exert influence in the firm. CEO duality indicates whether the CEO holds the position of chairperson of the board of directors (Krause et al. 2014). The chairperson determines the agenda for board meetings, sets priorities for the board, and leads the board's efforts to monitor the CEO's decisions and performance, including the responsibility for CEO succession and for the nomination of new directors (Zajac and Westphal 1996). Therefore, when the CEO also holds the chairperson position, the CEO enjoys structural power vis-à-vis the firm's board (Hambrick 1981) and greater discretion in executing decisions as a result of unity of command and avoidance of entrenchment (Finkelstein and D'Aveni 1994). In particular, by holding the chairperson's position, the CEO can nominate loyal directors (Westphal and Zajac 1995) and develop stronger social ties with other board members, thus facilitating trust and cooperation (Westphal 1999) and making it easier for the CEO to gain the board's support for initiatives. In fact, CEO duality enables directors to learn more about risky initiatives before these initiatives are discussed and approved in the boardroom (Klarner et al. 2020), while the CEO's preferences are more likely to be expressed and heard (Haynes and Hillman 2010). Finally, without an independent chairperson to monitor the CEO's decisions and question them, the CEO can more easily implement decisions that are aligned with that CEO's risk propensity. Overall, CEO duality can enhance the CEO's ability to exert power in the firm, and thus leads to greater alignment between the CEO's risk propensity and the firm's tendency to explore in product development.

Finally, the CEO's power is also tied to the CEO's origin. Prior research has distinguished inside CEOs who were appointed from within the firm from outside CEOs who were hired after spending their recent

career in other firms. Outside CEOs are less familiar with the firm's organization and social networks, which hinders their ability to gather internal support for introducing and implementing new initiatives (Shen and Cannella 2002). Boards face greater information asymmetry toward outside CEOs, whom they cannot evaluate internally prior to their appointment (Zajac 1990; Berns and Klarner 2017). This is likely to limit the board's support for new initiatives proposed by outside CEOs. In contrast, inside CEOs can better leverage their firm-specific and industry-specific experience, understanding of the organizational culture, and embedded social ties in the firm (Zhang and Rajagopalan 2003; Cao et al. 2006; Berns and Klarner 2017) to form coalitions and champion their initiatives. An example is Chuck Robbins, CEO of Cisco since 2015, who, as a long-time Cisco veteran, enjoyed the reputation of a "champion" of Cisco's culture, which "allows him to bring together teams at the organization while also disrupting the things that need to be changed" (Frangos 2018). Inside CEOs have time to develop social ties to key employees prior to their CEO appointment (Finkelstein et al. 2009), giving them a solid foundation on which to promote new initiatives with supportive internal stakeholders and identify potential change agents who can promote their initiatives. Moreover, inside CEOs share a common socialization process with some board members (Kanter 1977; Zajac and Westphal 1996), whom they can rely on to garner support from the board for their risk-taking initiatives. Therefore, an insider origin enables the CEO to exert more power and influence in the firm, and thus reinforces the positive association between the CEO's risk proneness and the firm's tendency to explore in product development.

Hypothesis 1: The positive association between the CEO's risk proneness and the firm's tendency to increase exploration in product development will be strengthened by the CEO's (a) tenure, (b) duality, and (c) origin as insider.

The ability to shape product development decisions in line with the CEO's risk propensity depends not only on the CEO's power, but also on organizational conditions that support or inhibit risk taking (Baird and Thomas 1985; Das and Teng 2001). The firm's capacity to engage in exploration may be shaped by various organizational conditions such as the firm's resource availability, but the firm's exploration experience can be considered a primary constraint for such capacity. In particular, a CEO's ability to implement organizational changes can be undermined by inertial pressures ingrained in organizational routines that

encode the firm's practices (Gilbert 2005; Parmigiani and Howard-Greenville 2011) and are shaped by the firm's prior experience (Nelson and Winter 1982; Becker 2004; Gavetti et al. 2012). Although normative perspectives suggest that firms should strive to balance exploration and exploitation (March, 1991), "in practice, researchers have long recognized the obstacles that firms face when simultaneously pursuing exploration and exploitation" (Lavie and Rosenkopf 2006: 800). Routines that support either exploration or exploitation in a firm's product development solidify with repeated use, thus fostering inertia, which makes it difficult to counter the firm's dominant tendency to explore or exploit. A firm that has previously focused on exploration features routines that support subsequent exploration, whereas a firm that has persistently engaged in exploitation exhibits routines for exploitation (Cyert and March 1963; Lavie and Rosenkopf 2006). Consequently, the firm's experience in either exploration or exploitation is likely to be self-reinforcing (Levinthal and March, 1993).

Established routines influence how a firm screens its environment in search of new knowledge, engages in knowledge recombination, and leverages existing knowledge (e.g., Fleming 2001; Rosenkopf and Nerkar 2001). Accumulated experience with exploration can therefore reinforce the effect of a CEO who is more risk prone on exploration in product development, whereas the firm's experience with exploitation may constrain this effect. Hence, the strength of the effect of a CEO's risk propensity depends on whether this propensity is aligned with the firm's prior experience in exploration or exploitation. If the firm's past experience is consistent with the CEO's risk propensity, the firm is likely to resort to its dominant routines and apply them repetitively (Amburgey et al. 1993), which reinforces its tendency to explore or exploit in product development. Consequently, when a CEO is more risk prone, the CEO may find it easier to increase the firm's tendency to explore if the firm has already accumulated substantial experience with exploration. In turn, when a CEO is more risk averse, the CEO may encounter challenges when fostering exploitation in such a firm, given that the firm's dominant routines support exploration rather than exploitation.

Therefore, if the firm has gained substantial experience with exploration, when its CEO is more risk prone, the CEO could capitalize on its established screening routines and innovation capabilities to further enhance its tendency to explore in product development. In turn, when the CEO is more risk averse and seeks

to promote exploitation in such a firm, this CEO is likely to find it difficult to engage the firm's managers and employees in exploitation, given that they have become accustomed to—and thus trained and skilled in—exploration. Moreover, the firm's routines for supporting the incremental versioning of products may be underdeveloped, which can impede its transition to exploitation. This may have been the case when Apple CEO Tim Cook, despite being an insider, encountered resistance to his conservative policies after he had succeeded the risk-prone Steve Jobs. News headlines and discussion boards reflected this state of affairs: “Is Tim Cook ruining Apple?” (Miller 2017); “Apple CEO Tim Cook acts like he's insane, analyst says” (Kilgore 2016). A firm's accumulation of more experience with exploration than with exploitation is thus likely to reinforce the firm's tendency to explore when its CEO is more risk prone, while weakening the transition to exploitation when its CEO is more risk averse.

Hypothesis 2: A firm's experience with exploration will strengthen the positive association between the CEO's risk proneness and the firm's tendency to increase exploration in product development.

The extent to which a CEO's risk propensity manifests in product development decisions depends not only on the CEO's personal power and the organizational support for such decisions in the firm, but also on pressures that originate from the external environment and influence risk taking in the firm. Research on exploration and exploitation has underscored the role of competitive pressure, which corresponds to the number of competitors that the firm encounters in its product markets. Competitive pressure imposes competitive threats to the firm's position in these markets and makes competitive interactions more visible and consequential (Smith et al. 1991). Therefore, competitive pressure facilitates frequent and aggressive competitive interactions between firms in product markets (Ferrier 2001; Chen et al. 2007), which can result in price cuts and lower margins (Porter 1980). It has been suggested that competitive pressure may drive exploration as firms aim to uncover new sources of competitive advantage (Levinthal and March 1993). For example, Voss et al. (2008) report that environmental threat facilitated financial investment and development of customer relations with the objective of improving firms' strategic positions.

We contend that competitive pressure can also indirectly influence the firm's tendency to explore by reinforcing the CEO's ability to pursue initiatives in line with that CEO's risk propensity. Indeed,

competitive pressure has been identified as an external governance mechanism that can enhance managerial discretion and mitigate agency problems, and thus facilitate the implementation of decisions (Kim and Lu 2011). Accordingly, product market competition has been shown to broaden the CEO's span of control (Guadalupe and Wulf 2010), which increases the CEO's access to information and influence in the firm. In particular, a firm that operates under competitive pressure sense urgency to seek new knowledge, experiment with product prototypes, and introduce new products to the market. Consequently, increased competitive pressure prompts a CEO who is more risk prone to take bolder actions and lead the firm's transition from exploitation to exploration. Because the firm's board is also likely to realize the urgency of reacting to the competitive pressure, a CEO who is more risk prone may find it easier to convince the board about the merits of risk taking and to approve investments in exploration in product development. Similarly, in the face of competitive pressure, when the CEO is more risk prone, the CEO can more easily garner support for new product development initiatives in the firm despite the uncertainty surrounding market performance of new products. This managerial discretion aligns the risk propensity with the firm's tendency to explore.

Unlike when a CEO is more risk prone and hence enjoys greater discretion under competitive pressure, when the CEO is more risk averse, the CEO is likely to react to intensifying competitive pressure with threat rigidity. The notion of threat rigidity suggests that when facing a looming possibility of loss, individuals and organizations tend to narrow their search for and processing of new information and resort to well-practiced dominant routines (Staw et al. 1981). Exogenous threats to the firm include intensifying competition in its product markets (Kreiser et al. 2020). Because threat rigidity leads risk-averse decision makers to focus on existing knowledge (Staw et al. 1981), competitive pressure can inhibit innovation (e.g., Kreiser et al. 2020). As a result, when the CEO is more risk averse, the CEO perceives the competitive pressure as an imminent threat to the firm's market position, such competitive pressure can lead to risk avoidance and reinforce exploitation in product development. Here again, the competitive pressure increases the alignment between the CEO's risk aversion and the tendency to limit exploration. In sum, competitive pressure is expected to strengthen the association between the CEO's risk propensity and exploration in product development.

Hypothesis 3: Competitive pressure in the firm's product market will strengthen the positive association

between the CEO's risk proneness and the firm's tendency to increase exploration in product development.

RESEARCH METHODS

We tested our hypotheses with panel data on U.S.-based publicly traded firms in the pre-packaged software industry (SIC 7372) during 1990–2001. In this period the industry thrived, exhibiting sufficient exploration in product development (see Figure 1): “In the early 1990s . . . packaged applications became much more flexible than ever before, and it no longer made sense for users to write their own software when something bought off-the-shelf could do it as well, for a fraction of the price” (Philipson 2005: 32). The golden age of packaged software concluded in the early 2000s with the transition to the Internet platform. Many software firms did not survive the Internet bubble burst in 2001, and product categories were transformed: “There was much talk of the ‘new economy,’ and many new companies were formed on the basis that the Internet boom would transform overnight the way consumers and businesses behaved” (Philipson 2005: 39). These structural changes in the industry account for our decision to end the study’s timeframe in 2001. The Internet bubble did not affect our study because the lag structure of our data restricts our explanatory variables to the years 1990–2000, and the requirement for a sufficient number of records in Compustat excludes e-business firms such as Yahoo. Thus, we avoid the bubble burst ramifications, while product categories remain stable during our timeframe.

***** INSERT FIGURE 1 ABOUT HERE *****

Our initial sample included all 229 firms with sufficient Compustat records. This industry context is suitable for our purposes because software firms frequently innovate with new products (Campbell-Kelly 2003) and introduce new versions of existing products (Stettner and Lavie 2014). Additionally, U.S.-based firms have dominated the software industry (Mowery and Nelson 1999), making our sample representative. Finally, a high proportion of software firms become publicly traded relatively early in their lifecycle, when they are still small, thus ensuring accessibility of financial information and limiting sensitivity to age- and size-related biases (Lavie 2007). During our study’s timeframe, the sampled firms introduced 5,046 new products and 7,027 versions of existing products, with an average of 3.855 new products and 5.368 versions of existing products per firm-year (see Figure 1).

