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RESEARCH ARTICLE

The impact of dynamic managerial capabilities on firm performance: A moderated mediation analysis of German DAX firms

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Abstract

In an era of hypercompetition, research and development (R&D) investments are vital for organizations to stay competitive. This microlevel study draws on dynamic managerial capability (DMC) theory to explore the mechanisms contributing to competitive advantages. It posits that DMCs enhance firm performance by increasing R&D spending, and explores the moderating role of slack resources due to their effect on resource availability. Employing hierarchical regression analysis and bootstrapping methods on a longitudinal sample comprising 31 German DAX firms, the findings robustly demonstrate that DMCs facilitate firm performance by fostering R&D expenditures and confirm the moderating effect of specific slack resources. However, only internal but not external slack resources amplify the relationship between DMCs and R&D intensity. Overall, this study emphasizes the critical role of managers' microlevel capabilities in determining firm performance and sheds light on how different slack resources influence the relationships between DMCs, R&D intensity, and firm performance.

Keywords: dynamic capability view; innovation and R&D; managerial capabilities; organizational performance; organizational transformation; resource allocation

Introduction

Capable top managers are increasingly vital for organizational performance in today's rapidly changing business environment. Their capabilities enable organizations to effectively adapt and respond to a constantly evolving business landscape (Aguinis, Audretsch, Flammer, Meyer, Peng, & Teece, 2022; Heubeck & Meckl, 2023). Managers are essential for incumbent firms as they accelerate innovation strategies and help navigate the evolving business landscape (Wallin, Pihlajamaa, & Malmelin, 2022; Weill & Woerner, 2015).

Although the current competitive landscape necessitates strong management capabilities (Helfat & Martin, 2015b; Heubeck & Meckl, 2023) required to sense and seize opportunities and transform resources (Helfat et al., 2007; Teece, 2007), existing literature predominantly focuses on firm-level capabilities in the context of organizational change (e.g., Farzaneh, Wilden, Afshari, & Mehralian, 2022; Ferreira, Coelho, & Moutinho, 2020). Thus, there exists a scarcity of research examining the critical linkages between dynamic managerial capabilities (DMCs), innovation, and firm performance.

Building on Adner and Helfat's (2003) DMC theory, this study shifts the prevailing focus from a macrolevel perspective on organizational change to a microlevel lens, examining the intricate dynamics of DMCs at the individual manager level and their implications on critical organizational outcomes. While existing research generally supports the positive effects of DMCs on performance and innovation (Heubeck, 2023a), it tends to focus separately on their direct benefits for firm performance or innovation (e.g., Guan, Deng, & Zhou, 2022; Heubeck & Meckl, 2022b; Tabares, Tavera, Álvarez Barrera, & Escobar-Sierra, 2022). As a result, there is a lack of research exploring the indirect performance benefits of DMCs, which is significant as DMC theory builds on a two-staged notion, where DMCs impact performance outcomes through their intermediate effect on resource portfolio orchestration (Adner & Helfat, 2003; Helfat & Martin, 2015b).

Therefore, this study aims to comprehensively examine the mechanisms of resource orchestration through which DMCs translate into firm performance. Specifically, it will argue that research and development (R&D) investments represent a critical resource deployment decision for chief executive officers (CEOs) in rapidly changing environments. These decision-making processes are contingent upon the strength of managerial capabilities, and strong DMCs enable managers to navigate their organizations effectively in rapidly changing business environments (Adner & Helfat, 2003; Helfat & Martin, 2015b). Hence, the first research question is: *How do DMCs influence firm performance, and to what extent do they have an impact?*

This study further aims to extend DMC theory by integrating it with the concept of organizational slack, which has been extensively studied in the context of innovation and firm performance because it provides surplus resources that foster risk-taking and reduce immediate success pressures (Cyert & March, 1963; Nohria & Gulati, 1996). These slack resources may enhance CEOs' inclination to invest resources in innovation. Therefore, this study proposes that organizational slack moderates the indirect relationship between DMCs, innovation, and firm performance. Hence, the second research question is: *How does organizational slack influence the relationship between DMCs, R&D intensity, and firm performance?*

This study significantly contributes to the management literature. First, it advances DMC theory by providing new insights into the mechanisms through which DMCs influence firm performance, contributing to the growing body of microlevel studies on strategic change (e.g., Heubeck & Meckl, 2022b; Korherr, Kanbach, Kraus, & Mikalef, 2022). Second, it highlights the specific management capabilities required to drive strategic change and firm performance in the context of a digitally transformed economy, adding to the research stream that examines management capabilities in today's altered competitive reality (e.g., Heubeck, 2023b; Warner & Wäger, 2019; Wrede, Velamuri, & Dauth, 2020). Third, it offers a different perspective on DMC theory, predominantly influenced by an Anglo-American perspective (e.g., Adner & Helfat, 2003; Bendig, Wagner, Jung, & Nüesch, 2022; Ener, 2019), by testing its propositions on a sample of German DAX firms. These findings contribute to a more comprehensive understanding of DMCs within a broader international context. Fourth, it complements the causal mechanism between DMCs, R&D intensity, and firm performance by considering organizational slack as a crucial contingency factor, providing a comprehensive understanding of their interaction and impact. These insights advance DMC theory by uncovering the black box between DMCs and firm performance and identifying contingencies involved. This study is relevant for both researchers seeking to expand their knowledge and practitioners aiming to enhance strategic decision-making in a competitive environment.

The remainder of this article is structured as follows: The following section reviews the theoretical background, and the "Hypotheses development" section establishes the research hypotheses. The "Data collection, sample description, and research methodology" section provides an overview of the data collection methods, sample characteristics, and research methodology. Hypothesis test results are presented in the "Results" section, with robustness assessments in the "Supplemental analyses" section. The "Discussion and research implications" section concludes the article by discussing the findings, their theoretical and practical implications, and research limitations and recommendations.

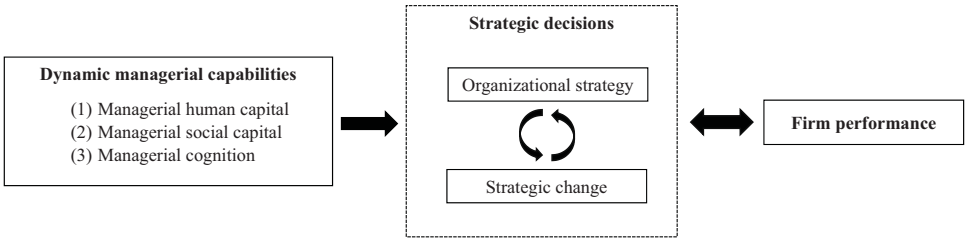

Figure 1. Firm-level effects of dynamic managerial capabilities, based on Beck and Wiersema (2013).

Theoretical background

In contrast to firm-level oriented dynamic capability theory (e.g., Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997), DMC theory adopts a microlevel viewpoint, asserting that managers' dynamic capabilities are the driving force behind the development of value-creating organizational strategies (Adner & Helfat, 2003; Helfat & Martin, 2015b). DMC theory addresses the neglected aspect of agency in strategic decision-making (Aguinis et al., 2022; Beck & Wiersema, 2013).

According to DMC theory, top managers serve as the primary strategic architects within firms, responsible for managing the adaptability and effectiveness of organizational strategies in dynamic environments (Helfat & Martin, 2015b). Managers leverage their unique DMCs to orchestrate a firm's resource portfolio and make strategic decisions based on their individual-level capabilities (Adner & Helfat, 2003; Beck & Wiersema, 2013; Martin, 2011). Therefore, DMCs are the root cause of competitive advantages, while the longevity of these advantages hinges on the strength of DMCs (Adner & Helfat, 2003; Heubeck & Meckl, 2022c). Figure 1 summarizes these causal mechanisms.

