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Dynamic managerial capabilities and R&D spending:

The role of CEO founder status

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Abstract

Today's hypercompetitive economy challenges chief executive officers (CEOs) to make complex yet integral investments in research and development (R&D). Although research has widely discussed R&D spending due to its implications for competitive advantage, it omits whether and how managers' dynamic capabilities materialize in these long-term investment decisions. This study builds on dynamic managerial capability (DMC) theory to argue that strong managerial-level dynamic capabilities increase R&D spending by improving the capacities of CEOs to sense opportunities and threats, seize them, and reconfigure organizational resources. CEO founder status is additionally proposed as a moderator of this relationship, as founder CEOs differ from professional CEOs in their investment behavior. The results reveal that DMCs only compositely contribute to R&D investments, while the DMC subcomponents—except for managerial social capital—exert no isolated effects. This study also finds that founder CEOs realize higher R&D investments through their DMCs than their professional counterparts.

Keywords

Dynamic managerial capabilities; founder CEOs; innovation; managerial cognition; managerial human capital; managerial social capital; R&D spending

1 Introduction

Sufficient investments in research and development (R&D) have long been recognized as the foundation for developing and sustaining competitive advantage (Barker and Mueller 2002; Rosenbusch et al. 2011). Steady R&D investments are necessary to facilitate the vital development of knowledge and convert this knowledge into commercializable innovation (Sciascia et al. 2015; M. Wang et al. 2022). Due to growing competitive pressures and the constant emergence of new technologies, R&D investments are even more integral in sustaining firms' innovative capacities in an age of hypercompetition, characterized by significant volatility, uncertainty, complexity, and ambiguity (Caloghirou et al. 2022; Heij et al. 2020; C. Wang et al. 2022).

The chief executive officer (CEO) is a firm's single most influential strategic architect (Wasserman 2003) and is also responsible for making fundamental R&D investment decisions (Barker and Mueller 2002; Silberzahn and Arregle 2019). Therefore, the level of R&D investment expresses the effort and commitment of a firm's CEO toward innovation (Ahuja et al. 2008; Lim 2015). Although allocating resources toward R&D is inherently risky, failure-prone, and detrimental to short-term performance (Baysinger et al. 1991; Klein and Sorra 1996), high investment levels are an essential prerequisite to developing and sustaining competitive advantage (Caloghirou et al. 2022; Rosenbusch et al. 2011). Therefore, the mounting competitive pressures of today's globalized digital economy make R&D investment decisions an increasingly challenging, albeit central, managerial task (Acciarini et al. 2021; Martin and Bachrach 2018; Yu et al. 2022).

Studies on R&D spending predominantly employ a firm-level perspective (Ahuja et al. 2008), thereby neglecting the actual agents of organizational change: individuals and their unique capabilities (Augier and Teece 2009; Felin and Foss 2005). Even though the individual-level capabilities of CEOs have significantly increased in their significance for

competitive advantage (Teece 2007a, 2007b), and research has started to adopt a micro-level perspective on organizational change (e.g., Åberg and Torchia 2020; Heubeck and Meckl 2022a, 2022b; Holzmayer and Schmidt 2020), the literature still lacks a comprehensive microfoundational theoretical framework for empirically analyzing the effects of individual-level capabilities on critical firm-level decisions underlying competitive advantage, such as R&D spending (Leão and da Silva 2021; Wrede et al. 2020). This research gap is alarming in the face of the need to understand the specific managerial capabilities integral for initiating and realizing strategic change in the current marketplace (Balakrishnan and Das 2020; Fernandez-Vidal et al. 2022; Fuel et al. 2022).

In addressing this research gap, this article builds on Adner and Helfat's (2003) dynamic managerial capability (DMC) theory to propose that CEOs vary in their ability to drive strategic change. According to DMC theory, differences in firm-level outcomes can be attributed to strategic decision-making variances originating from top managers' individual-level dynamic capabilities (DCs) (Helfat and Martin 2015a). Nevertheless, today's radically transformed economy represents a fundamentally new decision-making context that may necessitate significantly different managerial capabilities (Heubeck 2023; Wrede et al. 2020). Existing research lacks an in-depth understanding of the specific capabilities CEOs need to handle the ever-growing complexities of the globalized digital economy. This article addresses a critical research gap within the literature by examining the role of DMC in today's radically transformed economy. Thus, this article revives DMC theory to empirically test whether and to what extent its theoretical propositions are still valid.

To address this research gap, this study will argue that superior DMCs cause increased R&D investments. Specifically, these capabilities ensure that CEOs possess the necessary capabilities for sensing opportunities and threats, seizing identified commercial potential, and reconfiguring organizational resources efficiently and timely (Heubeck and

Meckl 2022b; Teece 2007a; Wach et al. 2022). Therefore, DMCs are proposed as an essential coping mechanism for CEOs to handle the increased complexities of a globalized digital economy (Firk et al. 2021; Verhoef et al. 2021). In summary, this study's first aim is to address the need for scientific inquiry into the managerial capabilities required to develop competitive advantages in a globalized digital economy (Fernandez-Vidal et al. 2022; Wrede et al. 2020). For this purpose, this study will assess whether CEOs with higher DMC levels allocate more resources toward R&D.

Even though CEOs impersonate a firm's principal strategic architect (Wasserman 2003), they differ in their predisposition to pursue innovation due to heterogeneities in their financial and psychological attachment to the firm as well as their underlying personalities (Hambrick 2015; Lee et al. 2020). As default entrepreneurs, founder CEOs are intrinsically risk-seeking, motivated, and committed to a firm's long-term goals (Deb and Wiklund 2017; Fahlenbrach 2009). The literature has widely discussed the effects of founder CEOs on organizational outcomes. Research demonstrates that founder-led firms differ from agent-led firms on central organizational factors, among them their decision-making that underlies critical investment choices, such as R&D spending (e.g., Deb and Wiklund 2017; Fahlenbrach 2009; Lee et al. 2020). Superior DMCs of founder CEOs may consequently cause even higher levels of R&D spending compared to those of their professional counterparts. To the best of the authors' knowledge, no study considers the contingency effect of CEO founder status in the context of DMC theory. This represents a significant void in the literature because founder CEOs might be more inclined to deploy their DMCs to foster the firm's R&D spending due to their unique characteristics.

The remainder of the article is structured as follows. Section 2 outlines the theoretical background, serving as the basis for the hypotheses development in Section 3. Section 4 describes the research methodology, and Section 5 presents the study's results. Section 6

discusses the empirical findings, from which theoretical and practical implications are derived. The sixth section finishes with a discourse on research limitations, from which future research directions are deduced. The article ends with a conclusion in Section 7.

2 Theoretical background and hypothesis development

2.1 DMC theory

As an outgrowth of firm-level dynamic capabilities (DCs) theory (e.g., Teece 2007a; Teece et al. 1997), DMC theory highlights the role of individual-level managerial DCs as determinants of the executive ability to "build, integrate, and reconfigure organizational resources and competences" (Adner and Helfat 2003, p. 1012). According to this micro-level perspective on strategic change, managers are a firm's primary decision-making entity responsible for designing and realizing organizational strategies (Adner and Helfat 2003; Helfat and Martin 2015a). Managers must consequently be proficient leaders—efficiently realizing organizational strategies—as well as visionary entrepreneurs—identifying, analyzing, and judging the commercial potential of emerging opportunities (Teece 2007a, 2012, 2016).