We integrated archival data sources and relied on a panel data design to overcome concerns relating to commonly used self-reported perceptual measures based on surveys (Gilley et al. 2002). We extracted firm-level data from the Compustat database. Information on the introduction of software products and releases of their subsequent versions during 1985–2001 was gathered from various databases including LexisNexis, Thomson’s Dialog New Product Announcements, annual reports (Edgar 10-K forms), and Gale Business & Company Resource Center (Stettner and Lavie 2014). We gathered data on firms’ CEOs from Edgar 10-K forms, Corporate Affiliations, and Thomson One databases. Five trained coders hand-collected demographic and compensation data for the CEOs, using sources such as LinkedIn profiles, firms’ annual reports, proxy statements, Bloomberg’s CEOs and Executives, BoardEx, Thomson Reuters Officers and Directors, and ExecuComp databases (e.g., Benischke et al. 2019). In total, 418 CEOs served in the sampled firms during our study, with an average position tenure of 5.61 years. During succession years, we retained records of the CEO that served most of the year. The employment history and positions that the CEOs held since 1985 were traced using the above sources, the Marquis Who’s Who, and LexisNexis databases. In 62% of the observations, the CEOs also served as chairperson of the board. A similar proportion of observations featured inside CEOs who founded the firm or were employed by it prior to their CEO appointment. The data were transformed into firm-year observations, resulting in 1,283 observations after accounting for missing data, discarding 187 observations in which the firms introduced no products (and for which the dependent variable was undefined), and dropping 219 observations for year 2001 as a result of our model’s lag structure. After incorporation of the AR(1) parameter, 219 firms relating to 298 CEOs and 1,064 observations remain.

Dependent Variable — Exploration Tendency

A firm’s tendency to explore versus exploit is measured with a single continuous variable (Lavie et al. 2010) capturing the proportion of new products that the firm introduced in a given year out of its total number of new products and versions of existing products. A software product typology encompassing four product classes (personal applications, system infrastructure, vertical applications, and business applications), 54 product segments, and 464 product functions (see <https://softwaretypology.github.io/visualization/>) was developed with the help of industry experts and in consultation with the Software & Information Industry

Association (SIIA) after integrating, supplementing, and elaborating established systems provided by SIIA, IDC Research, NPD Group, and CorpTech, thus providing more complete and coherent coverage. The classification system was finalized based on feedback received from a panel of 12 software industry experts and pretested with product announcement data to ensure completeness and consistency.

Product data were gathered using the aforementioned sources and manually screened for product information by experts with master's degrees in computer science. Using the software product typology and detailed guidelines, the functionality of each product was coded by two trained coders with profound professional expertise in the software industry in the 1990s. The coders held relevant graduate degrees and an average of 15 years of software industry experience in various positions, ranging from a programmer to a vice president, in international publicly traded software firms. Interrater reliability was 84.570%, with coding differences resolved by careful deliberation until agreement was reached. A product was coded as new if, per its description, it incorporated completely new functionality and thus was substantially distinct from the firm's prior products (Stettner and Lavie 2014). In many cases, existing product versions retained the product's name with a consecutive version number (e.g., Windows 3, 3.1, 3.11, 95, 98), but the coding of products was ultimately based on the coders' professional assessment of their functionality. For example, a new product released by Synopsys, a firm that offers applications for integrated circuit design, mentioned behavioral synthesis, which differs from the established logic synthesis functionality:

Behavioral Compiler, a revolutionary synthesis tool that drastically simplifies integrated circuit (IC) design...raises the level of design specification to a much higher level than logic synthesis... "This is the type of exploration designers have been looking for...our customers have been asking us for behavioral synthesis for years...Finally, it's here." —Business Wire, May 16, 1994

In contrast, another product of Synopsys incorporated functionality of a previous product version:

"Our team of world class synthesis experts have been very busy developing the most significant QoR and runtime improvements in the past five years"...[Synopsys will] introduce Design Compiler 1999.05(DC99), the latest version of its flagship product...The new release promises significant run-time and productivity enhancements. —*Electronic Engineering Times*, March 8, 1999

Based on the product's name and version number, and the prevalence of distinct functionality per the software product typology, the coders classified the product as a new product or as a version of an existing product. Following conventions in prior research (e.g., Katila and Ahuja 2002; Lavie and Rosenkopf 2006;

Luger et al. 2018; Duysters et al. 2020), all the independent variables, moderators, and controls were updated annually and lagged by one year (measured at year t) relative to the dependent variable (measured at year $t+1$). The one-year lag is justified by the fast product development process, short product life cycle, and frequent product introductions in the software industry (e.g., Stettner and Lavie 2014). By controlling for the firm fixed effects, we capture the transition on the exploration-exploitation continuum relative to the firm-level mean, which in turn is indicative of the firm's idiosyncratic balance between exploration and exploitation.

Independent Variable — CEO Risk Propensity

The CEO's risk propensity is measured using content analysis of press items mentioning the CEO in the past five years (year $t-4$ to year t). The five-year term was chosen as an intermediate period, because risk propensity is relatively stable yet somewhat changeable (Yadav et al. 2007; Nadkarni and Chen 2014). Our data reveal that CEOs' average risk propensity changed by only 10.852% from one year to the next. This finding is consistent with studies suggesting that personality traits are relatively stable in middle age (Roberts et al. 2006) (the mean age of CEOs in our sample was 47.822 years). Furthermore, in line with prior research (Henderson et al. 2006; Simsek 2007), we find that CEOs become more risk averse in the course of their tenure ($r = -0.11, p < 0.001$). Prior research has used media coverage to analyze CEOs' personality (Resick et al. 2009). CEOs from the information technology sector have received sufficient media coverage in the 1990s, which can be associated with their personality traits (Park and Berger 2004). Hence, we retrieved 26,138 press items for the 418 CEOs in our sample. Reliance on press data with excerpts from various sources besides the CEO minimizes self-assessment bias. It is also preferred to reliance on letters to shareholders, which may be cautious or geared toward particular audiences (Gerstner et al. 2013). In the process of constructing our measure, we applied a multi-step procedure to develop a dictionary of relevant words representing risk proneness and risk aversion. A dictionary customized to the context of software industry CEOs in the 1990s ensures the relevance of keywords and improved validity of the constructed measure compared to a generic dictionary originally developed for different subjects and documents (Loughran and McDonald 2011; Grimmer and Stewart 2013).

First, we conducted a broad search for literature on risk to identify words closely related to risk proneness and risk aversion. We then used thesauruses to identify the most relevant synonyms (Cho and Hambrick 2006). Next, we added risk-proneness and risk-aversion words mentioned in a random sample of 1,000 press items that refer to the risk propensity of a subset of CEOs in our sample. This step was required to customize the list of words to fit the language typical of the industry and the press sources that we used. To further establish content validity (Benischke et al. 2019), two senior scholars with expertise in research on individual risk propensity served as independent raters and assessed each keyword on a Likert scale ranging from 1 (high risk aversion) to 7 (high risk proneness). Inter-rater reliability was substantial (Krippendorff's Alpha = 0.610) (Landis and Koch 1977). Finally, we retained words with scores of 5 and higher (representing risk proneness) and 3 and lower (representing risk aversion). In this step, 72 words of the initially suggested 120 words were selected for the dictionary (see Appendix).

Next, we extracted from the LexisNexis database those press items in which the CEO was mentioned in the preceding five years. To identify each CEO, we developed a unique search string that specified the firms for which the CEO worked during specific periods and CEO name variants, including nicknames. We eliminated similar names not related to the CEO and out-of-context mentioning of the CEO, such as contact details. We developed a Python algorithm to count the number of risk-proneness and risk-aversion words appearing in the proximity of 15 words after the CEO's name (Jegadeesh and Wu 2013). This intermediate word distance was selected to ensure that risk-related words are indeed associated with the CEO, while excluding irrelevant words. In auxiliary analyses, we considered alternative word distances, but longer word distances may include risk-proneness words that are not relating to the CEO, while shorter word distances may exclude relevant risk-proneness words. Another analysis, in which three trained raters independently coded the press items for a subsample of 20 CEOs, revealed that most of the relevant risk-proneness words appeared after rather than before the CEO's name, thus supporting our operationalization. Moreover, in this analysis, only 2.119% of the coded words were suspected of reversed meaning because of adjunct negation words, which suggests that our measure is not sensitive to false positives.

We measured risk propensity with the formula $\left(\frac{1+RP}{1+NRP}\right) / \left(\frac{1+RA}{1+NRA}\right)$, where RP is the count of risk-proneness words, NRP is the count of press items containing risk-proneness words, RA is the count of risk-aversion words, and NRA is the count of press items containing risk-aversion words. A high value of this measure is indicative of a CEO's risk proneness. We relied on a ratio measure of risk propensity because the probabilities of finding risk-aversion and risk-proneness words may differ. Dividing by the number of press items in which these words were found accounts for the frequency of press coverage of the CEO.

Moderators

CEO tenure was measured as the number of years the individual has served as the firm's CEO (Shen and Cannella 2002). *CEO duality* indicated whether the CEO also served as the chairperson of the board (coded "1," and "0" otherwise) in a given year (Krause et al. 2014). *CEO origin* distinguished an outsider who was employed by another firm prior to the appointment as the CEO in the firm (coded "0") from an insider who spent at least two years in the firm in another position before being appointed as CEO (coded "1") (Zhang and Rajagopalan 2003). *Firm exploration experience* was measured as the ratio of the accumulated number of new products to the total number of products that a firm introduced (excluding year t , which precedes the year in which the dependent variable is measured), weighted by a memory decay rate of $r = 10\%$ (Stettner and Lavie 2014). The exploration experience measure took the form: $\sum_T N_{T-1} \times (1 - r)^{T-1} / \sum_T E_{T-1} \times (1 - r)^{T-1}$, where N_T is the firm's count of new products introduced in a given year, E_T is the count of all products introduced in that year, and T spans from 1 (for year $t-1$) to the year of first product introduction. Finally, because *competitive pressure* intensifies with the number of competitors that operate in the same product domain (Porter 1980), we measured it by counting the number of other firms in the sample that introduced software products in the past three years whose functionality overlaps with at least one of the firm's products during that period. The three-year period is in line with the observed average product lifecycle in our sample.

Control Variables

We included our moderators as control variables, given that the firm's exploration tendency may be

influenced by the CEO's tenure (Jansen et al. 2009), duality (Sariol and Abebe 2017), and origin (Zhang and Rajagopalan 2003), as well as by the firm's exploration experience (Lavie and Rosenkopf 2006) and competitive pressure (Voss et al. 2008). Following prior research, we included several other firm- and CEO-level controls that could influence a firm's exploration tendency. At the firm level, we controlled for a *firm's exploration* in the preceding year (t), which enabled our dependent variable to capture the firm's exploration tendency by measuring the deviation from that baseline exploration level (Lavie and Rosenkopf 2006). This variable also controls for possible regression toward the mean (Brown 1982; Shen and Cannella 2002; Karaevli 2007). *Firm size* was measured with a firm's assets in the preceding year, whereas *firm age* was measured as the number of years since its incorporation (Lavie and Rosenkopf 2006). Because inertia reinforces existing routines, a firm may shift from exploration to exploitation as it matures and grows in size (Hannan and Freeman 1984; Lavie and Rosenkopf 2006). Controlling for a firm's size and age also accounts for variance in inertial pressures that can counter firms' transitions between exploration and exploitation. A firm's *R&D intensity* indicates its investment in innovation or absorptive capacity, which can spur both exploration and exploitation (Lavie and Rosenkopf 2006). The *product lifecycle*, measured as the average number of years since the introduction of software products to the market (Harter et al. 2000), is expected to foster exploration in product development when previous generations of products mature and their additional versions no longer support further revenue growth (Sirmon et al. 2011; Edison et al. 2013).

The *exploration alliances* formed by the firm, as documented in the SDC database, Factiva press items, and SEC filings, are an alternative vehicle for exploration in product development (Stettner and Lavie 2014). Therefore, we accounted for them by measuring the proportion of alliances formed by the firm in a given year that included an R&D agreement (Lavie and Rosenkopf 2006). Next, a firm's *performance gap* captures the difference between the firm's actual performance and its executives' performance aspirations, which can facilitate the firm's exploration tendency (Greve 2007; Chen 2008; Greve 2008; Dothan and Lavie 2016). Following Greve (2003), we calculated performance aspiration as a linear combination of a firm's historical and social aspirations, using the formula: $A_{it} = a_1 \times S_{t,i} + (1 - a_1) \times HA_{t,i}$, where A_{it} is the performance aspiration of firm i in year t , $S_{t,i}$ is its social aspiration, $HA_{t,i}$ is its historical aspiration, and a_1 is a weight ranging from

0 to 1. We measured the historical aspiration as a function of the prior year's historical aspiration ($HA_{t-1,i}$) and a firm's return on assets (ROA) in the past year ($P_{t-1,i}$): $HA_{t,i} = a_2 \times HA_{t-1,i} + (1-a_2) \times P_{t-1,i}$, with a_2 , a weight ranging between 0 and 1. A firm's social aspiration was based on the median ROA of firms in the industry. The parameters a_1 and a_2 were determined empirically, using a grid search in which we derive the estimates that produced the best model fit. Our analysis yielded the parameters $a_1 = 0$ and $a_2 = 0.1$, suggesting reliance on historical rather than social aspirations. Nevertheless, it is possible that firms directly benchmark against the exploration efforts of industry peers and imitate them (Duysters et al. 2020). Hence, when other firms in its industry gain experience with exploration, the firm may increase its exploration tendency. We measured *industry exploration experience* as the median ratio of the accumulated number of new products that other firms in the sample introduced to their total number of introduced products, averaged across past years (while excluding the preceding year), with a memory decay function (Stettner and Lavie 2014). By studying a single industry, we control for the environmental antecedents of exploration, such as industry dynamism (Sorensen and Stuart 2000), technological change, and resource munificence (Lavie et al. 2010). Finally, firm fixed effects and the lagged dependent variable control for remaining unobserved interfirm heterogeneity.