DMC theory identifies three key managerial resources (Adner & Helfat, 2003). The first is *managerial human capital*, encompassing managers' knowledge, expertise, and skills (Beck & Wiersema, 2013; Castanias & Helfat, 2001). Two distinct types of human capital exist: general human capital, which comprises generic skills with high transferability acquired through general life and work experiences, and firm-specific human capital, which refers to highly specific skills with low transferability resulting from learning in a particular firm (Bailey & Helfat, 2003; Becker, 1983; Castanias & Helfat, 2001). The unique configuration of managerial human capital plays a decisive role in strategic decision-making and contributes to the strategic disparities observed between firms, given the significant variations in the breadth and depth of managerial skills (Adner & Helfat, 2003; Beck & Wiersema, 2013).

The second is *managerial social capital*, which refers to the relationships managers build over time through repeated interaction or shared experiences (Adler & Kwon, 2002). Social capital benefits managers by granting them power, control, and influence (Adler & Kwon, 2002; Blyler & Coff, 2003), providing resources and capabilities (Beck & Wiersema, 2013; Helfat & Martin, 2015b), and facilitating learning (Kogut & Zander, 1992; Zander & Kogut, 1995).

The third is *managerial cognition*, which encompasses two cognitive mechanisms influencing strategic decision-making: cognitive processes and structures. Cognitive processes involve how managers gather, interpret, and store information, while cognitive structures are simplified mental representations of specific information environments (Colman, 2015; Walsh, 1995). Managerial cognition is a complex resource with inherent ambiguity (Tripsas & Gavetti, 2000; Walsh, 1995). Past experiences can serve as a 'useful simplicity' (Walsh, 1995, p. 306), facilitating decision-making processes and allowing managers to connect new information with existing knowledge (Durán & Aguado, 2022; Karhu & Ritala, 2020). However, managerial cognition can also introduce limitations and biases in information search and interpretation (Tripsas & Gavetti, 2000; Walsh, 1995).

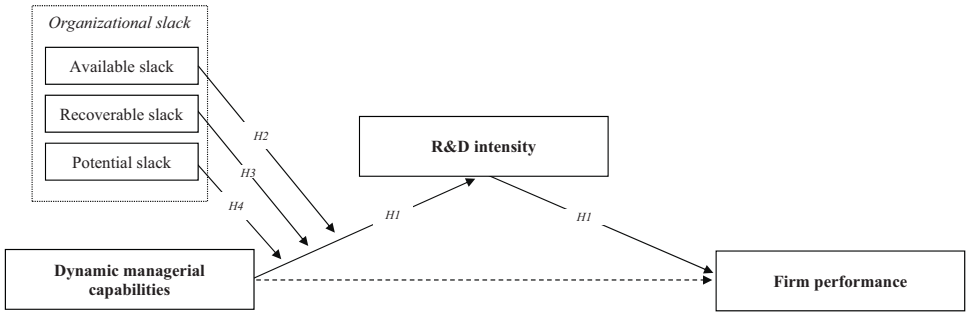

Figure 2. Research model.

Hypotheses development

This section introduces the research model depicted in Fig. 2, proposing that DMCs enhance firm performance by facilitating R&D spending. The first hypothesis builds on the notion that innovation is crucial for long-term competitiveness and growth (Caloghirou, Giotopoulos, Kontolaimou, & Tsakanikas, 2022; Sciascia, Nordqvist, Mazzola, & De Massis, 2015) and asserts that CEOs with strong DMCs possess the necessary capabilities to implement innovative strategies in dynamic environments (Heubeck, 2023a; Heubeck & Meckl, 2022c; Warner & Wäger, 2019).

Organizational slack occupies a pivotal role in a firm's resource portfolio, particularly concerning innovation initiatives. It plays a vital role in shaping the feasibility and sustainability of innovation projects while also influencing the capacity of managers to allocate resources for innovation. Organizational slack thus empowers managers with the means to access ample resources, thereby facilitating the realization of innovation projects and the continuous support of innovation-related investments (Nohria & Gulati, 1996; Tabesh, Vera, & Keller, 2019; Wang, Guo & Yin, 2017).

DMC theory, with its emphasis on the role of managers in driving strategic change through resource allocation (Helfat & Martin, 2015b; Heubeck, 2023a; Sirmon, Hitt, Ireland, & Gilbert, 2011), intricately converges with the realm of organizational slack. DMCs encapsulate a manager's proficiency in leveraging resources, orchestrating change, and steering the organization toward innovation and growth (Helfat et al., 2007; Heubeck & Meckl, 2023; Sirmon & Hitt, 2009). Within this context, managers with strong DMCs excel in organizations enriched with substantial slack resources. This organizational setting provides these capable managers the latitude to channel resources toward innovation-centric initiatives without stringent resource constraints (Beck & Wiersema, 2013; Sirmon & Hitt, 2009; Sirmon et al., 2011).

This study posits that because organizational slack functions as a buffer, enabling experimentation, risk-taking, and strategic exploration (Daniel, Lohrke, Fornaciari, & Turner, 2004; Nohria & Gulati, 1996; Tabesh, Vera, & Keller, 2019), and DMCs provide the essential skill set to harness these resources and direct them toward innovation-focused pursuits (Heubeck, 2023a; Sirmon & Hitt, 2009; Sirmon et al., 2011), slack resources can amplify the performance benefits of DMCs through increasing R&D spending.

Specifically, this study postulates that the three types of slack resources – available, recoverable, and potential – positively moderate the relationship between DMCs and R&D intensity, thereby enhancing firm performance. This proposition stems from the idea that the surplus resources offered by organizational slack complement the resource-leveraging capabilities contained in DMCs, creating a symbiotic relationship that nurtures innovation. This interplay not only triggers the initiation of innovation projects but also sustains innovation endeavors over time, ultimately contributing to organizational success.

In summary, this study seeks to advance DMC theory by empirically investigating how individual-level management capabilities influence firm performance. Additionally, it explores the role of slack

resources as moderators, considering the influence of a firm's resource endowment on how CEOs leverage their DMCs to drive firm performance.

DMCs, R&D intensity, and firm performance

Innovation is crucial for building and sustaining competitive advantage in today's dynamic environment (Damanpour & Aravind, 2012; Schumpeter, 2006). However, innovation investments come with risks and short-term losses (Kline & Rosenberg, 2009; Teece, 2012). With the pervasive influence of digital technology, managers, particularly in incumbent firms, must allocate significant resources to R&D (Wallin, Pihlajamaa, & Malmelin, 2022; Weill & Woerner, 2015).

Despite the importance of R&D investments for organizational survival, the underlying agency in these decisions has received limited attention in the literature (Heubeck & Meckl, 2022c; Korherr et al., 2022; Wrede et al., 2020). DMC theory provides a suitable perspective to examine whether management capabilities enable firms to pursue innovation in dynamic environments (Adner & Helfat, 2003; Helfat & Martin, 2015a). Strong DMCs enable managers to identify opportunities and threats in a timely manner (*sensing*), capitalize on opportunities or respond to emerging threats (*seizing*), and modify the firm's resource portfolio (*reconfiguring*) (Helfat et al., 2007; Teece, 2007). These capabilities ensure that managers make the right strategic choices at the right time, thus laying the foundation for firm performance (Sousa-Zomer, Neely, & Martinez, 2020; Teece, 2014; Warner & Wäger, 2019).

The performance benefits of strong DMCs arise from the synergistic interactions among their subcomponents. The diverse and in-depth skill set of strong DMCs enhances opportunity and threat sensing (Bock, Opsahl, George, & Gann, 2012; Tasheva & Nielsen, 2022). Additionally, strong DMCs facilitate sensemaking through complementary information and perspectives (Alguezaui & Filieri, 2010; Manev & Elenkov, 2005) and improve information processing accuracy and speed (Helfat & Martin, 2015a; Heubeck & Meckl, 2022a).

Strong DMC subcomponents contribute to effective opportunity seizing. Human capital enables proficient decision-making when exploring and exploiting commercial opportunities (Helfat & Martin, 2015a; Hitt, Ireland, & Hoskisson, 2017). Social capital leverages executive power to access and mobilize external resources and capabilities that benefit opportunity seizing (Burt, 2009; Helfat & Martin, 2015a). Managerial cognition improves information processing, which is crucial for making appropriate investment choices (Durán & Aguado, 2022; Heubeck & Meckl, 2022a; Tripsas & Gavetti, 2000).

