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**Business Strategy in Innovative SMEs: Digital Orientation, Diversity in Corporate
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Department of Management and Business Administration

Settore Scientifico Disciplinare ECON/06

Dottorando

Ludovica Antenzio

Coordinatore

Prof.ssa Federica Ceci

Tutor

Prof.ssa Augusta Consorti

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Business Strategy in Innovative SMEs: Digital Orientation, Diversity in Corporate Governance and Performance

Abstract

The thesis investigates the evolution of business strategy in innovative small and medium-sized enterprises (SMEs) by analysing how strategic orientation and corporate governance jointly influence firm performance. It explores multiple strategic and firm-level dimensions that explain how innovative SMEs achieve competitive advantage in dynamic landscapes. Specifically, four interconnected studies are developed examining i) the configuration of innovation drivers leading to high financial performance and the role of gender differences, ii) the curvilinear relationship between digital orientation and business performance, iii) the role of female board members in digital orientation-financial performance, vi) the relationship between digital strategy and young-female board members. By combining fuzzy-set qualitative comparative analysis with quantitative econometric methods such as Ordinary Least Square, Generalized Method of Moments and Two-Stage Least Square, this thesis offers a comprehensive understanding of the interplay between strategic orientation and governance mechanisms in sustain firm performance and shaping the business strategy trajectories of innovative SMEs. Finally, this work advances the current debate on SME strategy in the digital era, providing both theoretical insights and managerial implications on how to design, align, and govern digital and business resources for sustainable performance.

Keywords: Business strategy, innovative SMEs, digital orientation, corporate governance, gender, performance

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1. Introduction

This thesis entitled “Business Strategy in Innovative SMEs: Digital Orientation, Diversity in Corporate Governance and Performance” is a result of an in-depth research activity carried out during three years of my PhD in Accounting, Management and Business Economics (AMBE) at the Department of Management and Business Administration in the University “G. d’Annunzio” Chieti-Pescara, Italy. The research activities were conducted under the supervisor of prof. Augusta Consorti. The research topic was also developed during visiting periods at the Department of Business Administration and Product Design, University of Girona (Spain) under the host supervision of prof. Andrea Bikfalvi and prof. Pilar Marques; at the Department of Management and Strategy, Paris School of Business (France) under prof. Francesco Appio; and at the Department of Business Management, University of Valencia (Spain) under prof. Joaquin Alegre.

The main topic revolves around the development paths of business strategy of small and medium-sized enterprises (SMEs), with particular attention to digital strategic orientation and board diversity as key drivers of performance in innovative SMEs.

Today, firms operate in increasingly dynamic and uncertain environments that requires continuous adaptation and strategic reconfiguration. Within this context, SMEs play a pivotal role, accounting for the majority of employment and value creation in Europe (Gorgels et al., 2022; OECD, 2019). Among them, innovative SMEs, officially recognized as a subset of SMEs actively engage in technological advancements, R&D, and strategic digitalisation efforts (Alegre & Pasamar, 2018; Merín-Rodríguez et al., 2024; OECD, 2019) are more adaptable and responsive to technological change (Sawers et al., 2008) and are critical to the economic advancement of any country (Abubakar et al., 2019). For these reasons, innovative SMEs represent a fertile ground for studying the mechanisms through which business strategy affects performance (Arcuri et al., 2023; Merín-Rodríguez et al., 2024, 2025).

The digital revolution has redesigned how SMEs conceive and execute their strategies, emphasising the importance of digital orientation, intangible resources and corporate governance in sustaining performance (Kindermann et al., 2021; Xie et al., 2020). In this landscape, business strategy acts as the unifying framework through which firms allocate resources, leverage capabilities, and exploit emerging technologies

(Bharadwaj et al., 2013; Escoz Barragan & Becker, 2025), while board characteristics play a crucial role in supporting strategic choices (Triana et al., 2019; Xu et al., 2018).

The aim of this thesis is to analyse the relationship between business strategy, corporate governance traits and performance of innovative SMEs by considering the impact of innovation drivers, digital orientation and young and female board members. In this context, it is noteworthy to observe that strategic and governance dimensions are deeply intertwined. While digitalisation enables new business and growth opportunities (Merín-Rodrigáñez et al., 2024), governance mechanisms determine the firm's ability to recognize, select and implement them effectively (Xie et al., 2020). Thus, the main objective of this thesis is to explore the dual role of strategic orientation and governance diversity in driving innovative SMEs' performance, by analysing the positive and negative implications that arise along their evolutionary journey towards competitive advantage.

To achieve this aim, the thesis is structured into four main chapters that together provide a comprehensive understanding of how these constructs interact to shape performance trajectories in innovative SMEs. The second chapter investigates and evaluates different configurations of innovation drivers in innovative SMEs. The third chapter quantitatively analyses the relationship between digital orientation and innovative SME performance, considering both innovation and financial performance. The fourth chapter explores the relationship between digital orientation and financial performance, considering the role of female members in the corporate governance of innovative SMEs. Finally, in the fifth chapter particular attention is paid to the relationship between digital strategy and financial performance in innovative SMEs, with a specific focus on the complementary contribution of young-female board members (under 35 years old).

The research presented in this thesis is grounded in a combination of theoretical perspectives that collectively explain how firms create, deploy, and renew their strategic resources to sustain performance, and the role of board characteristics in guiding these mechanisms. At its core, the Resource-Based View (RBV) (Barney, 1991) provides the primary lens for understanding how valuable, rare, inimitable, and non-substitutable resources drive firm performance. Complementing this perspective, the Dynamic Capabilities (DC) (Teece et al., 1997) explains how SMEs adapt and reconfigure their resource base in response to technological change. The concept of the IT Paradox

(Brynjolfsson, 1993) further enriches the theoretical framework by addressing the non-linear and contradictory effects of digital investment on firm performance. In addition, the upper Echelon Theory (UET) (Hambrick & Mason, 1984) and Critical Mass Theory (Dahlerup, 1988) provide the conceptual basis for integrating the governance characteristics and behavioural dimensions into the analysis.