DMC theory attributes firm-level heterogeneities to differences in the managerial ability to sense and shape emerging opportunities or threats (*sensing)*, seize opportunities or react to threats (*seizing*), and transform a firm's resource portfolio (*reconfiguring*). More specifically, the capability of sensing involves assessing the environment by acquiring, filtering, and interpreting information to create an abstraction of emerging technologies, new customer demands, and changing market conditions. Previously identified opportunities that align with the firm's strengths and are relevant for ensuring competitiveness are subsequently translated into new products, processes, or services by allocating appropriate resources during the seizing process. Finally, reconfiguration is concerned with realizing organizational

change by developing, complementing, protecting, and recombining a firm's resources (Teece 2007a). To the extent that these capabilities are valuable, rare, inimitable, and nonsubstitutable, they engender competitive advantage (Adner and Helfat 2003; Helfat and Martin 2015a).

Three interdependent subcomponents, which develop from a manager's innate abilities and past experiences, underpin DMCs: managerial human capital, social capital, and cognition. These subcomponents, individually and through their interactions, cause differences in organizational behaviors, strategies, and subsequent performance (Adner and Helfat 2003; Martin 2011). DMC theory is particularly suitable for studying innovation due to focalizing the agency of individual managers (George et al. 2022; Huy and Zott 2019).

2.2 The effects of DMCs on R&D spending

The following sections derive the hypotheses related to the first research question by proposing the mechanisms through which DMCs and their three subcomponents directly affect R&D investments. Based on these arguments, the study develops four additional hypotheses by proposing CEO founder status as a moderator of the DMC–R&D spending relationship. Figure 1 summarizes the research model.

[INSERT FIGURE 1 ABOUT HERE]

2.2.1 Managerial human capital and R&D spending

The first DMC subcomponent, *managerial human capital*, contains the skillset that develops from formal and informal training, such as education and learning-by-doing (Adner and Helfat 2003; Becker 1983; Castanias and Helfat 2001). Human capital theory distinguishes between two main human capital types according to their applicability and

transferability between firms. *General human capital* is the most broadly applicable type, acquired through formal education or generic work experience, making it readily transferrable between firms or industries. In contrast, managers generate *firm-specific human* capital during their organizational tenure. These firm-specific skills, such as organizational knowledge or routines, are closely tailored to the requirements of this particular organization. Firm-specific human capital consequently possesses minimal or no value outside of the organization in which it is developed (Becker 1983; Castanias and Helfat 1991, 2001). Although human capital theory initially proposed that only firm-specific types can lead to competitive advantage (Durán et al. 2022), recent research shows that both human capital types may infer competitive advantages (e.g., Campbell et al. 2012).

The effect of managerial human capital on innovation has been extensively studied, although mostly in isolation (George et al. 2022). Research generally demonstrates that higher levels of human capital induce greater creativity and openness toward innovation in managers (e.g., Bantel and Jackson 1989; Kimberly and Evanisko 1981). Nevertheless, recent research that explicitly considers today's transformed decision-making context finds that middle and top managers' human capital is not directly beneficial for innovation (Heubeck and Meckl 2022b) and that not all types of human capital benefit digital business model transformation (Heubeck 2023).

This study conjectures that strong DMCs of CEOs are beneficial for R&D spending because they improve the ability of the firm's primary strategic architect to sense opportunities, seize their commercial potential, and appropriately reconfigure the firm's resource portfolio. Due to their hierarchical position, it is presumed that CEOs with strong DMCs have the authority to realize high R&D spending. First, in sensing opportunities, superior human capital allows CEOs to identify a broader range of realizable R&D opportunities (Bock et al. 2012; Helfat and Martin 2015b, 2015a). In seizing opportunities,

CEOs utilize human capital to cope with the uncertainties of the innovation process (Helfat and Martin 2015b; Tasheva and Nielsen 2022) and efficiently allocate resources toward R&D (Sirmon and Hitt 2009). Finally, CEOs with high human capital levels possess the necessary capabilities to ensure the alignment between internal resource endowments and changing external demands, which is particularly critical for sustained competitive advantage in today's hypercompetitive economy (Helfat and Martin 2015b; Heubeck and Meckl 2022b). Altogether, managerial human capital is an essential component underlying the superordinate DMC concept, as it determines the proficiency of CEOs in orchestrating and deploying a firm's resource portfolio (Adner and Helfat 2003; Helfat and Martin 2015a). These arguments conclude that superior human capital will likely allow CEOs to realize increased R&D spending. Thus, in assessing the research model depicted in Figure 1, the first hypothesis is proposed as follows:

Hypothesis 1a: CEOs with superior managerial human capital realize higher levels of R&D investment.

2.2.2 Managerial social capital and R&D spending

The second DMC subcomponent, *managerial social capital*, reflects the network ties rooted in formal and informal relationships that develop through social interactions over time. Social capital infuses goodwill between actors, leading to increased trust, power, reciprocity, and information sharing within the network that may infer competitive advantages (Adler and Kwon 2002; Adner and Helfat 2003). The literature distinguishes between two types of social capital. First, *internal social capital* accrues from social relationships within the firm and infers greater power and influence, allowing managers to access information and utilize capabilities spread across different hierarchical levels or functional areas (Adner and Helfat 2003). Second, *external social capital* provides access to valuable firm-external information

and resources, which may benefit the entire strategic decision-making process (Geletkanycz and Hambrick 1997). While the two types of social capital differ in their characteristics, location, and effects, both function as "a magnifier of one's own individual resources" (Beck and Wiersema 2013, p. 412), allowing managers to harness otherwise inaccessible resources and capabilities (Adner and Helfat 2003). Research provides strong evidence for the integrality of social capital for innovation, as it increases communication and resource exchange (e.g., Gant et al. 2002; Johnson et al. 2013; Presutti et al. 2022; Tsai and Ghoshal 1998). However, social capital may also have a detrimental side (Adler and Kwon 2002; Alguezaui and Filieri 2010). For example, Edelman et al. (2004) find that social capital hinders managers from considering discontinuous information and engaging in exploration. Social capital might consequently be a dual-edged sword for organizations. Nevertheless, it remains integral for "the search and discovery of valuable information that is otherwise difficult to obtain" (Edelman et al. 2004, p. S67).

In the subsequent section, it will be argued that the social capital of CEOs may affect the level of R&D investments. In sensing opportunities and threats, social capital is a conduit for acquiring and recombining complementary information critical for innovation (Cohen and Levinthal 1989; Gant et al. 2002; Kogut and Zander 1992). Both forms of social capital enhance information sharing that improves opportunity identification and reduces decision-making uncertainties: internal social capital drives information exchange by initiating the development of collaboration, confidence, and cohesion within the firm (Alguezaui and Filieri 2010; Manev et al. 2005; Presutti et al. 2022), while external social capital allows CEOs to tap into external knowledge, informing their sensing process with valuable information about unidentified opportunities and the best practices of other firms (Geletkanycz and Hambrick 1997; Peng and Luo 2000). Social capital, therefore, serves as a conduit for efficiently acquiring reliable information that is relevant and valuable for strategic

decision-making (Kemper et al. 2013; Nahapiet and Ghoshal 1998). Further, opportunity seizing benefits from higher social capital levels, as they facilitate information exchange and provide support for realizing R&D projects (Alguezaui and Filieri 2010; Geletkanycz and Hambrick 1997; Martin and Bachrach 2018). Finally, superior social capital infers greater power and legitimacy, giving CEOs greater discretion in reconfiguring resources necessary for facilitating R&D projects (Adler and Kwon 2002; Nahapiet and Ghoshal 1998).