Following research that relates executives' characteristics to corporate changes, risk taking, and R&D investments (e.g., Wiersema and Bantel 1992; Barker and Mueller 2002; Kish-Gephart and Campbell 2015; Sariol and Abebe 2017), we considered various demographic characteristics of CEOs. Besides the CEO's tenure, duality, and origin, we accounted for the CEO's relevant professional background based on years spent in managerial positions prior to the CEO appointment. *CEO managerial experience* included positions in planning, administration, and general management at the corporate office or business units. Because of missing values in some CEO characteristics, we incorporated other control variables for the functional background of the CEO in an auxiliary analysis. Finally, following research on CEO compensation and risk taking (Hoskisson et al. 2017; Benischke et al. 2019; Dai et al. 2020) we controlled for *CEO salary*, *CEO stock ownership* (the proportion of total common stock owned by the CEO out of the outstanding shares reported in the CRSP database), and *CEO stock options* (value of options granted).

Analysis

Because we observe exploration only when the firm introduces products to the market, we accounted for sample selection. We first pooled all observations at the firm-year level, including those years in which the firm did not introduce products, to predict the probability that products were introduced in a given year. Following prior research (e.g., Katila and Ahuja 2002; Stettner and Lavie 2014; Luger et al. 2018), we included the following lagged predictors in the selection model: firm size, firm age, R&D intensity, financial solvency, product lifecycle, performance gap, competitive pressure, and number of acquisitions (documented in the SDC database), number of alliances formed (based on the SDC and Factiva databases and 10-K forms), number of foreign subsidiaries (documented in the Corporate Affiliations database), and product experience (count of previously introduced products). The last three variables served as exclusion restrictions that impact the probability of product introduction (see Table 2) but are uncorrelated with residuals in the second-stage model (Certo et al. 2016). Indeed, when they were incorporated in the second-stage models, their coefficients were insignificant. To estimate the probability of product introductions, we used a probit model with standard errors clustered at the firm level. We report the results of this first-stage selection model in Table 2. In line with prior research, the firm's product experience (Srinivasan et al. 2007), competitive pressure (Luger et al. 2018), and number of alliances formed (Katila and Ahuja 2002; Rothaermel and Deeds 2004) were positively related to subsequent product introductions, while the number of foreign subsidiaries (Kumar et al. 2012) was negatively related to it. We include the inverse Mills ratio from this model as a control variable labeled λ product introduction in the second-stage models. The weak correlations between our independent variables in the second-stage models and the inverse Mills ratio as well as the substantial increase in pseudo R^2 when the exclusion restriction variables are introduced to the first-stage model attest to the strength of our exclusion restriction (Certo et al. 2016).

We tested our hypotheses using panel data analysis, reporting cross-section, time-series regressions with firm fixed effects and first-order autoregressive disturbances to account for autocorrelation (Baltagi 1995; Baltagi and Wu 1999). This panel data design enables us to exclude alternative explanations relating to interfirm differences while correcting for potential bias ascribed to omitted variables (Benner & Tushman, 2002). It also facilitates causal interpretation of the findings, with the autocorrelation parameter accounting

for temporal stability in product development (Luger et al., 2018). A Hausman test (Greene 2008) revealed that the fixed-effects models are superior to the random-effects models, which are also not well aligned with our theory. Our models predict a firm's exploration tendency relative to its mean level while accounting for exploration in the prior year. Our model was preferred to alternative model specifications using a generalized linear model (GLM), generalized estimating equations (GEE), and a fixed-effects Tobit model, which do not account for the autocorrelation in our data ($\rho = 0.31$). Also, the GEE model fits population-averaged panel data, which is inconsistent with our theory. The maximum variance inflation factor (VIF) in the full model (Model 8) exceeds the threshold level of 10 (Greene 2008) because of the multiple instances of the independent variable. For that reason, we rely on the partial models for hypothesis testing and standardize the explanatory variables in our models.

***** INSERT TABLES 1-3 ABOUT HERE *****

RESULTS

Table 1 reports the means, standard deviations, and correlations of our variables. Most correlations were relatively low, with the exception of a correlation between a firm's age and product lifecycle ($r = 0.54$), which suggests that mature firms tend to retain mature products (Dougherty and Hardy 1996). Table 3 reports the results of our second-stage models. Model 1 is the baseline model with the control variables. It reveals that a firm's tendency to explore is influenced by its exploration level in the preceding year ($\beta = -0.39, p < 0.001$) (Piao and Zajac 2016) and by the firm's age ($\beta = -0.98, p = 0.006$) (Greve 2007), R&D intensity ($\beta = -0.13, p = 0.006$), product lifecycle ($\beta = 0.32, p = 0.033$) (Sirmon et al. 2011), and exploration experience ($\beta = -0.33, p < 0.001$). These findings indicate that as a firm matures, it tends to engage in less exploration; however, a firm with maturing products tends to explore more given the discounting of outdated products in the market and the limited prospects of its existing product portfolio. The negative effect of a firm's exploration experience may suggest that a firm that reaches excessive exploration level following past exploration efforts is inclined to restrict its exploration tendency in a search for a balance between exploration and exploitation (Lavie and Rosenkopf 2006). The negative effect of a firm's R&D intensity may be due to investing most R&D efforts in refining existing products (Stettner and Lavie 2014). The

performance gap's effect was marginally significant ($\beta = -0.04, p = 0.088$) but became more significant in one partial model and in the full model. In line with prior research on performance feedback, performance above aspirations mitigates the tendency to explore (Greve 2007; Dothan and Lavie 2016). Similarly, the CEO's tenure undermined the tendency to explore ($\beta = -0.12, p = 0.066$). This effect becomes significant in some partial models and in the full model, and is consistent with prior research that reveals that a CEO tends to take fewer risks and to avoid strategic changes later in tenure (Finkelstein and Hambrick 1990), especially in dynamic technology-driven environments (Wu et al. 2005).

Model 2 reveals a positive association between a CEO's risk propensity and the firm's tendency to explore ($\beta = 0.10, p = 0.054$). This effect becomes more significant in some partial models. On average, for every one standard deviation increase in the CEO's risk propensity, the exploration level increases by 10.165 percentage points (on a scale from 0 to 100%). Given that our finding for the main effect is consistent with prior research that relied on surveys and alternative proxies for risk propensity, and that has demonstrated their positive association with innovation, entrepreneurship, and other forms of corporate risk taking (e.g., Gilley et al. 2002; Kraiczy et al. 2015; Bernile et al. 2017), this validates our measure of risk propensity.

Model 3 served for testing Hypothesis 1a. In line with this hypothesis, the CEO's tenure reinforces the positive association between the CEO's risk propensity and the firm's tendency to explore ($\beta = 0.10, p = 0.039$). On average, for every one standard deviation increase in the CEO tenure, the contribution of the CEO's average risk propensity to the firm's exploration level increases by 9.887 percentage points. Figure 2 depicts the moderating effect of CEO tenure on the association between the CEO's risk propensity and the firm's tendency to explore. It reveals how the absolute level of exploration drops due to the main effect of CEO tenure, but the slope of the risk propensity effect becomes more positive with tenure. Model 4 served for testing Hypothesis 1b, revealing that the CEO's duality positively moderates the effect of the CEO's risk propensity on the firm's tendency to explore ($\beta = 0.34, p < 0.001$). On average, holding the chairperson position increases the contribution of the CEO's average risk propensity to the firm's exploration level by 34.493 percentage points. Figure 3 depicts the moderating effect of CEO duality on the association between the CEO's risk propensity and the firm's tendency to explore. It reveals that when the CEO is not the

chairperson, there is a negative association between the CEO's risk propensity and the firm's tendency to explore in product development. Finally, Hypothesis 1c was tested using Model 5, which shows how the CEO's origin positively moderates the effect of the CEO's risk propensity on the firm's tendency to explore ($\beta = 0.13, p = 0.017$). On average, the contribution of an inside CEO's average risk propensity to the firm's exploration level increases by 12.782 percentage points compared to that of an outside CEO. Figure 4 depicts the CEO origin moderation of the CEO's risk-propensity effect. It reveals that unlike an inside CEO, an outside CEO faces a negative association between their risk propensity and the firm's tendency to explore in product development. Overall, our findings furnish support to Hypothesis 1.

Model 6 served for testing Hypothesis 2. Counter to this hypothesis, we find no support for our prediction that the firm's exploration experience reinforces the positive association between the firm's tendency to explore and the CEO's risk propensity. Instead, the firm's exploration experience moderates this association negatively ($\beta = -0.15, p < 0.001$). On average, for every one standard deviation increase in the firm's exploration experience, the contribution of the CEO's average risk propensity to the firm's exploration level decreases by 14.472 percentage points. Figure 5 depicts this moderating effect. A possible explanation for this unexpected finding is that a firm with accumulated experience in exploration has reached an excessive level of exploration beyond its desirable balance point on the exploration-exploitation continuum. Such a firm may strive to restrict its exploration in search of balance (March 1991), thus resisting the effort of a CEO who is more risk prone to further facilitate exploration in product development. Finally, Model 7 served for testing Hypothesis 3, revealing that competitive pressure reinforces the positive association between the CEO's risk propensity and the firm's tendency to explore ($\beta = 0.09, p = 0.045$), in line with our conjecture. On average, for every one standard deviation increase in competitive pressure, the contribution of the CEO's risk propensity to the firm's exploration level increases by 8.507 percentage points. Figure 6 depicts the moderating effect of competitive pressure.

***** INSERT FIGURES 2-6 ABOUT HERE *****

Robustness Tests

To test the robustness of our findings, we considered alternative measures and model specifications.

First, we replaced our independent variable with measures using a 10-, 20-, and 30-word distance. The effect of CEO risk propensity was significant with the 10-word distance but not significant with distances of 20 words or longer. With the exception of CEO duality for the 10-word distance, all moderators remained significant with the 10- and 20-word distances. In turn, besides the firm’s exploration experience and competitive pressure, all moderators lost significance with the 30-word distance. This reinforces our choice of the 15-word distance as most appropriate. In another analysis, we considered words appearing both before and after the CEO’s name, as opposed to only after the CEO’s name. With the exception of the moderating effect of competitive pressure, all effects remained significant. Second, we replaced our risk-propensity measure with an alternative measure, using three-year and seven-year windows during which the risk-proneness and risk-aversion words were counted. These models produced consistent findings, although the moderating effects of CEO origin and competitive pressure became insignificant. Furthermore, the main effect of CEO risk propensity became insignificant with the three-year window and more significant with the seven-year window, suggesting that the effect of risk propensity remains stable over longer timeframes.

Third, we considered alternative formulas for risk propensity, e.g., $\left(\frac{RP - RA}{RP + RA}\right)$, $\left(\frac{RP}{RP + RA}\right)$, $\left(\frac{RP}{NRP}\right) - \left(\frac{RA}{NRA}\right)$, $\frac{(RP / NRP) - (RA / NRA)}{(RP / NRP) + (RA / NRA)}$, and $\ln\left[\frac{\left(\frac{1 + RP}{1 + NRP}\right)}{\left(\frac{1 + RA}{1 + NRA}\right)}\right]$, all of which produced a significant positive effect on the firm’s tendency to explore. We retained our reported measure, which is standardized by the number of press items, takes values when there are no press items, and is not transformed non-linearly. Fourth, we considered alternative time lags for our independent variables. With no time lag relative to the dependent variable, only the interaction between the CEO’s risk propensity and the firm’s exploration experience remained significant. With a two-year lag, none of the effects was significant. When maintaining a two-year lag for new products and a one-year lag for product versions and adjusting the dependent variable accordingly, we obtained consistent findings that were significant for the CEO duality and competitive pressure moderators despite the loss of degrees of freedom. These results are in line with our model specification that assumes a one-year lag for both new products and versions of existing products.