Within the framework of this thesis, different methodologies are adopted for the study to ensure a robust and multidimensional investigation. Specifically, the fuzzy-set qualitative comparative analysis is applied to capture the complexity of strategic factors and to identify the different configurations of resources and governance gaining high performance in a rigorous and replicable method, leading to robust conclusions based on the current debate (Ragin, 2008). Given the dynamic nature of the digital orientation modelling (Kindermann et al., 2021, 2024), textual analysis, principal component analysis (PCA) are used also with the Generalized Method of Moments (GMM) for estimating parameters with lags of dependent variables. As a quantitative tools, the Ordinary Least Square (OLS), the GMM and Two-stage Least Square (2SLS) proved to be useful to ensure the robustness of the results between digital orientation, governance characteristics, and firm performance.

The sample includes Italian innovative SMEs officially registered in the national Chamber of Commerce, differing in significant characteristics (i.e. corporate status, firm size, and industry sector) reflecting the structural variety of SME population and captures the dynamics of the broader business system within the economies of most countries (OECD, 2019). Specifically, in the first chapter, the entire population of innovative SMEs was analysed to provide a comprehensive overview of their key characteristics and performance determinants, while in the subsequent chapters, a representative and heterogeneous subsample of innovative SMEs was selected to ensure data consistency and methodological robustness.

All these methodological approaches, which are presented in the following chapters, serve as complementary tools for developing the thesis and advancing research in this field. Results and related manuscripts are presented in the next four paper-based chapters organised as follows.

In the second chapter (“Driving Financial Performance in Innovative SMEs: Does Gender Matter?” with Daniela Di Berardino)¹, the authors explore the role of innovation in driving financial performance in innovative small and medium-sized enterprises (SMEs), distinguishing between female-led and non-female-led firms. It aims to examine which combination of R&D investment, qualified human capital, and intellectual property rights contributes to higher profitability, and whether gender influences this relationship. Using fuzzy-set qualitative comparative analysis (fsQCA), the study analyses a sample of 2,635 Italian innovative SMEs over a ten-year period (2013-2022). This approach allows for the identification of different innovation pathways that lead to high financial performance, considering both female-led and non-female-led SMEs.

Results highlight that R&D and highly qualified teams are more critical predictors of profitability than legal protection mechanisms. While female-led SMEs exhibit higher levels of innovation-related resources, the study finds no substantial differences in the specific innovation strategies leading to financial success between female-led and non-female-led SMEs. Moreover, when access to and control over resources is equitable, the impact of innovative practices on profitability appears to be gender neutral.

This study contributes to the academic debate on innovation in SMEs. By integrating a gender perspective, it advances the understanding of innovation-driven financial performance in these firms and suggests a gender-neutral dimension of innovation. The findings provide empirical insights into the key innovation pathways for high-performing SMEs, offering valuable implications for managers and policymakers aiming to foster innovation, gender equality, and competitiveness.

¹ A part of this chapter titled “Driving financial performance in Innovative SMEs: Does gender matter?” has been presented to the academic debate in the following conference and journal:

- i. Presented at the Sinergie-SIMA Management Conference - Management of sustainability and well-being for individuals and society, June 13-14, 2024 (Antenzio & Di Berardino, 2024a)
- ii. Presented at the 17th Annual Conference of the EuroMed Academy of Business - Global Business Transformation in a Turbulent Era, September 11-13, 2024 (Antenzio & Di Berardino, 2024b)
- iii. Accepted and published in *Management Research Review* in 2025. The journal is A-ANVUR and 1 ABS. DOI: [10.1108/MRR-02-2025-0094](https://doi.org/10.1108/MRR-02-2025-0094) (Di Berardino & Antenzio, 2025)

In the third chapter (“Digital orientation and performance in innovative SMEs: exploring the (curvi)linear effects” with Pilar Marques and Andrea Bikfalvi)², the authors focus on the relationship between digital orientation and SME performance. Digital orientation plays a key role in the competitiveness of firms, enhancing business processes and improving performance. In this paper, we examine how digital orientation affects innovative SMEs in terms of innovation and financial performance. Our analysis is based on an original panel data set of 250 innovative Italian SMEs over a period of 10 years, constructed using novel methods. We applied the Generalised Method of Moments, considering the curvilinear (inverted U-shaped) effect between businesses’ digital orientation and innovation and financial performance. The study finds support for the positive influence of digital orientation on financial performance, confirming the inverted U-shape, while results for innovation are contrary to the hypothesis raised. Our research provides insightful evidence of the complex relationship between digital orientation and different types of performance, contributing to the discussion on the IT paradox and highlighting a key managerial implication whereby innovative SMEs, rather than steadily increasing digital investment, should focus on optimising their digital assets to sustain both innovation and financial performance.

In the fourth chapter (“Digital Orientation and Gender Diverse Boards: Unpacking the Performance Link in Innovative SMEs” with Hussain Muhammad, Daniela Di Berardino and Augusta Consorti)³, the authors investigate the complex relationship between digital orientation and financial performance in innovative small and medium-sized enterprises (SMEs), with a focus on board gender diversity as a key moderating factor. Although digital orientation is broadly recognized as a strategic driver, its impact on performance remains inconsistent, indicating the contingent influence of critical governance mechanisms. Based on the resource-based view and upper echelons theories,

² A part of this chapter titled “Digital orientation and performance in innovative SMEs: exploring the (curvi)linear effects” has been presented to the academic debate in the following conference and journal:

- i. Presented at the Sinergie-SIMA Management Conference - Tertiarization & sustainability. New challenges for management in the digital era, June 12-13, 2025 (Antenozio et al., 2025b)
- ii. Presented at the 85th Annual Meeting of the Academy of Management Conference, July 25-29, 2025 (Antenozio et al., 2025a)
- iii. Accepted and published in *Technovation* on January 2026. The journal is A-ANVUR and 3 ABS. <https://doi.org/10.1016/j.technovation.2026.103478> (Antenozio et al., 2026)

³ As a part of this chapter titled “Digital Orientation and Gender Diverse Boards: Unpacking the Performance Link in Innovative SMEs” has been presented to the academic debate in the following journal:

- i. Submitted and under review in *Corporate Governance (Bingley)*. The journal is A-ANVUR and 2 ABS.

we argue that a gender-diverse board is not merely a compositional feature but a key governance mechanism that influences how digital strategies affect SME performance.

