Journal of Innovation & Knowledge 10 (2025) 100804

Contents lists available at ScienceDirect

Journal of Innovation & Knowledge

journal homepage: www.elsevier.com/locate/jik

Does environmental, social, and governance (ESG) performance lead to ambidextrous innovation? Integrating stakeholder and institutional theories

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ARTICLE INFO

JEL classification:
M14
O36

Keywords:
ESG
Ambidextrous innovation
Government subsidies
Market competition
Financing constraints

ABSTRACT

The challenges associated with achieving high Environmental, Social, and Governance (ESG) performance have become increasingly critical globally, leading to resource allocation issues, compliance complexities, and potential short-term disruptions in innovation activities, particularly within technology-intensive sectors. Despite the growing importance of ESG initiatives, limited studies in management have explored how ESG performance impacts different dimensions of firm innovation. This study investigates how ESG performance influences ambidextrous innovation, namely exploratory and exploitative innovation, among Chinese-listed new energy vehicle companies from 2009 to 2021. The findings reveal a U-shaped relationship, suggesting that initial ESG investments may hinder innovation owing to resource diversion and regulatory pressures, while sustained ESG efforts eventually lead to significant innovation gains. Government subsidies and market competition act as moderating factors in this relationship. Although both factors generally support innovation, their misalignment with ESG strategies may diminish their positive influence. Moreover, we identify financial constraints and risk propensity as mediating mechanisms. Enhanced ESG performance reduces financing barriers and encourages firms to undertake innovation-related risks. These findings offer important insights for policymakers and managers seeking to align ESG practices with innovation objectives, thereby contributing to more sustainable and balanced innovation outcomes in China and beyond.

Introduction

The rapid global transition towards sustainability underscores the importance of innovation, particularly within technology-intensive sectors such as new energy vehicles (NEVs) (Helfaya & Bui, 2025). These sectors face significant challenges related to environmental concerns and resource depletion, making ambidextrous innovation—which involves the simultaneous pursuit of exploratory and exploitative innovation—essential for sustained growth and long-term adaptability (McCollum et al., 2018; Wang et al., 2023; Abdelfattah & El-Shamy, 2024). Building on previous research that emphasises innovation's dual nature in technology evolution and market responsiveness (Voss & Voss, 2013; Enkel et al., 2017; Roth, Corsi & Hughes, 2024), this study argues for an expanded understanding of how corporate environmental, social, and governance (ESG) performance shapes innovation dynamics. Moreover, this study's primary objective is to clarify how ESG performance influences exploratory and exploitative innovations in NEV firms.

Despite the rising importance of ESG globally, exemplified by robust initiatives in the EU, Norway, South Korea, France, and China to promote NEV adoption (Yakob, Nakamura & Ström, 2018; Srai et al., 2022; Xu et al., 2024), scholarly exploration into ESG's specific role in driving ambidextrous innovation remains limited. Previous studies have highlighted ESG's economic impacts (dos Reis Cardillo & Basso, 2025), such as reduced operational costs and improved stakeholder trust (Houston & Shan, 2022; Cao et al., 2023; Long et al., 2023; Ruan, Yang & Dong, 2024). However, little is known about whether, why, and how ESG directly facilitates innovative activities. Particularly unclear is the mediating role of internal firm factors such as financing constraints and

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https://doi.org/10.1016/j.jik.2025.100804
Received 3 April 2025; Accepted 3 September 2025
Available online 9 September 2025

risk-taking behaviours, and the moderating effects of government subsidies and market competition (Sun, Wang & Ai, 2024; Wang et al., 2024).

However, understanding ESG's precise influence on corporate innovation necessitates further theoretical and empirical contributions. Integrating stakeholder and institutional theories offers a clearer understanding of how ESG engagement drives innovation. Methodologically, detailed longitudinal analyses using firm-level ESG and innovation data can provide deeper insights. Empirically, clarifying whether ESG impacts are uniform or vary according to governance structures and market conditions is essential (Nelson, Selin & Scott, 2021; Zhang, Zhu & Liu, 2024; Zhao et al., 2024). Thus, further research in these areas is crucial for comprehensively understanding ESG's role in innovation.

To bridge these gaps, this study investigates how ESG performance critically contributes to ambidextrous innovation. Existing literature suggests that ESG can enhance firms' resource access (Ren et al., 2022; Lei & Yu, 2024), mitigate risks, and foster long-term strategic orientations (Naimy, El Khoury & Iskandar, 2021; Iazzolino et al., 2023), which are vital for innovation activities (Azmi et al., 2021; Duque-Grisales & Aguilera-Caracuel, 2021; Waheed & Zhang, 2022). Drawing on these insights, the present study addresses the following research questions: (1) How does ESG performance impact exploratory and exploitative innovations in NEV firms? (2) How do government interventions and market competition moderate these relationships? (3) What internal mechanisms, such as financing constraints and risk-taking behaviours, mediate the ESG-innovation nexus? (4) Does firm heterogeneity influence the ESG-innovation relationship?

The study is driven by the integration of stakeholder and institutional theories to examine the ESG-innovation relationship. Stakeholder theory emphasises how firms balance diverse stakeholder interests to sustain competitive advantages (Freeman, Dmytriyev & Phillips, 2021), while institutional theory focuses on external pressures shaping organisational behaviours (DiMaggio & Powell, 1983). By applying these frameworks, this study empirically investigates the impact of ESG performance on innovation activities, utilizing comprehensive panel data from Chinese-listed NEV firms between 2009 and 2021. Furthermore, the analysis incorporates patent data, Huazheng ESG ratings, and various firm-specific characteristics.

Previous literature examining ESG impacts on corporate innovation largely neglects the combined effect of governmental interventions and competitive market dynamics (Scherer, 1967; Peneder & Wörter, 2014; Luo & Tung, 2018). Thus, significant theoretical and practical questions remain unresolved (Askenazy, Cahn & Irac, 2013; Moskovics et al., 2024). Understanding how these external factors interact with ESG strategies could guide firms in effectively managing innovation activities amid regulatory and competitive uncertainties. Therefore, addressing these gaps is crucial not only for theoretical completeness but also for enhancing practical decision-making in corporate and policy environments.

This study contributes to existing scholarship in several ways. First, it enriches stakeholder and institutional theory discussions by detailing how ESG frameworks influence innovation in NEV firms, thereby enhancing theoretical and empirical insights into ESG's operational impacts. Second, it examines how contextual factors, specifically government policies and market dynamics, moderate the ESG-innovation relationship, highlighting unique challenges within innovation-intensive sectors. Third, it uncovers internal mechanisms, particularly financing constraints and risk-taking behaviours, thereby clarifying the pathways through which ESG influences innovation. Fourth, it provides robust empirical evidence capturing multifaceted interactions among ESG performance, innovation types, governance, and market contexts. This offers a comprehensive framework beneficial for strategic management and policy formulation.

The study is organised as follows. Section 2 develops the theoretical framework and hypotheses. Section 3 describes data collection and methodology. Section 4 presents empirical findings. Finally, Section 5 concludes with theoretical and practical implications.

Theoretical framework and hypothesis development

Government policies play a pivotal role in shaping the NEV market, significantly impacting the innovation landscape within the automotive sector. Policies adopted by various governments globally, such as production targets, financial incentives, and stringent emissions regulations, directly condition market dynamics and the strategic responses of automotive companies (Ovaere & Proost, 2022; Xu et al., 2024). For instance, countries such as Norway and the EU have implemented aggressive timelines to phase out fossil fuel vehicles, significantly driving innovation and NEV adoption (Deuten, Vilchez & Thiel, 2020; Ovaere & Proost, 2022). However, recent studies highlight potential drawbacks, indicating that certain urban mobility policies may inadvertently hinder NEV development. Specifically, restrictive urban mobility frameworks intended to curb vehicular traffic and emissions have at times discouraged consumers from investing in NEVs, raising concerns about the overall efficacy of these policy instruments in fostering sustainable automotive innovation (Oduro & Taylor, 2023; Naeem et al., 2023). Therefore, it is essential to examine the nuances of urban mobility policies and their actual impact on NEV adoption and innovation trajectories.

ESG

ESG factors have become integral to corporate strategies, driving significant transformations in organisational decision-making, innovation, and stakeholder interactions. Companies are leveraging ESG commitments not only as ethical imperatives but also as strategic mechanisms to enhance market credibility, reduce risk, and achieve competitive differentiation (Grewal, Riedl & Serafeim, 2019; Flammer, 2021). While ESG initiatives offer significant benefits, their implementation and measurement present considerable challenges owing to inconsistent standards and rating methodologies (Berg, Koelbel & Rigobon, 2022; Christensen, Serafeim & Sikochi, 2022). Rigorous and transparent ESG reporting supports firms in achieving more accurate and credible disclosures, promoting sustainable practices, and mitigating reputational risks associated with superficial or misleading sustainability claims. Consequently, embedding ESG into corporate strategies is essential, as it improves resource efficiency, data integrity, and stakeholder confidence—key drivers of sustainable corporate growth.

Ambidextrous innovation

Ambidextrous innovation—which involves balancing exploratory and exploitative innovation—is critical for firms navigating the rapidly evolving NEV industry. Exploratory innovation involves pursuing ground-breaking technologies and market opportunities, whereas exploitative innovation focuses on incremental improvements and optimisation of existing resources (Raisch & Birkinshaw, 2008). Organisations achieving ambidexterity typically demonstrate enhanced resilience, adaptability, and competitive advantage, essential in addressing technological disruptions and market volatility (Raisch & Krakowski, 2021). In the context of NEVs, ambidexterity enables companies to leverage technological advancements, simultaneously optimizing current sustainability practices (e.g. energy efficiency, and compliance) and developing disruptive ESG-focused innovations (e.g. novel business models, and eco-innovations) (Asiaei et al., 2023; Lee, Pak & Roh, 2024). Hence, ambidextrous innovation functions as a crucial moderator, enabling effective translation of technological advancements into tangible ESG outcomes, thereby reinforcing strategic coherence, and facilitating sustainable competitive advantages.

Stakeholder theory and institutional theory

Traditional organisations adhere to a shareholder primacy principle, focusing organisational management on increasing the wealth of controlling shareholders (Mitchell, Agle & Wood, 1997). From this perspective, corporate actions and decisions often prioritise economic gains at the expense of other benefits such as societal well-being (Mitchell et al., 2016). However, stakeholder theory departs from these traditional constraints (Jones, Harrison & Felps, 2018), and asserts that firms must balance the interests of diverse stakeholder groups rather than concentrating solely on maximising shareholder returns (Kaler, 2006 & Pinto, 2019). Accordingly, organisations should broaden their objectives beyond financial metrics to incorporate social considerations (Brammer & Millington, 2008; Ioannou & Serafeim, 2012). Managers, in turn, ought to recognise and respect all individuals significantly affected by the firm's operations and outcomes, endeavouring to address their needs.

Stakeholder theory posits that integrating diverse stakeholder groups into corporate decision-making is both an ethical obligation and a strategic asset (Barney, 2018; Freeman, Dmytriyev & Phillips, 2021). From a utilitarian stakeholder perspective, fulfilling social responsibilities fosters reciprocal ties with stakeholders, securing their support and critical resources, which in turn enables the development of competitive advantages and strengthens overall performance (Jones, Harrison & Felp, 2018; Mayer, 2021; Bacq & Aguilera, 2022; Tao, Wu & Zhao, 2023). Innovation within firms involves multiple stakeholders forming networks through contractual ties, each with distinct objective functions and priorities (Reypens, Lievens & Blazevic, 2021). During the innovation process, divergent stakeholder demands may lead to conflicts, as stakeholders dynamically adjust their subjective evaluation of the legitimacy of corporate innovation outcomes based on associated risks and rewards (Bacq & Aguilera, 2022). Corporate innovation activities are categorised into two types: exploration and exploitation (Minoja, 2012; Ahsan et al., 2023). Successful organisations manage both exploratory and exploitative innovation, thereby achieving ambidextrous innovation (Voss & Voss, 2013; Ngo et al., 2019) This enables companies to develop existing capabilities while exploring new opportunities, vital for their survival and sustained growth (Cancela, Coelho & Duarte Neves, 2023). Stakeholders' general consensus on ESG principles builds legitimacy pressure for firms, which may choose to disclose ESG information to align with stakeholder demands. This garners recognition and support, thereby facilitating ambidextrous innovation.

Institutional theory posits that organisational structures and processes tend to seek meaning and stability rather than basing actions solely on anticipated outcomes or efficiency, such as organisational missions and objectives (Jennings & Zandbergen, 1995; Ruef & Scott, 1998). Institutional theory conceptualises institutions as the regulative, normative, and cognitive frameworks that underpin social behaviour, thereby imbuing it with both stability and meaning. The definition encompasses a comprehensive set of elements, such as laws, regulations, customs, social and professional norms, cultural values, and ethical principles, all of which collectively shape institutional environments (Kemal & Shah, 2023; Marrucci, Daddi & Iraldo, 2023). These institutional structures exert significant constraints on organisational behaviour, resulting in entities operating within the same institutional context and subject to similar external influences converging in their practices (Glynn & D'aunno, 2023; Napier, Liu & Liu, 2024). Corporate innovation results from interactions among multiple parties and is best understood within specific institutional contexts, allowing for a deeper exploration of its significance and mechanisms (Ogink et al., 2023). Typically, the enhancement of corporate innovation capabilities is driven by both government and market factors (Wang, Li & Wang, 2023). For NEV enterprises, ambidextrous innovation involves long cycles, high risks, and significant uncertainty (Peters & Buijs, 2022). Moreover, the government acts as an institutional force, playing a pivotal role in guiding ambidextrous innovation. Additionally, to expand existing market shares and enter profitable new product markets, companies may opt to continuously enhance their innovation capabilities (Tang, Zhang & Peng, 2021; Qu & Mardani, 2023). Thus, examining the ambidextrous innovation mechanisms of NEV enterprises from an institutional theory perspective holds theoretical and practical significance. In this study, both government subsidies and market competition intensity are considered part of the firms' external institutional environment, driving them toward homogeneity to achieve market acceptance. Government subsidies and market competition intensity can positively or negatively impact how NEV firms' ESG performance drives ambidextrous innovation.