Fifth, although in all models there was no temporal overlap between our dependent and independent variables, to further mitigate the reversed causality concern, we had three of our coders independently code the press items for a subsample of 20 CEOs. We found that 73.890% of the coded words between year $t-4$ and year t refer to risk propensity rather than to actual risk taken, and only one press item mentioned a product launch in connection with a risk-taking word; even then, there was no overlap with the products launched at year $t+1$ during which we measure our dependent variable. Firms probably avoid including risk-related words in their product announcements in the press, given their negative connotation in that context. In another analysis, we included year fixed effects to account for intertemporal shocks, while dropping the AR(1) parameter. With the exception of the year 1997, none of the year effects was significant. Given the high autocorrelation and insignificant year effects, we retained our reported models. Additionally, to eliminate the possibility of a potential “bubble burst” effect, we dropped all observations relating to the year 2000, and our reported findings remained intact.

Sixth, we tested a GLM specification with firm and year fixed effects and robust standard errors, which produced consistent results, with the moderating effects of the CEO’s duality and origin and the firm’s exploration experience remaining significant. Seventh, we replaced the firm fixed effects with CEO fixed effects in order to ensure that our findings could not be ascribed to selection of CEOs with a risk profile that matches the firm’s exploration tendency. Despite the loss of degrees of freedom, with the exception of the moderating effect of competitive pressure, our findings remained intact, exhibiting an even stronger main effect of CEO risk propensity. Still, the CEO fixed effects may be confounded with the risk propensity of the CEO, which is relatively stable over time. Hence, the firm fixed effects model is better aligned with our theory and enables us to control for unobserved interfirm heterogeneity.

Eighth, we tested a curvilinear moderation effect of the CEO tenure. This alternative prediction considers that at the outset of their tenure and before they manage to build coalitions, CEOs are less likely to alter their firms’ strategies. Once they have established legitimacy and gained stakeholder support, CEOs can modify established routines and shape these strategies in line with their risk propensity. But in the later years of their tenure, CEOs are less likely to institute further changes (Virany et al. 1992; Henderson et al. 2006). Hence,

while the CEO's ability to lead change may initially increase with tenure, it could decline beyond a certain threshold. We thus introduced a quadratic effect of CEO tenure and its interaction with the CEO's risk propensity, but neither effect was significant, which reconfirms the linear function reported in our model. Ninth, we added a dummy variable indicating whether the CEO was succeeded in a particular year, but its effect was insignificant and our findings remained unchanged. We excluded this variable from our reported model because of its correlation with the CEO's tenure. In another analysis, we dropped 191 observations relating to succession years. The corresponding effects were consistent with our reported findings, revealing enhanced significance for the CEO risk propensity and CEO-related moderators. These analyses demonstrate that exploration in product development is driven by the CEO's risk propensity rather than by selection of CEOs with a particular risk propensity that fits the firm's exploration tendency.

Tenth, we considered additional moderators that may set boundary conditions for the effect of the CEO's risk propensity on the firm's tendency to explore, including the firm's size, age, R&D intensity, solvency, and performance feedback, and the industry's exploration experience, but none of them was significant. We then considered the variability in the firm's exploration experience, finding that the standard deviation in the firm's exploration in the preceding five years positively moderates the effect of the CEO's risk propensity on exploration in product development. Hence, besides past experience with exploration, lack of consistent routines for either exploration or exploitation enable the CEO to align the firm's exploration with the CEO's risk propensity. Eleventh, we incorporated additional controls, such as the firm's advertising intensity, number of products in its portfolio, exploration via acquisitions, number of board members, proportion of outside board members, and the previous CEO's tenure in the firm, but none was significant, while missing values drastically reduced our sample size. Hence, we excluded these controls. Similarly, we incorporated additional CEO demographic controls, such as the CEO's gender, education, founder status, and prior experience in the software industry and in functional domains of finance, operations, marketing, R&D, strategy, and consulting, as well as in academia. These controls had no significant effects on exploration, with the exception of gender and experience in consulting and operations, which were significant in some models. Still, our findings remained intact despite the resulting loss of degrees of freedom. We excluded

these controls because of missing values and their confounding effects. Next, our findings were insensitive to the exclusion of control variables, such as the product lifecycle, and did not materially change when we dropped all of the controls including the lagged dependent variable and inverse Mills ratio, which was insignificant in our reported models. Finally, our findings were robust to the exclusion of outliers. Overall, the auxiliary analyses bestow confidence in our model specification and the robustness of our findings.

DISCUSSION

Scholars have paid little attention to the managerial antecedents of exploration. However, unlike factors that can explain inter-firm differences in tendencies to explore, managerial behavior can also explain changes in a firm's tendency to explore over time. We consider how a CEO's risk propensity shapes a firm's exploration tendency. Whereas prior studies have suggested that risk proneness facilitates the tendency to explore, we reveal that this occurs only under stringent environmental, organizational, and personal conditions that influence managerial discretion. In particular, competitive pressure creates a sense of urgency that reinforces the association between the CEO's risk propensity and risk taking. In turn, when the CEO's power is limited and the firm has already reached an excessive level of exploration, the CEO may fail to align the firm's exploration tendency with risk propensity. Hence, risk propensity does not automatically translate to exploration in product development, and it can in fact backfire.

Our study offers several contributions to the literature on exploration and exploitation. First, we bring to light an important yet often overlooked driver of firms' exploration tendencies, namely their CEOs' risk propensities. We thus complement studies that have underscored executives' cognitive processes when managing the balance between exploration and exploitation (e.g., Gibson and Birkinshaw 2004; Smith and Tushman 2005; Smith 2014; Heavey and Simsek 2017). This research directs attention to executives' psychological dispositions, such as regulatory focus, cognitive style, and transactive memory, which account for the tendency to explore versus exploit (Tuncdogan et al. 2015). In turn, we perceive the CEO as a change agent responsible for initiating, making, and monitoring strategic change in the firm (Schein 1992), so that the CEO's risk propensity can instigate a firm's transition between exploration and exploitation. This risk propensity also explains why firms that operate in the same industry exhibit different exploration tendencies.

Our main contribution is in demonstrating that the CEO's risk propensity drives exploration only when certain conditions are met. Departing from research that has implied a straightforward association between risk propensity and innovation (Gilley et al. 2002; Kraiczy et al. 2015), we explain under what conditions the CEO's risk propensity can steer a firm away from balance on the exploration-exploitation continuum. We contend that the aftermath of this process depends on personal, organizational, and environmental conditions that interplay with the CEO's risk propensity in shaping the firm's position on this continuum.

Our study explains how the CEO's power, which derives from tenure, duality, and insider origin, enables the CEO to align the firm's exploration tendency with that CEO's risk propensity. Although less risk is taken with tenure in the CEO position (Finkelstein and Hambrick 1990; Wu et al. 2005), some of this inclination is countervailed by the reinforcing effect of tenure in the case of a CEO who is more risk prone. The ability to gather support for risky exploration is also prevalent when the more risk-prone CEO assumes the chairperson position or can leverage organizational familiarity and social networks by virtue of being an insider to the firm. In fact, when the CEO has originated from outside the firm and is scrutinized by an independent board and its chairperson, the firm's exploration tendency may counter the CEO's risk propensity. We conclude that a long-tenured CEO, one who was grown in the firm, or a CEO who captures the chairperson position more easily gains support for exploration by resorting to an established coalition (Simsek 2007). This enables the CEO to foster exploration in product development per the CEO's risk propensity. Unless the CEO enjoys sufficient power, the inducement to explore, which is invoked by risk propensity, is insufficient for prompting exploration.

Nevertheless, the ability of a CEO who is more risk prone to foster exploration depends not only on the CEO's personal power but also on external and internal pressures. The entry of competitors into the firm's product domain creates urgency to improve the firm's market position. A CEO who is more risk prone can leverage this pressure to promote an agenda for exploration. In turn, such a CEO is likely to encounter difficulties when instigating exploration in a firm that has already accumulated extensive exploration experience. As a result, such a firm would transition from exploration to exploitation despite the CEO's risk propensity. A possible explanation for this counterintuitive result is that firms continuously strive to balance

exploration and exploitation (Lavie et al. 2010); otherwise, they may bear the cost of experimentation without benefiting from exploitation (March 1991). Thus, even if a firm's managers and employees have become accustomed to exploration, they can foresee the caveats of excessive exploration. Once the firm has accumulated excessive exploration experience and exhausted its most promising product development opportunities, it may seek to avoid taking further risk. This counterbalances a more risk-prone CEO's aspiration to foster exploration and limits the CEO's discretion (Hambrick and Finkelstein 1987; Ford et al. 2008). Paradoxically, over time, a CEO who is more risk prone may push the firm to explore extensively, but by so doing that CEO exhausts the employees' will and ability to strive for further exploration. We suspect that excessive exploration strains the firm and consumes resources that could otherwise be allocated to more productive and less risky endeavors (Levinthal and March 1993). Thus, when the CEO's risk proneness endangers the firm, middle managers, in charge of discovering exploration opportunities, may withhold information (Siggelkow and Rivkin 2006). This suggests that firms have a certain potential for exploration, and beyond that exploration capacity, firms' abilities to further their exploration efforts in product development are constrained. While scholars have long argued that firms encounter path dependence and thus face challenges when seeking to balance exploration and exploitation, our study reveals that a firm would still strive for balance after reaching excessive levels of exploration, and even a CEO who is more risk prone cannot overturn this pursuit. Beyond a certain level of exploration, a CEO who is more risk prone cannot prompt the firm to develop many new products, even though the firm has done so in the past. This may explain why Apple, which has continuously increased its rate of new product releases to the market, eventually turned to versioning its established products. After the successful introduction of the iPhone, Apple would have been short-sighted not to exploit this market with subsequent versions of the iPhone. Since exploration and exploitation compete for scarce resources and involve conflicting routines (Lavie and Rosenkopf 2006), excessive exploration diverts resources from exploitation and steers the firm away from its balance point.

Finally, we contribute to the dynamic perspective on balancing exploration and exploitation (Luger et al. 2018) by pointing to personal, organizational, and environmental conditions that interplay with the CEO's

risk propensity in driving such dynamics. Understanding the mechanisms that shape the dynamics of exploration and exploitation is central for research aiming to explain how firms achieve balance. Our study shifts focus from the means for maintaining balance at a given time to the dynamics characterizing firms' efforts to adjust their exploration and exploitation tendencies. Recent research has offered insights into the evolution of firms' balance between exploration and exploitation (Klarner and Raisch 2013; Kang and Kim 2020) but left unattended the question of how executives shape the evolution trajectory. We answer this question by revealing the nuanced way by which a CEO's risk propensity influences the firm's transitions between exploration and exploitation. Instead of studying the pattern of transitions, we uncover their triggers.

Managerial Implications

Our study offers insights into the CEO's role in driving or inhibiting the dynamics of exploration and exploitation. A CEO who is more risk prone cannot strive for exploration if lacking power, there is no competitive pressure, or the firm has over-explored. Specifically, a CEO who lacks tenure, insider status, or duality needs to build internal coalitions and garner organizational support for exploration. Even a CEO who enjoys discretion needs to assess the firm's idiosyncratic balance point and avoid drifting away from it. Advocating exploration without the supportive conditions is analogous to pushing the gas pedal in a car when the gear is in neutral; although the engine will roar, the car will not move. Similarly, a firm that has reached an optimal level of exploration may exhibit reluctance to follow its CEO's risky pursuit.

Our study also offers valuable insights for boards that monitor CEOs and maintain their firms' balance between adaptability and stability. Boards need to carefully assess CEOs' risk profiles to determine whether their behavioral inclinations are in line with firm traditions of exploration and exploitation. As our study shows, a CEO who is more risk prone is likely to foster even greater exploration during tenure, especially if the CEO originates from inside the firm and captures the chairperson position. This means that the board of a firm with a tradition of exploration should be concerned about powerful CEO who is more risk prone. It may be counterintuitive to worry about a CEO whose risk propensity is aligned with the firm's corporate history and culture, but as Tim Cook's tenure at Apple revealed, an apparent misfit can pay off. A CEO with the right risk propensity can be effective in a firm seeking a desirable balance point on the exploration-

exploitation continuum.