The DMC subcomponents are critical for reconfiguring the resource portfolio. Superior human capital allows managers to efficiently modify a firm's resource portfolio (Guo, Xi, Zhang, Zhao, & Tang, 2013; Helfat & Martin, 2015a). Strong social capital provides access to critical resources and capabilities (Beck & Wiersema, 2013; Blyler & Coff, 2003), supporting resource reconfiguration and strategy execution (Fukuyama, 1996; Helfat & Martin, 2015b). Extensive cognitive skills continuously update mental representations of a firm's asset portfolio, informing executive decision-making with accurate abstractions of its resource endowment (Heubeck & Meckl, 2022c; Tripsas & Gavetti, 2000; Walsh, 1995).

Strong DMCs benefit from the synergistic interactions among their subcomponents (Helfat & Martin, 2015a; Heubeck, 2023b). Social ties leverage managers' human capital, facilitating knowledge exchange and access to complementary skills (Adner & Helfat, 2003; Blyler & Coff, 2003). Cognitive capabilities enhance learning processes and interpretation of unfamiliar knowledge (Heubeck & Meckl, 2022a; Tripsas & Gavetti, 2000; Walsh, 1995). Social capital and managerial cognition reinforce each other, influencing information interpretation and network influence (Adner & Helfat, 2003; Burt, 2009; Krackhardt, 1990).

In conclusion, managers with strong DMCs possess an extensive skillset, comprehensive social network, and efficient cognitive abilities, fostering firms' innovative capacities through high R&D investments. Strong DMCs form the foundation of continuous innovation, essential for superior firm performance, suggesting that strong DMCs enhance firm performance by facilitating R&D investments. More formally

Hypothesis 1: R&D intensity mediates the relationship between DMCs and firm performance. Specifically, strong DMCs indirectly enhance firm performance by increasing R&D intensity.

Moderation role of organizational slack

Adequate resource allocation to R&D is crucial for organizations to pursue innovation (Barker & Mueller, 2002; Geiger & Cashen, 2002). Slack resources are vital in this process as they enable firms to explore new ideas and alleviate performance pressures associated with innovation projects. Slack resources refer to resources exceeding current operational demands, such as unused budgets, surplus inventory, or idle staff. They provide flexibility and resilience in dynamic environments (Daniel et al., 2004; Marlin & Geiger, 2015). Additionally, slack resources create a stable and supportive environment for innovation (Bourgeois, 1981; Nohria & Gulati, 1996; Tabesh, Vera, & Keller, 2019). Insufficient slack resources can impede innovation by hindering R&D investments or prioritizing efficiency over exploration (Wang et al., 2017; Yasai-Ardekani, 1986).

Slack resources can be categorized based on location, deployability, and discretion (Geiger & Cashen, 2002; Sharfman, Wolf, Chase, & Tansik, 1988). Organizational slack encompasses three forms: *available slack* (highly discretionary, unabsorbed financial resources), *recoverable slack* (excess resources already absorbed within the organization structure that can be mobilized if needed), and *potential slack* (additional resources from the external environment). These slack types contribute to organizational adaptability, innovativeness, and promote risk-taking, creativity, and experimentation (Bourgeois & Singh, 1983; Marlin & Geiger, 2015; Tan & Peng, 2003).

Moderation effect of available slack

Available slack resources enhance the positive relationship between DMCs and R&D intensity by improving managers' ability to sense and seize opportunities and reconfigure organizational resources. With access to available slack, skilled CEOs can strategically invest in R&D initiatives without being constrained by short-term financial concerns (Cyert & March, 1963; Woodman, Sawyer, & Griffin, 1993), allowing them to allocate funds for exploring new ideas, experimenting with innovation, and undertaking long-term research (Ashwin, Krishnan & George, 2016; Nohria & Gulati, 1996; Wang et al., 2017).

Additionally, the immediate availability of available slack facilitates timely decision-making and resource allocation. Managers can quickly mobilize these resources to capitalize on emerging opportunities or respond to market demands without facing delays or bureaucratic obstacles (Bradley, Shepherd & Wiklund, 2011; Woodman, Sawyer, & Griffin, 1993). This agility in resource deployment enables firms to seize competitive advantages and adapt to changing market dynamics more effectively.

Available slack cultivates an innovative culture within the organization by reducing immediate success pressures and enabling managers to make long-term R&D investments (Audia & Greve, 2006; Kim, Kim, & Lee, 2008; Nohria & Gulati, 1996). It is vital in facilitating R&D investments by providing managers with the necessary funds to take risks and explore opportunities in an innovative environment (Bradley et al., 2011; Marlin & Geiger, 2015; Nohria & Gulati, 1996).

The positive relationship between DMCs and firm performance is expected to be strengthened by available slack. Skilled CEOs can allocate more resources to R&D when they have access to available slack, which is a buffer against success pressures and allows for greater flexibility (Bourgeois & Singh, 1983; Cyert & March, 1963; Nohria & Gulati, 1996). The high deployability and immediate availability of available slack enable managers to seize opportunities and foster an innovative learning culture (Ashwin et al., 2016; Bentley & Kehoe, 2020; Geiger & Cashen, 2002).

More precisely, the three subcomponents of DMCs serve as valuable resources for effectively utilizing available slack to foster innovation. First, harnessing a manager's skillset, knowledge, creativity, adaptability, and collaborative proficiencies, human capital empowers managers to identify, strategize, and successfully execute innovative ideas (Guan, Deng, & Zhou, 2022; Guo et al., 2013;

Heubeck & Meckl, 2022c), optimizing the utilization of existing resources. Second, social capital can also play a pivotal role in capitalizing on available slack for innovation as it contributes to the effective utilization of available slack by fostering collaboration, facilitating knowledge exchange, enabling external partnerships, and cultivating an environment of trust and support (Alguezaui & Filieri, 2010; Kogut & Zander, 1992; Manev & Elenkov, 2005). The cultivation and sustenance of robust social connections, both internally and externally, can lead to the discovery of novel business prospects, the consolidation of resource pools, and the successful implementation of innovations (Beck & Wiersema, 2013; Blyler & Coff, 2003; Helfat & Martin, 2015b). Third, managerial cognition holds the potential to enhance the exploitation of available slack for innovation significantly, bolstering managerial capabilities in recognizing opportunities, mitigating risks, making astute strategic choices, and flexibly adapting to dynamic environments (Helfat & Martin, 2015b; Heubeck & Meckl, 2022a; Tasheva & Nielsen, 2022). This skill is imperative for effectively channeling available resources to drive innovative projects and initiatives. Consequently, an organization's success in leveraging available slack for innovation is closely tied to the cognitive abilities of its managers and their capacity to envision, implement, and capitalize on innovation projects.

In summary, slack resources can significantly enhance managers' dynamic capabilities by providing a reservoir of resources that can be strategically deployed to foster innovation, respond to changes, explore new opportunities, and facilitate learning. Due to their highly discretionary nature, available slack resources can leverage managers' human capital, social capital, and cognition. This argumentation leads to the following hypothesis:

Hypothesis 2: Available slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship.

Moderation effect of recoverable slack

Although not as readily deployable as available slack (Geiger & Cashen, 2002), recoverable slack plays a significant role in facilitating innovation investments. It serves as a buffer against business volatility and allows firms to sustain their innovation efforts even during challenging market conditions (Bourgeois & Singh, 1983; Bradley et al., 2011; Godoy-Bejarano, Ruiz-Pava, & Téllez-Falla, 2020; Greve, 2003).

Allocating recoverable slack requires strategic decision-making with a long-term orientation, as there may be a time lag between the decision to reallocate recoverable slack and the availability of these resources. Nevertheless, the availability of recoverable slack in future periods functions as resource insurance, instilling long-term-oriented thinking in managers and making them more likely to allocate sufficient resources toward R&D (Chandler, Scott, Stodder, & Tworoger, 2011; Lin, Cheng, & Liu, 2009; Wiersma, 2017).