Analyzing a panel of 250 innovative Italian SMEs with robust estimation methods, we confirm that digital orientation significantly enhances performance. Yet this effect is not uniform: the moderating role of female board representation introduces complexity, as gender diversity shapes whether digital orientation translates into amplified gains or muted outcomes, depending on firm-specific and environmental contingencies. The results offer practical guidance for integrating digital and governance strategies, thereby advancing scholarly understanding of strategic drivers in resource-constrained, innovative contexts.

Finally, in the fifth chapter (“Digital strategy for SMEs: how board diversity affects performance by leveraging social media” with Daniela Di Berardino and Augusta Consorti)⁴, the authors investigate digital strategy that has become a fundamental enabler for the competitiveness of SMEs. Social media results as a key component of digital strategy to improve internal processes and increase financial performance. Nonetheless, how this goal should be met and how the diversity in the firm’s governance impacts SME financial performance is still under debate. In this paper, we focus on the role of digital strategy, particularly social media to improve financial performance and the role of board diversity, such as young-female board to complement this relationship.

Based on novel data on 250 SMEs over 10 year-period and using the generalized method of moment, we demonstrated that social media have a positive impact on financial performance in SMEs. Furthermore, we find a complementary role of young-female governance to enhance the relationship between social media and performance. This study offers valuable insight for both academic and managers in business strategy, demonstrate the critical role of young-female board members for increase the benefits of social media in SME financial performance.

These four studies progressively deepen the understanding of how innovation, digitalisation, and governance jointly shape the business strategy and performance of

⁴ As a part of this chapter titled “Digital strategy for SMEs: how board diversity affects performance by leveraging social media” has been presented to the academic debate in the following conference and journal:

- i. Presented at European Academy of Management - Managing with purpose, June 25-29, 2025
- ii. Presented at the 85th Annual Meeting of the Academy of Management Conference, July 25-29, 2025 (Antenzio et al., 2025)
- iii. Submitted in *Journal of Small Business and Enterprise Development*. The journal is A-ANVUR and 2 ABS.

innovative SMEs. In addition to the core papers included in this thesis, several complementary research projects carried out during my PhD journey, further contributing to my academic professional growth. Specifically, the paper “Exploring the Interaction between Intangible Assets and Social Media on SME Innovation Performance” with Andrea Bikfalvi and Pilar Marques, which analyses the synergistic effect between traditional intangible assets and digital resources on innovation, is currently submitted in Management Decision (A-ANVUR, 2 ABS). This article was presented in AOM 2025 Conference⁵.

The article “Investimenti pubblici regionali e PMI innovative: una relazione duale”⁶, with Daniela Di Berardino, Augusta Consorti and Stefania Migliori, which provides a descriptive overview of the Italian innovative SME ecosystem and served as a foundation for the empirical dataset used in this thesis, is published in Azienda Pubblica (A-ANVUR).

The book chapter “Intercepting Smart Policies to Foster High-Tech SMEs in Regional Environment”⁷ with Daniela Di Berardino and Augusta Consorti, which discusses the smart public policies that enable the creation of innovative SMEs in Italy, is published as a in Digital (Eco) Systems and Societal Challenges, Springer.

The paper “Balancing Digital Implementation to Sustain Financial Performance in Innovative SMEs” with Francesco Appio, which investigates the inverted U-shaped relationship between digital implementation tools and financial performance under the Practice-Based View (PBV), is under review of Journal of Strategic Information System (A-ANVUR, 4 ABS). This article was presented in Sinergie-SIMA Management Conference, 2025⁸.

Together, these studies and complementary projects strengthen the coherence and depth of the research project, opening the way for the empirical analyses presented in the following chapters.

⁵ (Antenozio et al., 2025)

⁶ Antenozio, L.; Di Berardino, D; Consorti, A; Migliori, S. (2025) “Investimenti pubblici regionali e PMI innovative: una relazione duale”, Azienda Pubblica, Vol. 2, pp 191-211 DOI: 10.30448/AP.2025.2.08. (Antenozio et al., 2025)
This paper was also presented in AIDEA Conference, 2023 (Antenozio et al., 2023)

⁷ Antenozio, L.; Di Berardino, D; Consorti, A (2024) “Intercepting Smart Policies to Foster High-Tech SMEs in Regional Environment”, in Digital (Eco) Systems and Societal Challenges, pp 207-223 https://doi.org/10.1007/978-3-031-75586-6_12 (Antenozio et al., 2024).

This paper was also presented in itAIS Conference, 2023.