Corporate ESG performance and ambidextrous innovation in NEV firms

Traditional economic and corporate finance paradigms have long positioned firm value maximisation, with an emphasis on increasing shareholder wealth, as the primary objective guiding enterprise strategy (Queen, 2015; Battilana et al., 2022). Innovation, within this logic, serves as a vehicle to extend corporate longevity and secure supra-normal profits (Xie, Huo & Zou, 2019). However, the decoupling of ownership and control in modern corporations introduces agency problems, particularly under conditions of information asymmetry. In NEV firms, innovation projects typically involve long development cycles, high sunk costs, and substantial uncertainty (Fini et al., 2023; Yang, Zhu & Albitar, 2024). These features increase the risk of managerial risk aversion, as executives often prioritise short-term financial results tied to performance evaluations and reputational concerns. Meanwhile, external investors and financial institutions, lacking full visibility into internal operations, are often reluctant to support high-risk initiatives, preferring short-cycle and lower-risk projects (Amore, Schneider & Žaldokas, 2013).

Against this backdrop, ESG frameworks have emerged as a means of reconfiguring firm objectives and overcoming structural innovation constraints. Rooted in stakeholder theory, ESG principles shift strategic focus from a narrow financial calculus toward the broader alignment of firm activities with societal expectations and long-term value creation (Cohen & Winn, 2007; Bacq & Aguilera, 2022; Lashitew et al., 2022; Xing, Huang & Fang, 2025). ESG engagement helps firms mobilise both internal and external resources for innovation. Internally, strong ESG performance enhances employee identification and trust, facilitating the ability to attract and retain innovative talent (Lu et al., 2023). From an external perspective, enhanced legitimacy among key stakeholders, including government regulators, suppliers, and customers, contributes to improved access to subsidies, reduced resource constraints, and the development of broader collaborative networks (Lee, Pak & Roh, 2024; Luo et al., 2024; Saeedikiya, Salunke & Kowalkiewicz, 2025).

Moreover, ESG performance plays a vital governance role by mitigating principal-agent problems within NEV firms. By aligning managerial behaviour with stakeholder expectations and increasing transparency, ESG frameworks encourage managers to pursue more long-term, risk-intensive innovation strategies (Crifo, Escrig-Olmedo & Mottis, 2019). Furthermore, ESG credibility functions as a reputational buffer: when innovation projects fail, stakeholders are more likely to interpret the outcomes as part of a learning process rather than managerial incompetence (Wu, Li & Yang, 2023). This elevated trust increases organisational tolerance for failure and risk-taking (Yang, Shi & Shah, 2024). Simultaneously, ESG commitments reduce information collection costs for external stakeholders and improve oversight, enhancing firms' capacity to engage in both exploratory and exploitative innovation (Clauss et al., 2021; Houston & Shan, 2022).

However, the relationship between ESG performance and ambidextrous innovation is not linear. At low levels of ESG engagement, firms may experience increased reporting burdens, constrained resources, and limited stakeholder recognition, all of which may hinder innovation (Liu, Zhang & Zhang, 2024). Additionally, opportunistic behaviours among senior managers may arise, such as diverting resources away

from R&D when ESG governance is weak (Jiao, Shuai & Li, 2024; Otto et al., 2024). In contrast, once ESG performance surpasses a critical threshold and becomes institutionally recognised, it yields net positive effects. A strong ESG performance fosters a heightened sense of responsibility among senior executives (Baek & Lee, 2024), enhances employee engagement, and secures broader stakeholder support, thereby collectively fostering an environment conducive to ambidextrous innovation (Tajeddini et al., 2024).

Overall, strong ESG performance supports the advancement of both exploratory innovations—oriented toward novel technologies, business models, or sustainable energy solutions—and exploitative innovation, aimed at enhancing operational efficiency and refining existing products. As such, ESG practices serve as a strategic mechanism through which NEV firms can overcome traditional innovation barriers, mitigate agency conflicts, and align their long-term environmental and economic objectives. Accordingly, this study proposes the following hypotheses:

H1a. The relationship between the ESG performance of NEV companies and their exploratory innovation is 'U-shaped': ESG performance above a certain threshold can promote a company's exploratory innovation.

H1b. The relationship between the ESG performance of NEV companies and their exploitative innovation is 'U-shaped': ESG performance above a certain threshold can promote a company's exploitative innovation.

The moderating role of government subsidies

According to institutional theory, firms that align their strategies and practices with external institutional expectations, including government policies, are more prone to survive and experience long-term growth (Dacin, Oliver & Roy, 2007; Greenwood et al., 2011). Within this framework, government subsidies function as key instruments to correct market failures in R&D by mitigating innovation risks and encouraging technological advancement (Klette, Møen & Griliches, 2000; Song et al., 2022). These supports, which range from fiscal grants to tax incentives, reduce innovation costs and facilitate performance improvements (Leung & Sharma, 2021; Yi et al., 2021).

For NEV firms facing high uncertainty and weak short-term incentives, subsidies can promote ambidextrous innovation by easing financial constraints and signalling legitimacy (Peters & Buijs, 2022; Christofi et al., 2024; Schiefer et al., 2024). Firms meeting environmental performance thresholds (e.g. low emissions) are more likely to receive support, thereby accelerating both exploratory and exploitative innovation (Abbas et al., 2024; Badu & Micheli, 2024; Kwilinski, Lyulyov & Pimonenko, 2025).

Yet, subsidies also risk inducing adverse effects. Weak oversight may prompt firms to pursue 'window-dressing' projects that feign innovation to access funds, only to abandon them after disbursement (Jain et al., 2024). Since the 2009 NEV subsidy rollout, policy shifts have broadened coverage, but inconsistent local implementation has sometimes undermined national objectives, supporting inefficient firms and distorting market selection mechanisms (Meng, Li & Cao, 2024; Sun et al., 2024; Tao, 2024). Moreover, this has encouraged rent-seeking behaviours and resource misallocation, thereby weakening firms' intrinsic motivation to innovate (Zhao et al., 2024).

Accordingly, while subsidies can alleviate resource constraints, they may also dilute the positive innovation effects of ESG performance, especially when misused. As such, this study proposes the following hypotheses:

H2a. Government subsidies negatively moderate the relationship between the ESG performance of NEV companies and their exploratory innovation, that is, they weaken the 'U-shaped' relationship between the two.

H2b. Government subsidies negatively moderate the relationship between the ESG performance of NEV companies and their exploitative innovation, that is, they weaken the 'U-shaped' relationship between the two.

The moderating role of market competition intensity

Market competition intensity reflects the degree of rivalry a firm faces, often shaped by the number, capability, and strategic aggressiveness of its competitors (Jaworski & Kohli, 1993; Leppänen, George & Alexy, 2023). In resource-constrained markets, heightened competition compels firms to invest in scanning and interpreting external signals to mitigate uncertainty and maintain competitiveness (Morandi, Santalo & Giarratana, 2020; Lee, Narula & Hillemann, 2021). Theoretical and empirical studies reveal a non-linear relationship between competition and innovation. While moderate competition may stimulate innovation by pressuring firms to differentiate, excessive competition can deter R&D investment owing to diminished appropriation and uncertain returns (Utterback & Suárez, 1993; Ang, 2008; Peneder & Wörter, 2014; Bento, 2020). Intense competition, coupled with rapid imitation and insufficient appropriation of innovation rents lead firms to scale back innovation initiatives (Park, Srivastava & Gnyawali, 2014).

Moreover, highly competitive markets create disincentives for R&D manipulation, as firms with strong reputational capital and high market share are less willing to undertake risky behaviour that could draw regulatory scrutiny (Jermias, 2008; Suder et al., 2025). In such environments, firms prioritise stability over experimentation, opting for safer, short-term innovation activities aligned with operational efficiency and incremental market expansion.

In the context of NEV firms, this study posits that intense market competition negatively moderates the U-shaped relationship between ESG performance and ambidextrous innovation. Under conditions of intense competition, firms—even those with sufficient resources—may avoid ambidextrous innovation strategies owing to their long-term investment horizons, high costs, and elevated uncertainty levels. Instead, they focus on less risky, efficiency-driven initiatives that offer immediate competitive advantages. Accordingly, this study proposes:

H3a. Market competition intensity negatively moderates the relationship between ESG performance of NEV companies and their exploratory innovation, that is, it weakens the 'U-shaped' relationship between the two.

H3b. Market competition intensity negatively moderates the relationship between ESG performance of NEV companies and their exploitative innovation, that is, it weakens the 'U-shaped' relationship between the two.

ESG performance, financing constraints, and ambidextrous innovation in NEV enterprises

Financing constraints are a critical barrier to corporate innovation, particularly in high-risk, long-horizon R&D activities that demand stable and patient capital (Zhang et al., 2024). Owing to information asymmetries, financial institutions often exhibit reluctance in funding such projects, especially in contexts such as China where capital markets are less mature and equity financing options are limited, particularly for innovation-intensive small and medium-sized enterprises (SMEs) (Cumming, 2007; Li et al., 2023). Alleviating financing constraints is therefore essential for promoting both exploratory and exploitative innovation.

Strong ESG performance offers a potential pathway to reduce these constraints. Prior studies highlight that ESG engagement enhances corporate transparency, thereby reducing information asymmetry and increasing investor confidence (Raimo et al., 2021; Reber, Gold & Gold, 2022). From a signalling theory perspective, firms that consistently

disclose credible ESG and financial information improve their legitimacy in the eyes of external stakeholders (Kirmani & Rao, 2000; Colombo, 2021). While ESG initiatives may entail substantial costs, they convey positive signals regarding a firm's operational robustness and ethical governance, especially when accompanied by high-quality financial disclosure (Bofinger, Heyden & Rock, 2022; Song et al., 2022; Luo et al., 2024). Moreover, ESG reporting is associated with reduced earnings manipulation and stronger governance practices, further reinforcing trust (Rezaee & Tuo, 2019).

Consequently, firms with strong ESG performance are more likely to access favourable financing conditions from investors, creditors, and suppliers (Chen, Song & Gao, 2023). In contrast, weak ESG performers may face reputational risks, regulatory pressure, and financial exclusion, thereby worsening their capital constraints (Kölbel, Busch & Jancso, 2017; Chen, Dong & Lin, 2020). Given the centrality of financing to innovation outcomes, ESG thus indirectly influences firms' capacity to undertake ambidextrous innovation by mitigating funding limitations.

Accordingly, this study proposes:

H4a. The financing constraints of NEV companies play a mediating role in the 'U-shaped' relationship between their ESG performance and exploratory innovation.

H4b. The financing constraints of NEV companies play a mediating role in the 'U-shaped' relationship between their ESG performance and exploitative innovation.

ESG performance, risk propensity, and ambidextrous innovation in NEV companies

Organisational risk propensity plays a pivotal role in shaping firms' innovation strategies. In many firms, equity-based incentives and performance evaluation systems emphasise short-term financial outcomes, incentivizing managers to prioritise low-risk, high-certainty projects over long-term, uncertain innovation investments (Dalton et al., 2007; Zhang & Gimeno, 2016; Faller & zu Knyphausen-Aufseß, 2018). Entrepreneurial firms, although generally more risk-tolerant during their initial development phases, often adopt more conservative strategies as they attain market stability and financial security (Lieberman, Lee & Folta, 2017). In environments lacking rigorous external oversight, this bias toward predictability is further reinforced by stakeholders who prefer stable returns, thereby collectively diminishing the organisation's overall risk appetite (Wang & Bansal, 2012; Ortiz-de-Mandojana & Bansal, 2016).

Adopting strong ESG practices offers a pathway to counteract excessive risk aversion. ESG frameworks help address principal-agent problems by aligning managerial incentives with long-term, sustainability-oriented objectives (Aguilera et al., 2021; Derchi, Zoni & Dossi, 2021). Integrating ESG goals into executive compensation and reporting broadens corporate accountability beyond shareholder value to include wider stakeholder concerns, encouraging a strategic orientation that supports long-term innovation (Branco & Rodrigues, 2006; Flammer, 2018). Notably, firms with strong ESG reputations are more likely to benefit from stakeholder goodwill and trust, fostering a more tolerant external environment in which innovation failures are attributed to uncontrollable factors rather than managerial misjudgement (Dickson, Weaver & Hoy, 2006; Sun et al., 2024). This higher tolerance for failure ultimately enhances firms' willingness to engage in both exploratory and exploitative innovation.

Accordingly, this study proposes the following hypotheses:

H5a. The risk propensity of NEV companies mediates the U-shaped relationship between their ESG performance and exploratory innovation.

H5b. The risk propensity of NEV companies mediates the U-shaped relationship between their ESG performance and exploitative innovation.

Overall, the conceptual model presented in Fig. 1 delineates the impact of ESG performance on ambidextrous innovation within NEV companies.

Methods

Data and sample

This study examines the relationship between ESG performance and ambidextrous innovation, which encompasses both exploratory and exploitative innovation, using data from Chinese listed NEV firms between 2009 and 2021. ESG performance scores were obtained from the Wind financial terminal, a widely used data source in Chinese capital market research. Innovation indicators were constructed using firms' stock codes to match patent data from the China State Intellectual Property Office (SIPO). Building on established research, this study aligns patent types with innovation modes to operationalise the exploration versus exploitation dichotomy. Invention patents undergo rigorous substantive examination and must satisfy strict criteria for novelty, inventive step, and utility. These requirements reflect a firms' pursuit of fundamentally new technological principles or breakthrough solutions, making invention patents widely accepted as indicators of exploratory innovation (Wang et al., 2014; Guan & Liu, 2016; Rong, Wu & Boeing, 2017). In contrast, utility-model and design patents are subject to a shorter, less demanding review that focuses on incremental modifications to product structure, form, or function, making them suitable proxies for exploitative innovation (Beneito, 2006; Guan & Liu, 2016; Hu, Pan & Huang, 2020). The distinction is particularly salient in China, where invention patents typically require more than two to three years for authorisation and are often filed before commercialisation, signalling high uncertainty and forward-looking R&D, whereas utility-model and design patents are usually granted within six to twelve months, matching firms' needs for rapid product iteration and market responsiveness. These temporal and procedural contrasts mirror Katila and Ahuja's (2002) dual logic in which exploratory innovation focuses on discovering new knowledge, whereas exploitative innovation deepens and recombines existing knowledge. Accordingly, this study measures exploratory innovation by the count of invention patents and exploitative innovation by the combined count of utility-model and design patents. Additional firm-level financial and governance variables were sourced from the China Stock Market & Accounting Research (CSMAR) Database.