Mobilizing recoverable slack can be challenging due to resource embedding and interrelatedness (Mishina, Pollock, & Porac, 2004). Strong DMCs are essential in effectively utilizing recoverable slack for innovation. They equip managers with the necessary skills to identify, reallocate, and leverage recoverable slack (Wang et al., 2017). Human capital equips managers with the necessary skills to identify and mobilize recoverable slack toward innovation (Heubeck & Meckl, 2022c, 2022b). Through their social capital, they can obtain support from stakeholders and make more comprehensive decisions about mobilizing recoverable slack efficiently due to informational benefits (Blyler & Coff, 2003; Guo et al., 2013; Heubeck & Meckl, 2022c). Leveraging cognition is also crucial for firm performance because cognitively skilled managers can also make more informed decisions about how to mobilize recoverable slack for innovation as they base their decision-making on an accurate abstraction of the firm's resource portfolio (Beck & Wiersema, 2013; Helfat & Martin, 2015b; Heubeck, 2023a). Thus, managers' human capital, social capital, and cognition collectively shape their ability to utilize recoverable slack for innovation. Their skills, relationships, and cognitive abilities

influence the identification, allocation, and execution of innovative initiatives that utilize recoverable resources effectively while maintaining the stability of core operations.

Therefore, strong DMCs are vital in mobilizing recoverable slack for innovation within organizations. They empower managers to navigate the challenges associated with resource mobilization, ensuring that recoverable slack is utilized effectively for R&D. By leveraging their DMCs, managers can overcome the complexities from resource embedding and interrelatedness, thereby harnessing the full potential of recoverable slack to drive innovation and ultimately enhance firm performance. Consequently, strong DMCs allow managers to make informed decisions about the most effective utilization of recoverable slack for innovation. This argumentation leads to the following hypothesis:

Hypothesis 3: Recoverable slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship.

Moderation effect of potential slack

While different from available and recoverable slack, potential slack shares characteristics that promote experimentation and innovation. Managers with access to potential slack are less concerned about short-term costs and potential failure in R&D investments (Geiger & Cashen, 2002; Marlin & Geiger, 2015), suggesting its facilitative role in R&D spending when managers possess the necessary capabilities.

Furthermore, potential slack is less likely to result in suboptimal investment behavior because managers face capital market pressures that encourage appropriate investment decision-making (Bourgeois & Singh, 1983; Geiger & Cashen, 2002). Acquiring potential slack signals the firm's commitment to innovation and long-term growth in the capital market (Chandler et al., 2011; Geiger & Cashen, 2002; Marlin & Geiger, 2015). Actively seeking and acquiring external resources demonstrates the firm's intention to invest in R&D, enhance reputation, attract financial support, and strengthen external partnerships (Bourgeois & Singh, 1983; Daniel et al., 2004; Herold, Jayaraman, & Narayanaswamy, 2006). This positive signaling effect fosters trust and confidence from stakeholders, facilitating innovation and improving firm performance.

When DMCs are strong, the presence of potential slack further amplifies their positive impact by offering additional resources for innovation initiatives, allowing managers to leverage their capabilities to a greater extent. Regarding the three subcomponents of DMCs, potential slack provides the resources necessary for skilled managers to invest in R&D. As managers harness their human capital, potential slack fuels their ability to drive innovation through informed decisions and creative problem-solving. Further, with potential slack available, managers can expand their networks, forging connections with external partners and experts who can contribute to innovative projects. Finally, potential slack complements managers' cognitive abilities, such as strategic thinking and adaptability, by offering managers the opportunity to allocate cognitive resources strategically. Thus, potential slack allows skilled managers to deploy their DMCs to identify opportunities, analyze risks, and make insightful decisions that drive innovative initiatives.

To summarize, potential slack enhances the relationship between DMCs and firm performance by enabling financial flexibility, fostering a long-term perspective, and generating positive signaling effects. The interaction between potential slack and DMCs is crucial in how external resources and internal capabilities jointly impact firm outcomes. Potential slack provides the flexibility needed for managers to pursue innovation initiatives. These initiatives often require reallocating resources from existing operations, which potential slack can facilitate without disrupting core functions. Thus, potential slack can encourage managers to think beyond incremental changes and embrace more ambitious innovation endeavors. When potential slack exists, managers can harness their combined human capital, social capital, and cognitive abilities more effectively for innovation – this synergy between DMCs and potential slack leads to enhanced innovation outcomes that ultimately benefit firm performance.

Considering potential slack alongside DMCs, this hypothesis contributes to a comprehensive understanding of leveraging external resources and internal capabilities for innovation and superior performance. Based on these arguments, this study proposes that managers with strong DMCs are more likely to allocate greater resources to R&D when recoverable slack is available. More formally

Hypothesis 4: Potential slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship.

Data collection, sample description, and research methodology

Data collection and sample description

The study used firms listed in the DAX 30 index between 2010 and 2019 to avoid potential survivorship bias (Brown, Goetzmann, Ibbotson, & Ross, 1992). This time frame was chosen to exclude the Global Financial Crisis and the COVID-19 pandemic (Issah, Anwar, Clauss, & Kraus, 2023; Kraus et al., 2020).

The initial sample consisted of 42 firms from Thomson Reuter's Refinitiv Eikon database. Missing data were manually collected from annual reports, company websites, online networks, and media outlets (Heubeck & Meckl, 2023; Seo, Lee, & Park, 2022). If a firm had multiple CEOs in a year, the CEO at the beginning of that year was selected.

The final sample includes 31 firms actively conducting R&D (exclusion of 9 firms from industries with no R&D spending) and explicitly reporting their R&D activities in their financial statements (exclusion of 2 firms with no R&D activities in the traditional sense) (Koh & Reeb, 2015). For more details on the sample composition by industry codes, see Table 1.

Measurement of variables

Dependent variable

This study employed return on assets (ROA) to measure the dependent variable *firm performance*. ROA is a widely accepted accounting measure of performance, calculated by dividing a firm's net operating profit by its total assets. This performance metric has been extensively utilized in the management literature (Adams, Bessant, & Phelps, 2006; Richard, Devinney, Yip, & Johnson, 2009).

To ensure the robustness of results, two additional measures of firm performance were considered. Return on equity (ROE) was used to capture the value generated for shareholders, representing the ratio of net profit to shareholder's equity (Armour & Teece, 1978; Richard et al., 2009). Tobin's *q*, defined as the ratio of asset market value to asset replacement costs (Daines, 2001; Singhal, Fu, & Parkash, 2016), was employed as a supplemental performance measure.

Table 1. Sample composition

Sector	NAICS code	Industry description	Absolute frequency	Relative frequency
Manufacturing			*22*	*70.97%*
	21	Mining	1	3.23%
	31–33	Manufacturing	21	67.74%
Service			*9*	*29.03%*
	22	Utilities	3	9.67%
	42	Wholesale Trade	1	3.23%
	44–45	Retail Trade	1	3.23%
	51	Information	2	6.45%
	62	Health Care and Social Assistance	2	6.45%

Independent variable

DMCs were operationalized by measuring their three subcomponents individually and then aggregating the *Z*-standardized measures to calculate the composite measure of DMCs.

Building on Castanias and Helfat's (1991, 2001) managerial rents model, which differentiates between a generic and a firm-specific dimension of managers' human capital, the measure of managerial human capital consisted of two underlying dimensions: (1) generic human capital, assessed by categorizing CEOs' age into four age intervals (Colombo & Grilli, 2005; Horng, Lee, & Chen, 2001); and (2) firm-specific human capital, measured in terms of years of tenure within the firm (Bailey & Helfat, 2003; Tabesh, Vera, & Keller, 2019).

Managerial social capital was operationalized by quantifying the number of active or previous corporate affiliations (Holzmayer & Schmidt, 2020).