Limitations and Future Research Directions

Our study offers important insights but faces limitations. First, extending recent research that underscores the CEO's personality (Gerstner et al. 2013; Nadkarni and Chen 2014; Gamache and McNamara 2019), we focused on the risk propensity of the CEO. Future research may consider how other personality traits, such as the CEO's narcissism, creativity, and regulatory focus, may affect the firm's tendency to explore or exploit (e.g., Higgins 1998; Kammerlander et al. 2015; Tuncdogan et al. 2015). Moreover, further research is needed to study the role of the CEO's cognition (e.g., Wilden et al. 2018). Although scholars have examined how executives' orientation relates to a firm's adaptation to its environment (Chaganti and Sambharya 1987; Wiersema and Bantel 1992; Bigley and Wiersema 2002) or how the CEO's cognitive style is tied to radical product innovation (De Visser and Faems 2015), future research can examine how the CEO's confidence (Hayward and Hambrick 1997; Chatterjee and Hambrick 2011) or temporal depth (Bluedorn 2002) relates to transitions between exploration and exploitation.

Additionally, constraints on data availability prevented us from studying the risk propensity of other senior executives, besides the CEO, who may influence exploration. This creates opportunities for future research to study the interactions between executives with different risk propensities, and to reveal to what extent such differences can be reconciled when balancing exploration and exploitation. Next, we could not measure some of the mechanisms invoked by our theory, such as the association between risk propensity and risk taking, which has been demonstrated elsewhere (e.g., Sitkin and Weingart 1995). We also provided a post hoc explanation for the contradictory finding relating to the moderating effect of the firm's exploration experience, but further research is needed to corroborate our explanation of over-exploitation and the firm's resistance to drifting away from its balance point. Furthermore, although we considered various boundary conditions at the personal, organizational, and environmental levels, additional contingencies should be studied, such as the firm's governance and incentives, the CEO's interpersonal networks, and the firm's alliance networks, which can facilitate the tendency to explore versus exploit (e.g., Duysters et al. 2020).

Empirically, we relied on media coverage to measure CEOs' risk propensity. Although our conservative

measure supports longitudinal analysis and offers advantages over proxies based on demographic data, scholars may rely on alternative sources, such as conference calls. Our textual analysis is more accurate than indirect proxies such as obtaining a pilot license, but may not be as direct as relying on a survey. Additionally, we studied the U.S. pre-packaged software industry, which exhibits innovation emanating from public firms. Although generalization to contexts such as computing and electronics (e.g., Apple's frequent introduction of new products and versions of its iPhone product) is straightforward, future research may study the generalizability of our findings in less dynamic industries, in other countries, or in small family firms in which the CEO is more actively involved in product development efforts (e.g., Kraiczy et al. 2015). Of particular interest are industries with longer product development cycles. Whereas in the software industry, developing a new product often takes about the same time as introducing a version of an existing product, the R&D needed, for example, to introduce a new drug may take years more than to release a modified version of an existing drug. This means that in biopharmaceuticals, the transition to exploration prompted by a CEO who is more risk prone may be slower than the transition to exploitation. Similarly, in the software industry, product development efforts almost always lead to the announcements of product introductions, which we observe, yet in other industries, such as biopharmaceuticals, failed product development is more frequent and hence less observed. Additionally, although we believe that our findings are generalizable to the current time period, in our sample most CEOs held the chairperson position, whereas the recent trend is to split the CEO and chairperson positions in large publicly traded firms (Joseph 2019). Future research may examine how sources of CEO power influence the association between CEO personality traits and strategic decisions such as new product development. Finally, our study limits concern to exploration in product development, but firms can also explore via other means such as alliances and acquisitions (e.g., Stettner and Lavie, 2014), so future research may generalize our findings to other modes of exploration.

In conclusion, despite a rich literature on exploration and exploitation, research on their managerial antecedents remains relatively scarce. Our study demonstrates that CEOs' risk propensities drive their firms' exploration tendencies only under certain conditions relating to the prevalent competitive pressure, the CEO's power in the firm, and organizational experience with exploration. The CEO's risk propensity, in and

of itself, is insufficient for steering the firm away from its presumed balance point between exploration and exploitation. We hope that our study paves the way for future research on the managerial antecedents of the dynamics of exploration and exploitation.

REFERENCES

- Alderfer CP (1986) The invisible director on corporate boards. *Harvard Bus. Rev.* 64(6):38–50.
- Alexiev AS, Jansen JJP, van den Bosch FAJ, Volberda HW (2010) Top management team advice seeking and exploratory innovation: The moderating role of TMT heterogeneity. *J. Manag. Stud.* 47(7):1343–1364.
- Amburgey TL, Kelly D, Barnett WP (1993) Resetting the clock: The dynamics of organizational change and failure. *Admin. Sci. Quart.* 38(1):51–73.
- Baird IS, Thomas H (1985) Toward a contingency model of strategic risk taking. *Acad. Manag. Rev.* 10(2):230–243.
- Baltagi BH (1995) *Econometric Analysis of Panel Data* (Wiley, Chichester, UK).
- Baltagi BH, Wu PX (1999) Unequally spaced panel data regressions with AR(1) disturbances. *Econometric Theory* 15(6):814–823.
- Barker VL, Mueller GC (2002) CEO characteristics and firm R&D spending. *Manag. Sci.* 48(6):782–801.
- Bebchuk LA, Fried JM (2006) Pay without performance: Overview of the issues. *J. Appl. Corp. Finance* 17(4):8–23.
- Becker MC (2004) Organizational routines: A review of the literature. *Ind. Corp. Change* 13(4):643–677.
- Benischke MH, Martin GP, Glaser L (2019) CEO equity risk bearing and strategic risk taking: The moderating effect of CEO personality. *Strateg. Manag. J.* 40(1):153–177.
- Benner MJ, Tushman M (2002). Process management and technological innovation: A longitudinal study of the photography and paint industries. *Admin. Sci. Quart.* 47(4): 676–707.
- Bernile G, Bhgwat V, Rau PR (2017) What doesn't kill you will only make you more risk-loving: Early-life disasters and CEO behavior. *J. Financ.* 72(1):167–206.
- Berns KVD, Klarner P (2017) A review of the CEO succession literature and a future research program. *Acad. Manag. Perspect.* 31(2):83–108.
- Bigley GA, Wiersema MF (2002) New CEOs and corporate strategic refocusing: How experience as heir apparent influences the use of power. *Admin. Sci. Quart.* 47(4):707–727.
- Bluedorn AC (2002) *The Human Organization of Time: Temporal Realities and Experience* (Stanford University Press, Stanford, CA).
- Brockhaus RH Sr (1980) Risk taking propensity of entrepreneurs. *Acad. Manag. J.* 23(3):509–520.
- Bromiley P, Miller KD, Rau D (2001) Risk in strategic management research. Hitt MA, Freeman RE, Harrison JS, eds. *The Blackwell Handbook of Strategic Management* (Blackwell, Malden, MA), 259–288.
- Brown MC (1982) Administrative succession and organizational performance: The succession effect. *Admin. Sci. Quart.* 27(1):1–16.
- Burke D, Elkind P (2008) The trouble with Steve Jobs. *Fortune* (March 17), 88–100.
- Cain MD, McKeon SN (2016) CEO personal risk-taking and corporate policies. *J. Financ. Quant. Anal.* 51(1):139–164.
- Campbell-Kelly M (2003) *From Airline Reservations to Sonic the Hedgehog: A History of the Software Industry* (MIT Press, Cambridge, MA).
- Cao Q, Gedajlovic E, Zhang H (2009) Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects. *Organ. Sci.* 20(4):781–796.
- Cao Q, Maruping LM, Takeuchi R (2006) Disentangling the effects of CEO turnover and succession on organizational capabilities: A social network perspective. *Organ. Sci.* 17(5):563–576.

- Cao Q, Simsek Z, Jansen JJP (2015) CEO social capital and entrepreneurial orientation of the firm: Bonding and bridging effects. *J. Manag.* 41(7):1957–1981.
- Cao Q, Simsek Z, Zhang H (2010) Modelling the joint impact of the CEO and the TMT on organizational ambidexterity. *J. Manag. Stud.* 47(7):1272–1296.
- Carpenter MA, Geletkanycz MA, Sanders WG (2004) Upper echelons research revisited: Antecedents, elements, and consequences of top management team composition. *J. Manag.* 30(6):749–778.
- Certo ST, Busenbark JR, Woo HS, Semadeni M (2016) Sample selection bias and Heckman models in strategic management research. *Strateg. Manag. J.* 37(13):2639–2657.
- Chaganti R, Sambharya R (1987) Strategic orientation and characteristics of upper management. *Strateg. Manag. J.* 8(4):393–401.
- Chatterjee A, Hambrick DC (2011) Executive personality, capability cues, and risk taking: How narcissistic CEOs react to their successes and stumbles. *Admin. Sci. Quart.* 56(2):202–237.
- Chen M-J, Su K-H, Tsai W (2007) Competitive tension: The awareness-motivation-capability perspective. *Acad. Manag. J.* 50(1):101–118.
- Chen W-R (2008) Determinants of firms' backward- and forward-looking R&D search behavior. *Organ. Sci.* 19(4):609–622.
- Cho SY, Kim SK (2017) Horizon problem and firm innovation: The influence of CEO career horizon, exploitation and exploration on breakthrough innovations. *Res. Policy* 46(10):1801–1809.
- Cho TS, Hambrick DC (2006) Attention as the mediator between top management team characteristics and strategic change: The case of airline deregulation. *Organ. Sci.* 17(4):453–469.
- Cyert RM, March JG (1963) *A Behavioral Theory of the Firm* (Prentice Hall, Englewood Cliffs, NJ).
- Dai Y, Rau PR, Stouraitis A, Tan W (2020) An ill wind? Terrorist attacks and CEO compensation. *J. Financ. Econ.* 135(2):379–398.
- Danneels E, Sethi R (2011) Overcoming competence traps and temporal myopia: New product exploration under environmental turbulence. *Organ. Sci.* 22(4):1026–1039.
- Das TK, Teng B-S (2001) Strategic risk behavior and its temporalities: Between risk propensity and decision context. *J. Manag. Stud.* 38(4):515–534.
- De Visser M, Faems D (2015) Exploration and exploitation within firms: The impact of CEOs' cognitive style on incremental and radical innovation performance. *Creativity Innov. Manage.* 24(3):359–372.
- Dothan A, Lavie D (2016) Resource reconfiguration: Learning from performance feedback. Folta B, Helfat CE, Karim S, *Resource Redeployment and Corporate Strategy. Advances in Strategic Management*, vol. 35 (Emerald Group, Bingley, UK), 319–369.
- Dougherty D, Hardy C (1996) Sustained product innovation in large, mature organizations: Overcoming innovation-to-organization problems. *Acad. Manag. J.* 39(5):1120–1153.
- Duysters G, Lavie D, Sabidussi A, Stettner U (2020) What drives exploration? Convergence and divergence of exploration tendencies among alliance partners and competitors. *Acad. Manag. J.* 63(5):1425–1454.
- Edison T, bin Ali N, Torkar R (2013) Towards innovation measurement in the software industry. *J. Syst. Softw.* 86(5):1390–1407.
- Ferrier W (2001) Navigating the competitive landscape: The drivers and consequences of competitive aggressiveness. *Acad. Manag. J.* 44(4): 858–877.
- Fiegenbaum A, Thomas H (1988) Attitudes toward risk and the risk–return paradox: Prospect theory explanations. *Acad. Manag. J.* 31(1):85–106.
- Finkelstein S, D'Aveni RA (1994) CEO duality as a double-edged sword: How boards of directors balance entrenchment avoidance and unity of command. *Acad. Manag. J.* 37(5):1079–1108.
- Finkelstein S, Hambrick DC (1990) Top-management-team tenure and organizational outcomes: The moderating role of managerial discretion. *Admin. Sci. Quart.* 35(3):484–503.
- Finkelstein S, Hambrick DC, Cannella AA Jr (2009) *Strategic Leadership: Theory and Research on Executives, Top Management Teams, and Boards* (Oxford University Press, New York).