To ensure the robustness and reliability of the dataset, several data-cleaning procedures were implemented. First, we excluded firms in the financial sector owing to their unique regulatory environments and balance sheet structures, which differ significantly from those of industrial firms. Second, firms classified as Special Treatment (ST or *ST) in a given year, often as a result of financial distress or regulatory infractions, were excluded from the sample to minimise potential bias arising from atypical firm behaviour. Third, firms with substantial missing data on key variables were excluded from the sample. Finally, all continuous variables were winsorised at the 1st and 99th percentiles to mitigate the influence of extreme outliers. These steps align with established empirical practices and enhance the validity of the regression results.

The selection of listed NEV companies as the study sample is supported by three key considerations. First, in light of the 'dual carbon' objectives and the broader green economy initiative, advancing energy-efficient and low-carbon transportation is essential for sustainable national development. Second, while NEVs are widely recognised as the future of the automotive industry, China continues to face substantial technological hurdles, especially in core areas such as power batteries, motor systems, and other essential components. These challenges underscore the pressing need to strengthen innovation capabilities. Third,

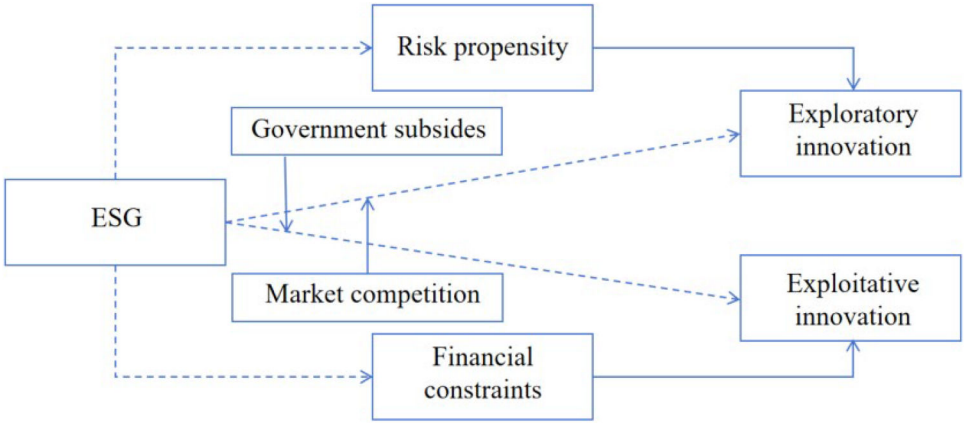

Fig. 1. Research model.
Note: Solid lines indicate linear relationships, while dashed lines represent quadratic curve relationships.

publicly listed companies offer a more robust and accessible source of data, as financial disclosures and annual reports provide reliable information for measuring the variables of interest.

Main variables

Dependent variables

In line with prior research that employs patent counts as a proxy for innovation performance (Fleming & Sorenson, 2004), this study adopts established ambidextrous innovation measurement approaches (Cui, Ding, & Yanadori, 2019). Specifically, exploratory innovation is measured as the natural logarithm of one plus the number of invention patents independently filed by listed NEV firms, while exploitative innovation is captured by the logarithm of one plus the number of utility model and design patents independently applied for. To construct these measures, we extracted patent application and grant data from the SIPO using the firms' stock codes. Next, we manually filtered the data using International Patent Classification (IPC) codes to distinguish between invention patents and non-invention patents (i.e. utility models and design patents), and aggregated the counts on an annual basis.

Independent variables

The explanatory variable, ESG, is operationalised using the Huatai Securities ESG rating system, which categorises companies into nine levels: C, CC, CCC, B, BB, BBB, A, AA, and AAA. In this framework, listed companies are assigned a numerical score from 1 to 9 in ascending order of ESG performance. The corporate ESG metric is then defined as the natural logarithm of one plus the annual average of these ratings. Given the extensive temporal coverage and broad applicability of the Huatai Securities ESG ratings, this measure is employed as a proxy for corporate ESG performance. Notably, Huatai Securities has been assessing ESG performance for A-share and bond issuers since 2009, and its rating system now covers all A-share listed companies, garnering widespread recognition in both academic and industry circles.

Moderating variables

This study incorporates government subsidies and market competition intensity as key variables. For government subsidies, the focus is on R&D support mechanisms, encompassing fiscal subsidies, innovation awards, and support funds identified through keywords such as R&D, technology, innovation, science and technology, and intellectual property (Guo, Guo, & Jiang, 2016). These subsidies are quantified in billions. To gauge market competition intensity, the analysis employs the inverse of the Herfindahl-Hirschman Index (HHI), a well-established metric for assessing industry concentration (Wang & Zhang, 2015). The HHI is calculated as the sum of the squares of the revenue shares of all firms within an industry, where higher values indicate greater market concentration and reduced competitive pressure. By taking the inverse of the HHI, the resulting measure effectively reflects the intensity of market competition.

Mediating variables

Following Hadlock and Pierce (2010), this study employs the SA Index as a proxy for financing constraints, which effectively quantifies the external funding challenges faced by firms. In parallel, to gauge a firm's risk propensity, we adopt the approach used by Galletta and Mazzù (2023), and Cui, Ding, and Yanadori (2019), measuring it as the ratio of R&D personnel to the total workforce. This ratio serves as an indicator of the firm's willingness to engage in risky and innovative activities.

Control variables

Drawing on prior studies (Cronqvist & Yu, 2017; Di Giuli & Kostovetsky, 2014; Ferrell, Liang, & Renneboog, 2016), this analysis incorporates several firm-level control variables to mitigate confounding influences. Specifically, we include the cash ratio, profitability, firm age, selling expense ratio, quick ratio, and financial expense ratio. The corresponding data for these variables are primarily sourced from the CSMAR database.

Estimation methods

Based on the theoretical framework proposed by Hausman and Taylor (1981), this study adopts a negative binomial regression model to test the proposed hypotheses. Variance inflation factors were calculated for all regression models, with all values well below the conventional threshold of 10 (Gujarati & Porter, 2009; Kutner, Nachtsheim & Neter, 2004), indicating minimal multicollinearity. The selection of the model is informed by the characteristics of the dependent variables, as the number of patents filed by firms constitutes non-negative integer count data, warranting the use of appropriate count-based regression techniques. Moreover, both exploratory and exploitative innovation measures exhibit clear signs of overdispersion, as the variance (i.e. the square of the standard deviation) substantially exceeds the mean, thereby satisfying the distributional assumptions of the negative binomial model.

To mitigate potential heterogeneity across firms and enhance the robustness of the regression results, we conducted a Hausman test using Stata software to determine the appropriate model specification. The test results support the use of a fixed effects model. Accordingly, we implemented a fixed effects negative binomial regression analysis on the panel dataset. Table 1 reports the Hausman specification tests that guide the selection between fixed effects and random effects estimators. In every model specification, including the baseline regressions for

Table 1
Summary of Hausman test results for model selection.

Dependent variable	Moderator	Hausman Chi²	p-value	Recommended model
Exploratory innovation	None	70.19	0.0000	Fixed Effects
Exploitative innovation	None	56.78	0.0000	Fixed Effects
Exploratory innovation	Government subsidies	172.15	0.0000	Fixed Effects
Exploitative innovation	Government subsidies	86.21	0.0000	Fixed Effects
Exploratory innovation	Market competitive	105.86	0.0000	Fixed Effects
Exploitative innovation	Market competitive	66.04	0.0000	Fixed Effects

exploratory innovation and exploitative innovation and the interaction models that combine ESG performance with government subsidies or market competition, the chi-square statistics are large and all p-values are below 0.001 (for example, $\chi^2 = 70.19$ for the exploratory innovation baseline model and $\chi^2 = 172.15$ for the exploratory innovation model with government subsidies). These results reject the null hypothesis—that fixed effects and random effects coefficients are equal—which implies that the explanatory variables correlate with unobserved, time-invariant firm characteristics. Under such circumstances, random effects estimates become inconsistent, whereas fixed effects estimates remain consistent. Consequently, we select the fixed effects estimator for all subsequent analyses. Adopting a fixed-effects negative binomial regression allows us to control for firm-specific heterogeneity that remains constant over time, enabling robust within-firm estimates of the influence of ESG performance—along with its interactions with government subsidies and market competition—on both exploratory and exploitative innovation.

To examine the impact of ESG performance on exploratory and exploitative innovation in new energy vehicle companies, this paper constructs the following models (where the subscripts *i*and *t*represent the sample individual and year, respectively):

To empirically assess the influence of ESG performance on both exploratory and exploitative innovation in new energy vehicle firms, we specify the following econometric models. In these models, the subscript*i*denotes individual firms and*t*denotes the year:

Main effect model:

$$EI_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \alpha_2 ESG_{i,t}{}^2 + \alpha_3 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (1)$$

$$LI_{i,t} = \beta_0 + \beta_1 ESG_{i,t} + \beta_2 ESG_{i,t}{}^2 + \beta_3 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (2)$$

Model under the moderating effect of government subsidies:

$$EI_{i,t} = \gamma_0 + \gamma_1 ESG_{i,t} + \gamma_2 ESG_{i,t}{}^2 + \gamma_3 GS_{i,t} + \gamma_4 GS_{i,t} \times ESG_{i,t} + \gamma_5 GS_{i,t} \times ESG_{i,t}{}^2 + \gamma_6 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (3)$$

$$LI_{i,t} = \chi_0 + \chi_1 ESG_{i,t} + \chi_2 ESG_{i,t}{}^2 + \chi_3 GS_{i,t} + \chi_4 GS_{i,t} \times ESG_{i,t} + \chi_5 GS_{i,t} \times ESG_{i,t}{}^2 + \chi_6 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (4)$$

Model under the moderating effect of market competition intensity:

$$EI_{i,t} = \delta_0 + \delta_1 ESG_{i,t} + \delta_2 ESG_{i,t}{}^2 + \delta_3 GS_{i,t} + \delta_4 GS_{i,t} \times ESG_{i,t} + \delta_5 GS_{i,t} \times ESG_{i,t}{}^2 + \delta_6 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (5)$$

$$LI_{i,t} = \phi_0 + \phi_1 ESG_{i,t} + \phi_2 ESG_{i,t}{}^2 + \phi_3 MC_{i,t} + \phi_4 MC_{i,t} \times ESG_{i,t} + \phi_5 MC_{i,t} \times ESG_{i,t}{}^2 + \phi_6 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (6)$$

Model for testing the mediating effect of financing constraints:

$$FC_{i,t} = \eta_0 + \eta_1 ESG_{i,t} + \eta_2 ESG_{i,t}{}^2 + \eta_3 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (7)$$

$$EI_{i,t} = \kappa_0 + \kappa_1 FC_{i,t} + \kappa_2 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (8)$$

$$EI_{i,t} = \lambda_0 + \lambda_1 ESG_{i,t} + \lambda_2 ESG_{i,t}{}^2 + \lambda_3 FC_{i,t} + \lambda_4 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (9)$$

$$LI_{i,t} = \mu_0 + \mu_1 ESG_{i,t} + \mu_2 ESG_{i,t}{}^2 + \mu_3 FC_{i,t} + \mu_4 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (10)$$

Model for testing the mediating effect of risk propensity:

$$RP_{i,t} = \nu_0 + \nu_1 ESG_{i,t} + \nu_2 ESG_{i,t}{}^2 + \nu_3 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (11)$$

$$EI_{i,t} = \pi_0 + \pi_1 RP_{i,t} + \pi_2 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (12)$$

$$EI_{i,t} = \varpi_0 + \varpi_1 ESG_{i,t} + \varpi_2 ESG_{i,t}{}^2 + \varpi_3 RP_{i,t} + \varpi_4 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (13)$$

$$LI_{i,t} = \vartheta_0 + \vartheta_1 ESG_{i,t} + \vartheta_2 ESG_{i,t}{}^2 + \vartheta_3 RP_{i,t} + \vartheta_4 Control_{i,t} + YEAR + \varepsilon_{i,t} \quad (14)$$

In these models, the dependent variable*EI*represents exploratory innovation of the firm, and *LI*represents exploitative innovation of the firm. The key explanatory variable*ESG*is the annual average of the Huatai Securities*ESG*rating. The moderating variables*GS*,*MC*represent government subsidies and market competition intensity, respectively. The mediating variables *FC*,*RP*represent financing constraints and risk propensity. In addition, all models include fixed year effects to control for annual variations, and the error term$\varepsilon_{i,t}$is captured in the residuals.

Results

Descriptive statistics

Table 2 summarises the descriptive statistics of the primary variables used in this study. Exploratory innovation values range from 0 to 8.58, with a standard deviation of 1.55, suggesting considerable variability. Similarly, exploitative innovation spans from 0 to 7.80 with a standard deviation of 1.63. For ESG performance, the measured values lie between 0.69 and 2.08, with a standard deviation of 0.21. These figures indicate that both types of innovation display significant dispersion and volatility. Table 3 presents the correlation matrix for the main variables, providing further insight into their interrelationships.

Baseline regression results

The outcomes of these regressions are presented in Table 4. Specifically, columns (1) and (2) include both the ESG performance variable and its squared term, along with a set of control variables, to evaluate their effects on exploratory and exploitative innovation, respectively. Columns (3) and (4) then examine how government subsidies moderate

Table 2
Descriptive statistics.

	Observations	Mean	S.D.	Min	Max
Exploratory innovation	3043	1.53	1.55	0.00	8.58
Exploitative innovation	3043	1.85	1.63	0.00	7.80
ESG performance	2926	1.61	0.21	0.69	2.08
Government subsidies	1218	0.63	2.66	0.00	43.79
Market competitive	2422	−0.16	0.11	−1.00	−0.04
Financing constraints	3043	20.90	163.35	0.00	3570.99
Risk propensity	1770	16.21	11.25	0.00	86.18
Cash ratio	3043	0.62	1.10	−0.20	19.03
Profitability	3043	0.01	2.16	−109.59	34.27
Firm age	3043	26.06	4.91	11.00	41.00
Sales expense ratio	3043	0.15	0.26	−0.08	13.19
Quick ratio	3043	1.69	1.79	0.00	22.34
Financial expense ratio	3044	0.01	0.06	−0.59	1.86

Table 3
Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Exploratory innovation	1.00												
(2) Exploitative innovation	0.78	1.00											
(3) ESG performance	0.23	0.17	1.00										
(4) Government subsidies	0.26	0.27	0.17	1.00									
(5) Market competitive	−0.01	−0.11	0.10	−0.09	1.00								
(6) Financing constraints	0.22	0.20	0.11	0.72	−0.08	1.00							
(7) Risk propensity	0.28	0.18	0.07	0.03	0.15	−0.01	1.00						
(8) Cash ratio	−0.00	−0.04	0.04	−0.05	0.03	−0.04	0.10	1.00					
(9) Profitability	0.02	0.02	0.01	−0.00	0.02	0.00	−0.01	0.02	1.00				
(10) Firm age	−0.18	−0.21	−0.04	0.02	−0.03	−0.05	−0.11	−0.09	−0.03	1.00			
(11) Sales expense ratio	−0.04	−0.05	−0.09	−0.03	0.08	−0.02	0.17	0.02	0.06	0.07	1.00		
(12) Quick ratio	−0.00	−0.03	0.06	−0.07	0.06	−0.06	0.09	0.86	0.04	−0.13	−0.01	1.00	
(13) Financial expense ratio	−0.11	−0.11	−0.11	−0.04	−0.01	−0.02	−0.08	−0.22	−0.45	0.10	0.63	−0.24	1.00

Table 4
Results of fixed effects negative binomial regression.