Innovation is an inherently social process requiring the continuous recombination of resources to develop new value offerings (Landry et al. 2002; Ruiz-Moreno et al. 2008). Therefore, social capital may significantly impact R&D spending by determining the availability of resources and capabilities required for making and implementing these strategic decisions (Adner and Helfat 2003; Nahapiet and Ghoshal 1998). Higher levels of social capital will consequently make CEOs more inclined to allocate resources toward R&D. More formally:

Hypothesis 1b: CEOs with superior managerial social capital realize higher levels of R&D investment.

2.2.3 Managerial cognition and R&D spending

Managerial cognition constitutes the third DMC subcomponent (Adner and Helfat 2003). Cognitive management research proposes that heterogeneities in firm-level outcomes originate from executive decision-making processes (Helfat and Peteraf 2015; Manesh et al. 2022; Walsh 1995). Managerial cognition contains two distinct components that influence decision-making: (1) *cognitive processes*, which refer to the mechanisms individuals use to recognize, filter, interpret, and store information, and (2) *cognitive structures*, which are simplified mental templates that infuse structure and meaning (Neisser 1976; Schneider and Angelmar 1993; Walsh 1995).

Managers primarily draw on an automatic processing mode, in which they interpret information by relating it to their previous experiences in similar situations (Busenitz and Barney 1997; Walsh 1995), in order to cope with the inherent limitations of cognitive capacities and the mounting pressures for swift decision-making (Heubeck and Meckl 2022a; Manesh et al. 2022; Puglisi et al. 2022; Vlačić et al. 2022). Thus, automatic processing facilitates decision-making speed by reducing the complexity and quantity of information (Gioia 1986; Tripsas and Gavetti 2000; Walsh 1995). At the same time, this processing mode can severely bias decision-making by causing information search that is informed by "impoverished views of the world" (Gioia 1986, p. 346). Therefore, managers reach the majority of strategic decisions by interpreting a limited amount of information while ignoring unfamiliar information or adopting simplified worldviews that may bias decision-making (Busenitz and Barney 1997; Gioia 1986; Simon 1991).

Managerial cognition significantly influences sensing, seizing, and reconfiguring by serving as the cognitive basis for R&D-related decision-making (Tripsas and Gavetti 2000; Vlačić et al. 2022; Walsh 1995). First, in sensing opportunities and threats, managerial cognition determines which information managers attend to and how they screen, interpret, and store it (Gioia 1986; Tripsas and Gavetti 2000; Walsh 1995). The intricate nature of today's hypercompetitive environment pressures CEOs to continually realign their existing cognitions to transformed circumstances (Abatecola et al. 2022; Heubeck and Meckl 2022a). Thus, besides determining a CEO's information processing capacities, managerial cognition also governs the flexibility of cognitive processes and structures (Helfat and Martin 2015b; Tripsas and Gavetti 2000; Walsh 1995). This cognitive adaptability is integral in sensing, seizing, and reconfiguring activities, in which CEOs need to break with the status quo and overcome change-inhibiting path dependencies (Garud et al. 2010; Saebi et al. 2017; Sassetti et al. 2022).

Managerial cognition shapes the cognitive abilities of CEOs required for sensing, seizing, and reconfiguration activities. High levels of cognition are consequently integral to continually realigning internal cognitions with external requirements (Sassetti et al. 2022; Tripsas and Gavetti 2000; Walsh 1995). Based on these arguments, CEOs with superior cognitive abilities will likely contribute to higher firm-level R&D spending. They are more skilled at sensing opportunities and threats, seizing commercial potential, and appropriately reconfiguring a firm's resource portfolio to execute organizational strategies. More formally:

Hypothesis 1c: CEOs with superior managerial cognition realize higher levels of R&D investment.

2.2.4 DMCs and R&D spending

Differences in R&D investments between firms are also likely to be caused by the interactions between the DMC subcomponents, as these individual-level DCs represent "the expertise and human capital required in decision making, the social capital that provides the relevant information, and the cognition that creates biases in the actions taken" (Adner and Helfat 2003, p. 1022).

First, more significant human capital improves social capital, as highly skilled CEOs are more attractive as relationship partners and in greater demand to serve as directors in other firms (Castanias and Helfat 2001). In turn, social capital enhances human capital by increasing information exchange that benefits learning (Adner and Helfat 2003; Cohen and Levinthal 1990; Geletkanycz and Hambrick 1997). Third, human capital and cognition also reinforce each other: previous experiences that underlie human capital are inherently linked to cognition, and cognition shapes learning processes by providing new knowledge required to update human capital (Adner and Helfat 2003; Hambrick and Mason 1984; Helfat and Martin 2015b). Finally, social capital and cognition interact in shaping DMCs. While social

capital informs decision-making processes with socially-constructed frames for interpreting information, managerial cognition influences the perceived importance of specific network actors (Helfat and Martin 2015a).

Based on these arguments, CEOs with superior DMCs are more inclined to foster higher levels of R&D investment, as they are generally more receptive toward risk-taking, develop more innovative ideas, and possess the abilities to develop and realize innovation (Helfat and Martin 2015a; Heubeck and Meckl 2022b; Wach et al. 2022). These arguments lead to the following hypothesis:

Hypothesis 1d: CEOs with superior DMCs realize higher levels of R&D investment.

2.3 Moderating effect of CEO founder status

As the epitome of the entrepreneur, founder CEOs are critical in managing many of today's most reputable firms, as illustrated by Facebook's Mark Zuckerberg and Amazon's Jeff Bezos (Hsu et al. 2020; Tang et al. 2016). Founder CEOs have unique relationships with their firm and are intrinsically motivated to pursue new opportunities, making them risk-seeking and proactive in their investment behaviors (Deb and Wiklund 2017; Jayaraman et al. 2000; Schuster et al. 2020). The differences between founder and nonfounder CEOs can be attributed to substantial heterogeneities in the "knowledge, values, and attitudes they bring to bear in managing the firm" (Souder et al. 2012, p. 24). Therefore, research in the upper echelons strand substantiates that CEO founder status causes differences in the decision-making process underlying R&D investments required to sustain competitive advantage by ensuring a firm's current and future innovative capacities (e.g., Renée Adams et al. 2009; Barker and Mueller 2002; Duran et al. 2016; Schuster et al. 2020).

Based on this general line of reasoning, and as depicted in the research model in Figure 1, CEO founder status is expected to moderate the DMC–R&D spending relationship. First, founder CEOs have a significant psychological and financial attachment to their firm, amplified by the increased reputational stakes attached to the performance of founder-led firms (Jayaraman et al. 2000). Thus, founder CEOs are more long-term oriented in their decision-making and persistent in pursuing uncertain projects, such as innovation (Renée Adams et al. 2009; Pryor et al. 2019). Second, founder CEOs are more risk-seeking and have a greater desire for achievement (Busenitz and Barney 1997; Deb and Wiklund 2017; Jayaraman et al. 2000), demonstrating "intense, prolonged and repeated efforts to accomplish something difficult" (Murray and McAdams 2007, p. 164). Third, founder CEOs tend to have significantly more power and influence within their firm than professional CEOs (R. B. Adams et al. 2005; Fahlenbrach 2009; Gao and Jain 2012). For one, founder CEOs have greater structural and ownership power, owing to the CEO position and founder status, respectively (R. B. Adams et al. 2005; Buyl et al. 2011). Due to their long-term investment in the firm and their positive signal effect on outside parties, founder CEOs possess more significant expert and prestige power than professional CEOs (Deb and Wiklund 2017).