- Fischhoff B, Lichtenstein S, Slovic P, Derby SL, Keeney RL (1981) *Acceptable Risk* (Cambridge University Press, Cambridge, UK).
- Fleming L (2001) Recombinant uncertainty in technological search. *Manag. Sci.* 47(1):117–132.
- Ford JD, Ford LW, D'Amelio A (2008) Resistance to change: The rest of the story. *Acad. Manag. Rev.* 33(2):362–377.
- Frangos C (2018) Making leadership last: How long-tenure CEOs stand their ground. *Forbes* (December 3). <https://www.forbes.com/sites/cassandrafrangos/2018/12/03/making-leadership-last-how-long-tenure-ceos-stand-their-ground/?sh=449aa633132e>.
- Gamache DL, McNamara G (2019) Responding to bad press: How CEO temporal focus influences the sensitivity to negative media coverage of acquisitions. *Acad. Manag. J.* 62(3):918–943.
- Gamache DL, McNamara G, Mannor MJ, Johnson RE (2015) Motivated to acquire? The impact of CEO regulatory focus on firm acquisitions. *Acad. Manag. J.* 58(4):1261–1282.
- Gavetti G, Greve HR, Levinthal DA, Ocasio W (2012) The behavioral theory of the firm: Assessment and prospects. *Acad. Manag. Ann.* 6(1):1–40.
- Gerstner WC, König A, Enders A, Hambrick DC (2013) CEO narcissism, audience engagement, and organizational adoption of technological discontinuities. *Admin. Sci. Quart.* 58(2):257–291.
- Gibson CB, Birkinshaw J (2004) The antecedents, consequences, and mediating role of organizational ambidexterity. *Acad. Manag. J.* 47(2):209–226.
- Gilbert CG (2005) Unbundling the structure of inertia: Resource versus routine rigidity. *Acad. Manag. J.* 48(5):741–763.
- Gilley KM, Walters BA, Olson BJ (2002) Top management team risk taking propensities and firm performance: Direct and moderating effects. *J. Bus. Strategies* 19(2):95–114.
- Goodstein J, Boeker W (1991) Turbulence at the top: A new perspective on governance structure changes and strategic change. *Acad. Manag. J.* 34(2):306–330.
- Greene WH (2008) *Econometric Analysis*, 6th ed (Prentice Hall, Upper Saddle River, NJ).
- Greiner L, Bhambri A (1989) New CEO intervention and dynamics of deliberate strategic change. *Strateg. Manag. J.* 10(S1):67–86.
- Greve HR (2003) *Organizational Learning from Performance Feedback: A Behavioral Perspective on Innovation and Change* (Cambridge University Press, Cambridge, UK).
- Greve HR (2007) Exploration and exploitation in product innovation. *Ind. Corp. Change* 16(5):945–975.
- Greve HR (2008) A behavioral theory of firm growth: Sequential attention to size and performance goals. *Acad. Manag. J.* 51(3):476–494.
- Greve HR, Mitsuhashi H (2007) Power and glory: Concentrated power in top management teams. *Organ. Stud.* 28(8):1197–1221.
- Grimmer J, Stewart BM (2013) Text as data: The promise and pitfalls of automatic content analysis methods for political texts. *Political Anal.* 21(3):267–297.
- Guadalupe M, Wulf J (2010) The flattening firm and product market competition: The effect of trade liberalization on corporate hierarchies. *Amer. Econ. J.: Appl. Economics* 2(4):105–127.
- Gupta A, Nadkarni S, Mariam M (2019) Dispositional sources of managerial discretion: CEO ideology, CEO personality, and firm strategies. *Admin. Sci. Quart.* 64(4):855–893.
- Gupta AK, Smith KG, Shalley CE (2006) The interplay between exploration and exploitation. *Acad. Manag. J.* 49(4):693–706.
- Hambrick DC (1981) Environment, strategy, and power within top management teams. *Admin. Sci. Quart.* 26(2):253–275.
- Hambrick DC (1995) Fragmentation and the other problems CEOs have with their top management teams. *Calif. Manag. Rev.* 37(3):110–126.
- Hambrick DC (2007) Upper echelons theory: An update. *Acad. Manag. Rev.* 32(2):334–343.

- Hambrick DC, Finkelstein S (1987) Managerial discretion: A bridge between polar views on organizations. Cummings LL, Staw BM, eds. *Research in Organizational Behavior* (JAI Press, Greenwich, CT), 369–406.
- Hambrick DC, Fukutomi GDS (1991) The seasons of a CEO's tenure. *Acad. Manag. Rev.* 16(4):719–742.
- Hambrick DC, Mason P (1984) Upper echelons: The organization as a reflection of its top managers. *Acad. Manag. Rev.* 9(2):193–206.
- Hannan MT, Freeman J (1984) Structural inertia and organizational change. *Amer. Sociol. Rev.* 49(2):149–164.
- Harter DE, Krishnan MS, Slaughter SA (2000) Effects of process maturity on quality, cycle time, and effort in software product development. *Manag. Sci.* 46(4):451–466.
- Haynes KT, Hillman A (2010) The effect of board capital and CEO power on strategic change. *Strateg. Manag. J.* 31(11):1145–1163.
- Hayward MLA, Hambrick DC (1997) Explaining the premiums paid for large acquisitions: Evidence of CEO hubris. *Admin. Sci. Quart.* 42(1):103–127.
- Heavey C, Simsek Z (2017) Distributed cognition in top management teams and organizational ambidexterity: The influence of transactive memory systems. *J. Manag.* 43(3):919–945.
- Henderson AD, Miller D, Hambrick DC (2006) How quickly do CEOs become obsolete? Industry dynamism, CEO tenure, and company performance. *Strateg. Manag. J.* 27(5):447–460.
- Herrmann P, Nadkarni S (2014) Managing strategic change: The duality of CEO personality. *Strateg. Manag. J.* 35(9):1318–1342.
- Higgins ET (1998) Promotion and prevention: Regulatory focus as a motivational principle. Zanna MP (ed.) *Advances in Experimental Social Psychology*, vol. 30 (Academic Press, New York), 1–46.
- Hoskisson RE, Chirico F, Zyung J, Gambeta E (2017) Managing risk taking: A multitheoretical review and future research agenda. *J. Manag.* 43(1):137–169.
- Jansen JJ, Kostopoulos KC, Mihalache OR, Papalexandris A (2016) A socio-psychological perspective on team ambidexterity: The contingency role of supportive leadership behaviours. *J. Manag. Stud.* 53(6):939–965.
- Jansen JJP, Tempelaar MP, van den Bosch FAJ, Volberda HW (2009) Structural differentiation and ambidexterity: The mediating role of integration mechanisms. *Organ. Sci.* 20(4):797–811.
- Jansen JJP, Vera S, Crossan M (2009) Strategic leadership for exploration and exploitation: The moderating role of environmental dynamism. *Leadersh. Q.* 20(1):5–18.
- Jegadeesh N, Wu D (2013) Word power: A new approach for content analysis. *J. Finan. Econ.* 110(3):712–729.
- Joseph L (2019) It's not just Boeing: More companies are splitting CEO and chairman roles. *CNBC* (November 5). <https://www.cnbc.com/2019/11/05/its-not-just-boeing-more-companies-are-splitting-ceo-and-chairman-roles.html>, accessed online on January 2, 2020.
- Kammerlander N, Burger D, Fust A, Fueglistaller U (2015) Exploration and exploitation in established small and medium-sized enterprises: The effect of CEOs' regulatory focus. *J. Bus. Venturing* 30(4):582–602.
- Kang J, Kim SJ (2020) Performance implications of incremental transition and discontinuous jump between exploration and exploitation. *Strateg. Manag. J.* 41(6):1083–1111.
- Kanter RM (1977) *Men and Women of the Corporation* (Basic Books, New York).
- Karaevli A (2007) Performance consequences of new CEO “outsiderness”: Moderating effects of pre- and post-succession contexts. *Strateg. Manag. J.* 28(7):681–706.
- Katila R, Ahuja G (2002) Something old, something new: A longitudinal study of search behavior and new product introduction. *Acad. Manag. J.* 45(6):1183–1194.
- Khanagha S, Volberda H, Oshri I (2017) Customer co-creation and exploration of emerging technologies: The mediating role of managerial attention and initiatives. *Long Range Plann.* 50(2):221–242.
- Kilgore T (2016) Apple CEO Tim Cook acts like he's insane, analyst says. Retrieved March 1, 2021, <https://www.marketwatch.com/story/apple-ceo-tim-cook-acts-like-hes-insane-analyst-says-2016-01-31>.

- Kim EH, Lu Y (2011) CEO ownership, external governance, and risk-taking. *J. Financ. Econ.* 102(2):272–292.
- Kish-Gephart JJ, Campbell JT (2015) You don't forget your roots: The influence of CEO social class background on strategic risk taking. *Acad. Manag. J.* 58(6):1614–1636.
- Klarner P, Probst G, Useem M (2020) Opening the black box: Unpacking board involvement in innovation. *Strateg. Organ.* 18(4):487–519.
- Klarner P, Raisch S (2013) Move to the beat—Rhythms of change and firm performance. *Acad. Manag. J.* 56(1):160–184.
- Kraatz MS, Zajac EJ (2001) How organizational resources affect strategic change and performance in turbulent environments: Theory and evidence. *Organ. Sci.* 12(5):632–657.
- Kraiczy ND, Hack A, Kellermanns FW (2015) What makes a family firm innovative? CEO risk-taking propensity and the organizational context of family firms. *J. Prod. Innov. Manag.* 32(3):334–348.
- Krause R, Semadeni M, Cannella AAJ (2014) CEO duality: A review and research agenda. *J. Manag.* 41(1):256–286.
- Kreiser PM, Anderson BS, Kuratko DF, Marino LD (2020) Entrepreneurial orientation and environmental hostility: A threat rigidity perspective. *Entrep. Theory Pract.* 44(6):1174–1198.
- Kumar V, Guar AS, Pattnaik C (2012) Product diversification and international expansion of business groups. *Manag. Internat. Rev.* 52(2):175–192.
- Landis JR, Koch GG (1977) The measurement of observer agreement for categorical data. *Biometrics* 33(1):159–174.
- Lavie D (2007) Alliance portfolios and firm performance: A study of value creation and appropriation in the U.S. software industry. *Strateg. Manag. J.* 28(12):1187–1212.
- Lavie D, Rosenkopf L (2006) Balancing exploration and exploitation in alliance formation. *Acad. Manag. J.* 49(4):797–818.
- Lavie D, Stettner U, Tushman ML (2010) Exploration and exploitation within and across organizations. *Acad. Manag. Ann.* 4(1):109–155.
- Levinthal DA, March JG (1993) The myopia of learning. *Strateg. Manag. J.* 14(Special Issue):95–112.
- Li Q, Maggitti PG, Smith KG, Tesluk PE, Katila R (2013) Top management attention to innovation: The role of search selection and intensity in new product introductions. *Acad. Manag. J.* 56(3):893–916.
- Ling Y, Simsek Z, Lubatkin MH, Veiga JF (2008) Transformational leadership's role in promoting corporate entrepreneurship: Examining the CEO-TMT interface. *Acad. Manag. J.* 51(3):557–576.
- Loughran T, McDonald B (2011) When is a liability not a liability? Textual analysis, dictionaries, and 10-Ks. *J. Finance* 66(1):35–65.
- Luger J, Raisch S, Schimmer M (2018) Dynamic balancing of exploration and exploitation: The contingent benefits of ambidexterity. *Organ. Sci.* 29(3):449–470.
- MacCrimmon K, Wehrung D (1990) Characteristics of risk taking executives. *Manag. Sci.* 36(4):422–435.
- Macey JR (2008) *Corporate Governance: Promises Kept, Promises Broken* (Princeton University Press, Princeton, NJ).
- Maggitti PG, Smith KG, Katila R (2013) The complex search process of invention. *Res. Policy* 42(1):90–100.
- Makri M, Scandura TA (2010) Exploring the effects of creative CEO leadership on innovation in high-technology firms. *Leadersh. Quart.* 21(1):75–88.
- March JG (1991) Exploration and exploitation in organizational learning. *Organ. Sci.* 2(1):71–87.
- Miller M (2017) Is Tim Cook ruining Apple? Retrieved March 1, 2021, <https://www.quora.com/Is-Tim-Cook-ruining-Apple>.
- Mintzberg H (1983) *Power In and Around Organizations* (Prentice-Hall, Englewood Cliffs, NJ).
- Mowery DC, Nelson RR (1999) *Sources of Industrial Leadership: Studies of Seven Industries* (Cambridge University Press, New York).