	(1) Exploratory innovation	(2) Exploitative innovation	(3) Exploratory innovation	(4) Exploitative innovation	(5) Exploratory innovation	(6) Exploitative innovation
ESG	−2.4329***	−1.7696**	−2.4200*	−1.4908	−3.7179***	−2.7349***
	(0.7305)	(0.6574)	(1.2162)	(1.1426)	(0.8757)	(0.7949)
ESG squared	1.1382***	0.7953***	1.0059**	0.6242*	1.6027***	1.1611***
	(0.2395)	(0.2170)	(0.3874)	(0.3657)	(0.2888)	(0.2635)
Government subsidies			0.0446*	0.0392*		
			(0.0237)	(0.0226)		
Government subsidies*ESG			0.2466*	0.2170*		
			(0.1306)	(0.1248)		
Government subsidies*ESG squared			−0.0276*	−0.0236*		
			(0.0131)	(0.0125)		
Market competitive					−0.8708***	−1.4005***
					(0.1974)	(0.1774)
Market competitive*ESG					22.9087*	15.8080*
					(9.2589)	(8.2728)
Market competitive*ESG squared					−8.1232**	−5.7521*
					(3.0248)	(2.7074)
Cash ratio	0.0588*	−0.0053	0.0858	0.0268	0.0114	−0.0360
	(0.0330)	(0.0319)	(0.0746)	(0.0677)	(0.0363)	(0. 0356)
Profitability	0.0758	0.0747	−0.0189	−0.1287	0.0185	0.0245
	(0.0490)	(0.0558)	(0.0974)	(0.0978)	(0.1019)	(0.0964)
Firm age	−0.0271***	−0.0329***	−0.0167***	−0.0250***	−0.0322***	−0.0384***
	(0.0037)	(0.0034)	(0.0050)	(0.0047)	(0.0044)	(0.0041)
Sales expense ratio	0.4594**	0.2716	0.9717***	0.8873**	0.7569**	0.4282
	(0.1523)	(0.1792)	(0.3036)	(0.2928)	(0.2789)	(0.2632)
Quick ratio	−0.0914***	−0.0727***	−0.1084**	−0.0484	−0.0475*	−0.0411*
	(0.0217)	(0.0200)	(0.0398)	(0.0357)	(0.0252)	(0.0237)
Financial expense ratio	−6.2584***	−6.0055***	−9.3667***	−6.7483***	−6.7402***	−6.2677***
	(0.7890)	(0.7132)	(1.4686)	(1.2771)	(0.9233)	(0.8277)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	−4669.5504	−5090.0475	−1936.014	−2075.4269	−3617.3932	−4002.3192
Observations	2926	2926	1170	1170	2342	2342

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

the relationship between ESG performance and both types of innovation. Finally, columns (5) and (6) explore the moderating effect of market competition intensity on the ESG–innovation relationship for exploratory and exploitative innovation.

Fixed effects negative binomial estimates in Table 4 indicate a statistically significant U-shaped association between ESG performance and corporate innovation. For exploratory innovation, ESG performance exerts a significant negative linear effect ($\beta = -2.433$, $p < 0.01$) and a significant positive quadratic effect ($\beta = 1.138$, $p < 0.01$). For exploitative innovation, the pattern is similar: the linear term is significantly negative ($\beta = -1.770$, $p < 0.05$) and the squared term significantly positive ($\beta = 0.795$, $p < 0.01$). These coefficient signs and significance levels confirm Hypotheses H1a and H1b, indicating that ESG improvements initially dampen innovation but, beyond a certain threshold, have a positive, innovation-enhancing effect.

Introducing government subsidies alters this curvature. When the interaction between ESG^2 and subsidies is included, its coefficient is negative and marginally significant for both exploratory ($\beta = -0.028$, $p < 0.10$) and exploitative ($\beta = -0.024$, $p < 0.10$) innovation. These results suggest that subsidies flatten the U-shape, implying that the innovation-boosting threshold is reached earlier, but the subsequent acceleration is more moderate. Accordingly, Hypotheses H2a and H2b are supported.

Market competition exerts an even stronger moderating influence. The interaction between ESG^2 and competition intensity is significantly negative for exploratory innovation ($\beta = -8.123$, $p < 0.05$) and exploitative innovation ($\beta = -5.752$, $p < 0.10$). Greater competitive pressure therefore further flattens the ESG curve, weakening the incremental innovation gains at higher ESG levels and validating Hypotheses H3a and H3b.

Testing the mediating mechanisms

(1) Financing constraints are recognised as a major impediment to corporate innovation. The core objective of ESG initiatives is to reorient corporate priorities from a singular focus on maximising economic profits toward achieving a balance between economic and social values. This strategic shift can bolster a firm's credibility with financial institutions and other stakeholders, thereby facilitating access to the necessary funds for innovation. Drawing on Hadlock and Pierce (2010), we use the SA index to proxy financing constraints. The *SA* index is calculated as:

$$SA = -0.737 \times size + 0.043 \times size^2 - 0.040 \times age \quad (15)$$

where *size* is defined as the natural logarithm of total assets and age represents the number of years since the firm's establishment. Notably, the *SA* index typically yields negative values, with a smaller absolute value indicating more severe financing constraints.

Column (1) of Table 5 illustrates that the linear ESG term is statistically indistinguishable from zero (β = –0.554, n.s.), whereas the quadratic term is positive and marginally significant (β = 0.231, $p < 0.10$). This pattern indicates a U-shaped association between ESG performance and financing constraints: modest ESG efforts tighten financing, but stronger ESG commitments eventually ease firms' funding frictions. Turning to innovation outcomes, columns (2) and (4) reveal that reduced financing constraints have a pronounced positive impact on both exploratory innovation (β = 0.656, $p < 0.01$) and exploitative innovation (β = 0.468, $p < 0.01$). When financing constraints are introduced into the innovation equations (columns 3 and 5), their coefficients remain strongly positive (exploratory: β = 0.572, $p < 0.01$; exploitative: β = 0.409, $p < 0.01$) while the magnitude of the ESG-squared term decreases, consistent with partial mediation. Thus, alleviating financing constraints constitutes a key channel through which ESG performance stimulates both exploratory and exploitative innovation, thereby supporting Hypotheses H4a and H4b. Robustness checks employing Poisson and alternative specifications (columns 6–10) deliver parallel signs and significance levels, confirming that the mediating role of financing constraints is stable across estimation methods.

(2) Risk propensity mechanism. Corporate management typically avoids high-risk innovations owing to political repercussions and career risks linked to project failures. ESG initiatives mitigate these concerns by reducing principal-agent conflicts among owners, managers, and stakeholders, thus fostering higher risk propensity and a more innovation-friendly environment.

Column (1) of Table 6 illustrates that ESG performance initially lowers a firm's risk-taking propensity; however, once a certain threshold is exceeded, it begins to increase. Specifically, the linear ESG term is negative and marginally significant (β = −0.929, $p < 0.10$), whereas the quadratic term is positive and marginally significant (β = 0.378, $p < 0.10$), confirming a U-shaped association. Risk propensity, in turn, exerts a strong positive influence on innovation. As exhibited in columns (2) and (4), a one-unit increase in risk propensity raises exploratory innovation by β = 0.017 ($p < 0.01$) and exploitative innovation by β = 0.009 ($p < 0.01$). When risk propensity is included in the innovation equations (columns 3 and 5), its coefficient remains positive and highly significant (exploratory: β = 0.015, $p < 0.01$; exploitative: β = 0.008, $p < 0.01$), while the magnitude of the ESG-squared term drops from 0.840 to 0.755 in the exploratory model and from 0.864 to 0.752 in the exploitative model. This attenuation is consistent with partial mediation, indicating that a firm's heightened willingness to take risks represents one pathway through which ESG engagement stimulates both types of innovation, thereby supporting Hypotheses H5a and H5b. Finally, alternative specifications reported in columns (6)–(10) yield parallel signs and significance levels, confirming that the mediating role of risk propensity remains robust across different estimation techniques.

Table 7 consolidates the key coefficients that correspond to each theoretical prediction. For the U-shaped effects (H1), we report the linear and quadratic ESG terms. For the moderation hypotheses (H2–H3), we provide the interaction terms with the linear and quadratic ESG components. For the two mediation hypotheses (H4–H5), we report (i) the effect of ESG^2 on the mediator (path a), and (ii) the effect of the mediator on innovation (path b). Significance levels are reported in accordance with the original tables (*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$). All coefficients are derived from the fixed effects negative binomial models reported in Tables 4–6.

Table 5
Testing the mediating role of financing constraints and robustness of results.

	Negative binomial regression					Poisson regression				
	(1) Financing constraints	(2) Exploratory innovation	(3)	(4) Exploitative innovation	(5)	(6) Financing constraints	(7) Exploratory innovation	(8)	(9) Exploitative innovation	(10)
ESG	−0.5539		−1.1514		−0.9025	−0.5539		−1.0718*		−0.8904
	(0.4214)		(0.7126)		(0.6483)	(0.4214)		(0.6452)		(0.5694)
ESG squared	0.2312*		0.6251**		0.4465*	0.2312*		0.5961**		0.4439*
	(0.1405)		(0.2335)		(0.2143)	(0.1405)		(0.2102)		(0.1876)
Financing constraints		0.6556***	0.5720***	0.4677***	0.4091***		0.6606***	0.5741***	0.4651***	0.4057***
		(0.0380)	(0.0386)	(0.0350)	(0.0360)		(0.0332)	(0.0345)	(0.0304)	(0.0316)
Cash ratio	−0.0401***	−0.0008	−0.0028	−0.0550***	−0.0578***	−0.0401***	0.0061	0.0019	−0.0531***	−0.0575***
	(0.0118)	(0.0166)	(0.0164)	(0.0169)	(0.0171)	(0.0118)	(0.0144)	(0.0149)	(0.0156)	(0.0160)
Profitability	0.0039	0.0807	0.0197	0.0343	0.0065	0.0039	0.1117*	0.0449	0.0563	0.0188
	(0.0138)	(0.0751)	(0.0691)	(0.0642)	(0.0578)	(0.0138)	(0.0552)	(0.0592)	(0.0508)	(0.0495)
Firm age	0.0158***	−0.0603***	−0.0555***	−0.0571***	−0.0533***	0.0158***	−0.0580***	−0.0533***	−0.0550***	−0.0512***
	(0.0022)	(0.0042)	(0.0041)	(0.0038)	(0.0038)	(0.0022)	(0.0035)	(0.0036)	(0.0032)	(0.0033)
Financial expense ratio	−0.0629	−6.3662***	−5.5776***	−6.3607***	−5.7211***	−0.0629	−5.1840***	−4.8792***	−5.3745***	−5.0926***
	(0.2750)	(0.7363)	(0.6793)	(0.6757)	(0.6471)	(0.2750)	(0.4819)	(0.4985)	(0.4573)	(0.4731)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	−4496.5303	−4749.2948	−4576.6539	−5214.0895	−5034.2465	−4496.5303	−4791.649	−4603.736	−5257.201	−5067.1675
Observations	2925	3042	2925	3042	2925	2925	3042	2925	3042	2925

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 6
Testing the mediating role of risk propensity and robustness of results.

	Negative binomial regression					Poisson regression				
	(1) Risk propensity	(2) Exploratory innovation	(3)	(4) Exploitative innovation	(5)	(6) Risk propensity	(7) Exploratory innovation	(8)	(9) Exploitative innovation	(10)
ESG	−0.9291*		−1.6933*		−1.7147*	−0.7510***		−1.7642*		−1.7079**
	(0.5462)		(0.7610)		(0.6808)	(0.2232)		(0.7069)		(0.6293)
ESG squared	0.3777*		0.8402***		0.7549***	0.3090***		0.8643***		0.7524***
	(0.1828)		(0.2494)		(0.2254)	(0.0744)		(0.2308)		(0.2080)
Risk propensity		0.0168***	0.0149***	0.0092***	0.0081***		0.0156***	0.0143***	0.0087***	0.0079***
		(0.0016)	(0.0015)	(0.0015)	(0.0015)		(0.0013)	(0.0013)	(0.0013)	(0.0013)
Cash ratio	0.0952***	−0.1891***	−0.1908***	−0.1552***	−0.1580***	0.0730***	−0.1941***	−0.1938***	−0.1611***	−0.1623***
	(0.0254)	(0.0386)	(0.0377)	(0.0348)	(0.0343)	(0.0082)	(0.0358)	(0.0358)	(0.0327)	(0.0327)
Profitability	−0.1746*	0.2614*	0.1051	0.1595	0.0534	−0.1983***	0.2832*	0.1155	0.1639	0.0544
	(0.0803)	(0.1306)	(0.1243)	(0.1175)	(0.1136)	(0.0322)	(0.1201)	(0.1169)	(0.1070)	(0.1053)
Firm age	−0.0105***	−0.0104*	−0.0127**	−0.0200***	−0.0215***	−0.0106***	−0.0084*	−0.0114**	−0.0190***	−0.0207***
	(0.0030)	(0.0042)	(0.0041)	(0.0039)	(0.0038)	(0.0012)	(0.0037)	(0.0037)	(0.0035)	(0.0035)
Financial expense ratio	−2.1259***	−6.1843***	−5.2435***	−5.1244***	−4.6077***	−2.3101***	−6.1596***	−5.2375***	−5.3030***	−4.7719***
	(0.5984)	(1.1337)	(1.0644)	(0.9895)	(0.9474)	(0.2697)	(1.0357)	(1.0038)	(0.9270)	(0.9021)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	−6289.5444	−3000.0654	−2940.5418	−3177.8253	−3139.5845	−9198.7823	−3021.9699	−2949.3837	−3190.6129	−3146.78
Observations	1763	1770	1763	1770	1763	1763	1770	1763	1770	1763

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 7
Hypothesis test results.