The differences between founder and nonfounder CEOs are likely to translate into the nature of their investment decisions. Research corroborates that founder CEOs are "more ambitious and motivated than nonfounder CEOs in pursuing long-term, value-maximizing strategies that involve investments in risky and innovative projects" (Deb and Wiklund 2017, p. 36), and empirically demonstrates that founder-led firms have significantly higher R&D investments (e.g., Duran et al. 2016; Fahlenbrach 2009; Schuster et al. 2020). These arguments are grounded in agency and entrepreneurship theories (Souder et al. 2012). R&D investments are particularly vulnerable to agency conflicts, making CEO founder status an essential coping mechanism to avoid agency costs and ensure goal alignment between

principals and agents (Hsu et al. 2020; Schuster et al. 2020). The unique characteristics of founder CEOs also seem particularly critical in today's hypercompetitive economy, allowing firms to realize their long-term vision of sustained competitive advantage (Jayaraman et al. 2000; Schuster et al. 2020), for which high levels of R&D spending are required to continually exploit emerging opportunities and be capable of reacting to nascent threats. In contrast, due to the inherent short-term performance detriments, high uncertainty, and resource-consuming nature of R&D investments, professional CEOs are likely to underinvest in R&D in order not to jeopardize their employment or personal wealth. Nonfounder CEOs, therefore, differ from founder CEOs in their risk preferences and prioritize short-term goals—both their personal as well as the organization's—over the actual long-term goals of the organization (Hsu et al. 2020; Souder et al. 2012; Wu et al. 2005).

In summary, the differences between founder CEOs and professional CEOs are likely to make founder CEOs more inclined to deploy their DMCs in realizing increased R&D spending. The idiosyncratic characteristics of CEOs underlying their innovation-related decision-making are relatively stable over time, as they are a fundamental part of an individual's personality (Chen et al. 2015; March and Shapira 1987). The differences between founder and nonfounder CEOs consequently prevail and may constitute a source of competitive advantage (Busenitz and Barney 1997; Lee et al. 2020). Thus, this study predicts:

Hypothesis 2a: CEO founder status positively moderates the managerial human capital–R&D spending relationship.

Hypothesis 2b: CEO founder status positively moderates the managerial social capital–R&D spending relationship.

Hypothesis 2c: CEO founder status positively moderates the managerial cognition–R&D spending relationship.

Hypothesis 2d: CEO founder status positively moderates the DMC–R&D spending relationship.

3 Research methodology and sample

3.1 Data collection and sample description

The study draws on data from NASDAQ 100 firms listed at least once in the index during 2021 to avoid potential survivorship bias (Brown et al. 1992). This procedure yielded an initial sample of 113 firms. After removing duplicates and acquired firms, 107 firms remained. Financial and CEO data were collected from Thomson Reuter's Refinitiv Eikon Database. Missing CEO data was manually researched by screening annual reports, proxy statements, and corporate websites, as well as third-party information sources, such as LinkedIn and Bloomberg (Seo et al. 2022).

Missing R&D expenditures were handled in the following way to avoid biasing the results by assigning pseudo-blank R&D firms—non-reporting R&D firms with existing innovation activities—with zero R&D spending (Koh and Reeb 2015). In a first step, annual reports were screened for explicit R&D spending disclosures or their implicit inclusion in other cost positions. Firms with no discernable R&D disclosure and no general mention of R&D spending in their annual report were considered non-innovators, and assigned with R&D expenditures of zero. Firms mentioning their efforts toward R&D, yet failing to report these expenditures transparently, were considered pseudo-blank R&D firms, for which missing R&D was replaced with the industry average (Koh and Reeb 2015). Finally, R&D spending was assessed on an industry level, excluding non-innovating industries in which R&D spending is not a critical success factor. The following industries were excluded from the analysis: NAICS 22 – Utilities Sector, NAICS 42 – Wholesale Trade, NAICS 72 –

Accommodation and Food Services, and NAICS 81 – Other Services (except Public Administration) (US Census Bureau 2022).

This procedure yielded a final sample of 74 firms with complete data. The study considered the CEO with the most time in office during the focal year when two individuals were appointed as CEOs (Quigley and Hambrick 2015). In case a firm implemented a co-CEO structure, both CEOs were included in the analysis because they share decision-making power and are jointly responsible for organizational outcomes (Arena et al. 2011).

3.2 Measurement of variables

3.2.1 Main variables

Following previous research (e.g., Richard Adams et al. 2006; Marlin and Geiger 2015), the dependent variable, *R&D intensity*, was measured as R&D expenditures to total sales.

The independent variable, *DMCs*, was operationalized by drawing on its three subcomponents. First, *managerial human capital* comprised two dimensions: (1) general human capital, representing the years of higher education, and (2) firm-specific human capital, reflecting the years of organizational tenure (Bailey and Helfat 2003; Herrmann and Datta 2005; Tabesh et al. 2019). Second, *managerial social capital* included (1) firm-internal social capital, proxied by the number of different top management positions within the firm, and (2) firm-external social capital, measured as the number of active or past directorates (Geletkanycz and Hambrick 1997; Kor and Sundaramurthy 2009; Tian et al. 2011; Wincent et al. 2009). Third, *managerial cognition* was operationalized on a ten-point scale capturing the field of education (technical, business, none of the two) and level of education (bachelor's, master's, or doctoral degree). Managers vary in their cognitions due to educational differences (Daellenbach et al. 1999; Rodenbach and Brettel 2012). Managers

with a technical background are more likely to examine R&D spending from a long-term perspective (Cummings and Knott 2018; Hayes and Abernathy 1980) and may generally have a greater propensity toward R&D due to their technical imprint (Barker and Mueller 2002; Marvel and Lumpkin 2007). Business education enhances R&D-related cognitions because dual-skilled CEOs can complement their technical knowledge with business expertise (Daellenbach et al. 1999). Dual-skilled CEOs possess a profound and diverse skillset, allowing them to proficiently interpret strategy-relevant information and understand the necessity for investing resources in R&D compared to their less-qualified counterparts (Daellenbach et al. 1999; Geletkanycz and Black 2001; Musteen et al. 2006). As summarized in Appendix 1, CEOs scoring highest on the cognitive capital scale have attained a high level of technical and business education. The independent variable *DMCs* represents the average score of the three DMC subcomponents.

The moderator, *CEO founder status*, was operationalized as a dummy variable (1 = CEO is a founder or founding member; 0 = otherwise) (Fahlenbrach 2009; Tang et al. 2016). The study draws on multiple information sources to ensure the validity of a CEO's founder status: (1) corporate websites and annual reports, (2) Google search queries using company name plus founder, and (3) third-party websites, such as LinkedIn, Bloomberg, Forbes, and Wikipedia (Lee et al. 2017).

3.2.2 Control variables

The research model considered additional variables at the individual, board, and firm levels as possible influences on R&D intensity. At the individual level, the model controlled for *CEO age*, *CEO gender*, *CEO compensation*, *CEO uncertainty avoidance*, and *CEO long-term orientation*. *CEO age* (focal year minus birth year) and *CEO gender* (dummy variable: 0 = male; 1 = female) were included due to causing differences in the risk-taking attitudes

between older and younger as well as male and female executives (Faccio et al. 2016; He et al. 2022; Rodenbach and Brettel 2012). *CEO compensation* was measured as the total yearly compensation (in one million US dollars), consisting of salary, annual bonus, restricted stock/option grants, and all other compensation (Frydman and Jenter 2010). CEO remuneration potentially affects R&D spending by shaping a CEO's risk propensity and time horizon (Wheatley and Doty 2010). The final two control variables at the individual level, *CEO uncertainty avoidance* and *CEO long-term orientation*, were included to account for a CEO's cultural background. Uncertainty avoidance captures the tolerance of culture members regarding unfamiliar situations, with high scores indicating that cultures can handle uncertainty (scaled from 0 to 100) (Hofstede et al. 2010). Long-term orientation measures whether cultures focus on the future (high scores) or the past and present (low scores) (Hofstede et al. 2010; Holzmayer and Schmidt 2020).