- Nadkarni S, Chen J (2014) Bridging yesterday, today, and tomorrow: CEO temporal focus, environmental dynamism, and rate of new product introduction. *Acad. Manag. J.* 57(6):1810–1833.
- Nelson RR, Winter SG (1982) *An Evolutionary Theory of Economic Change* (Belknap, Cambridge, MA).
- Park D-J, Berger BK (2004) The presentation of CEOs in the press, 1990–2000: Increasing salience, positive valence, and a focus on competency and personal dimensions of image. *J. Public Relat. Res.* 16(1):93–125.
- Parmigiani A, Howard-Greenville J (2011) Routines revisited: Exploring the capabilities and practice perspectives. *Acad. Manag. Ann.* 5(1):413–453.
- Petriglieri G (2011) Steve Jobs wasn't (just) a leader. *Harvard Bus. Rev.* (October 7).
- Pfeffer J, Salancik GR (1978) *The External Control of Organizations: A Resource Dependence Perspective* (Harper & Row, New York).
- Philipson G (2005) A short history of software. R. Barrett, ed. *Management, Labour Process and Software Development* (Routledge, New York), 13–44.
- Piao M, Zajac EJ (2016) How exploration impedes and impels exploration: Theory and evidence. *Strateg. Manag. J.* 37(7):1431–1447.
- Pol H, Nadkarni S (2014) Managing strategic change: The duality of CEO personality. *Strateg. Manag. J.* 35(9):1318–1342.
- Porter ME (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors* (Free Press, New York).
- Resick CJ, Whitman DS, Weingarden SM, Hiller NJ (2009) The bright-side and the dark-side of CEO personality: Examining core self-evaluations, narcissism, transformational leadership, and strategic influence. *J. Appl. Psychol.* 94(6):1365–1381.
- Roberts BW, Walton KE, Viechtbauer W (2006) Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychol. Bull.* 132(1):1–25.
- Rosenkopf L, Nerkar A (2001) Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strateg. Manag. J.* 22(4):287–306.
- Rothaermel FT, Deeds DL (2004) Exploration and exploitation alliances in biotechnology: A system of new product development. *Strateg. Manag. J.* 25(3):201–221.
- Rowe WD (1977) *An Anatomy of Risk* (Wiley, New York).
- Sariol AM, Abebe MA (2017) The influence of CEO power on explorative and exploitative organizational innovation. *J. Bus. Res.* 73(C):38–45.
- Schein EH (1992) The role of the CEO in the management of change: The case of information technology. TA Kochan, M Useem, eds. *Transforming Organizations* (Oxford University Press, Oxford), 80–95.
- Shen W, Cannella AAJ (2002) Revisiting the performance consequences of CEO succession: The impacts of successor type, postsuccession senior executive turnover, and departing CEO tenure. *Acad. Manag. J.* 45(4):717–733.
- Sidhu JS, Commandeur HR, Volberda HW (2007) The multifaceted nature of exploration and exploitation: Value of supply, demand, and spatial search for innovation. *Organ. Sci.* 18(1):20–38.
- Sidhu JS, Volberda NW, Commandeur HR (2004) Exploring exploration orientation and its determinants: Some empirical evidence. *J. Manag. Stud.* 41(6):913–932.
- Siggelkow N, Rivkin JW (2006) When exploration backfires: Unintended consequences of multilevel organizational search. *Acad. Manag. J.* 49(4):779–795.
- Simsek Z (2007) CEO tenure and organizational performance: An intervening model. *Strateg. Manag. J.* 28(6):653–662.
- Simsek Z, Heavey D, Veiga JF, Souder D (2009) A typology for aligning organizational ambidexterity's conceptualizations, antecedents, and outcomes. *J. Manag. Stud.* 46(5):864–894.
- Sirmon DG, Hitt MA, Ireland RD, Gilbert BA (2011) Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *J. Manag.* 37(5):1390–1412.

- Sitkin SB, Weingart LR (1995) Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity. *Acad. Manag. J.* 38(6):1573–1592.
- Smith KG, Grimm CM, Gannon MJ, Chen M-J (1991) Organizational information processing, competitive responses, and performance in the U.S. domestic airline industry. *Acad. Manag. J.* 34(1):1–26.
- Smith WK (2014) Dynamic decision making: A model of senior leaders managing strategic paradoxes. *Acad. Manag. J.* 57(6):1592–1623.
- Smith WK, Tushman ML (2005) Managing strategic contradictions: A top management model for managing innovation streams. *Organ. Sci.* 16(5):522–536.
- Sorensen JB, Stuart TE (2000) Aging, obsolescence, and organizational innovation. *Admin. Sci. Quart.* 45(1):81–112.
- Srinivasan R, Haunschild P, Grewal R (2007) Vicarious learning in new product introductions in the early years of a converging market. *Manag. Sci.* 53(1):16–28.
- Staw BM, Sandelands LE, Dutton JE (1981) Threat rigidity effects in organizational behavior: A multilevel analysis. *Admin. Sci. Quart.* 26(4):501–524.
- Stettner U, Lavie D (2014) Ambidexterity under scrutiny: Exploration and exploitation via internal organization, alliances, and acquisitions. *Strateg. Manag. J.* 35(13):1903–1929.
- Szulanski G (2003) *Sticky Knowledge: Barriers to Knowing in the Firm* (Sage, Thousand Oaks, CA).
- Tuncdogan A, Van den Bosch FAJ, Volberda HW (2015) Regulatory focus as a psychological micro-foundation of leaders' exploration and exploitation activities. *Leadersh. Quart.* 26(5):838–850.
- Virany B, Tushman ML, Romanelli E (1992) Executive succession and organization outcomes in turbulent environments: An organization learning approach. *Organ. Sci.* 3(1):72–91.
- Voss GB, Sirdeshmukh D, Voss ZG (2008) The effects of slack resources and environmental threat on product exploration and exploitation. *Acad. Manag. J.* 51(1):147–164.
- Wangrow DB, Schepker DJ, Barker VL III (2015) Managerial discretion: An empirical review and focus on future research directions. *J. Manag.* 41(1):99–135.
- Weick KE, Quinn RE (1999) Organizational change and development. *Annu. Rev. Sociol.* 50(1):361–386.
- Westphal JD (1999) Collaboration in the boardroom: Behavioral and performance consequences of CEO-board social ties. *Acad. Manag. J.* 42(1):7–24.
- Westphal JD, Zajac EJ (1995) Who shall govern? CEO/board power, demographic similarity, and new director selection. *Admin. Sci. Quart.* 40(1):60–83.
- Wiersema MF, Bantel KA (1992) Top management team demography and corporate strategic change. *Acad. Manag. J.* 35(1):91–121.
- Wilden R, Hohberger J, Devinney TM, Lavie D (2018) Revisiting James March (1991): Whither exploration and exploitation? *Strateg. Organ.* 16(3):352–369.
- Wu S, Levitas E, Priem RL (2005) CEO tenure and company invention under differing levels of technological dynamism. *Acad. Manag. J.* 48(5):859–873.
- Yadav MS, Prabhu JC, Chandy RK (2007) Managing the future: CEO attention and innovation outcomes. *J. Mark.* 71(4):74–101.
- Zajac EJ (1990) CEO selection, succession, compensation and firm performance: A theoretical integration and empirical analysis. *Strateg. Manag. J.* 11(3):217–230.
- Zajac EJ, Westphal JD (1996) Who shall succeed? How CEO/board preferences and power affect the choice of new CEOs. *Acad. Manag. J.* 39(1):64–90.
- Zhang Y, Rajagopalan N (2003) Explaining new CEO origin: Firm versus industry antecedents. *Acad. Manag. J.* 46(3):327–338.

TABLES AND FIGURES

TABLE 1: Descriptive Statistics and Pairwise Correlations (N = 1,283)

Variable	Mean	Std.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Firm exploration _{t+1}	0.47	0.31																			
2 Firm exploration	0.49	0.32	0.36																		
3 Firm size	0.26	1.02	-0.07	-0.06																	
4 Firm age	12.25	7.77	0.00	-0.01	0.08																
5 Firm R&D intensity	0.22	0.22	-0.09	-0.04	-0.12	-0.13															
6 Product lifecycle	3.03	1.78	-0.04	-0.07	0.07	0.54	-0.09														
7 Exploration alliances	0.44	0.33	-0.04	-0.04	0.09	-0.07	0.03	0.01													
8 Performance gap	-0.07	1.40	0.01	-0.00	0.01	0.03	-0.21	0.01	-0.00												
9 Firm exploration experience	0.54	0.27	0.29	0.32	-0.08	-0.04	0.03	-0.09	0.01	-0.00											
10 Industry exploration experience	0.51	0.04	-0.01	0.09	-0.03	-0.04	0.02	-0.08	0.01	-0.01	-0.00										
11 Competitive pressure	57.58	41.79	-0.16	-0.15	0.29	0.14	-0.02	0.21	0.14	0.02	-0.21	-0.25									
12 CEO tenure	5.64	6.29	-0.00	-0.00	0.09	0.36	-0.15	0.08	-0.11	0.02	-0.04	0.07	0.01								
13 CEO duality	0.62	0.48	-0.04	-0.04	0.06	0.01	-0.08	-0.04	-0.02	-0.00	-0.02	0.04	0.02	0.26							
14 CEO origin (insider)	0.62	0.49	0.03	0.01	0.04	-0.09	-0.02	-0.22	-0.05	0.01	0.02	0.07	-0.13	0.30	0.25						
15 CEO managerial experience	2.30	4.17	0.01	-0.01	-0.01	-0.01	0.04	0.02	0.09	-0.00	-0.03	-0.04	0.09	-0.19	-0.09	-0.18					
16 CEO salary	0.20	0.18	0.01	-0.00	0.32	0.23	-0.11	0.20	0.10	0.02	-0.03	-0.15	0.32	0.12	0.09	-0.00	0.03				
17 CEO stock ownership	0.06	0.12	0.05	0.04	-0.03	0.08	-0.11	-0.00	-0.09	0.03	0.01	-0.08	0.03	0.35	0.12	0.23	-0.11	0.07			
18 CEO stock options	8.66	72.60	-0.03	-0.03	0.18	-0.02	-0.06	-0.01	0.03	0.01	-0.07	-0.04	0.12	0.03	0.05	0.03	0.02	0.23	0.02		
19 CEO risk propensity	1.56	0.40	-0.09	-0.13	0.10	0.07	-0.07	0.14	0.11	-0.01	-0.10	-0.16	0.28	-0.11	-0.03	-0.11	0.11	0.15	0.00	0.15	
20 λ product introduction	0.10	1.05	-0.19	-0.22	0.22	0.21	-0.09	0.32	0.13	0.01	-0.28	-0.05	0.43	0.04	0.06	-0.09	0.05	0.33	-0.08	0.05	0.20

Correlations larger than 0.06 in absolute value are significant at the 5% level.