Based on recent research, managerial cognition was assessed using two indicators (Heubeck & Meckl, 2022b, 2023). The first indicator was the field of education, coded as 0 for business-related degrees and 1 for STEM (science, technology, engineering, mathematics) degrees (Greven, Kruse, Vos, Strese, & Brettel, 2022). The second indicator was the level of education, with bachelor's, master's, and doctorate degrees assigned values of 0, 1, and 2. This operationalization captures how educational background influences cognitive processes and biases in R&D investment decision-making (Daellenbach, McCarthy, & Schoenecker, 1999; Rodenbach & Brettel, 2012). Managers become increasingly attached to their cognitions with higher education levels (Geletkanycz & Black, 2001; Musteen, Barker, & Baeten, 2006), while the field of education shapes the nature of their cognition. Education in STEM disciplines enhances managers' receptiveness to long-term R&D investments (Cummings & Knott, 2018) and improves their ability to assess investment returns compared to their business-educated counterparts (Hayes & Abernathy, 1980). Therefore, managers' cognitive processes and R&D investment choices vary based on differences in field and level of education (Marvel & Lumpkin, 2007; Rodenbach & Brettel, 2012), which remain relatively stable over time (Epstein & Pacini, 1999; Marzi, Fakhar Manesh, Caputo, Pellegrini, & Vlačić, 2023).

Mediating variable

R&D intensity represents the financial investment dedicated to innovation projects and is calculated as yearly R&D spending divided by total sales (Adams, Bessant, & Phelps, 2006). R&D intensity captures both the development of internal knowledge (Sciascia et al., 2015) and the absorption of external knowledge (Cohen & Levinthal, 1989, 1990), signifying the proactive approach of CEOs in driving innovation by strategically allocating financial resources, as supported by research (e.g., Barker & Mueller, 2002; Kor, 2006; Lim, 2015).

Moderating variables

This study measured organizational slack across its three dimensions (Bourgeois & Singh, 1983; Geiger & Cashen, 2002; Marlin & Geiger, 2015). *Available slack* was assessed using three indicators: current ratio (total assets divided by total liabilities), quick ratio (sum of total cash, short-term investments, and accounts receivable divided by total liabilities), and working capital (difference between current assets and current liabilities divided by total sales). *Recoverable slack* was operationalized by examining the ratio of selling, general, and administrative expenses to total sales. *Potential slack* was calculated as the average of three ratios: total debt to total equity, total debt to total sales, and total debt to total assets.

Control variables

The research model included additional control variables to ensure the analysis' robustness. At the managerial level, two variables were initially considered. *CEO nationality*, a dummy variable coded as 0 if the current CEO is German and 1 otherwise, aims to capture the influence of national culture on decision-making. *CEO gender* was included as a dummy variable, coded as 0 if the current CEO is male and 1 if female, to account for possible differences in risk-taking

(Faccio, Marchica, & Mura, 2016; Ho, Li, Tam, & Zhang, 2015). Because all CEOs in the sample identified as male, CEO gender was excluded from further analysis.

Three control variables were incorporated to account for firm characteristics. To account for influences on organizational structure and culture, *firm age*, measured as the years since founding, and *firm size*, calculated as the logarithm of the total number of employees, were included (Audia & Greve, 2006; Chandy & Tellis, 2000). *Industry dummies* were introduced to capture possible variations between manufacturing (NAICS codes 21 and 31–33; coded as 0) and service industries (NAICS codes 22, 42, 44–45, 51, and 62; coded as 1) (Dalziel, 2007).

At the governance level, four control variables were included. *Board size*, indicating the total number of directors on a firm's board, was considered due to its possible impact on corporate governance effectiveness (Goodstein, Gautam, & Boeker, 1994). *Board independence*, measured as the ratio of independent directors to board size, was included to assess its potential influence on board functioning (Hillman & Dalziel, 2003). *Board meeting frequency*, representing the number of board meetings in a financial year, was incorporated due to its influence on corporate governance efficacy (Conger, Finegold, & Lawler, 1998; Lipton & Lorsch, 1992). *Directorial tenure*, measured as the average number of years directors have served on the board, was included to examine its effects on supervising executives (Hillman, Shropshire, Certo, Dalton, & Dalton, 2011) and support for organizational change (Golden & Zajac, 2001).

Year dummies were also included to account for variations in R&D spending and firm performance across different years.

Statistical procedure

Hierarchical regression analysis was performed using *IBM SPSS Statistics 29.0*. The *PROCESS plugin* (Hayes, 2018) with bootstrapping and heteroscedasticity-consistent inference *HC4* (Cribari-Neto) was employed to evaluate the significance of mediation and moderated mediation effects.

Mediation was assessed based on Baron and Kenny's (1986) three conditions: (1) significant total effect of the independent variable on the dependent variable, (2) significant effect of the independent variable on the mediator, and (3) significant effect of the independent variable on the dependent variable in the full regression model. Recent research by Hayes (2009) and Zhao, Lynch, and Chen (2010) suggests that mediation still be present if Conditions 2 and 3 are met, even if Condition is not. Thus, this study evaluated mediation effects based on the fulfillment of Conditions 2 and 3 and utilized the *PROCESS plugin* for effect size estimation and confidence intervals using bootstrap inference. Sobel's test (Baron & Kenny, 1986; Sobel, 1982) was also used to validate the robustness of the mediation effects.

The *PROCESS plugin* was employed to test moderated mediation effects. By utilizing heteroscedasticity-consistent inference *HC4* (Cribari-Neto) and mean-centered interaction terms, the moderated mediation effects of the a-path are calculated, and conditional mediation (CoMe) indices along with the respective confidence intervals are constructed using bootstrap inference. Significant moderated mediation effects were assessed through conditional effects analysis and indirect effects sizes at different moderator values ($-SD$, Mean, $+SD$).

Results

Table 2 presents a summary of descriptive statistics and bivariate results. The average firm within the sample has an average age of 98.89 years and employs 119,353.13 employees. The sampled firms span seven industry sectors, with 70.97% operating in manufacturing and 29.03% in service industries (refer to Table 1 for details).

Table 3 presents the hierarchical regression analysis results, comprising four regression models. Models 1 and 2 focus on R&D intensity as the dependent variable. Model 1 includes control variables

Table 2. Descriptive statistics and bivariate results

	Variable	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1	Firm performance (ROA)	5.305	3.759	1											
2	R&D intensity	0.041	0.044	0.424***	1										
3	Dynamic managerial capabilities	0.017	0.493	0.165*	0.373***	1									
4	Available slack	0.770	0.340	0.342***	0.197**	−0.025	1								
5	Recoverable slack	0.238	0.124	0.407***	0.481***	0.049	0.280***	1							
6	Potential slack	0.502	0.393	−0.383***	−0.193**	0.074	−0.453***	−0.342***	1						
7	Firm age	99.146	70.170	0.061	0.295***	0.152*	0.003	0.416***	−0.157*	1					
8	Firm size	11.189	1.045	−0.152*	0.066	0.171**	−0.532***	−0.212***	0.447***	−0.017	1				
9	Board size	16.460	3.934	−0.155*	0.172**	0.116	−0.172**	0.002	0.324***	0.149*	0.381***	1			
10	Board independence	50.152	31.720	0.034	0.160*	0.084	−0.093	0.049	0.188**	−0.098	0.122	−0.203**	1		
11	Board meetings	6.318	2.666	0.029	0.132*	0.049	−0.040	−0.003	−0.037	−0.274***	−0.027	−0.064	0.192**	1	
12	Director tenure	6.260	2.075	0.233***	−0.055	0.147*	0.045	0.141*	0.030	0.054	0.054	−0.190**	0.149*	−0.175**	1

Notes: R&D = research and development, ROA = return on assets, *SD* = standard deviation, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; $N = 239$.