⁸ (Antenozio & Appio, 2025)

2. Driving Financial Performance in Innovative SMEs: Does Gender Matter?

2.1. Introduction

Small and medium-sized enterprises (SMEs) constitute the backbone of most global economies, accounting for more than 99% of all business in the European Union and playing a critical role in employment, value creation, and innovation (Gorgels et al., 2022; OECD, 2021; Schulze et al., 2025). Although the management literature has extensively explored the ability of SMEs to promote economic growth, through local employment, profit development, and innovation (Audretsch et al., 2023; Owalla et al., 2022), the low survival rate of SMEs, the incidence of their innovations, and the resource constraints of these firms remain widespread phenomena that require further investigation (Anwar et al., 2025; Kumar et al., 2012; Woschke et al., 2017). Prior literature considers innovation, especially digital innovation, a key source of SMEs' performance (Arcuri et al., 2023; Hassan et al., 2024; Zhang et al., 2023) and competitiveness (Garzoni et al., 2020) in a dynamic landscape (Aldieri et al., 2019; Sebuwufu & Timilsina, 2023; Troise et al., 2022; Zhang et al., 2022). This current debate is particularly relevant in the context of innovative SMEs, defined as a subset of SMEs that have efforts in strategic digitalisation, active in technological advancement and in R&D investments (Alegre & Pasamar, 2018; Merín-Rodrigáñez et al., 2024; OECD, 2019). While traditional SMEs often struggle to develop or sustain innovation due to structural and financial constraints (Anwar et al., 2025), innovative SMEs embody formalized innovation strategy (Merín-Rodrigáñez et al., 2025) and are characterized by agility and flexibility (Levy & Powell, 1998; Sawers et al., 2008) making them to facilitate the development of innovation patterns. For instance, this subset often includes technology-based ventures, where innovation is not incidental but a part of a continuous strategic process (Merín-Rodrigáñez et al., 2024). SMEs can succeed in innovation and digital transformation by developing adaptive knowledge and skills (Albis Salas et al., 2023) to counter large companies, while developing and capitalizing internal resources mainly related to intangible assets (Albis Salas et al., 2023; Hidayat & Pok, 2025). Specific intangible resources devoted to innovation activities, like R&D investments (Haddoud et al., 2023; Revilla & Fernández, 2012; Vrontis et al., 2021) and intellectual property (Liu et al., 2023; Ostrovsky & Picot, 2021; Sinadinos, 2022) are widely considered as innovation drivers for innovative SMEs. In this context, researchers

agree that qualified human capital is another distinctive factor that is positively associated with firms' earnings, profitability and operational efficiency (Xu & Li, 2019). Human capital and technology make SMEs competitive and attractive, helping them overcome the barriers linked to limited resources and scarce funding (Protogerou et al., 2017). However, many studies explore SMEs as a homogeneous group, thus limiting a deeper understanding of their innovation pathways. It overlooks the different strategic commitment and usages of resource portfolios that SMEs allocate to innovation initiatives (Merín-Rodrigáñez et al., 2025). Additionally, the systemic interaction between these factors remains underexplored in innovative SMEs literature, leaving a significant gap especially since innovative SMEs are important to economic advancement of any territory (Abubakar et al., 2019).

Focusing on human capital, many studies unveil that gender diversity at the top management team improves innovation (Adams et al., 2016; Dohse et al., 2019; Foss et al., 2022; García-Meca et al., 2024; Lee & Chung, 2022; Xie et al., 2020) and firm performance (Cox & Blake, 1991; Gordini & Rancati, 2017; Jeong & Harrison, 2017; Talke et al., 2010; Usman et al., 2019; Vo et al., 2021). Nevertheless, some studies highlight that women entrepreneurs are less innovative than men (Henry et al., 2016), take fewer risky investments (Yang et al., 2019), and that, in firms with a top management team mainly composed of female directors, the innovations achieved generate less impact in the business environment (Lee & Chung, 2022). Few studies have explored the interplay between multiple intangible resources, such as female leadership, R&D investments and intellectual property, in innovative SMEs (Arcuri et al., 2023).

Our study, adopting the Resource Based View (RBV), the complex theory, the configurational approach and the critical mass theory (Dahlerup, 1988; Di Paola et al., 2025; García-Meca et al., 2024; Kanter, 2008) aims to contribute to the academic debate on the factors affecting innovation and the performance of female-led firms, through the observation of the interplay between women's leadership, skilled human capital, financial performance and internal intangible resources linked to innovative initiatives within SMEs. We attempt to explore what combination of innovative resources generates greater performance in innovative SMEs over time, comparing female-led firms and non-female led-firms and using the fuzzy-set qualitative analysis method (fsQCA). The fsQCA approach examines whether the presence or absence of certain conditions is necessary to

achieve high level of outcomes, and which specific combinations of conditions are sufficient to generate superior performance. This approach allows for identifying multiple, equifinal configurations of innovation drivers that lead to financial success. This technique is useful to observe causal complexity in situations “*in which an outcome may follow from several different combinations of conditions*” (Ragin, 2008) and it can identify “*which combinations are more (or less) important than others*” (Pappas & Woodside, 2021).

By investigating multiple innovation drivers, this study poses the following research questions:

RQ1) Which combinations of innovation resources are relevant for achieving higher profitability in innovative SMEs?

RQ2) Are there differences in these combinations between female-led innovative SMEs and other innovative SMEs?

RQ3) Does female representation in decision-making positions positively influence the financial performance in innovative SMEs?

To answer our research questions, this study explores a dataset of 2.635 Italian innovative SMEs within a 10 years’ time frame (2013-2022). We explore SMEs included in the Italian Register of Innovative SMEs. Italy is a relevant setting since the dominance of SMEs in its economy and the regulation of innovative SMEs, like in most of European countries (i.e. Spain, France, Netherlands) and the ongoing debate on these firms (Kraus et al., 2012; Martin-Rios et al., 2022; Merín-Rodrigáñez et al., 2024, 2025; Schifilliti & La Rocca, 2024). The relevance of innovative SMEs in economic development, the growing involvement in innovation and digital transformation (DESI Index 2022) and the institutional alignment with European Union innovation policies make Italy a suitable setting to examine innovation-performance relationship in innovative SME landscape. We are going to find out if strategic investments in R&D, skilled human capital, female leadership and intellectual property can alone strengthen the potential of the profitability of innovative SMEs and how different combinations of innovation drivers push profitability, unveiling gender differences between female-led and non-female-led enterprises.