Hypothesis	Key statistics	Supported
H1a: ESG→ exploratory innovation	ESG= −2.433***; ESG^2= 1.138***	√
H1b: ESG→ exploitative innovation	ESG= −1.770**; ESG^2= 0.795***	√
H2a: Government subsidies × ESG→ exploratory innovation	GS × ESG= 0.247*; GS × ESG^2= −0.028*	√
H2b: Government subsidies × ESG→ exploitative innovation	GS × ESG= 0.217*; GS × ESG^2= −0.024*	√
H3a: Market competition × ESG→ exploratory innovation	MC × ESG= 22.909*; MC × ESG^2= −8.123**	√
H3b: Market competition × ESG→ exploitative innovation	MC × ESG= 15.808*; MC × ESG^2= −5.752*	√
H4a: Financing constraints mediation (ESG→exploratory innovation)	Path a: ESG^2= 0.231*; Path b: FC= 0.656***	√
H4b: Financing constraints mediation (ESG→exploitative innovation)	Path a: ESG^2= 0.231*; Path b: FC= 0.468***	√
H5a: Risk propensity mediation (ESG→exploratory innovation)	Path a: ESG^2= 0.378*; Path b: RP= 0.017***	√
H5b: Risk propensity mediation (ESG→exploitative innovation)	Path a: ESG^2= 0.378*; Path b: RP= 0.009***	√

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Robustness tests

To ensure the validity of the primary results, we implemented a series of robustness checks. First, we applied alternative regression techniques to verify that the estimated relationships were not an artifact of a particular methodological approach. Second, we addressed potential endogeneity concerns through appropriate econometric strategies. The consistency of the results across these various tests reinforces the robustness of the conclusions.

(1) Changing the regression method. To verify the robustness of the findings, we re-estimated the models using a Poisson regression framework, as presented in Table 8. The results obtained through this alternative approach are largely consistent with the previous estimates. All hypothesised relationships remain statistically significant, thereby reinforcing the validity of the original findings and confirming that all hypotheses hold under this specification.

(2) Addressing issues of endogeneity. Given that a firm's capacity for technological innovation may also influence its ESG rating, there exists a potential issue of reverse causality and endogeneity between ESG and dual innovation within companies. Moreover, to address concerns that omitted variables might affect dual innovation, we implement an Instrumental Variable (IV) approach. This strategy helps mitigate endogeneity issues by isolating the causal impact of ESG performance on both exploratory and exploitative innovation, thereby reinforcing the robustness.

This study employs the number of ESG fund holdings as IV to proxy for corporate ESG performance. This choice is justified on several grounds. First, ESG funds, as prominent institutional investors, influence corporate governance and management practices through mechanisms such as 'voting with their feet' and continuous oversight. By incorporating their investment philosophy into company operations, ESG funds improve companies' ESG performance, thus fulfilling the relevance criterion. Second, it is unlikely that ESG funds directly affect the innovation investments of companies. This is because ESG funds typically do not interfere directly in the day-to-day operations of companies but may engage in private dialogues with executives to enhance ESG performance. The realisation of their investment philosophy primarily depends on the fund managers' stock selection and other decision-making processes. Furthermore, corporate innovation relies significantly on participants' knowledge and technical skills in specific scientific or engineering fields, which surpasses the general qualifications expected of fund investment personnel, thereby meeting the exclusivity criterion.

Table 9 reports the results from the IV analysis. In column (1), the first-stage regression uses the number of ESG fund holdings as an instrument to explain corporate ESG performance. The predicted ESG values derived from this stage are then incorporated into the second-stage regressions, with the results for exploratory and exploitative innovation presented in columns (2) and (3), respectively. Notably, the squared ESG term remains significantly positive at the 1 % level in both models, thereby reinforcing the previous findings and confirming the robustness of the U-shaped relationship between ESG performance and dual innovation.

Furthermore, the statistical results from the identification test and weak instrument variable test indicate that there are no issues of under-identification or weak instruments in this study. Additionally, since the number of IVs (ESG fund holdings) does not exceed the number of explanatory variables (corporate ESG), over-identification is not a

Table 8
Poisson regression results.

	(1) Exploratory innovation	(2) Exploitative innovation	(3) Exploratory innovation	(4) Exploitative innovation	(5) Exploratory innovation	(6) Exploitative innovation
ESG	−2.2991***	−1.7182***	−2.4324*	−1.4348	−3.4863***	−2.5918***
	(0.6323)	(0.5605)	(1.1343)	(1.0498)	(0.7507)	(0.6648)
ESG squared	1.0924***	0.7799***	1.0105**	0.6101*	1.5271***	1.1182***
	(0.2058)	(0.1844)	(0.3609)	(0.3357)	(0.2458)	(0.2195)
Government subsidies			0.0401*	0.0384*		
			(0.0203)	(0.0195)		
Government subsidies*ESG			0.2226*	0.1858*		
			(0.1117)	(0.1039)		
Government subsidies*ESG squared			−0.0248*	−0.0203*		
			(0.0111)	(0.0103)		
Market competitive					−0.8168***	−1.2791***
					(0.1639)	(0.1385)
Market competitive *ESG					21.4452**	13.7614*
					(8.0205)	(6.9101)
Market competitive *ESG squared					−7.5718**	−4.9896*
					(2.6056)	(2.2525)
Cash ratio	0.0532*	−0.0181	0.0851	0.0247	0.0092	−0.0472
	(0.0297)	(0.0286)	(0.0711)	(0.0634)	(0.0320)	(0.0312)
Profitability	0.0795*	0.0738*	−0.0162	−0.1206	0.0933	0.0586
	(0.0387)	(0.0418)	(0.0892)	(0.0887)	(0.0673)	(0.0652)
Firm age	−0.0248***	−0.0311***	−0.0160***	−0.0243***	−0.0293***	−0.0357***
	(0.0031)	(0.0029)	(0.0046)	(0.0043)	(0.0037)	(0.0033)
Sales expense ratio	0.3237**	0.2166	0.9612***	0.8895***	0.6163**	0.3171
	(0.1141)	(0.1385)	(0.2809)	(0.2658)	(0.2238)	(0.2096)
Quick ratio	−0.0835***	−0.0645***	−0.1090**	−0.0487	−0.0395*	−0.0347*
	(0.0188)	(0.0171)	(0.0376)	(0.0331)	(0.0214)	(0.0197)
Financial expense ratio	−4.8144***	−5.0500***	−9.2376***	−6.8492***	−4.8429***	−5.0868***
	(0.4879)	(0.4760)	(1.3603)	(1.1924)	(0.5144)	(0.5110)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	−4728.3945	−5141.3457	−1939.8724	−2080.0394	−3664.0225	−4052.2382
Observations	2926	2926	1170	1170	2342	2342

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 9
Instrumental variable (IV) regression results.

	First stage regression of IVs	Second stage regression of IVs	
	(1)	(2)	(3)
	ESG	Exploratory innovation	Exploitative innovation
Number of ESG fund holdings	−0.0022***		
	(0.0005)		
ESG		−138.2197***	−92.6776***
		(34.9975)	(25.97342)
ESG squared		46.1447***	30.9863***
		(11.4922)	(8.5393)
Cash ratio	−0.0009*	−0.0374	−0.0789
	(0.0006)	(0.1024)	(0.0790)
Profitability	−0.0010	−0.0920	−0.1525
	(0.0015)	(0.2647)	(0.2247)
Firm age	0.0001	−0.0223	−0.0451***
	(0.0001)	(0.0149)	(0.0109)
Sales expense ratio	0.0018	1.9716	1.3284
	(0.0072)	(1.2357)	(0.9445)
Quick ratio	0.0005	−0.0387	−0.0574
	(0.0005)	(0.0718)	(0.0535)
Financial expense ratio	−0.0461*	−15.6163***	−14.4478***
	(0.0213)	(3.5186)	(2.5980)
Kleibergen-Paap rk LM statistic (P-val)	0.0000		
Kleibergen-Paap Wald rk F statistic	19.18		
Anderson-Rubin Wald test (P-val)	0.0000		
Year	Yes	Yes	Yes
Observations	2759	2759	2759

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

concern. Ultimately, the regression results demonstrate that after controlling for potential endogeneity issues, the conclusions of this study remain robust.

Heterogeneity test

The ownership structure of firms may significantly influence the relationship between ESG performance and ambidextrous innovation in the NEV sector. State-owned enterprises (SOEs), which operate under stringent governmental oversight and carry substantial social responsibilities, embody both economic and political attributes. With the growing emphasis on sustainable development, SOEs have increasingly become pivotal instruments for government-led high-quality growth. As a result, compared to private firms, SOEs tend to experience more rigorous environmental regulatory pressures and enhanced market supervision. This study further examines how these ownership attributes affect the interplay between ESG performance and both exploratory and exploitative innovation in NEV companies.

Columns (3) and (4) of Table 10 reveal that state ownership negatively moderates the U-shaped relationship between ESG performance and exploratory innovation in NEV companies. In contrast, state ownership does not significantly affect the U-shaped relationship between ESG and exploitative innovation. One possible explanation is that SOEs typically feature elongated principal-agent chains and less rigorous supervisory and constraint mechanisms compared to private firms. This structural rigidity can dampen entrepreneurial spirit, resulting in inflexible management practices and weaker incentive systems. Leadership appointments and promotions in SOEs are often determined by higher-level authorities, which tend to emphasise short-term performance outcomes over long-term, higher-risk innovation. Consequently, SOE leaders are less inclined to invest in exploratory innovation, which generally involves longer cycles and greater uncertainty.

Table 10
Analysis of heterogeneity in corporate ownership attributes.

	(1) Exploratory innovation	(2) Exploitative innovation	(3) Exploratory innovation	(4) Exploitative innovation
ESG	−2.4329***	−1.7696**	−2.8984***	−2.0551**
	(0.7305)	(0.6574)	(0.8065)	(0.7281)
ESG squared	1.1382***	0.7953***	1.2230***	0.8302***
	(0.2395)	(0.2170)	(0.2664)	(0.2418)
State-owned enterprise			0.0234	0.0018
			(0.0436)	(0.0390)
State-owned enterprise*ESG			0.7014*	0.4065*
			(0.2759)	(0.2398)
State-owned enterprise*ESG squared			−0.0632*	−0.0305
			(0.0329)	(0.0291)
Cash ratio	0.0588*	−0.0053	0.0266	−0.0426
	(0.0330)	(0.0319)	(0.0363)	(0.0342)
Profitability	0.0758	0.0747	0.1069*	0.0824
	(0.0490)	(0.0558)	(0.0539)	(0.0523)
Firm age	−0.0271***	−0.0329***	−0.0282***	−0.0324***
	(0.0037)	(0.0034)	(0.0039)	(0.0036)
Sales expense ratio	0.4594**	0.2716	0.3846*	0.3063*
	(0.1523)	(0.1792)	(0.1611)	(0.1632)
Quick ratio	−0.0914***	−0.0727***	−0.0809***	−0.0554**
	(0.0217)	(0.0200)	(0.0225)	(0.0203)
Financial expense ratio	−6.2584***	−6.0055***	−6.2412***	−5.9452***
	(0. 7890)	(0.7132)	(0.8008)	(0.7163)
Year	Yes	Yes	Yes	Yes
Log likelihood	−4669.5504	−5090.0475	−4466.1988	−4887.1027
Observations	2926	2926	2810	2810

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Moreover, SOEs usually face fewer financing constraints, therefore, the influence of ESG performance on their financial conditions is relatively muted. As exploratory innovation demands substantial technological input, higher costs, and acceptance of greater uncertainty, SOEs are less proactive in these areas compared to private enterprises. Therefore, the ESG–exploratory innovation relationship is attenuated in SOEs.

Conversely, exploitative innovation, characterised by incremental improvements aimed at enhancing innovation output and operational efficiency, is common to both SOEs and private companies. As exploitative innovation is less specialised, less confidential, and less affected by information asymmetries in capital markets, it encounters smaller principal–agent problems. As a result, the impact of ESG performance on exploitative innovation does not differ significantly between SOEs and non-SOEs.

Robustness tests, which involved changing the regression method and re-estimating the models (as depicted in Table 11), yield results that are essentially consistent with the earlier findings, thereby confirming the robustness of the heterogeneity outcomes related to ownership attributes.

Table 11
Robustness test for corporate ownership attributes.

	(1) Exploratory innovation	(2) Exploitative innovation	(3) Exploratory innovation	(4) Exploitative innovation
ESG	−2.2991***	−1.7182**	−2.8277***	−2.0069***
	(0.6323)	(0.5605)	(0.6805)	(0.6086)
ESG squared	1.0924***	0.7799***	1.2050***	0.8205***
	(0.2058)	(0.1844)	(0.2237)	(0.2020)
State-owned enterprise			0.0330	0.0068
			(0.0379)	(0.0337)
State-owned enterprise*ESG			0.7181**	0.4116*
			(0.2419)	(0.2087)
State-owned enterprise*ESG squared			−0.0670*	−0.0322
			(0.0284)	(0.0250)
Cash ratio	0.0532*	−0.0181	0.0168	−0.0558*
	(0.0297)	(0.0286)	(0.0322)	(0.0300)
Profitability	0.0795*	0.0738*	0.1045*	0.0778*
	(0.0387)	(0.0418)	(0.0418)	(0.0403)
Firm age	−0.0248***	−0.0311***	−0.0260***	−0.0306***
	(0.0031)	(0.0029)	(0.0033)	(0.0030)
Sales expense ratio	0.3237**	0.2166	0.2763*	0.2510*
	(0.1141)	(0.1385)	(0.1216)	(0.1281)
Quick ratio	−0.0835***	−0.0645***	−0.0726***	−0.0479**
	(0.0188)	(0.0171)	(0.0192)	(0.0171)
Financial expense ratio	−4.8144***	−5.0500***	−4.9950***	−5.0963***
	(0.4879)	(0.4760)	(0.5129)	(0.4900)
Year	Yes	Yes	Yes	Yes
Log likelihood	−4728.3945	−5141.3457	−4524.7142	−4937.1311
Observations	2926	2926	2810	2810

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Discussion

Drawing on an integrated stakeholder and institutional perspective, we investigate how ESG engagement influences exploratory and exploitative innovation among Chinese NEV firms from 2009 to 2021. In contrast to the prevailing view that superior ESG performance consistently boosts innovation (Eccles, Ioannou & Serafeim, 2014; Broadstock et al., 2020), the findings reveals a contingent U-shaped association. When ESG capabilities remain below a threshold, compliance tasks absorb managerial attention and reallocate slack resources, thereby suppressing both exploration and exploitation. Once firms surpass this capability threshold, accumulated routines, enhanced legitimacy, and stronger stakeholder goodwill collectively spur dual-mode innovation. This finding aligns with capability life-cycle theory, which describes early adjustment costs followed by delayed returns in emerging organisational practices (Teece, 2007).