Table 3. Hierarchical regression results

	DV: R&D intensity				DV: Firm performance (ROA)			
	Model 1		Model 2		Model 3		Model 4	
	b (*SE*)	β	*b* (*SE*)	β	*b* (*SE*)	β	*b* (*SE*)	β
Model variables								
Dynamic managerial capabilities			0.028*** (0.005)	0.315***			0.034 (0.487)	0.004
Available slack			0.024** (0.008)	0.188**			1.170 (0.746)	0.106
Recoverable slack			0.134*** (0.021)	0.378***			5.668** (2.104)	0.187**
Potential slack			−0.017* (0.007)	−0.153*			−1.815** (0.659)	−0.190**
R&D intensity							29.213*** (6.130)	0.341***
Control variables								
Firm age	0.000*** (0.000)	0.257***	0.000 (0.000)	0.103	−0.001 (0.004)	−0.020	−0.011** (0.004)	−0.205**
Firm size	−0.001 (0.003)	−0.021	0.009** (0.003)	0.210**	−0.579* (0.251)	−0.161*	0.060 (0.257)	0.017
Board size	0.002** (0.001)	0.205**	0.002* (0.001)	0.136*	−0.019 (0.070)	−0.020	−0.071 (0.091)	−0.073
Board independence	0.000*** (0.000)	0.279***	0.000** (0.000)	0.192**	0.012 (0.009)	0.101	0.002 (0.008)	0.015
Board meetings	0.003* (0.001)	0.179*	0.002 (0.001)	0.100	0.082 (0.102)	0.058	−0.066 (0.087)	−0.047
Director tenure	0.000 (0.001)	−0.023	−0.004** (0.001)	−0.175**	0.488*** (0.120)	0.269***	0.002 (0.008)	0.015
Industry dummy	−0.016* (0.007)	−0.170*	0.001 (0.006)	0.010	−1.692** (0.592)	−0.210**	−0.891 (0.553)	−0.111
Year dummies significant at $p < 0.05$	0 of 9		0 of 9		2 of 9		1 of 9	
Constant	−0.044 (0.034)		−0.137*** (0.035)		7.145* (2.989)		1.502 (3.259)	
R^2	0.222***		0.428***		0.166***		0.426***	
p	<0.001		<0.001		<0.001		<0.001	
N	239		239		239		239	

Notes: *b* = regression coefficient, β = standardized regression coefficient, DV = dependent variable, *N* = sample size, *p* = significance value, R^2 = coefficient of determination, *SE* = standard error, R&D = research and development, ROA = return on assets, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

regressed on R&D intensity, while Model 2 incorporates the study variables. The study variables account for an additional 20.6% of the variance in R&D intensity.

Models 3 and 4 examine firm performance (ROA) as the dependent variable. Model 3 considers control variables regressed on firm performance, while Model 4 includes the study variables. Including the study variables explains an additional 26.0% of the variance in firm performance.

To assess multicollinearity, variance inflation factors (VIF) were calculated for each variable and model. VIF values below 2.5 indicate no significant influence of multicollinearity (Johnston, Jones, & Manley, 2018). Correlation coefficients further confirm the absence of significant multicollinearity (Kennedy, 2008).

The research model is constructed based on well-established theories and empirical evidence, minimizing endogeneity concerns (Wintoki, Linck, & Netter, 2012). It is built on a priori theorizing, drawing from well-established theories and empirical evidence to guide the expected relationships between variables. According to Li, Ding, Hu, and Wan (2021), the research is not threatened by dynamic endogeneity if the independent and dependent variables operate at different levels, remain time-invariant, or change slowly. In this study, DMCs are measured at the individual level, while firm performance is an organizational outcome, and DMCs demonstrate considerable consistency over time. Therefore, there is minimal risk of dynamic endogeneity from a theoretical standpoint. Furthermore, as suggested by Li et al. (2021), regressing the independent variable on the lagged dependent variable yielded no significant effect. Thus, the research model exhibits no signs of endogeneity from both theoretical and empirical perspectives, allowing for a confident interpretation of the findings as causal relationships based on the robust theoretical logic of the research model.

The hypothesis test results, presented in Tables 3–5, are summarized in this section. Effect sizes are defined according to Cohen's (1988) criteria: weak effect ($\beta > 0.02$), moderate effect ($\beta > 0.15$), and strong effect ($\beta > 0.35$).

Hypothesis 1 posits that the relationship between DMCs and firm performance is mediated by R&D intensity. Model 2 fulfills Condition 2, with DMCs significantly and moderately positively affecting the mediator R&D intensity ($b = 0.028$, $\beta = 0.135$, $p < 0.001$). Additionally, Model 4 satisfies Condition 3, as R&D intensity has a highly significant and strong positive impact on firm performance ($b = 29.213$, $\beta = 0.341$, $p < 0.001$). Thus, Hypothesis 1 is supported. The effect sizes and confidence intervals of the mediation effect, calculated through bootstrapping inference (see Table 4), reveal a positive and significant indirect effect of DMCs on firm performance via R&D intensity ($b = 0.820$, 99% *CI*: [0.225, 1.556]). Sobel's test further confirms Hypothesis 1 ($b = 0.821$, $p = 0.003$).

Table 5 presents the moderation effects of the three slack types on the *DMC–R&D intensity–firm performance* relationship, specifically focusing on the DMC–R&D path. Hypothesis 2 suggests that available slack positively moderates this relationship. The interaction between DMCs and available slack is positive and significant ($b = 0.039$, $p < 0.001$), leading to an 8.0% increase in explained variance. Bootstrapping inference reveals a positive and significant CoMe index ($b = 1.226$, 99% *CI*: [0.073, 2.465]). Therefore, Hypothesis 2 is supported.

Hypothesis 3 proposes that recoverable slack positively moderates the indirect relationship between DMCs and R&D intensity. The interaction term is significant and positive ($b = 0.288$, $p < 0.001$), resulting in a 16.4% increase in explained variance. The CoMe index is positive and significantly different from zero ($b = 10.268$, 99% *CI*: [4.048, 17.489]). Thus, Hypothesis 3 is supported.

However, Hypothesis 4, proposing that potential slack moderates the positive relationship between DMCs and R&D intensity, is rejected. The interaction term is insignificant and negative ($b = -0.022$, $p = 0.065$), and the CoMe index is negative and not significantly different from zero due to the CI including zero (95% *CI*: [–1.549, 0.060]).

An overview of the hypothesis test results can be found in Table 6, and Fig. 3 illustrates the research model with unstandardized regression coefficients.

Table 4. Indirect effects: Bootstrapping regression and Sobel's test results with robustness checks

		Confidence interval				Confidence interval			Sobel's test	
Path	*b* (*SE*)	Significance level	Lower limit	Upper limit	β (*SE*)	Significance level	Lower limit	Upper limit	*b*	*p*
DMCs → R&D intensity → Firm performance (ROA)	0.820** (0.263)	99%	0.225	1.556	0.108** (0.034)	99%	0.030	0.201	0.821**	0.003
Robustness tests										
DMCs → R&D intensity → Firm performance (ROE)	0.931 (0.577)	90%	0.027	1.900	0.048 (0.034)	90%	0.001	0.113	0.933	0.121
DMCs → R&D intensity → Firm performance (Tobin's *q*)	0.618** (0.162)	99%	0.230	1.072	0.195** (0.040)	99%	0.092	0.302	0.619***	<0.001

Notes: DMC = dynamic managerial capability, *b* = regression coefficient, β = standardized regression coefficient, *p* = significance value, *SE* = standard error, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; bootstrap inference for model coefficients with heteroscedasticity-consistent robust standard errors (HC4) and covariance matrix estimator, number of bootstrap samples = 5000, $N = 239$.

Table 5. Moderated mediation effects

Interaction	*b* (*SE*)	*p*	R^2 change	CoMe index (*SE*)	Confidence interval		
					Significance level	Lower limit	Upper limit
DMCs × Available slack	0.039*** (0.012)	<0.001	0.080	1.226** (0.438)	99%	0.073	2.465
DMCs × Recoverable slack	0.288*** (0.042)	<0.001	0.164	10.268** (2.630)	99%	4.048	17.489
DMCs × Potential slack	−0.022 (0.012)	0.075	0.065	−0.704 (0.407)	95%	−1.549	0.060

Notes: DMC = dynamic managerial capability, *b* = regression coefficient, CoMe = conditional mediation, *P* = significance value, *SE* = standard error, ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$; bootstrap inference for model coefficients with heteroscedasticity-consistent robust standard errors (HC4) and covariance matrix estimator, mean centered interaction terms, number of bootstrap samples = 5000, $N = 239$.