At the board level, the model controlled for *CEO duality*, *board size*, *board gender diversity*, and *board independence*. *CEO duality* was coded as a binary variable (1 = CEO is also chairman of the board; 0 = otherwise) (Kor 2006). Although research on CEO duality is inconsistent, its effect on strategic decision-making is undisputed (Dalton and Dalton 2011; Faleye 2007). Second, the model included *board size* measured as the total number of directors because differences in board size affect corporate governance efficacy (Coles et al. 2008; Pfeffer and Salancik 1978; Roffia et al. 2022). Third, *board gender diversity* captured the share of women directors. More female directors can improve decision-making by providing novel perspectives and different capabilities (Hillman et al. 2007; Miller and Del Carmen Triana 2009), yet can also reduce decision-making speed by causing increased risk aversion and group division (R. B. Adams and Ferreira 2004; Ryan and Haslam 2007). Finally, *board independence* was measured as the share of outside directors (Fama 1980). Theory and evidence regarding the advantageousness of board independence remain

contradictory: from an agency perspective, board independence benefits corporate governance (Hillman and Dalziel 2003), while from a resource-dependency perspective, outside directors enhance decision-making by providing valuable resources (Hillman et al. 2000).

At the firm level, the model controlled for *firm age*, *firm performance*, *firm size*, and *institutional ownership*. First, *firm age* captured the gradual formalization of organizational processes and increasing obsolescence of value offerings that may affect R&D spending over time (Audia and Greve 2006). *Firm performance,* measured as return on assets (Richard et al. 2009), causes differences in resource availability between more and less profitable firms (Bourgeois 1981). Third, the model included *firm size*, measured as the natural logarithm of a firm's number of employees (Leiponen and Helfat 2010), to account for size effects on R&D expenditures. Smaller firms can implement change more swiftly than larger firms due to less formalized and inert organizational structures (Chandy and Tellis 2000; Dean et al. 1998), while larger firms have bigger, more loyal target groups that ensure commercial success (Leiponen and Helfat 2010; Traore 2004). Last, *institutional ownership* was included to capture the mixed effects of institutional investors on R&D spending reported by empirical studies (Brossard et al. 2013).

4 Results

Table 1 summarizes descriptive statistics and bivariate results. The data does not suffer from multicollinearity: the maximum variance inflation factor is 1.97, falling below the restrictive cut-off value of 2.50 (Johnston et al. 2018), while all correlation coefficients are below 0.90 (Kennedy 2008).

Table 2 displays regression results with the dependent variable R&D intensity. DMC is the independent variable in Models 1 and 2, while the DMC subcomponents are the

independent variables in Models 3 and 4. More specifically, Models 1 and 3 include the direct effects of all independent variables on R&D intensity, and Models 2 and 4 test the moderation effects by including the interaction between the DMC portfolio as well as the DMC subcomponents with CEO founder status. Table 3 summarizes the hypothesis test results outlined in the following.

Hypotheses 1a to 1d were concerned with the direct DMC effects on R&D intensity. Hypothesis 1a is not confirmed because managerial human capital exerts no significant, positive effect on R&D intensity ($p > 0.05$). In contrast, the results support Hypothesis 1b by demonstrating that managerial social capital exerts a significant, positive effect on R&D spending ($p < 0.05$). The data reveals a positive, insignificant effect of managerial cognition on R&D spending, offering no support for Hypothesis 1c ($p > 0.05$). Finally, Hypothesis 1d predicted that CEOs with a superior DMC portfolio realize higher R&D investment levels. This hypothesis is strongly supported, as the data provides evidence for a significant, positive DMC–R&D spending relationship ($p < 0.001$).

Hypothesis 2a to 2d tested the moderation effect of CEO founder status on the DMC–R&D spending relationship. Due to the insignificance of the main effects, Hypothesis 2a and 2c, which were concerned with the moderation effect of CEO founder status on the relationship between managerial human capital and R&D intensity and managerial cognition and R&D intensity, respectively, are not confirmed ($p > 0.05$). Although the analysis evidences a direct relationship between managerial social capital and R&D intensity, there is no evidence for a moderation effect of CEO founder status on this relationship ($p > 0.05$). In contrast to these findings, the analysis demonstrates that CEO founder status positively moderates the significant, positive DMC–R&D spending relationship ($p < 0.01$) by showcasing a significant, positive interaction between DMC and CEO founder status ($p < 0.05$).

[INSERT TABLES 1, 2, AND 3 ABOUT HERE]

6 Discussion and contributions

6.1 Discussion

This study aimed to close the existing void in the microfoundational management literature by gaining an empirical understanding of the significance of top managers' micro-level capabilities for a highly critical firm-level strategic decision: the level of R&D investment. This study identified two critical research gaps addressed through the research model outlined in Figure 1. The first research gap was concerned with the direct effects of DMC on R&D spending—both through the DMC portfolio and the underlying DMC subcomponents. The second research gap was related to the question of whether the DMCs of founder CEOs might be particularly beneficial for firms as founder CEOs differ from professional CEOs in their motivation, risk-taking attitudes, and psychological as well as financial commitment to the firm (Jayaraman et al. 2000; Schuster et al. 2020; Souder et al. 2012). Based on these arguments, founder CEO status was proposed as a moderator of the DMC–R&D spending relationship.

The results confirm some, but not all, hypotheses. Regarding the first research question, the analysis reveals that firms led by CEOs with high DMC levels invest more resources in R&D. The data shows that although managers' social capital drives R&D spending, neither human capital nor cognition affects these critical investment decisions. These findings significantly advance management literature by demonstrating that DMCs are integral to a firm's innovation strategy by affecting firm-level R&D spending critical for sustained competitive advantage. At the same time, the subcomponents exert diverging effects on R&D investments. Therefore, this study opens the black box of how individual-

level capabilities antecede organizational change, demonstrating that DMCs are—in line with theoretical assumptions (Adner and Helfat 2003; George et al. 2022; Helfat and Martin 2015a)—a multilayered construct that must be examined holistically.

The findings related to the second research question demonstrate that founder CEOs differ from professional CEOs in their investment behavior. This study provides novel evidence on the advantageousness of founders' versus nonfounders' DMCs for innovation, showing that superior DMCs in founder CEOs contribute to higher R&D investments. These findings can be attributed to the long-term motivation, commitment, and investment of founder CEOs (Renée Adams et al. 2009; Jayaraman et al. 2000; Schuster et al. 2020), which strongly aligns with the high levels of risk and uncertainty associated with R&D projects that often take a considerable amount of time until they yield any financial benefits (Baysinger et al. 1991; Klein and Sorra 1996).

In this vein, this study sheds light on the underlying effect mechanisms, revealing that while CEO founder status affects the DMC–R&D spending relationship, its effects are not unequivocal across all DMCs. In line with expectations, CEO founder status reinforces the positive DMC effect on R&D. However, in contrast to expectations, CEO founder status affects none of the relationships between the three DMC subcomponents—managerial human capital, social capital, and cognition—on R&D spending. Therefore, the study provides novel evidence on CEO founder status in the context of DMC and innovation, offering a nuanced account of the underlying mechanisms driving R&D investment decisions and illustrating how a CEO's background characteristics shape these relationships.