The upward segment of this curve is carried by two parallel mechanisms. First, credible ESG disclosure eases financing constraints, lowering the cost of external capital and enlarging the pool of funds available for R&D (Ioannou & Serafeim, 2015). Second, heightened ESG credibility increases managerial tolerance for uncertainty, leading to a greater willingness to invest in risky projects that underpin both exploratory breakthroughs and incremental improvements (Cucculelli & Bettinelli, 2015). Demonstrating these financial and behavioural channels within a single analytical framework extends existing micro-foundation research, which often examines them separately (Hafenbrädl & Waeger, 2017). Additionally, it underscores the need to view ESG as deeply embedded in resource allocation and decision-making processes rather than as a purely symbolic initiative.

External context significantly moderates the ESG-innovation relationship. Government subsidies and intense product-market competition flatten the rebound of the U-shape, indicating partial substitution between externally provided incentives and ESG-derived advantages. While prior work emphasises the innovation-stimulating effects of regulation and rivalry (Porter & Linde, 1995; Delmas & Toffel, 2008), the results suggest that excessive external pressure can hinder the learning benefits that arise from internally driven ESG initiatives. Ownership structure offers further nuance: SOEs, constrained by administrative routines, translate ESG credibility into dynamic innovation less effectively than private firms. Taken together, the findings clarify when ESG initiatives hinder or enhance innovation, the internal channels through which they operate, and the institutional conditions under which their impact is most pronounced.

Theoretical implications

This study makes four key theoretical contributions to the literature on ESG, innovation management, and sustainability strategy domains.

First, we enrich existing research on the relationship between ESG performance and innovation by revealing a nonlinear, U-shaped association with both exploratory and exploitative innovation. While prior studies often assume a positive and linear relationship, suggesting that higher ESG performance invariably leads to improved innovation outcomes (Eccles, Ioannou & Serafeim, 2014; Broadstock et al., 2020; Clementino & Perkins, 2021), the study's findings challenge this orthodoxy. By identifying a performance threshold beyond which ESG engagement catalyses innovation, we demonstrate that ESG initiatives initially impose adjustment costs and organisational frictions, but ultimately generate innovation enhancing returns. This supports a contingent resource based logic, aligning with arguments in organisational theory that emphasise time-lagged and path dependent effects in capability development (Teece, 2007). This study thus contributes to a more nuanced understanding of how sustainability investments translate into firm-level innovation outcomes.

Second, we extend the literature on organisational ambidexterity by theorizing ESG performance as a strategic antecedent that simultaneously influences exploitative and exploratory innovation (O'Reilly & Tushman, 2013; Xing, Huang & Fang, 2025). While prior studies have primarily examined structural configurations and leadership capabilities as enablers of ambidexterity (Jansen, Van den Bosch & Volberda, 2006; Raisch & Birkinshaw, 2008; Randhawa et al., 2021), limited attention has been given to how external governance mechanisms, particularly those associated with ESG initiatives, influence the composition of firms' innovation portfolios. By integrating stakeholder theory and institutional theory, the findings suggest that ESG orientation provides firms with the institutional legitimacy and stakeholder endorsement necessary to balance short term optimisation with long-term adaptability (O'Reilly & Tushman, 2013). This reconceptualization positions ESG not merely as a constraint or risk mitigation mechanism but as a strategic lever for dynamic capability deployment.

Third, we contribute to the emerging literature on the micro foundations of ESG based value creation (Barney & Felin, 2013; Hafenbrädl & Waeger, 2017) by unpacking the mediating mechanisms through which ESG impacts innovation. Specifically, the empirical analyses demonstrate that firms with strong ESG performance experience lower financial constraints and exhibit higher risk-taking propensity—two organisational conditions that are foundational to innovation (Cucculelli & Bettinelli, 2015), yet are rarely integrated into ESG influenced innovation models. These results challenge the view of ESG as a primarily symbolic or reputational tool and instead highlight its tangible role in shaping resource allocation and strategic decision-making within the firm. This mechanism-based explanation introduces granularity to the existing literature on sustainability performance relationships and underscores ESG's embeddedness in internal organisational processes.

Fourth, the findings contribute to the institutional logics perspective by examining how the relationship between ESG and innovation is shaped by external contingencies, including government subsidies and market competition (Thornton, Ocasio & Lounsbury, 2012; Xing, Huang & Fang, 2025). While prior studies have typically emphasised the enabling effects of public policy (Delmas & Toffel, 2008) and competitive intensity (Porter & van der Linde, 1995), the moderation analysis reveals a more complex interplay. Excessive external pressures, whether from regulatory incentives or market dynamics, can dilute the firm's internal ESG-driven logic, resulting in strategic ambiguity or symbolic compliance. This insight contributes to the literature on institutional complexity and hybrid organising by highlighting the potential for misalignment between external institutional demands and internal sustainability-oriented strategies (Greenwood et al., 2011; Shabbir, 2025). This offers a theoretical lens to explain why ESG initiatives may fail to produce expected innovation outcomes under certain boundary conditions.

Managerial implications

The findings offer critical insights for corporate executives, sustainability managers, and policymakers striving to balance environmental responsibility with competitive innovation strategies, particularly in high-tech, regulation-intensive industries such as NEVs.

For corporate managers, the U-shaped ESG innovation relationship underscores the importance of strategic patience and alignment. Early stage ESG adoption may divert resources away from R&D and innovation activities owing to compliance costs and organisational restructuring. However, once a critical capability threshold is surpassed, ESG practices begin to generate innovation dividends by enhancing stakeholder trust, reducing risk exposure, and facilitating strategic partnerships (Bhandari, Ranta, & Salo, 2022; Hart & Dowell, 2011). Managers should therefore treat ESG not as a short-term cost centre but as a long-term enabler of ambidextrous innovation, capable of reconciling operational efficiency with radical transformation.

In practice, ESG oriented firms should actively monitor and manage internal readiness conditions, such as capital liquidity and risk

tolerance, to optimise innovation outcomes. Investment in ESG reporting systems, governance reforms, and stakeholder engagement mechanisms can bolster transparency and signal credibility to investors and partners, thereby easing financing constraints and reducing perceived innovation risk (Ioannou & Serafeim, 2015). These adjustments are especially vital when pursuing exploratory innovation, which often requires more flexible organisational structures and higher tolerance for failure.

Furthermore, the role of government subsidies and market competition as double-edged swords presents an important strategic consideration. Although these external forces can incentivise innovation, their interaction with high ESG performance may lead to diminishing marginal returns if not well calibrated. For instance, over-reliance on government subsidies could shift managerial focus from long term innovation capacity building to short term grant compliance or rent-seeking behaviours. Companies should therefore develop internal evaluation mechanisms to ensure that external incentives reinforce, rather than replace, intrinsic innovation motivations.

For policymakers, the findings suggest a shift from blanket subsidy strategies to differentiated support schemes. Incentives should be conditional upon clear ESG milestones and innovation outcomes, with monitoring systems in place to discourage symbolic ESG adoption. Moreover, the observed ownership heterogeneity implies that state-owned firms may require governance reforms or incentive redesign to better integrate ESG principles into their strategic core. This could include revising performance appraisal criteria, granting managerial autonomy in innovation decisions, or creating hybrid incentive structures that reward both compliance and creativity.

The international relevance of these insights is evident. In developed economies with relatively mature ESG infrastructure, the Chinese case serves as a mirror, highlighting the risks of over-standardisation and greenwashing. Firms in such contexts should guard against box-ticking approaches to ESG and instead cultivate strategic capabilities that enhance learning, adaptability, and stakeholder co-creation (Luo & Bhattacharya, 2006; Nidumolu, Prahalad & Rangaswami, 2009).

Ultimately, the study advocates for a systemic integration of ESG and innovation strategy, where sustainability is not an external add-on but a core lens through which firms design and execute their innovation portfolios. By clarifying the trade-offs, thresholds, and institutional contingencies involved, these findings help organisations navigate the sustainability innovation interface with greater precision and purpose.

Conclusions

This study explores how ESG performance influences exploratory and exploitative innovation in the context of China's NEV industry. We identify a nonlinear U-shaped relationship, where initial ESG engagement imposes adjustment costs and suppresses innovation. However, beyond a critical point, it significantly enhances innovation capabilities. Through mediation analysis, we demonstrate that ESG performance improves firms' access to financial resources and increases their willingness to undertake risk, which are crucial drivers of innovation. In addition, the moderation analysis reveals that both government subsidies and market competition can dilute the positive effects of ESG at higher performance levels. Additionally, ownership characteristics play a critical role, with SOEs facing more constraints in leveraging ESG for exploratory innovation owing to institutional rigidity and lower responsiveness. By integrating insights from stakeholder theory and institutional theory, this research highlights ESG as a dual-force mechanism. It acts both as a constraint and a catalyst, depending on the timing and contextual conditions. These findings contribute to a more dynamic understanding of how sustainability commitments shape innovation strategies.

Limitations and future research

Several limitations provide avenues for future inquiry. First, the current analysis does not distinguish between green and non-green innovation, which limits the ability to evaluate ESG's environmental relevance. Second, while financing constraints and risk-taking serve as mediators, other mechanisms such as dynamic capabilities or innovation culture may also play significant roles and deserve further attention. Third, the exclusive use of the Huazheng ESG rating system may restrict the robustness of the findings. Incorporating alternative ESG metrics and primary data would improve measurement validity. Fourth, the sample is limited to listed firms in the NEV sector, which constrains the generalisability of the results. Future research should consider a broader range of industries and institutional contexts to validate and extend these insights. We hope this study encourages continued exploration into the complex relationship between ESG engagement and corporate innovation, particularly under varying institutional pressures and organisational structures.

CRediT authorship contribution statement

Huanyong Ji: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jing Huang:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation. **Keke Sun:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Formal analysis. **Zeyu Xing:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Data curation, Conceptualization.

Acknowledgments

The authors would like to thank the editors and the anonymous review team for their insightful comments and suggestions that immensely helped to improve this article. This research was supported by the National Natural Science Foundation of China (Nos. 72102020) and the National Social Science Foundation of China (Nos. 23CJY070).

References

Abbas, S., Saqib, N., Mohammed, K. S., Sahore, N., & Shahzad, U. (2024). Pathways towards carbon neutrality in low carbon cities: The role of green patents, R&D and energy use for carbon emissions. *Technological Forecasting and Social Change, 200*, Article 123109.

Abdelfattah, I., & El-Shamy, A. M. (2024). Review on the escalating imperative of zero liquid discharge (ZLD) technology for sustainable water management and environmental resilience. *Journal of Environmental Management, 351*, Article 119614.

Aguilera, R. V., Aragón-Correa, J. A., Marano, V., & Tashman, P. A. (2021). The corporate governance of environmental sustainability: A review and proposal for more integrated research. *Journal of Management, 47*(6), 1468–1497.

Ahsan, M., Adomako, S., Donbesuur, F., & Mole, K. F. (2023). Entrepreneurial passion and product innovation intensity in new ventures: Mediating effects of exploration and exploitation activities. *British Journal of Management, 34*(2), 849–872.

Amore, M. D., Schneider, C., & Žaldokas, A. (2013). Credit supply and corporate innovation. *Journal of Financial Economics, 109*(3), 835–855.

Ang, S. H. (2008). Competitive intensity and collaboration: Impact on firm growth across technological environments. *Strategic Management Journal, 29*(10), 1057–1075.

Asiaei, K., O'Connor, N. G., Barani, O., & Joshi, M. (2023). Green intellectual capital and ambidextrous green innovation: The impact on environmental performance. *Business Strategy and the Environment, 32*(1), 369–386.

Askenazy, P., Cahn, C., & Irac, D. (2013). Competition, R&D, and the cost of innovation: Evidence for France. *Oxford Economic Papers, 65*(2), 293–311.

Azmi, W., Hassan, M. K., Houston, R., & Karim, M. S. (2021). ESG activities and banking performance: International evidence from emerging economies. *Journal of International Financial Markets, Institutions and Money, 70*, Article 101277.

Bacq, S., & Aguilera, R. V. (2022). Stakeholder governance for responsible innovation: A theory of value creation, appropriation, and distribution. *Journal of Management Studies, 59*(1), 29–60.

Badu, D. A., & Micheli, P. (2024). How performance measurement systems enable or hinder organizational ambidexterity. *International Journal of Operations & Production Management*.

Baek, S., & Lee, D. H. (2024). Can R&D investment be a key driver for sustainable development? Evidence from Korean industry. *Corporate Social Responsibility and Environmental Management, 31*(2), 838–853.

Barney, J. A. Y., & Felin, T. (2013). What are microfoundations? *Academy of Management Perspectives, 27*(2), 138–155.

Barney, J. B. (2018). Why resource-based theory's model of profit appropriation must incorporate a stakeholder perspective. *Strategic Management Journal, 39*(13), 3305–3325.

Battilana, J., Obloj, T., Pache, A. C., & Sengul, M. (2022). Beyond shareholder value maximization: Accounting for financial/social trade-offs in dual-purpose companies. *Academy of Management Review, 47*(2), 237–258.

Bento, P. (2020). Competition, innovation, and the number of firms. *Review of Economic Dynamics, 37*, 275–298.

Beneito, P. (2006). The innovative performance of in-house and contracted R&D in terms of patents and utility models. *Research Policy, 35*(4), 502–517.

Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of Finance, 26*(6), 1315–1344.

Bhandari, K. R., Ranta, M., & Salo, J. (2022). The resource-based view, stakeholder capitalism, ESG, and sustainable competitive advantage: The firm's embeddedness into ecology, society, and governance. *Business Strategy and the Environment, 31*(4), 1525–1537.

Bofinger, Y., Heyden, K. J., & Rock, B. (2022). Corporate social responsibility and market efficiency: Evidence from ESG and misvaluation measures. *Journal of Banking & Finance, 134*, Article 106322.

Brammer, S., & Millington, A. (2008). Does it pay to be different? An analysis of the relationship between corporate social and financial performance. *Strategic Management Journal, 29*(12), 1325–1343.

Branco, M. C., & Rodrigues, L. L. (2006). Corporate social responsibility and resource-based perspectives. *Journal of Business Ethics, 69*, 111–132.