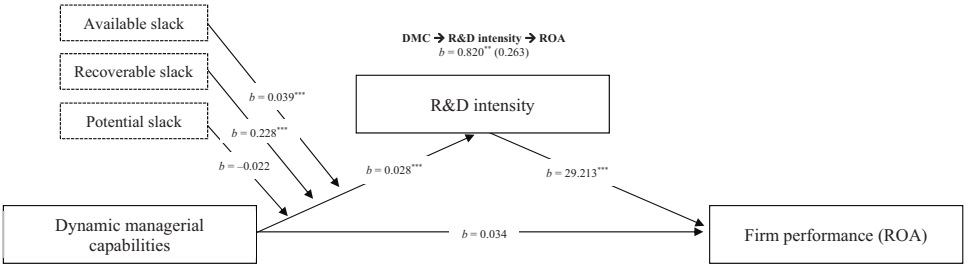

Figure 3. Research model with unstandardized regression coefficients.
Notes: DMC = dynamic managerial capability, R&D = research and development, ROA = return on assets, ***$P < 0.001$, **$P < 0.01$, *$P < 0.05$; $N = 239$

Table 6. Summary of hypothesis results

Hypothesis		Result
Hypothesis 1	R&D intensity mediates the relationship between DMCs and firm performance. Specifically, strong DMCs indirectly enhance firm performance by increasing R&D intensity.	Supported
Hypothesis 2	Available slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship.	Supported
Hypothesis 3	Recoverable slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship	Supported
Hypothesis 4	Potential slack positively moderates the indirect positive effect of DMCs on firm performance by amplifying the DMC–R&D intensity relationship	Not supported

Notes: DMC = dynamic managerial capability, R&D = research and development; supported if $P < 0.05$.

Supplemental analyses

To ensure the robustness of the findings, two alternative measures of firm performance were examined as dependent variables (see Table 4), considering the potential influence of the performance measure choice on the results.

First, the dependent variable ROA was replaced with the alternative performance measure ROE. The bootstrapping results show a positive coefficient ($b = 0.931$) that significantly differs from zero, but only at the 10% significance level (90% *CI*: [0.001, 0.113]). Sobel's test does not confirm the significance of this indirect effect ($b = 0.933$, $p = 0.121$). Thus, the evidence regarding the indirect relationship between DMCs and firm performance (ROE) via R&D intensity is mixed. However, as bootstrapping produces more robust results than Sobel's test (Preacher & Hayes, 2004; Shrout &

Bolger, 2002), the evidence shows some support for Hypothesis 1 when using ROE as the performance measure.

Second, Tobin's *q* was incorporated as an alternative measure of firm performance. The results support Hypothesis 1 using Tobin's *q* as the performance measure. The bootstrapping analysis provides evidence for a positive effect ($b = 0.931$) that significantly differs from zero (99% *CI*: [0.092, 0.302]). Sobel's test confirms the significance of this indirect effect ($b = 0.619$, $p < 0.001$). In conclusion, the supplementary analyses using alternative measures of firm performance provide additional support for the robustness of the results.

To examine significant moderated mediation effects in greater detail, indirect conditional effects of the focal predictor were calculated at different moderator values (see Appendix 1). The supplementary analysis also involved computing the conditional indirect effects (presented in Appendix 2). The findings reveal that the association between DMCs and R&D intensity is contingent upon the level of available and recoverable slack. The moderating effect of available slack on the DMC–R&D intensity relationship is positive and becomes more pronounced as the level of available slack increases. These results align with the observed indirect effect at different values of the moderator, indicating that available slack enhances the positive impact of DMC on firm performance through R&D intensity across all levels of the moderator.

Finally, conditional effects were examined for the second significant moderation effect. The additional analysis demonstrates that the effect size of the moderator, recoverable slack, also varies across different levels. No significant moderation effect is observed at low levels, whereas at medium and high levels, a positive and significant moderation effect is present, with its magnitude increasing as the level of recoverable slack rises. Consequently, higher levels of recoverable slack amplify the indirect relationship between DMCs, R&D intensity, and firm performance, particularly at medium and high levels of the moderator.

Discussion and research implications

Discussion

This study examined how DMCs contribute to firm performance through increased R&D spending in the context of hypercompetition. The role of slack resources as a moderator in the DMC–R&D intensity relationship was also explored. Based on longitudinal data from 31 German DAX firms, the study provides valuable insights into the importance of microlevel capabilities and resource availability for organizational success.

The findings robustly support the hypothesis that DMCs enhance firm performance by facilitating R&D investments. This suggests that DMCs alone do not directly impact firm performance, but they influence CEOs to allocate more resources to R&D. This enables firms to develop innovative products, services, technologies, and processes, leading to competitive advantage and improved overall performance (Beck & Wiersema, 2013; Helfat & Martin, 2015b; Heubeck, 2023b).

Furthermore, this study demonstrates that specific types of slack resources enhance the relationship between DMCs and R&D intensity, thereby strengthening the performance benefits of DMCs. Internal slack resources, such as financial reserves or excess capacity (Geiger & Cashen, 2002; Tan & Peng, 2003), were found to be more effective in facilitating R&D investments and leveraging the benefits of DMCs compared to external resources. However, potential slack, an external resource, did not have the same impact. These findings highlight the multidimensional nature of slack resources, indicating that different types have varying implications for organizational success, as suggested by previous research (Geiger & Cashen, 2002; Marlin & Geiger, 2015).

This study emphasizes the crucial role of recoverable slack as the primary moderator, followed by available slack. This finding suggests that recoverable slack, such as excess capacity or staff, is a buffer to maintain consistent R&D investments and absorb uncertainties without compromising their R&D activities (Daniel et al., 2004; Marlin & Geiger, 2015). Consequently, this study demonstrates that leveraging recoverable slack allows firms to sustain their investment in R&D, leading to improved

performance. The analysis also indicates that the strength of the moderation effect of recoverable slack depends on its level. While it is insignificant at low levels, its positive effect becomes significant and more pronounced with higher levels of recoverable slack. Therefore, the study suggests that firms should aim to maintain high levels of recoverable slack to maximize its benefits for firm performance.

Furthermore, this study uncovers that available slack positively moderates the relationship between DMCs and R&D intensity. The strength of this effect increases when managers have more discretion in allocating available slack resources. While the moderation effect of available slack is smaller than recoverable slack, it still plays a beneficial role in facilitating R&D investments. The smaller effect of available slack suggests that while readily available resources are advantageous, their impact may be less pronounced than recoverable slack. This could be because converting available slack into active resources requires additional efforts, whereas recoverable slack is already embedded within the organization and easily redeployed. Nonetheless, the findings emphasize that available slack contributes positively to the relationship between DMCs and R&D intensity, highlighting the importance of considering all surplus resources in supporting R&D activities that drive firm performance.

Contrasting with previous research (e.g., Carnes, Xu, Sirmon, & Karadag, 2019; Daniel et al., 2004; Geiger & Cashen, 2002), this study does not support the notion that potential slack leads to innovation or subsequent performance advantages. As an external form of slack, potential slack differs significantly from internal slack because it is not as readily accessible for managers, requiring the mobilization and internalization of external resources (Marlin & Geiger, 2015). Mobilizing potential slack is time-consuming and involves complex decision-making processes (Wiersma, 2017). Potential slack may be too inert in dynamic environments, where quick responses to emerging opportunities are crucial for innovation investments. Additionally, mobilizing potential slack, especially through debt financing, presents challenges and hesitancy due to the additional costs and risks associated with interest expenses. Firms may be cautious in allocating potential slack for uncertain R&D projects to balance the benefits against the costs.

Theoretical contributions

This study challenges and expands upon the conventional understanding of dynamic capabilities at the firm level (e.g., Eisenhardt & Martin, 2000; Teece, 2007; Teece, Pisano, & Shuen, 1997) by adopting a microlevel lens on organizational change and firm performance (Adner & Helfat, 2003). It builds upon existing research on DMCs (e.g., Heubeck & Meckl, 2022c; Korherr et al., 2022; Matarazzo, Penco, Profumo, & Quaglia, 2021) but goes further by providing new evidence for the integral role of a manager's entire portfolio of DMCs in driving firm performance through innovative strategies.

The findings highlight the significant differences in managerial capabilities in sensing and seizing opportunities, and reconfiguring the firm's asset portfolio. These differences emphasize the crucial role of managers in organizational success, particularly in the current era of digital and global competition. Thus, this study transfers Teece's (2007) notion of the microfoundations of dynamic capabilities to the context of DMCs, validating the idea that managerial capabilities have become increasingly vital for organizational success (Aguinis et al., 2022; Wallin, Pihlajamaa, & Malmelin, 2022; Weill & Woerner, 2015).