6.2 Theoretical contributions

In an age of hypercompetition, firms can no longer rely on their existing recipes for success (Heij et al. 2020; Heubeck and Meckl 2022b). Instead, due to the fundamental

changes caused by globalization and digitalization, firms are pressured to continually safeguard and reinstate their innovative capacities to protect competitive advantages (Appio et al. 2021; Fernandez-Vidal et al. 2022). The significance of top managers and their individual-level capabilities for innovation is, therefore, greatly accentuated in the face of the imperative for continued strategic change (Fernandez-Vidal et al. 2022; Heubeck and Meckl 2022b; Sousa and Rocha 2019). Nevertheless, the literature still lacks a holistic empirical analysis of the managerial capabilities required to drive strategic change in today's ever-changing marketplace (Leão and da Silva 2021; Sousa and Rocha 2019; Wrede et al. 2020).

This study significantly advances academic understanding of the micro-level origins of organizational adaptation by providing novel empirical evidence on the role of DMCs in driving innovation strategies. The study's findings offer four main contributions to the management literature. First, this study validates the fundamental notion of Adner and Helfat's (2003) DMC theory by demonstrating that heterogeneity in organizational outcomes originates from variances in the capabilities of individual managers. Thus, the integrality of managers in making critical investment decisions underlying innovation, as theoretically attested (e.g., Adner and Helfat 2003; Beck and Wiersema 2013; Helfat and Martin 2015b, 2015a), is confirmed by the findings.

Second, in responding to the general calls for research on the microfoundations of innovation (e.g., Aguinis et al. 2022; Felin et al. 2012; Felin and Foss 2005) and the particular calls for holistic DMC research (e.g., George et al. 2022; Helfat and Martin 2015a), the study provides novel evidence of the mechanisms through which the DMC subcomponents mold a firm's innovative capacity. The findings do not support all of the theoretical propositions of DMC theory, demonstrating that superior managerial human capital and cognition do not contribute to higher R&D investments as previously subsumed (e.g., Bock et al. 2012; Tasheva and Nielsen 2022; Tripsas and Gavetti 2000). In contrast, this

study reaffirms the significance of a manager's social capital for innovation strategies (e.g., Alguezaui and Filieri 2010; Landry et al. 2002; Manev et al. 2005; Ruiz-Moreno et al. 2008). The findings highlight that while superior social capital is highly beneficial for ensuring firms' innovativeness, human capital and cognition do not facilitate R&D investments. One possible explanation for these findings lies in the disparate nature of the three DMC subcomponents in the unique context of innovation. Due to their idiosyncratic origins, human capital and cognition are primarily located within individual managers, while social capital is developed through the continued interactions between individuals (Durán et al. 2022; Durán and Aguado 2022a, 2022b). Social capital infers two benefits the other DMC subcomponents do not entail, yet are highly facilitative to the innovation process: (1) access to valuable information and (2) activation of scarce resources (Adler and Kwon 2002; Kogut and Zander 1992; Nahapiet and Ghoshal 1998). While superior human capital and cognition may increase the perceived need of CEOs to foster R&D investments, without valuable external information leveraged through complementary resources, CEOs cannot realize these strategic initiatives in the long term. Therefore, CEOs without sufficient social capital would be unable to reap the benefits of innovative strategies, leading to a decrease in R&D investments. Furthermore, these findings align with the transformed nature of the innovation process in today's economy. Due to the fundamental changes caused by globalization and digitalization, such as the blurring of industry borders, decreasing product life cycles, and growing customer demands, firms have fundamentally altered their view of innovation from a closed to an open innovation paradigm (Leão and da Silva 2021; Moggi et al. 2022). In these industry-spanning networks characterized by coopetitive structures, firms are competitors and collaborators, openly sharing information to enhance their innovative capacities (Bouncken et al. 2015; Emami et al. 2022). Owing to these fundamental transformations in how firms compete and innovate, the role of social capital in driving innovation strategies is accentuated. Therefore,

the findings echo the competitive paradigm shift rooted in the increasing importance of social capital for the entire innovation process, yet do not concur with the literature that views human capital as the primary driver of innovation and transformation processes (e.g., Fenech et al. 2019; Fernandez-Vidal et al. 2022; Sousa and Rocha 2019).

Third, to the best of the authors' knowledge, this is the first study to empirically assess the effect of CEO founder status in the context of DMC theory and R&D investments, adding new evidence to this severely understudied relationship (Hsu et al. 2020). The results reveal that the DMCs of founder CEOs contribute to higher R&D spending than those of their professional counterparts. The findings evidence that the long-term motivation, commitment, and stake attributed to founder CEOs by previous researchers (e.g., Renée Adams et al. 2009; Jayaraman et al. 2000; Wasserman 2003) better align with the characteristics of innovation investments. Thus, although the results confirm that DMCs shape a manager's "perception of opportunities, inclination to invest, willingness to undertake strategic change, and ability to implement it" (George et al. 2022, p. 3), the advantageousness of DMCs for a firm's innovative capacity is greater when the CEO is a founder of the firm. These findings concur with research that demonstrates that founder CEOs facilitate organizational adaptation in highly dynamic and competitive environments (e.g., Lee et al. 2020; Tang et al. 2016), rather than supporting the literature that argues that owing to their lack of managerial capabilities, founder CEOs need to be replaced by a professional CEO eventually (e.g., Haveman and Khaire 2004; Wasserman 2003).

Fourth, this study provides further evidence for an upper echelon's view of the firm, supporting the notion that executive background characteristics translate into organizational outcomes (e.g., Barker and Mueller 2002; Faccio et al. 2016; He et al. 2022; Hsu et al. 2020; Musteen et al. 2006). Thus, the findings echo the literature stream that argues for an explicit

integration of upper echelons theory into microfoundational research (e.g., Bendig et al. 2018; Castanias and Helfat 1991; Felin et al. 2015).

Altogether, this study contributes to the emerging stream of holistic DMC studies (e.g., Heubeck 2023; Holzmayer and Schmidt 2020; Tasheva and Nielsen 2022) by demonstrating that DMCs are integral to sustaining competitive advantage in an era of hypercompetition. At the same time, the results provide a highly nuanced account of the underlying effect mechanisms by demonstrating that managerial human capital and cognition do not contribute to higher R&D spending in isolation. Instead, managers need to draw on an entire DMC portfolio to drive a firm's innovation strategy, while social capital is the most critical DMC subcomponent for innovation. These findings align with the transformed nature of the hypercompetitive economy, where firms compete based on continued open innovation. Furthermore, the study provides the first evidence of how CEO founder status affects the DMC–R&D spending relationship. The results illustrate that the DMCs of founder CEOs are particularly beneficial for R&D investments, acknowledging that the innovation-enhancing effects of DMCs are contingent not only on their level but also on the unique background characteristics of their owner.

6.3 Managerial implications

Besides their theoretical merits, the findings of this study have significant implications for managerial practice. First, this study accentuates that CEOs play an integral role in developing and sustaining their firm's innovative capacities by realizing high R&D investment levels. In executing this vital task, top managers draw on their DMC portfolio to improve their abilities to sense opportunities and threats, seize commercial potential, and reconfigure organizational resources. Superior DMCs are an essential coping mechanism against the increased competitive pressures of today's economy, making them integral for

ensuring that firms can develop and sustain competitive advantages based on continual efforts toward innovation.

Second, the findings advise the board of directors to appoint highly skilled CEOs or develop the DMCs of their current CEO. By implication, firms deficient in innovative capacities are encouraged to replace their CEO with a more skilled predecessor. If they have to or wish to retain their current CEO yet lack sufficient innovative power required to sustain their competitiveness, firms should proactively confront the task of enhancing the DMC portfolio of their CEO. Otherwise, innovation deficiencies will likely lead to organizational decay in the long run.