Broadstock, D. C., Matousek, R., Meyer, M., & Tzeremes, N. G. (2020). Does corporate social responsibility impact firms' innovation capacity? The indirect link between environmental & social governance implementation and innovation performance. *Journal of Business Research, 119*, 99–110.

Cancela, B. L., Coelho, A., & Duarte Neves, M. E. (2023). Greening the business: How ambidextrous companies succeed in green innovation through to sustainable development. *Business Strategy and the Environment, 32*(6), 3073–3087.

Cao, J., Titman, S., Zhan, X., & Zhang, W. (2023). ESG preference, institutional trading, and stock return patterns. *Journal of Financial and Quantitative Analysis, 58*(5), 1843–1877.

Chen, S., Song, Y., & Gao, P. (2023). Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance. *Journal of Environmental Management, 345*, Article 118829.

Chen, T., Dong, H., & Lin, C. (2020). Institutional shareholders and corporate social responsibility. *Journal of Financial Economics, 135*(2), 483–504.

Christensen, D. M., Serafeim, G., & Sikochi, A. (2022). Why is corporate virtue in the eye of the beholder? The case of ESG ratings. *The Accounting Review, 97*(1), 147–175.

Christofi, M., Stylianou, I., Hadjielias, E., De Massis, A., & Kastanakis, M. N. (2024). Tackling pandemic-related health grand challenges: The role of organizational ambidexterity, social equality, and innovation performance. *Journal of Product Innovation Management, 41*(2), 347–378.

Clauss, T., Kraus, S., Kallinger, F. L., Bican, P. M., Brem, A., & Kailer, N. (2021). Organizational ambidexterity and competitive advantage: The role of strategic agility in the exploration-exploitation paradox. *Journal of Innovation & Knowledge, 6*(4), 203–213.

Clementino, E., & Perkins, R. (2021). How do companies respond to environmental, social and governance (ESG) ratings? Evidence from Italy. *Journal of Business Ethics, 171*(2), 379–397.

Cohen, B., & Winn, M. I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing, 22*(1), 29–49.

Colombo, O. (2021). The use of signals in new-venture financing: A review and research agenda. *Journal of Management, 47*(1), 237–259.

Crifo, P., Escrig-Olmedo, E., & Mottis, N. (2019). Corporate governance as a key driver of corporate sustainability in France: The role of board members and investor relations. *Journal of Business Ethics, 159*(4), 1127–1146.

Cronqvist, H., & Yu, F. (2017). Shaped by their daughters: Executives, female socialization, and corporate social responsibility. *Journal of Financial Economics, 126*(3), 543–562.

Cucculelli, M., & Bettinelli, C. (2015). Business models, intangibles and firm performance: Evidence on corporate entrepreneurship from Italian manufacturing SMEs. *Small Business Economics, 45*, 329–350.

Cui, V., Ding, W. W., & Yanadori, Y. (2019). Exploration versus exploitation in technology firms: The role of compensation structure for R&D workforce. *Research Policy, 48*(6), 1534–1549.

Cumming, D. (2007). Government policy towards entrepreneurial finance: Innovation investment funds. *Journal of Business Venturing, 22*(2), 193–235.

Dacin, M. T., Oliver, C., & Roy, J. P. (2007). The legitimacy of strategic alliances: An institutional perspective. *Strategic Management Journal, 28*(2), 169–187.

Dalton, D. R., Hitt, M. A., Certo, S. T., & Dalton, C. M. (2007). 1 the fundamental agency problem and its mitigation: Independence, equity, and the market for corporate control. *Academy of Management Annals, 1*(1), 1–64.

Delmas, M. A., & Toffel, M. W. (2008). Organizational responses to environmental demands: Opening the black box. *Strategic Management Journal, 29*(10), 1027–1055.

Derchi, G. B., Zoni, L., & Dossi, A. (2021). Corporate social responsibility performance, incentives, and learning effects. *Journal of Business Ethics, 173*(3), 617–641.

Deuten, S., Vilchez, J. J. G., & Thiel, C. (2020). Analysis and testing of electric car incentive scenarios in the Netherlands and Norway. *Technological Forecasting and Social Change, 151*, Article 119847.

Di Giuli, A., & Kostovetsky, L. (2014). Are red or blue companies more likely to go green? Politics and corporate social responsibility. *Journal of Financial Economics, 111*(1), 158–180.

Dickson, P. H., Weaver, K. M., & Hoy, F. (2006). Opportunism in the R&D alliances of SMES: The roles of the institutional environment and SME size. *Journal of Business Venturing, 21*(4), 487–513.

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147–160.

dos Reis Cardillo, M. A., & Basso, L. F. C. (2025). Revisiting knowledge on ESG/CSR and financial performance: A bibliometric and systematic review of moderating variables. *Journal of Innovation & Knowledge, 10*(1), Article 100648.

Duque-Grisales, E., & Aguilera-Caracuel, J. (2021). Environmental, social and governance (ESG) scores and financial performance of multilatinas: Moderating effects of geographic international diversification and financial slack. *Journal of Business Ethics, 168*(2), 315–334.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management Science, 60*(11), 2835–2857.

Enkel, E., Heil, S., Hengstler, M., & Wirth, H. (2017). Exploratory and exploitative innovation: To what extent do the dimensions of individual level absorptive capacity contribute? *Technovation, 60*, 29–38.

Faller, C. M., & zu Knyphausen-Aufseß, D. (2018). Does equity ownership matter for corporate social responsibility? A literature review of theories and recent empirical findings. *Journal of Business Ethics, 150*, 15–40.

Ferrell, A., Liang, H., & Renneboog, L. (2016). Socially responsible firms. *Journal of Financial Economics, 122*(3), 585–606.

Fini, R., Perkmann, M., Kenney, M., & Maki, K. M. (2023). Are public subsidies effective for university spinoffs? Evidence from SBIR awards in the University of California system. *Research Policy, 52*(1), Article 104662.

Flammer, C. (2018). Competing for government procurement contracts: The role of corporate social responsibility. *Strategic Management Journal, 39*(5), 1299–1324.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics, 142*(2), 499–516.

Freeman, R. E., Dmytriyev, S. D., & Phillips, R. A. (2021). Stakeholder theory and the resource-based view of the firm. *Journal of Management, 47*(7), 1757–1770.

Galletta, S., & Mazzù, S. (2023). ESG controversies and bank risk taking. *Business Strategy and the Environment, 32*(1), 274–288.

Glynn, M. A., & D'aunno, T. (2023). An intellectual history of institutional theory: Looking back to move forward. *Academy of Management Annals, 17*(1), 301–330.

Greenwood, R., Raynard, M., Kodeih, F., Micelotta, E. R., & Lounsbury, M. (2011). Institutional complexity and organizational responses. *Academy of Management Annals, 5*(1), 317–371.

Grewal, J., Riedl, E. J., & Serafeim, G. (2019). Market reaction to mandatory nonfinancial disclosure. *Management Science, 65*(7), 3061–3084.

Guan, J., & Liu, N. (2016). Exploitative and exploratory innovations in knowledge network and collaboration network: A patent analysis in the technological field of nano-energy. *Research Policy, 45*(1), 97–112.

Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics* (5th ed.). New York, NY: McGraw-Hill/Irwin.

Guo, D., Guo, Y., & Jiang, K. (2016). Government-subsidized R&D and firm innovation: Evidence from China. *Research Policy, 45*(6), 1129–1144.

Hadlock, C. J., & Pierce, J. R. (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies, 23*(5), 1909–1940.

Hafenbrädl, S., & Waeger, D. (2017). Ideology and the micro-foundations of CSR: Why executives believe in the business case for CSR and how this affects their CSR engagements. *Academy of Management Journal, 60*(4), 1582–1606.

Hart, S. L., & Dowell, G. (2011). Invited editorial: A natural-resource-based view of the firm: Fifteen years after. *Journal of Management, 37*(5), 1464–1479.

Hausman, J. A., & Taylor, W. E. (1981). Panel data and unobservable individual effects. *Econometrica: Journal of the Econometric Society*, 1377–1398.

Helfaya, A., & Bui, P. (2025). Pursuing a corporate sustainable identity: Green governance strategy, hybrid vehicle development, knowledge and sustainability performance. *Journal of Innovation & Knowledge, 10*(2), Article 100660.

Houston, J. F., & Shan, H. (2022). Corporate ESG profiles and banking relationships. *The Review of Financial Studies, 35*(7), 3373–3417.

Hu, J., Pan, X., & Huang, Q. (2020). Quantity or quality? The impacts of environmental regulation on firms' innovation-quasi-natural experiment based on China's carbon emissions trading pilot. *Technological Forecasting and Social Change, 158*, Article 120122.

Iazzolino, G., Bruni, M. E., Veltri, S., Morea, D., & Baldissarro, G. (2023). The impact of ESG factors on financial efficiency: An empirical analysis for the selection of sustainable firm portfolios. *Corporate Social Responsibility and Environmental Management, 30*(4), 1917–1927.

Ioannou, I., & Serafeim, G. (2012). What drives corporate social performance? The role of nation-level institutions. *Journal of International Business Studies, 43*, 834–864.

Ioannou, I., & Serafeim, G. (2015). The impact of corporate social responsibility on investment recommendations: Analysts' perceptions and shifting institutional logics. *Strategic Management Journal, 36*(7), 1053–1081.

Jain, M., Talwar, S., Rastogi, R., Kaur, P., & Dhir, A. (2024). Policy stimulation for the electric vehicle industry: An analysis of mainstream media discourse. *Business Strategy and the Environment*.