Our study attempts to contribute to the broader discourse on innovation, SMEs and gender, by introducing new insight into the interplay between innovation drivers,

corporate governance attributes and performance (Lee & Chung, 2022) to provide a foundation for informed policymaking and supporting the top management team in planning strategies within SMEs. In particular, by comparing female-led and non-female led SMEs, and focusing on a specific subgroup of SMEs, related to innovative ones, we aim to test whether the female directors significantly influence the way innovation inputs are transformed into financial performance, thus challenging prevailing assumptions about gender-based managerial differences. Furthermore, adopting the fsQCA method, we attempt to improve the understanding of the complexity of entrepreneurial phenomena, as suggested by literature (Latifi et al., 2021). While traditional statistical methods estimate the individual net effects of variables, fsQCA explores how combinations of complex conditions can lead to outcomes (Ragin, 2008). Understanding how SMEs strategically combine innovation-related resources is therefore essential not only for academic research but also for shaping effective policy frameworks at national and international levels.

2.2 Theoretical background

2.2.1 Innovation drivers and financial performance in innovative SMEs

This study explores this phenomenon by combining the theoretical lens of the Resource-Based View (RBV) (Barney, 1991), complexity theory (Woodside, 2013, 2014) and critical mass theory (Dahlerup, 1988). RBV suggests that the combination of firm-specific strategic resources leads to sustainable competitive advantage (Barney, 1991). Extant literature on innovation confirms that SMEs, which are more flexible than larger firms, are better able in combining and reconfiguring their resources to create innovations (Hassan et al., 2024; O'Regan & Ghobadian, 2005). According to Yeh-Yun Lin and Yi-Ching Chen (2007), the literature on innovation includes many strands of research that explore the types of innovation, antecedents and impacts of innovation. Our study aims to contribute to those strands of literature that focus on both the determinants and consequences of this phenomenon, based on the assumption that organizational performance achieved through innovation may differ depending on different combinations of innovation drivers, including gender as a dimension.

Innovation is affected by the intensity of R&D (Haddoud et al., 2023; Revilla & Fernández, 2012; Vrontis et al., 2021), by the legal protection of innovation (Liu et al.,

2023; Ostrovsky & Picot, 2021; Sinadinos, 2022; Zhang et al., 2022), and by the quality of human capital (Xu & Li, 2019). However, financial and technical constraints limit the ability of SMEs to obtain and managing patents (Ben Arfi et al., 2018) or stimulating impactful innovation (Woschke et al., 2017). Despite the entrepreneurship literature stating that innovation is a relevant driver for business growth and profitability (Crossan & Apaydin, 2010; Hassan et al., 2024), there are ambiguous findings about the relation between innovation and financial performance within the innovative SME' setting. Some analyses confirms this positive influence of innovation (Aleksić et al., 2022), while others show a negative impact due to the costs and the risk of innovative activities (Artz et al., 2010), or no impacts under different conditions (Kusa et al., 2021). Other studies confirm the ambiguous impacts of innovation on SMEs performance, suggesting that further examination is needed (Kusa et al., 2021). Many studies have shown that the positive role of innovation on performance is mediated by the age of the firm, by industry, by the type of innovation (Jaaffar et al., 2017; Yeh-Yun Lin & Yi-Ching Chen, 2007), by digital capabilities (Borah et al., 2022), by strategic orientation (Aragón-Sánchez & Sánchez-Marín, 2005) and by the intellectual capital (Agostini et al., 2017). However, few studies explore innovative SMEs and their relationship with financial performance (Alegre & Pasamar, 2018; Merín-Rodrigáñez et al., 2024, 2025). For example Merín-Rodrigáñez et al. (2024) examined the context of Spanish innovative SMEs in the relationship with digital transformation and financial performance, showing a positive effect mediated by business model innovation and offering a valuable context for analysing the mechanisms between innovation drivers and financial outcomes.

Therefore, stand-alone innovation is not enough to foster performance, which is instead shaped by the dynamic interaction between multiple innovation drivers (Sok et al., 2013). Those studies that have applied the fsQCA method and the configurational approach have shown that innovative SMEs take different pathways to improve their performance when innovation is changing their processes, combining several resource allocation strategies and business model changes (Bouwman et al., 2019). While many theoretical frameworks rely on symmetric and linear reasoning to explore innovation drivers, the configurational approach posits that innovation emerges from diverse, asymmetric, and non-linear combinations of factors, each capable of leading to specific

outcome (Di Paola et al., 2025; Zoppelletto & Orlandi, 2022). Therefore, we hypothesise that:

H1: innovative SMEs that integrate R&D investment, qualified human capital and intellectual property achieve superior financial performance.

2.2.2 Gender, innovation and SMEs

Prior literature reveals that gender significantly influences the innovation strategies, patent development (Adams et al., 2016; Dohse et al., 2019; Foss et al., 2022; García-Meca et al., 2024; Lee & Chung, 2022; Wang et al., 2022; Xie et al., 2020) and the firm performance (Jeong & Harrison, 2017; Schifilliti & La Rocca, 2024; Talke et al., 2010; Usman et al., 2019; Vo et al., 2021). Gender studies unveil that female leaders stimulate innovation for many reasons: they adopt more collaborative and inclusive management approaches, which lead participation and the exchange of knowledge, ideas, solutions (Tate & Yang, 2015); they stimulate cognitive diversity which enhances problem-detection and problem-solving capabilities (Foss et al., 2022) and the rapid recognition of innovative solutions (Wuchty et al., 2007); they devise more innovative ideas to overcome some discriminatory practices within organisations (Jones & Clifton, 2018; Wang et al., 2022) and to protect the environment (Javed et al., 2023; Nadeem et al., 2020); they are more concerned with long-term nonfinancial performance rather than short-term financial performance (Nair, 2020). Furthermore, to compensate their limited access to power, women engage alliances and social networks, intercepting multiple experiences which stimulate innovative solutions (Foss et al., 2022). Nevertheless, some studies confirm that the legal enforcement of female board quota may generate tensions within the board or fail to improve the financial performance (Gordini & Rancati, 2017; Mazza et al., 2024). This finding supports a critical examination of structural inequality and power relations in private companies, encouraging a gender sensitive analysis of innovative entrepreneurship. Corporate governance literature and gender studies adopt the critical mass theory to describe the number of critical factors that generate a collective and innovative actions in the social context (Dahlerup, 1988; García-Meca et al., 2024; Kanter, 2008). According to this idea, to stimulate a substantial influence on strategic decision-making, the corporate board of directors must include at least three women directors to avoid conforming to the requirements of majority. This perspective considers the women directors as the minority subgroup, and the groups with gender and