Third, this study accentuates that social capital is hugely vital for innovation. As previously outlined, firms no longer operate and innovate within the confinements of their industry borders but collaborate with various players across industries and throughout their value chain. Firms should consequently implement socially conducive organizational structures while initiating or positioning themselves in industry-spanning innovation ecosystems to give CEOs appropriate opportunities for developing social capital.

Fourth, firms would be ill-advised to disregard their CEO's human capital and cognition. Although the findings offer no support for the isolated benefits of these two DMC subcomponents for pursuing innovation projects, they do not infer that human capital or cognition are irrelevant. Instead, due to the integrality of the DMC portfolio for innovation strategies, of which these two subcomponents are major constituents, the findings caution firms to offer recurrent training programs and design incentive structures conducive to the continued development and refinement of their CEO's human capital and cognition.

Fifth, in a hypercompetitive economy, where competitive advantage calls for continued innovation, firms should retain their founder as CEO. The study's findings demonstrate that founder CEOs can better realize higher R&D investments through their

DMCs than nonfounder CEOs. Founder-led firms consequently have a critical advantage over agent-led firms if they reap the benefits of their CEO's DMCs in enhancing their innovation capabilities (Hsu et al. 2020) and can further enhance their innovative capacities by developing their founder CEO's DMCs.

In conclusion, this study guides managerial practice in demonstrating the integrality of CEOs and their individual-level managerial capabilities for sustained innovation as the basis for competitive advantages. The findings advise firms to develop the DMCs of their CEO holistically—not focus on isolated subcomponents. Additionally, founder CEOs are particularly beneficial for innovation in an era of hypercompetition due to their inherent entrepreneurial orientation. Thus, DMCs represent a central source of competitive advantage, while the particular DMCs of founder CEOs are especially beneficial for improving a firm's innovation capacities.

6.4 Research limitations and recommendations

This study faces certain limitations that offer fruitful avenues for future research. First, this study adopts the lens of DMC theory by focusing on top-level managers. The current competitive landscape also necessitates that lower-level managers possess sufficient managerial capabilities (Heubeck and Meckl 2022a). Thus, future studies could explicitly examine the DMCs of lower-level managers as potential facilitators of innovation strategies. Second, the research focuses on the effects of DMC and CEO founder status on R&D investments. Future research can build on the research model and methodology to assess how DMCs may affect other central strategic initiatives, such as mergers and acquisitions, diversification, or internationalization (Hsu et al. 2020). Third, future studies could supplement the input-oriented innovation measurement of R&D intensity with an outcome-oriented innovation measurement, such as the number of product developments or patent

citations (Ashwin et al. 2016). Fourth, R&D investments are used to measure innovation. Therefore, the results offer no suggestions for how DMC and CEO founder status may affect other types of innovation, such as business model innovation (Heubeck 2023; Lee et al. 2020). Fifth, this study analyzes cross-sectional data. The analysis consequently does not consider time-variant effects in testing the relationships. This caveat could be addressed by future research using a longitudinal sample. Sixth, this study analyzes a sample primarily composed of shareholder-oriented US-based firms, which limits the generalizability of the results. Future research could investigate whether the results are affected by the governance model (i.e., one-tier versus two-tier board) or other cultural factors. Finally, the study only considered CEO founder status as a moderator of the DMC–R&D spending relationship. Future research could analyze other executive background characteristics, such as CEO tenure or ownership, as potential moderators of this relationship.

7 Conclusion

This study clearly demonstrates that CEOs are integral in making strategic innovation investment decisions contingent on the level of their DMCs. In this vein, the findings provide empirical support for the notion that DMCs are "a formative construct where resources converge" (Durán and Aguado 2022b, p. 6) and that the DMC subcomponents differ in their firm-level effects. In an era of hypercompetition, social capital seems to be the only direct facilitator of R&D investments, which matches the inherently social nature of the innovation process in general and the present open innovation paradigm in particular. Further, this study provides novel evidence for the heightened significance of founder CEOs and their DMCs for innovation, demonstrating that their DMCs are particularly beneficial for realizing innovation strategies.

This study altogether demonstrates that high levels of DMCs represent a central source of competitive advantage by ensuring that firms can develop and sustain their innovative capacities. Additionally, CEOs differ in their inclination to invest resources in R&D projects contingent on their status as founders or agents. The findings of the present study, therefore, significantly contribute to the microfoundational strategic management literature in general (e.g., Adner and Helfat 2003; Aguinis et al. 2022; Felin et al. 2012; Felin and Foss 2005) and the nascent empirical DMC literature in particular (e.g., Heubeck and Meckl 2022b; Holzmayer and Schmidt 2020; Tasheva and Nielsen 2022).

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Appendix 1. Operationalization of managerial cognition.

Score	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Description	No technical or business education	Business bachelor's degree	Business master's degree	Business doctorate/PhD degree	Technical bachelor's degree	Technical bachelor's degree and business degree	Technical master's degree	Technical master's degree and business degree	Technical doctorate/PhD	Technical doctorate/PhD and business degree

Table 1. Descriptive statistics and bivariate results.

	Variable	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	R&D intensity	0.172	0.143	1.000																		
2	Dynamic managerial capabilities	7.005	2.630	0.226	1.000																	
3	Managerial human capital	10.953	5.751	0.060	0.825***	1.000																
4	Managerial social capital	4.331	3.570	0.147	0.526***	0.064	1.000															
5	Managerial cognition	5.730	2.495	0.367**	0.508***	0.211	0.084	1.000														
6	CEO founder status	0.203	0.405	0.472***	0.109	0.142	–0.113	0.177	1.000													
7	CEO gender	0.054	0.228	–0.028	–0.016	–0.076	0.037	0.074	–0.121	1.000												
8	CEO age	57.108	7.076	–0.265*	0.308**	0.334**	0.136	0.009	–0.256*	0.022	1.000											
9	CEO compensation	21.898	23.721	–0.069	0.182	0.212	0.002	0.086	–0.199	0.008	0.140	1.000										
10	CEO uncertainty avoidance	51.554	15.266	–0.044	–0.160	–0.124	–0.144	–0.016	–0.067	–0.021	–0.167	–0.075	1.000									
11	CEO long-term orientation	37.351	19.600	0.109	0.109	0.015	–0.050	0.381***	0.096	0.143	0.005	–0.077	0.423***	1.000								
12	CEO duality	0.568	0.499	–0.001	–0.120	0.000	–0.130	–0.194	0.033	0.088	0.099	–0.142	–0.130	–0.119	1.000							
13	Board size	10.405	1.767	–0.360**	–0.066	–0.051	0.024	–0.124	–0.327**	–0.123	0.088	0.008	0.205	–0.129	–0.078	1.000						
14	Board gender diversity	26.596	9.020	–0.194	0.037	0.033	–0.066	0.137	–0.192	0.032	0.028	–0.003	–0.071	–0.104	–0.034	0.018	1.000					
15	Board independence	84.129	9.020	–0.211	–0.042	0.035	–0.112	–0.051	–0.247*	–0.164	0.052	0.077	0.010	0.094	–0.171	0.301**	0.212	1.000				
16	Firm age	24.378	14.986	–0.215	0.330**	0.386***	0.040	0.096	–0.236*	0.102	0.303**	0.116	–0.099	0.005	0.053	0.046	0.100	0.109	1.000			
17	Firm performance	0.092	0.128	–0.505***	0.199	0.220	0.044	0.060	–0.287*	0.095	0.128	0.110	0.049	0.186	–0.095	0.061	0.188	0.198	0.348**	1.000		
18	Firm size	9.939	1.295	–0.504***	0.042	0.198	–0.029	–0.281*	–0.266*	0.081	0.258*	0.303**	0.130	–0.070	0.060	0.350**	0.225	0.193	0.214	0.161	1.000	
19	Institutional ownership	76.373	17.605	0.012	0.049	–0.003	0.081	0.048	–0.236*	0.015	0.076	–0.017	–0.221	–0.175	0.296*	0.076	0.084	0.062	0.183	0.093	–0.091	1.000

Note. CEO = Chief executive officer; R&D = Research and development; *SD* = Standard deviation; $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$; $N = 74$.