TABLE 2. First-Stage Probit Model for Product Introduction

Dependent variable: Product introduction in year t+1	
Firm size	4.26 (2.89)
Firm age	-0.05 (0.05)
Firm R&D intensity	-0.02 (0.05)
Firm solvency	0.13 [†] (0.07)
Product lifecycle	-0.03 (0.07)
Product experience	0.95** (0.36)
Alliances formed	0.65** (0.23)
Acquisitions	0.03 (0.09)
Foreign market subsidiaries	-0.17** (0.07)
Performance gap	0.08 (0.17)
Competitive pressure	0.19* (0.09)
Constant	2.36*** (0.37)
N firm-years (N selected)	1,561 (1,426)
Pseudo R ²	0.178
Wald χ^2	66.57***

Standardized coefficients. Standard errors clustered at the firm. Significance levels: [†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

TABLE 3: Results of Fixed-Effects Panel Model Predicting Firm Exploration

Firm exploration _{t+1}	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
CEO risk propensity			0.10 [†]	0.05	0.11*	0.05	-0.09	0.07	0.09 [†]	0.05	0.11*	0.05	0.10 [†]	0.05	-0.09	0.07
CEO risk propensity × CEO tenure					0.10*	0.05									-0.05	0.10
CEO risk propensity × CEO duality							0.34***	0.08							0.32***	0.09
CEO risk propensity × CEO origin									0.13*	0.05					0.11	0.11
CEO risk propensity × Firm exploration experience											-0.15**	0.05			-0.13**	0.05
CEO risk propensity × Competitive pressure													0.09*	0.04	0.09*	0.04
Firm fixed effects	Included		Included		Included		Included		Included		Included		Included		Included	
Firm exploration	-0.39***	0.04	-0.39***	0.04	-0.39***	0.04	-0.39***	0.03	-0.39***	0.04	-0.40***	0.04	-0.39***	0.04	-0.40***	0.04
Firm size	-0.02	0.04	-0.01	0.04	-0.01	0.04	-0.01	0.04	-0.01	0.04	-0.01	0.04	-0.02	0.04	-0.02	0.04
Firm age	-0.98**	0.35	-1.08**	0.36	-1.07**	0.36	-1.11***	0.35	-1.05**	0.36	-1.07**	0.36	-1.04**	0.36	-1.05**	0.35
Firm R&D intensity	-0.13**	0.05	-0.13**	0.05	-0.13**	0.05	-0.13**	0.05	-0.14**	0.05	-0.14*	0.05	-0.13**	0.05	-0.14**	0.05
Product lifecycle	0.32*	0.15	0.33*	0.15	0.32*	0.15	0.36*	0.15	0.31*	0.15	0.31*	0.15	0.32*	0.15	0.31*	0.15
Exploration alliances	0.00	0.03	-0.00	0.03	-0.00	0.03	-0.01	0.03	-0.00	0.03	-0.01	0.03	-0.00	0.03	-0.01	0.03
Performance gap	-0.04 [†]	0.02	-0.04 [†]	0.02	-0.04 [†]	0.02	-0.04 [†]	0.02	-0.04 [†]	0.02	-0.05*	0.02	-0.04 [†]	0.02	-0.05*	0.02
Firm exploration experience	-0.33***	0.07	-0.31***	0.07	-0.31***	0.07	-0.30***	0.07	-0.32***	0.07	-0.38***	0.07	-0.31***	0.07	-0.37***	0.07
Industry exploration experience	-0.02	0.03	-0.02	0.03	-0.01	0.03	-0.01	0.03	-0.02	0.03	-0.02	0.03	-0.02	0.03	-0.01	0.03
Competitive pressure	-0.04	0.07	-0.04	0.07	-0.04	0.07	-0.06	0.07	-0.04	0.07	-0.06	0.07	-0.04	0.07	-0.07	0.07
CEO tenure	-0.12 [†]	0.06	-0.12 [†]	0.06	-0.15*	0.06	-0.14*	0.06	-0.15*	0.06	-0.13*	0.06	-0.16*	0.07	-0.18**	0.07
CEO duality	0.03	0.09	0.03	0.09	0.02	0.09	-0.07	0.09	0.03	0.09	0.03	0.09	0.04	0.09	-0.05	0.09
CEO origin (insider)	0.04	0.11	0.03	0.11	0.03	0.11	0.03	0.11	0.05	0.11	0.02	0.11	0.02	0.11	0.04	0.11
CEO managerial experience	0.07	0.05	0.07	0.05	0.08	0.05	0.07	0.05	0.08	0.05	0.07	0.05	0.08	0.05	0.08	0.05
CEO salary	-0.02	0.05	-0.02	0.05	-0.02	0.05	-0.00	0.05	-0.02	0.05	-0.02	0.05	-0.02	0.05	-0.00	0.05
CEO stock ownership	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.06	0.05
CEO stock options	0.04	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.02	0.04	0.03	0.04	0.01	0.04
λ product introduction	0.08	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.07	0.09	0.08	0.09	0.08	0.09
Constant	-0.05	0.07	-0.06	0.07	-0.04	0.07	0.01	0.07	-0.06	0.07	-0.07	0.07	-0.06	0.07	-0.01	0.07
AR(1) parameter	0.31		0.31		0.31		0.32		0.31		0.32		0.31		0.32	
N firm-years	1,064		1,064		1,064		1,064		1,064		1,064		1,064		1,064	
Number of firms	219		219		219		219		219		219		219		219	
F	8.35***		8.12***		7.93***		8.85***		8.00***		8.29***		7.95***		8.08***	
R ²	0.400		0.401		0.402		0.406		0.403		0.404		0.402		0.411	

Standardized coefficients. Significance levels: [†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

FIGURE 1: Product Introductions of the Sampled Firms During 1990–2000

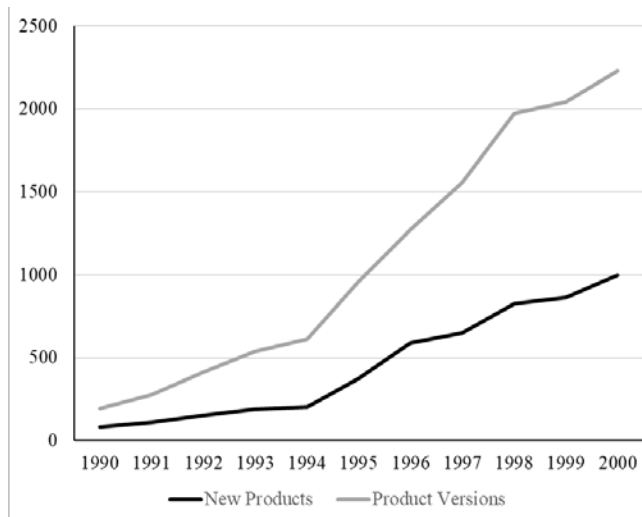


FIGURE 3: Firm Exploration Level by CEO Risk Propensity and CEO Duality

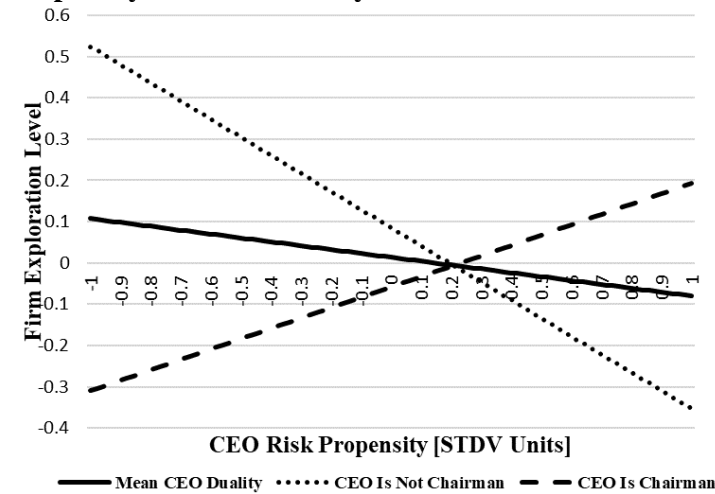


FIGURE 5: Firm Exploration Level by CEO Risk Propensity and Firm Exploration Experience

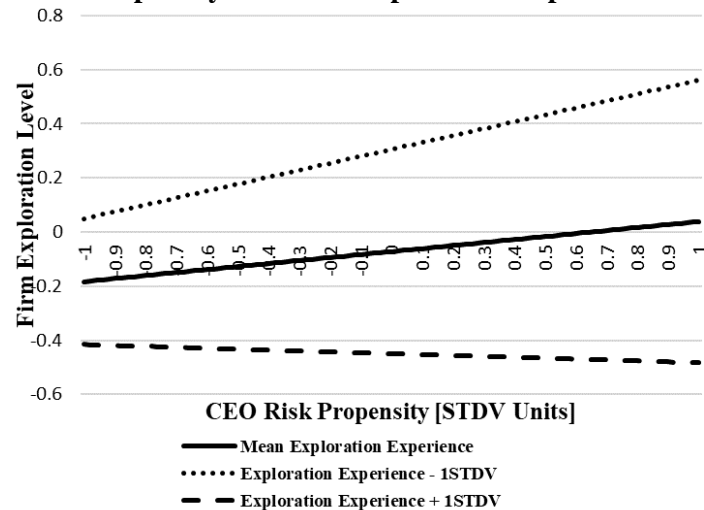


FIGURE 2: Firm Exploration Level by CEO Risk Propensity and CEO Tenure

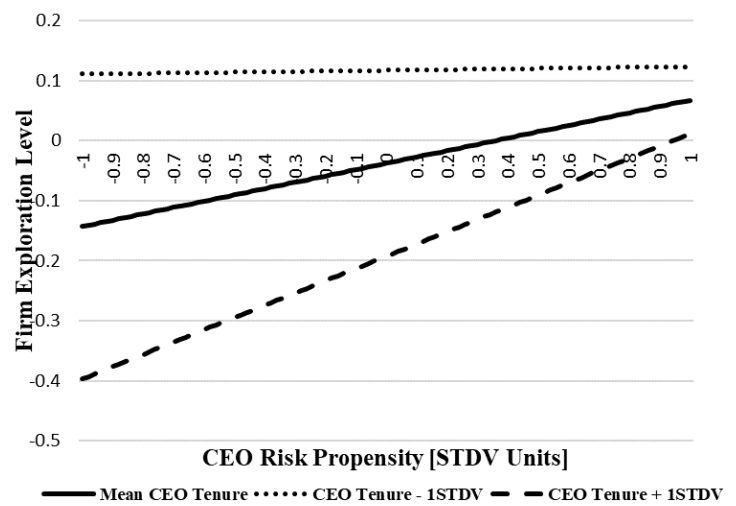


FIGURE 4: Firm Exploration Level by CEO Risk Propensity and CEO Insider

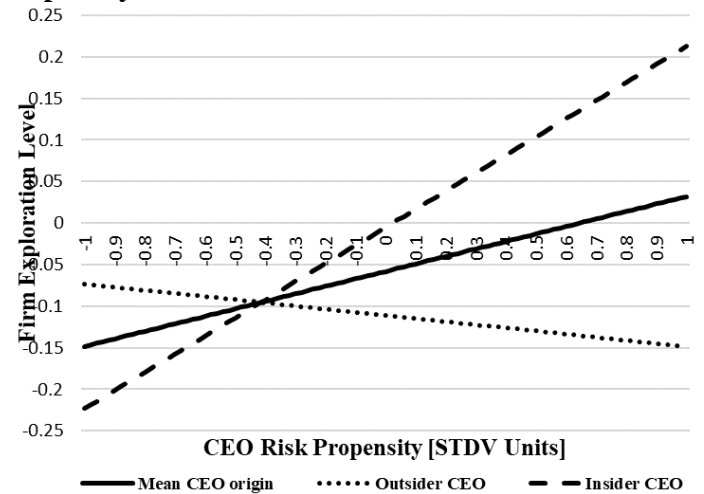
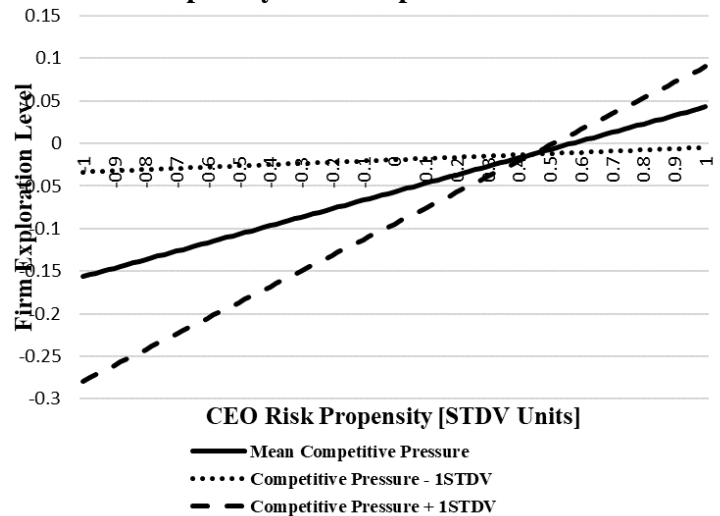


FIGURE 6: Firm Exploration Level by CEO Risk Propensity and Competitive Pressure



APPENDIX: Dictionary of Risk-Propensity Words

Risk-aversion words

avoid*
careful*
cautious*
charily
chary
conserve*
cower*
discourag*
dither*
eschew*
guarantee*
guard*
hesitant
hesitat*
insecure*
keep* away from
maintain*
meticulous
plan*
play* safe
preserv*
protect*
prudent
refrain*
reluctan*
resist*
retain*
safe*
scrupulous*
secur*
shield*
shun* away from
sidestep*
stabiliz*
stay* away from
stay* clear from
sustain*
think* through
turn* away
vigilant

Risk-seeking words

adventur*
alter*
bold
brave
careless*
courageous*
danger
daring
dauntless
defy*
enterpris*
explor*
fearless*
gambl*
has the guts
hazard
heedless*
improvis*
imprudent*
intrepid*
menace
modif*
opportunit*
peril
pioneer*
prospect
rash*
reckless*
risk*
seize
speculat*
take a chance
unafraid
unconcern*
uncontrol*
unsafe
valiant
wager