Jansen, J. J., Van Den Bosch, F. A., & Volberda, H. W (2006). Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Management Science, 52*(11), 1661–1674.
Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing, 57*(3), 53–70.
Jennings, P. D., & Zandbergen, P. A. (1995). Ecologically sustainable organizations: An institutional approach. *Academy of Management Review, 20*(4), 1015–1052.
Jermias, J. (2008). The relative influence of competitive intensity and business strategy on the relationship between financial leverage and performance. *The British Accounting Review, 40*(1), 71–86.
Jiao, J., Shuai, Y., & Li, J. (2024). Identifying ESG types of Chinese solid waste disposal companies based on machine learning methods. *Journal of Environmental Management, 360*, Article 121235.
Jones, T. M., Harrison, J. S., & Felps, W. (2018). How applying instrumental stakeholder theory can provide sustainable competitive advantage. *Academy of Management Review, 43*(3), 371–391.
Kaler, J. (2006). Evaluating stakeholder theory. *Journal of Business Ethics, 69*, 249–268.
Katila, R., & Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal, 45*(6), 1183–1194.
Kemal, A. A., & Shah, M. H. (2023). Digital innovation in social cash organizations–the effects of the institutional interactions for transforming organizational practices. *Information Technology & People*.
Kirmani, A., & Rao, A. R. (2000). No pain, no gain: A critical review of the literature on signaling unobservable product quality. *Journal of Marketing, 64*(2), 66–79.
Klette, T. J., Møen, J., & Griliches, Z. (2000). Do subsidies to commercial R&D reduce market failures? Microeconometric evaluation studies. *Research Policy, 29*(4–5), 471–495.
Kölbel, J. F., Busch, T., & Jancso, L. M. (2017). How media coverage of corporate social irresponsibility increases financial risk. *Strategic Management Journal, 38*(11), 2266–2284.
Kutner, M. H., Nachtsheim, C. J., & Neter, J. (2004). *Applied linear regression models* (4th ed.). New York, NY: McGraw-Hill/Irwin.
Kwilinski, A., Lyulyov, O., & Pimonenko, T. (2025). The role of green finance in attaining environmental sustainability within a country's ESG performance. *Journal of Innovation & Knowledge, 10*(2), Article 100674.
Lashitew, A. A., Narayan, S., Rosca, E., & Bals, L. (2022). Creating social value for the 'base of the pyramid': An integrative review and research agenda. *Journal of Business Ethics, 178*(2), 445–466.
Lee, J. M., Narula, R., & Hillemann, J. (2021). Unraveling asset recombination through the lens of firm-specific advantages: A dynamic capabilities perspective. *Journal of World Business, 56*(2), Article 101193.
Lee, M. J., Pak, A., & Roh, T. (2024). The interplay of institutional pressures, digitalization capability, environmental, social, and governance strategy, and triple bottom line performance: A moderated mediation model. *Business Strategy and the Environment*.
Lei, X., & Yu, J. (2024). Striving for sustainable development: Green financial policy, institutional investors, and corporate ESG performance. *Corporate Social Responsibility and Environmental Management, 31*(2), 1177–1202.
Leppänen, P., George, G., & Alexy, O. (2023). When do novel business models lead to high performance? A configurational approach to value drivers, competitive strategy, and firm environment. *Academy of Management Journal, 66*(1), 164–194.
Leung, T. Y., & Sharma, P. (2021). Differences in the impact of R&D intensity and R&D internationalization on firm performance–Mediating role of innovation performance. *Journal of Business Research, 131*, 81–91.
Li, C., Wang, Y., Zhou, Z., Wang, Z., & Mardani, A. (2023). Digital finance and enterprise financing constraints: Structural characteristics and mechanism identification. *Journal of Business Research, 165*, Article 114074.
Lieberman, M. B., Lee, G. K., & Folta, T. B. (2017). Entry, exit, and the potential for resource redeployment. *Strategic Management Journal, 38*(3), 526–544.
Liu, Y., Zhang, H., & Zhang, F. (2024). The power of CEO growing up in poverty: Enabling better corporate environmental, social, and governance (ESG) performance. *Corporate Social Responsibility and Environmental Management, 31*(3), 1610–1633.
Long, H., Feng, G. F., Gong, Q., & Chang, C. P. (2023). ESG performance and green innovation: An investigation based on quantile regression. *Business Strategy and the Environment, 32*(7), 5102–5118.
Lu, J., Guo, S., Qu, J., Lin, W., & Lev, B. (2023). "Stay" or "leave": Influence of employee-oriented social responsibility on the turnover intention of new-generation employees. *Journal of Business Research, 161*, Article 113814.
Luo, W., Tian, Z., Fang, X., & Deng, M. (2024). Can good ESG performance reduce stock price crash risk? Evidence from Chinese listed companies. *Corporate Social Responsibility and Environmental Management, 31*(3), 1469–1492.
Luo, X., & Bhattacharya, C. B. (2006). Corporate social responsibility, customer satisfaction, and market value. *Journal of Marketing, 70*(4), 1–18.
Luo, Y., & Tung, R. L. (2018). A general theory of springboard MNEs. *Journal of International Business Studies, 49*, 129–152.
Marrucci, L., Daddi, T., & Iraldo, F. (2023). Institutional and stakeholder pressures on organisational performance and green human resources management. *Corporate Social Responsibility and Environmental Management, 30*(1), 324–341.
Mayer, C. (2021). The future of the corporation and the economics of purpose. *Journal of Management Studies, 58*(3), 887–901.
McCollum, D. L., Wilson, C., Bevione, M., Carrara, S., Edelenbosch, O. Y., Emmerling, J., … van Vuuren, D. P. (2018). Interaction of consumer preferences and climate policies in the global transition to low-carbon vehicles. *Nature Energy, 3*(8), 664–673.
Meng, Q., Li, Y., & Cao, Q. (2024). The paradox analysis and functional mechanism between R&D efficiency and transformation effect: Evidence from key universities in China. *Technovation, 130*, Article 102934.
Minoja, M. (2012). Stakeholder management theory, firm strategy, and ambidexterity. *Journal of Business Ethics, 109*(1), 67–82.
Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of Management Review, 22*(4), 853–886.
Mitchell, R. K., Weaver, G. R., Agle, B. R., Bailey, A. D., & Carlson, J. (2016). Stakeholder agency and social welfare: Pluralism and decision making in the multi-objective corporation. *Academy of Management Review, 41*(2), 252–275.
Morandi Stagni, R., Santalo, J., & Giarratana, M. S. (2020). Product-market competition and resource redeployment in multi-business firms. *Strategic Management Journal, 41*(10), 1799–1836.
Moskovics, P., Wanke, P., Tan, Y., & Gerged, A. M. (2024). Market structure, ESG performance, and corporate efficiency: Insights from Brazilian publicly traded companies. *Business Strategy and the Environment, 33*(2), 241–262.
Naeem, M. A., Appiah, M., Taden, J., Amoasi, R., & Gyamfi, B. A. (2023). Transitioning to clean energy: Assessing the impact of renewable energy, bio-capacity and access to clean fuel on carbon emissions in OECD economies. *Energy Economics, 127*, Article 107091.
Naimy, V., El Khoury, R., & Iskandar, S. (2021). ESG versus corporate financial performance: Evidence from East Asian Firms in the industrials sector. *Studies of Applied Economics, 39*(3).
Napier, E., Liu, S. Y., & Liu, J. (2024). Adaptive strength: Unveiling a multilevel dynamic process model for organizational resilience. *Journal of Business Research, 171*, Article 114334.
Nelson, J. P., Selin, C. L., & Scott, C. T. (2021). Toward anticipatory governance of human genome editing: A critical review of scholarly governance discourse. *Journal of Responsible Innovation, 8*(3), 382–420.
Ngo, L. V., Bucic, T., Sinha, A., & Lu, V. N. (2019). Effective sense-and-respond strategies: Mediating roles of exploratory and exploitative innovation. *Journal of Business Research, 94*, 154–161.
Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review, 87*(9), 56–64.
Oduro, R. A., & Taylor, P. G. (2023). Future pathways for energy networks: A review of international experiences in high income countries. *Renewable and Sustainable Energy Reviews, 171*, Article 113002.
Ogink, R. H., Goossen, M. C., Romme, A. G. L., & Akkermans, H. (2023). Mechanisms in open innovation: A review and synthesis of the literature. *Technovation, 119*, Article 102621.
O'Reilly, C. A., III, & Tushman, M. L (2013). Organizational ambidexterity: Past, present, and future. *Academy of Management Perspectives, 27*(4), 324–338.
Ortiz-de-Mandojana, N., & Bansal, P. (2016). The long-term benefits of organizational resilience through sustainable business practices. *Strategic Management Journal, 37*(8), 1615–1631.
Otto, B. D., Schuessler, E. S., Sydow, J., & Vogelgsang, L. (2024). Finding creativity in predictability: Seizing kairos in chronos through temporal work in complex innovation processes. *Organization Science*.
Ovaere, M., & Proost, S. (2022). Cost-effective reduction of fossil energy use in the European transport sector: An assessment of the Fit for 55 package. *Energy Policy, 168*, Article 113085.
Park, B. J. R., Srivastava, M. K., & Gnyawali, D. R. (2014). Walking the tight rope of coopetition: Impact of competition and cooperation intensities and balance on firm innovation performance. *Industrial Marketing Management, 43*(2), 210–221.
Peneder, M., & Wörter, M. (2014). Competition, R&D and innovation: Testing the inverted-U in a simultaneous system. *Journal of Evolutionary Economics, 24*, 653–687.
Peters, K., & Buijs, P. (2022). Strategic ambidexterity in green product innovation: Obstacles and implications. *Business Strategy and the Environment, 31*(1), 173–193.
Pinto, J. (2019). Key to effective organizational performance management lies at the intersection of paradox theory and stakeholder theory. *International Journal of Management Reviews, 21*(2), 185–208.
Porter, M. E., & Linde, C. V. D. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives, 9*(4), 97–118.
Qu, Y., & Mardani, A. (2023). Market orientation, technological opportunity, and new product innovation performance. *Journal of Business Research, 162*, Article 113841.
Queen, P. E. (2015). Enlightened shareholder maximization: Is this strategy achievable? *Journal of Business Ethics, 127*, 683–694.
Raimo, N., Caragnano, A., Zito, M., Vitolla, F., & Mariani, M. (2021). Extending the benefits of ESG disclosure: The effect on the cost of debt financing. *Corporate Social Responsibility and Environmental Management, 28*(4), 1412–1421.
Raisch, S., & Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of Management, 34*(3), 375–409.
Raisch, S., & Krakowski, S. (2021). Artificial intelligence and management: The automation-augmentation paradox. *Academy of Management Review, 46*(1), 192–210.
Randhawa, K., Nikolova, N., Ahuja, S., & Schweitzer, J. (2021). Design thinking implementation for innovation: An organization's journey to ambidexterity. *Journal of Product Innovation Management, 38*(6), 668–700.
Reber, B., Gold, A., & Gold, S. (2022). ESG disclosure and idiosyncratic risk in initial public offerings. *Journal of Business Ethics, 179*(3), 867–886.
Ren, C., Ting, I. W. K., Lu, W. M., & Kweh, Q. L. (2022). Nonlinear effects of ESG on energy-adjusted firm efficiency: Evidence from the stakeholder engagement of apple incorporated. *Corporate Social Responsibility and Environmental Management, 29*(5), 1231–1246.

Reypens, C., Lievens, A., & Blazevic, V. (2021). Hybrid orchestration in multi-stakeholder Innovation Networks: Practices of mobilizing multiple, diverse stakeholders across organizational boundaries. *Organization Studies, 42*(1), 61–83.
Rezaee, Z., & Tuo, L. (2019). Are the quantity and quality of sustainability disclosures associated with the innate and discretionary earnings quality? *Journal of Business Ethics, 155*, 763–786.
Rong, Z., Wu, X., & Boeing, P. (2017). The effect of institutional ownership on firm innovation: Evidence from Chinese listed firms. *Research Policy, 46*(9), 1533–1551.
Roth, L., Corsi, S., & Hughes, M. (2024). Ambidexterity within a multinational context: How organisations can leverage explorative and exploitative reverse innovation. *R&D Management*.
Ruan, L., Yang, L., & Dong, K. (2024). Corporate green innovation: The influence of ESG information disclosure. *Journal of Innovation & Knowledge, 9*(4), Article 100628.
Ruef, M., & Scott, W. R. (1998). A multidimensional model of organizational legitimacy: Hospital survival in changing institutional environments. *Administrative Science Quarterly*, 877–904.
Saeedikiya, M., Salunke, S., & Kowalkiewicz, M. (2025). The nexus of digital transformation and innovation: A multilevel framework and research agenda. *Journal of Innovation & Knowledge, 10*(1), Article 100640.
Scherer, F. M. (1967). Market structure and the employment of scientists and engineers. *The American Economic Review, 57*(3), 524–531.
Schiefer, T., Mahr, D., van Fenema, P. C., & Mennens, K. (2024). A collaborative approach to manage continuous service innovation. *Technovation, 134*, Article 103029.
Shabbir, M. S. (2025). Corporate Sustainability reimagined: A bibliometric–Systematic literature review of governance, technology, and stakeholder-driven strategies for SDG impact. *Business Strategy and the Environment*.
Song, Y., Sahut, J. M., Zhang, Z., Tian, Y., & Hikkerova, L. (2022). The effects of government subsidies on the sustainable innovation of university-industry collaboration. *Technological Forecasting and Social Change, 174*, Article 121233.
Srai, J. S., Joglekar, N., Tsolakis, N., & Kapur, S. (2022). Interplay between competing and coexisting policy regimens within supply chain configurations. *Production and Operations Management, 31*(2), 457–477.
Suder, M., Kusa, R., Duda, J., & Okręglicka, M. (2025). Mediating or moderating? Innovative approach to the role of flexibility in the relationship between entrepreneurial orientation and firm growth under different market conditions. *Journal of Innovation & Knowledge, 10*(2), Article 100658.
Sun, G., Wang, J., & Ai, Y. (2024a). The impact of government green subsidies on stock price crash risk. *Energy Economics*, Article 107573.
Sun, J., Hou, S., Deng, Y., & Li, H. (2024b). New media environment, green technological innovation and corporate productivity: Evidence from listed companies in China. *Energy Economics*, Article 107395.
Tajeddini, K., Gamage, T. C., Tajdini, J., Hameed, W. U., & Tajeddini, O. (2024). Exploring the effects of service innovation ambidexterity on service design in the tourism and hospitality industry. *International Journal of Hospitality Management, 119*, Article 103730.
Tang, T. Y., Zhang, S. K., & Peng, J. (2021). The value of marketing innovation: Market-driven versus market-driving. *Journal of Business Research, 126*, 88–98.
Tao, M. (2024). Dynamics between electric vehicle uptake and green development: Understanding the role of local government competition. *Transport Policy, 146*, 227–240.
Tao, R., Wu, J., & Zhao, H. (2023). Do corporate customers prefer socially responsible suppliers? An instrumental stakeholder theory perspective. *Journal of Business Ethics, 185*(3), 689–712.
Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350.
Thornton, P. H., Ocasio, W., & Lounsbury, M. (2012). *The institutional logics perspective: A new approach to culture, structure, and process*. Oxford University Press.
Utterback, J. M., & Suárez, F. F. (1993). Innovation, competition, and industry structure. *Research Policy, 22*(1), 1–21.
Voss, G. B., & Voss, Z. G. (2013). Strategic ambidexterity in small and medium-sized enterprises: Implementing exploration and exploitation in product and market domains. *Organization Science, 24*(5), 1459–1477.
Waheed, A., & Zhang, Q. (2022). Effect of CSR and ethical practices on sustainable competitive performance: A case of emerging markets from stakeholder theory perspective. *Journal of Business Ethics, 175*(4), 837–855.
Wang, C., Rodan, S., Fruin, M., & Xu, X. (2014). Knowledge networks, collaboration networks, and exploratory innovation. *Academy of Management Journal, 57*(2), 484–514.
Wang, C. A., Wang, L., Zhao, S., Yang, C., & Albitar, K. (2024). The impact of fintech on corporate carbon emissions: Towards green and sustainable development. *Business Strategy and the Environment*.
Wang, F., & Zhang, X. P. S. (2015). The role of the Internet in changing industry competition. *Information & Management, 52*(1), 71–81.
Wang, L., Han, C., Zheng, Y., Peng, X., Yang, M., & Gupta, B. (2023a). Search for exploratory and exploitative service innovation in manufacturing firms: The role of ties with service intermediaries. *Journal of Innovation & Knowledge, 8*(1), Article 100288.
Wang, M., Li, Y., & Wang, Z. (2023b). A nonlinear relationship between corporate environmental performance and economic performance of green technology innovation: Moderating effect of government market-based regulations. *Business Strategy and the Environment, 32*(6), 3119–3138.
Wang, T., & Bansal, P. (2012). Social responsibility in new ventures: Profiting from a long-term orientation. *Strategic Management Journal, 33*(10), 1135–1153.
Wu, D., Li, H., & Yang, J. (2023). How does social responsibility investment strategy contribute to hospitality firms' recovery from public health emergencies? The case of COVID-19 pandemic. *International Journal of Hospitality Management, 113*, Article 103530.
Xie, X., Huo, J., & Zou, H. (2019). Green process innovation, green product innovation, and corporate financial performance: A content analysis method. *Journal of Business Research, 101*, 697–706.
Xing, Z., Huang, J., & Fang, D. (2025). From compliance to competitiveness: Unpacking the impact of ESG performance on strategic innovation and market dynamics. *IEEE Transactions on Engineering Management*.
Xu, J., Guan, Y., Oldfield, J., Guan, D., & Shan, Y. (2024). China carbon emission accounts 2020-2021. *Applied Energy, 360*, Article 122837.
Yakob, R., Nakamura, H. R., & Ström, P. (2018). Chinese foreign acquisitions aimed for strategic asset-creation and innovation upgrading: The case of Geely and Volvo Cars. *Technovation, 70*, 59–72.
Yang, C., Zhu, C., & Albitar, K. (2024a). ESG ratings and green innovation: AU-shaped journey towards sustainable development. *Business Strategy and the Environment*.
Yang, H., Shi, X., & Shah, S. G. M. (2024b). Can heterogeneous media attention invigorate green technological innovation: A moderating role of chief executive officer narcissism. *Corporate Social Responsibility and Environmental Management*.
Yi, J., Murphree, M., Meng, S., & Li, S. (2021). The more the merrier? Chinese government R&D subsidies, dependence, and firm innovation performance. *Journal of Product Innovation Management, 38*(2), 289–310.
Zhang, M., Zhu, X., & Liu, R. (2024a). Patent length and innovation: Novel evidence from China. *Technological Forecasting and Social Change, 198*, Article 123010.
Zhang, P., Wang, Y., Wang, R., & Wang, T. (2024b). Digital finance and corporate innovation: Evidence from China. *Applied Economics, 56*(5), 615–638.
Zhang, Y., & Gimeno, J. (2016). Earnings pressure and long-term corporate governance: Can long-term-oriented investors and managers reduce the quarterly earnings obsession? *Organization Science, 27*(2), 354–372.
Zhao, S., Abbassi, W., Hunjra, A. I., & Zhang, H. (2024). How do government R&D subsidies affect corporate green innovation choices? Perspectives from strategic and substantive innovation. *International Review of Economics & Finance, 93*, 1378–1396.