demographic diversity could stimulate divergent thinking, many strategic alternatives, a wide range of problem solutions, original approaches to decision-making (Torchia et al., 2011).

However, other studies show controversial results. Some studies reveal that women directors take fewer risks than men and higher conservative policy, reducing the propensity for radical innovation (Guizani & Abdalkrim, 2023; Jianakoplos & Bernasek, 1998; Yang et al., 2019). Similarly, Lee and Chung (2022) show that firms with more women in the board of directors generate fewer cumulative and impactful innovations in the world. Accordingly, we hypothesise that:

H2: Configuration of almost two of R&D investment, qualified human capital, and intellectual property is more likely to lead to superior financial performance when innovative SMEs are female led.

The impact on performance is controversial. Although some studies confirm the positive relationships between profitability and the proportion of female directors (Brahma et al., 2021; Carter et al., 2003; Erhardt et al., 2003), other studies find negative relationships (Adams & Ferreira, 2009; Cox & Blake, 1991; Dobbin & Jung, 2011) or no significant relationships (Du Rietz & Henrekson, 2000; Mínguez-Vera & Martin, 2011; Smith et al., 2006). Recent studies unveil that when women exercise substantial control over the resources under their responsibility and actively participate in decision-making processes, they can achieve outcomes comparable to those of male-led enterprises (Aker et al., 2017). Although female-led SMEs may develop distinct innovation pathways, these findings seem to suggest that innovation outputs may be gender-neutral. Observing Italian firms, Gordini and Rancati (2017) unveil that the gender equality in the board of directors of listed companies improve the financial performance more than the presence of female directors per se. Many of these studies explored listed or large companies and these different findings suggest further investigation within the SMEs setting. Additionally, few studies examined the role of female in innovative SMEs like previous work of Schifilliti and La Rocca (2024) that examined the relationship between female representation and financial performance in innovative SMEs showing a negative effect. This leaves an open and emerging debate on gender and performance in SMEs, especially high-tech ones. Accordingly, we hypothesise that:

H3: The presence of critical mass of female directors significantly reduces the financial performance disparity between innovative female-led innovative SMEs and their non-female led counterparts.

2.3. Methodology

We performed an empirical analysis through the fuzzy-set qualitative comparative analysis (fsQCA) method, based on complexity theory and configurational approach (Di Paola et al., 2025; Ragin, 2008; Schneider & Wagemann, 2012; Subramanian et al., 2022; Zoppelletto & Orlandi, 2022) using the software fsQCA 4.1. This technique differs from conventional statistical methods (Ragin, 2008; Woodside, 2013) by investigating how various causal combinations of factors can lead to a specific outcome. However, due to the principle of asymmetry, this approach assumes that the absence of the condition does not imply the absence of the outcome and that different nonexclusive combinations of conditions can lead to the same outcome (Ragin, 2008). It emphasizes that the outcome depends on the combination of causal characteristics, rather than on the isolated values (Ragin, 2008) and it is suitable to explore phenomena that are not binary but emerge from different scenarios. Complex theory assumes that «within the same set of data X relates to Y positively, negatively, and not at all. Thus, reporting how X relates positively to Y with and without additional terms in multiple regression models ignores important information available in a data set» (Woodside, 2014). Using complex theory and utilizing Boolean algebra to identify combinations of conditions (input) that may be sufficient and/or necessary for the outcome, the fsQCA allows for the comparison of different case combinations, while excluding irrelevant features. In this logic, fsQCA first evaluates whether individual conditions are necessary (they must be present for the outcome to occur), and subsequently identifies sufficient combinations of conditions that jointly lead to high performance (Ragin, 2008). Contrasting to regression-based methods, it does not test the magnitude or direction of effects among variables but focuses on how different conditions coexist to produce the superior outcome. For these reasons, this method enables researchers to identify a concise set of technological innovation factors that significantly impact the financial performance as outcome.

Accordingly, in this study, R&D investment, qualified human capital, and intellectual property are conceptualized as antecedent innovation drivers. Rather than exhibiting isolated causal effects on financial performance, these drivers interact as

complementary and interdependent conditions. Distinct configurations of these factors can jointly generate superior financial performance among innovative SMEs.

Unlike traditional models that rely on binary variables, fsQCA offers a more refined approach by allowing variables to take on any value between 0 and 1, providing a more realistic representation of complex causal relationships (Pappas & Woodside, 2021). Due to this attribute, the fs-QCA approach is best suited to analyze combinations of firm-level conditions that are non-adaptive and nonlinear (Pappas & Woodside, 2021). According to Ragin (2008, 2017), performing an fs-QCA analysis requires three main steps: (i) calibration of conditions, (ii) determination of necessary conditions, and (iii) analysis of sufficient conditions and construction of the truth table.