This study reinforces the notion that innovation has become the bedrock for firm performance (e.g., Appio, Frattini, Petruzzelli, & Neirotti, 2021; Martín-Peña, Díaz-Garrido, & Sánchez-López, 2018; Verhoef et al., 2021). As organizations face tough environments, innovating and adapting becomes paramount for sustaining competitive advantage and achieving superior performance. The findings underscore the significance of DMCs in fostering innovation and driving firm success, underscoring the importance of prioritizing and developing these capabilities in organizations.

This study contributes to DMC theory by empirically demonstrating that the performance benefits of strong DMCs are not direct but are mediated by their impact on R&D investments. This intermediate effect of DMCs reinforces the two-staged rationale of DMC theory, stating that managers

influence firm performance by effectively allocating resources, and this ability is contingent upon the heterogeneity of DMCs (Adner & Helfat, 2003; Helfat & Martin, 2015b).

Further, this study highlights that strong DMCs enable firms to adapt strategically to changing market dynamics. It demonstrates that the benefits of DMCs are realized indirectly through their impact on R&D investments, which are crucial for innovation and long-term performance. These findings align with recent research on DMCs (Heubeck & Meckl, 2022a, 2022b) yet advance this research stream by robustly supporting the two-staged nature of DMC theory. This study consequently emphasizes the importance of considering the intermediate effect of DMCs on performance outcomes.

This study empirically demonstrates that the linkage between DMCs and firm performance is significantly influenced by a firm's resource configuration, as proposed in DMC theory (e.g., Adner & Helfat, 2003; Beck & Wiersema, 2013). Specifically, the findings highlight the role of organizational slack as a critical component of a firm's resource portfolio for innovation. While previous research has touched upon this idea (e.g., Sirmon, Hitt, & Ireland, 2007; Sirmon et al., 2011), it has not been explicitly incorporated into the study of DMCs until now. Therefore, this study advances the understanding of DMCs by considering the configuration of a firm's resource portfolio as a crucial factor in the DMCs–firm performance relationship. The findings emphasize the importance of top managers in effectively deploying slack resources for innovation (Ruiz-Moreno, García-Morales, & Llorens-Montes, 2008; Sirmon et al., 2007; Wiersma, 2017) and the role of DMCs in efficiently utilizing these resources as catalysts for innovation (Adner & Helfat, 2003; Beck & Wiersema, 2013).

This study expands the research on organizational slack by adopting a multidimensional perspective and considering the effects of different types of slack resources. Unlike previous studies focusing primarily on highly discretionary slack (e.g., Ashwin et al., 2016; Bentley & Kehoe, 2020; Tabesh, Vera, & Keller, 2019), this research takes a comprehensive approach to understanding slack resources. The findings highlight that internal slack resources (available and recoverable slack) play a crucial role in strengthening the indirect effect of DMCs on firm performance by amplifying the relationship between DMCs and R&D intensity. In contrast, external slack resources (potential slack) do not significantly influence these relationships. Therefore, the study underscores the multifaceted nature of slack resources and their varying effects at the firm level.

This study significantly contributes to the microfoundational strategic management literature by empirically examining the relationship between DMCs and firm performance (e.g., Aguinis et al., 2022; Felin, Foss, Heimeriks, & Madsen, 2012; Helfat & Martin, 2015b). The findings support the role of DMCs in enhancing performance but reveal that the impact is indirect, mediated by increased R&D spending. This study provides empirical evidence for the two-staged conceptualization of DMC theory (e.g., Helfat & Martin, 2015b; Heubeck, 2023b; Tasheva & Nielsen, 2022) and emphasizes the crucial role of CEOs in resource allocation for innovation. These findings reinforce the fundamental propositions of DMCs (e.g., Adner & Helfat, 2003; Martin, 2011; Sirmon et al., 2007), the importance of CEOs in sustaining competitive advantages and driving strategic change while acknowledging variations in their capabilities.

Managerial implications

This study has significant implications for managerial practice. First, it emphasizes the importance of CEOs with strong DMCs in driving organizational renewal and survival. Firms should carefully select highly skilled CEOs or consider replacing their current CEO with a more competent successor. Organizations must conduct comprehensive assessments and actively develop the DMCs of their CEOs.

Second, it highlights how DMCs influence organizational performance, emphasizing that strong DMCs do not directly lead to superior firm performance. Instead, they facilitate financial success by increasing R&D spending. This finding implies that DMCs are essential for organizational survival in dynamic environments, emphasizing the need to cultivate and leverage these capabilities. Further,

this demonstrates that firms should recognize the importance of allocating resources toward R&D initiatives as part of their strategic efforts.

Third, this study emphasizes that firms should provide appropriate resources to highly skilled CEOs to enhance their innovative capacities and performance. Firms should grant skilled CEOs discretion over internal slack resources, enabling them to allocate more resources toward R&D activities. Examples from innovative companies like Alphabet and 3M (Chireka & Fakoya, 2017; age & Brin, 2004) demonstrate the accumulation of available resources and the integration of excess capacities, inspiring firms to adopt similar resource allocation strategies.

Fourth, while external slack does not directly impact R&D spending or firm performance, it is still vital for firms to have the ability to secure external funds when necessary. This may be particularly important for other investment types that do not face immediate time pressures, such as acquisitions.

In conclusion, this study offers practical insights for managerial practice. Firms should prioritize the appointment or development of CEOs with strong DMCs, comprehend the role of DMCs in driving performance through increased R&D spending, provide appropriate resources to amplify the benefits of DMCs, and ensure the capacity to secure external funds when required. By implementing these recommendations, organizations can enhance their competitive advantage, foster innovation, and improve performance in dynamic business environments.

Research limitations and recommendations

While this study has made several notable contributions to the existing literature and has important implications for managerial practice, certain limitations present opportunities for future research. To begin with, the scope of this study was limited to publicly listed firms. Subsequent investigations could expand upon the research model by applying it to datasets from privately held enterprises, particularly focusing on small- and medium-sized entities. This approach would yield insights into potential differences in the mechanisms and the moderating role of slack resources between larger and smaller firms.

Another limitation pertains to the sample of firms analyzed, which were exclusively German. This geographical constraint may restrict the generalizability of the findings. To enhance the external validity of the results, future research endeavors could replicate this study across diverse countries, including those classified as emerging markets.

Moreover, this study employed quantitative research methods. However, this approach may not have entirely captured the intricate interplay between DMCs, R&D intensity, organizational slack, and firm performance. Subsequent studies could employ qualitative techniques like surveys or case studies to gather subjective data. This qualitative exploration would enable a deeper comprehension of the intricate relationships at play.

Furthermore, this study relied on an innovation input-oriented metric, specifically R&D intensity. While consistent with a significant portion of the innovation literature (Adams, Bessant, & Phelps, 2006) and grounded in the rationale of capturing CEOs' proclivity for innovation (Hill & Snell, 1988; Kor, 2006), future research avenues could involve exploring output-oriented innovation measures. Examples include patents or new product development, which would provide insights into the tangible commercial outcomes of R&D investments.

Another aspect worth considering is that this study centered around the dynamic capabilities of individual managers without delving into the mechanisms through which these dynamic capabilities aggregate. Consequently, prospective research could delve into the aggregation of DMCs within top management teams and how this aggregation shapes strategic decision-making and overall firm performance.

Additionally, an aspect that remained unaddressed in this study is the potential influence of DMCs at lower management tiers. As middle-level management continues to be pivotal in strategy execution and organizational change (e.g., Greven et al., 2022; King, Fowler, & Zeithaml, 2001; Wilden, Lin,

Hohberger, & Randhawa, 2022), a promising avenue for future investigation would be to explore whether middle managers' DMCs also contribute to organizational success.

Lastly, considering the ever-evolving nature of today's dynamic economic landscape, it would be advantageous to replicate this study at a later juncture to ascertain the robustness and consistency of the findings over time.

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