Table 2. Regression results with dependent variable R&D intensity.

	Variables	Model 1		Model 2		Model 3		Model 4	
		b (*se*)	*β*	*b* (*se*)	*β*	*b* (*se*)	*β*	*b* (*se*)	*β*
Independent variables	DMC	0.020*** (0.005)	0.365***	0.016** (0.005)	0.302**				
	Managerial human capital					0.005 (0.002)	0.194	0.004 (0.002)	0.141
	Managerial social capital					0.008* (0.003)	0.199*	0.007* (0.004)	0.182*
	Managerial cognition					0.011 (0.006)	0.190	0.011 (0.006)	0.196
Moderator variable	CEO founder status	0.058 (0.034)	0.164	–0.195 (0.118)	–0.554	0.063 (0.036)	0.178	–0.109 (0.132)	–0.310
Interaction terms	DMC x CEO founder status			0.031* (0.014)	0.701*				
	Managerial human capital x CEO founder status							0.020** (0.007)	0.768**
	Managerial social capital x CEO founder status							0.006 (0.008)	0.089
	Managerial cognition x CEO founder status							–0.019 (0.016)	–0.377
Control variables	CEO gender	0.035 (0.051)	0.055	0.024 (0.050)	0.038	0.028 (0.052)	0.044	0.018 (0.050)	0.028
	CEO age	–0.004 (0.002)	–0.178	–0.006** (0.002)	–0.288**	–0.003 (0.002)	–0.167	–0.005* (0.002)	–0.240*
	CEO compensation	0.001 (0.001)	0.097	0.001 (0.000)	0.102	0.001 (0.001)	0.093	0.001 (0.001)	0.112
	CEO uncertainty avoidance	0.001 (0.001)	0.090	0.000 (0.001)	0.047	0.001 (0.001)	0.103	0.001 (0.001)	0.059
	CEO long-term orientation	0.001 (0.001)	0.080	0.001 (0.001)	0.095	0.000 (0.001)	0.042	0.001 (0.001)	0.076
	CEO duality	0.008 (0.025)	0.029	0.006 (0.024)	0.022	0.013 (0.025)	0.047	0.019 (0.025)	0.066
	Board size	–0.011 (0.008)	–0.141	–0.017* (0.008)	–0.209*	–0.013 (0.008)	–0.158	–0.017* (0.008)	–0.207*
	Board gender diversity	–0.000 (0.001)	–0.004	0.000 (0.001)	–0.028	0.000 (0.001)	–0.023	–0.001 (0.001)	–0.073
	Board independence	0.001 (0.002)	0.055	0.001 (0.002)	0.057	0.001 (0.002)	0.071	0.002 (0.002)	0.073
	Firm age	–0.000 (0.001)	–0.028	–0.000 (0.001)	–0.020	–0.000 (0.001)	–0.016	–0.000 (0.001)	–0.017
	Firm performance	–0.543*** (0.098)	–0.486***	–0.555*** (0.095)	–0.496***	–0.527*** (0.100)	–0.472***	–0.569*** (0.096)	–0.509***
	Firm size	–0.037*** (0.011)	–0.339***	–0.032** (0.011)	–0.295**	–0.034** (0.012)	–0.304**	–0.037** (0.012)	–0.335**
	Institutional ownership	0.001 (0.001)	0.099	0.000 (0.001)	0.052	0.001 (0.001)	0.088	0.000 (0.001)	0.028
	Constant	0.535** (0.201)		0.749* (0.216)		0.470* (0.212)		0.715** (0.230)	
Model specifications	R^2	0.667		0.694		0.673		0.721	
	$R^2_{adjusted}$	0.581		0.608		0.574		0.616	
	F-value	7.754		8.089		6.795		6.858	
	p-value	< 0.001		< 0.001		< 0.001		< 0.001	
	N	74		74		74		74	

Note. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$; CEO = Chief executive officer, DMC = Dynamic managerial capability

Table 3. Summary of hypothesis test results.

Hypothesis		Result
Main effect hypotheses		
Hypothesis 1a	CEOs with superior managerial human capital realize higher levels of R&D investment.	Not supported
Hypothesis 1b	CEOs with superior managerial social capital realize higher levels of R&D investment.	Supported
Hypothesis 1c	CEOs with superior managerial cognition realize higher levels of R&D investment.	Not supported
Hypothesis 1d	CEOs with superior DMCs realize higher levels of R&D investment.	Supported
Moderation hypotheses		
Hypothesis 2a	CEO founder status positively moderates the managerial human capital–R&D spending relationship.	Not supported
Hypothesis 2b	CEO founder status positively moderates the managerial social capital–R&D spending relationship.	Not supported
Hypothesis 2c	CEO founder status positively moderates the managerial cognition–R&D spending relationship.	Not supported
Hypothesis 2d	CEO founder status positively moderates the DMC–R&D spending relationship.	Supported

Note. CEO = Chief executive officer, DMC = Dynamic managerial capability; R&D = Research and development; supported if $p < 0.05$.

Figure 1. Research model: DMCs, CEO founder, and R&D intensity.

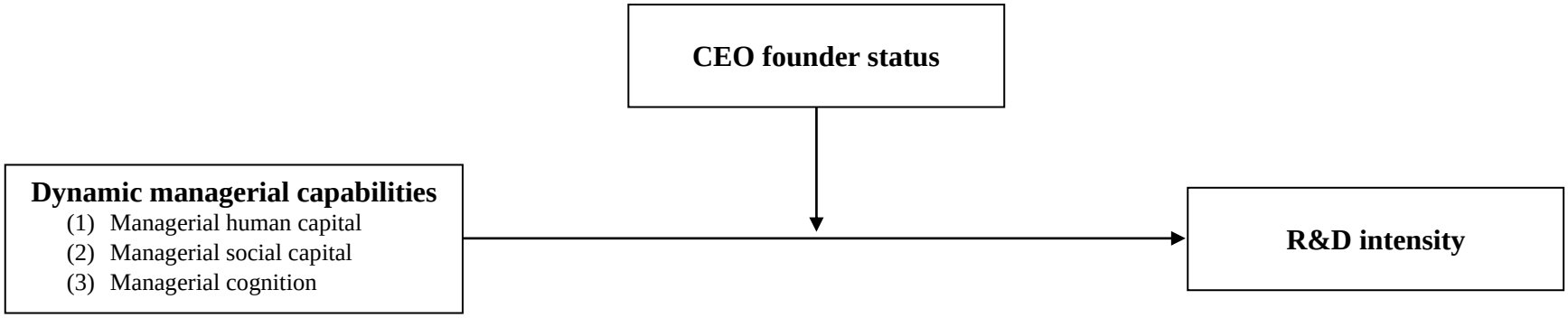

Figure caption

Figure 1. Research model: DMCs, CEO founder, and R&D intensity.