2.3.1 Sample and data collection

Our analysis explores a sample of Italian innovative SMEs for these reasons. While SMEs are structurally under-resourced compared to large companies, they account for the majority of firms in most economies, especially in Europe and play a pivotal role in the national innovation ecosystem (OECD, 2021). Italy is a relevant test case since 99%⁹ of national enterprises are SMEs located across the country, both in well and less-developed regions (Arcuri et al., 2023; Matricano, 2023). Our sample included SMEs collected by the special section of National Register of Italian Enterprises at 31.12.2022, which represents the most recent national observation (Arcuri et al., 2023; Cavallo et al., 2020; Matricano, 2023). Data on innovative SMEs are systematically reported, ensuring the reliability and comparability of the dataset. Additionally, by using innovative SMEs allow to control for the regulatory environment, thereby allowing to focus on internal factors that would impact organizational performance. The legal definition of Innovative SMEs settled in Italy and in other countries (i.e. Spain) (Merín-Rodríguez et al., 2024, 2025; OECD, 2018) introduces a unique and objective institutional framework that formalizes eligibility criteria based on innovation-related inputs. This regulatory environment, combined with structural resource constraints typical of SMEs, offers an insightful lens through which examine what different combinations of innovation drivers, treated as antecedent innovation conditions, lead to financial outcomes and helps to extend the generalizability on findings to most European countries. Moreover, this institutional

⁹ Eurostat SME Performance Review 2024 - Italy country sheet

setting provides an analysis between comparable groups in objective manner, in term of “innovative firm” concept. Italy, in line with other European countries has invested substantial resources in innovation development through EU-funded programs, supporting the overall innovation ecosystem. Moreover, while general SMEs can also undertake innovative activities, their innovation inputs are often less structured and less consistently documented. For these reasons, our research focuses on this sample of innovative SMEs allow for more precise identification of the resource configurations (inputs) that drive financial performance (outcome), verifying which configurations are essential and which are peripheral, in line with the methodological approach of fsQCA. We gathered financial data and the corporate governance profile of the sample through AIDA Bureau van Dijk’s database.

Our final sample consists of 2.635 Italian innovative SMEs with a 10 years' time frame (2013-2022) to understand the changes in performance and internal resources over the years. Moreover, Italy’s gender equality index shows pronounced inequality in the work domain and greater growth in the domain of power¹⁰. Many efforts have been made by the government to improve female participation in decision-making positions within companies, especially through the mandatory 40 percent quota of female directors required of listed companies by Laws No. 120/2011 and No. 160/2019. The European 2024 gender equality index report reveals that 44 percent of listed companies comply with the mandatory quota on the board of directors. However, the impact of innovation on profitability in those firms with increased engagement of women in executive committees or leadership positions outside this mandatory quota has not been well explored.

According to the theoretical framework, SMEs were divided into female-led and non-female-led innovative SMEs to achieve a 'comparison' effect, based on the average presence of women in the ownership structure and on the board of directors. Female prevalence is measured as the mean value between the percentage of SMEs’ capital owned by women and the percentage of female managers in the board of directors. This ratio is calculated using the data provided by each SME at the time of data extraction (Arcuri et al., 2023; Del Bosco et al., 2021). The outputs have four values: “No” if this ratio was lower than 50%; “Majority” if it was above 50%; “Strong” above 66% and

¹⁰ [Gender Equality Index - Italy](#)

“Exclusive” if the ratio was equal to 100%¹¹. To evaluate both female and non-female Innovative SMEs, we use a dummy, equal to 0 if they have a ratio lower than 50% and 1 when SMEs have this condition equal to or above 50% (Arcuri et al., 2023).

2.3.2 Variables

2.3.2.1 Outcome

We selected the ROS (return on sale) ratio as our outcome related to financial performance. On the one hand, ROS is widely used in academic research as a measure of firms’ performance, as it reflects both internal efficiency and the new operating cash flow generated by sales (Arcuri et al., 2023; Lu & Beamish, 2006). On the other hand, ROS is the most appropriate metric to evaluate the growth of SMEs (Somohano-Rodríguez & Madrid-Guijarro, 2022; Taghizadeh et al., 2024) that suffer from limited resources (Borah et al., 2022; Hervás-Oliver et al., 2021).

2.3.2.2 Inputs

In our model, the role of strategic intangible resources in affecting innovation performance is measured through these input variables: expenditures on R&D (Haddoud et al., 2023; Kirner et al., 2009), presence of qualified team (Martínez-Martínez et al., 2023; Vaisman et al., 2022) and intellectual property rights (Doh & Kim, 2014; Jafari-Sadeghi et al., 2021; Lee & Chung, 2022; Rodríguez-Pose & Crescenzi, 2008). To qualify an Italian SMEs as innovative, it must fulfil almost two of the following conditions: a) *“the volume of expenditure on R&D and innovation to an extent of at least 3% of the greater amount between the cost and total value of the SME's production innovation; b) Employment as employees or contractors in any title, in a ratio of at least equal to 1/5 of the total workforce, of personnel holding a Ph.D. degree or who are pursuing a Ph.D. degree at an Italian or foreign university, or in possession of a bachelor's degree and who have carried out, for at least three years, certified research activities at public or private, in Italy or abroad, or, in a share at least equal to 1/3 of the total manpower, of personnel having a master's degree; c) ownership, including as a depositary or licensee, of at least one industrial design, relating to an industrial, biotechnological, topographical, semiconductor or new plant variety product or ownership of the rights to an original computer program registered with the Special Public Register for Computer*

¹¹ startup.registrodelleimprese.it

Programs, provided that such design is directly related to the corporate purpose and business activity” (art. 4, DL 3/2015)¹².

To measure R&D investments we use the percentage of R&D assets to total assets per each SMEs with a 10-years’ time frame (Liu et al., 2023). Qualified Team (QT) is measured through a dummy variable (Albis Salas et al., 2023; Martínez-Martínez et al., 2023; Peón & Martínez-Filgueira, 2020; Vaisman et al., 2022), where 1 is associated to the condition ‘b’ stated above for innovative SME status, 0 otherwise. Intellectual property (IP) is measured through a dummy variable (Hervas-Oliver et al., 2021; Jafari-Sadeghi et al., 2023; Rodríguez-Pose & Crescenzi, 2008; Sun Yoo et al., 2023), where 1 is associated if the SME has the condition ‘c’ above stated, 0 otherwise.

This allows us to examine which of these three factors, individually or in combination, are necessary and/or sufficient to achieve higher performance, and whether these configurations differ between female-led and male-led innovative SMEs. Table 1 shows the descriptive analysis of outcome and input conditions.

2.3.3. Analysis

2.3.3.1 Data Calibration

The first step in fsQCA involves “data calibration”, specifically referring calibrating raw variables into fuzzy-set membership scores that range between 0 and 1. In this context, conditions and outcome were framed within fuzzy sets, where the assigned values indicate the degree to which a case belongs to a particular condition or outcome category. In this phase, we adopted the direct method of calibration outlined by Ragin (2008) and widely used in main research on fsQCA in Business and Management literature of this method (Pappas & Woodside, 2021; Ragin, 2008, 2017; Woodside, 2013), which requires setting three qualitative anchors: full membership (1.0); full non membership (0.0) and a crossover point (0.5) that represent the maximum ambiguity point.

To ensure consistency and robustness, the empirical maximum, mean and minimum values of each variable are used as anchors for calibration (Ragin, 2017). This approach was adopted for both continuous variables (ROS and R&D) and binary variables (QT and IP). Specifically, the maximum value in the dataset for each variable was used as the threshold for full membership (i.e. maximum ROS for Female Innovative SMEs = 29.96

¹² <https://www.gazzettaufficiale.it/eli/id/2015/03/25/15A02336/sg>

and maximum ROS for Non-female Innovative SMEs= 30.00), the mean as the crossover point (i.e. mean R&D for Female Innovative SMEs = 0.215 and mean R&D for Non-female Innovative SMEs = 0.228), and the minimum as the threshold for full non-membership (i.e. minimum QT for Female Innovative SMEs = 0.000 and minimum QT for Non-female Innovative SMEs = 0.000). This calibration strategy is consistent with prior fsQCA studies involving binary conditions and large samples (Llach et al., 2023; Pappas & Woodside, 2021). Calibration was performed using the “calibrate” function in fsQCA 4.1. This method reflects the actual empirical distribution of each variable and is particularly suited to large-N studies involving heterogeneous organizational configurations (Llach et al., 2023; Pappas & Woodside, 2021; Ragin, 2017).

The descriptive analysis (Table 1) shows that all the mean values for variables selected are greater in female cluster than male cluster. Although the mean value of profitability is low, female-lead firms show higher ROS than male-lead firms, suggesting a more efficient conversion of revenue into profit despite potential structural challenges. Similarly, the female-cluster exhibits higher levels of qualified human capital, R&D investments and IPRs ownership. These findings indicate that female-led SMEs tend to prioritize innovation-oriented resources, potentially reflecting a strategic approach aimed at long-term competitive advantage.

Table 1. Descriptive analysis

	Female Innovative SMEs					Non-Female Innovative SMEs				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Outcome										
<i>ROS</i>	1.862	3.390	10.926	-49.47	29.96	24.488	2.057	10.554	-49.99	30
Conditions										
<i>R&D</i>	1.724	0.215	0.241	0	1	20.910	0.201	0.228	0	1
<i>QT</i>	1.862	0.594	0.491	0	1	26.488	0.510	0.500	0	1
<i>IP</i>	1.862	0.656	0.475	0	1	26.488	0.560	0.496	0	1

Source(s): Created by authors

2.3.3.2. Analysis of necessary conditions

The second step of fs-QCA, following the best practice outlined by Schneider and Wagemann (2010) was the analysis of necessary conditions. This step assesses whether any conditions are indispensable for the outcome. To evaluate whether combinations of variables are necessary and/or sufficient to influence outcomes, the fsQCA analyzes all

the antecedents and uses a membership function to express the relationships between combinations and outcomes (Huang & Huarng, 2015; Huang et al., 2016). Analyzing necessary conditions allows us to test whether membership (or non-membership) is in the set of conditions. For example, the set of SMEs with positive R&D, is associated with membership (or non-membership) in the set of outcomes, while the set of innovative SMEs is associated with a high degree of performance.

Therefore, the analysis of necessary conditions tests whether the presence or absence (labelled with a tilde $\sim$) of a condition is necessary for the presence (ROS) of the outcome. Following established methodological standards, we considered a condition to be necessary when its consistency score exceeded 0.90, in line with the criteria proposed by Schneider and Wagemann (2010) and widely adopted in recent fsQCA applications (Cheng & Wang, 2022; Jia et al., 2024; Llach et al., 2023; Subramanian et al., 2022; Zoppelletto & Orlandi, 2022). This threshold reflects the idea that a necessary condition must be present in almost all cases in which the outcome is observed. Consistency values close or above 0.90 indicate that the condition is indispensable for the outcome, even if it does not guarantee it on its own. Conditions with consistency scores below this threshold are considered not necessary in configurational terms. In the present study, we employed necessary conditions tables for both female-led SMEs and non-female-led SMEs. Table 2 presents the outcome of all necessary conditions analyses to achieve a high-level of financial performance for the two clusters.

Given that the highest consistency value of any condition were 0.834 for the absence of R&D investment and 0.701 for the presence of intellectual property when the outcome was financial performance in female SMEs, and the same for non-female SMEs (0.847 for the absence of R&D investment and 0.702 for the presence of intellectual property), no single condition alone can predict the outcomes, nor is any condition necessary to achieve a high level of ROS at the firm level. It appears that neither the presence nor absence of any conditions significantly distinguishes between female and non-female SMEs. None of the conditions allow us to assert that female firms are more likely to have high performance through innovation investments. Thus, it can be assumed that the presence of women in high-level positions does not significantly affect the firm's innovation choices or financial performance.

Table 2. Necessary Conditions

Conditions	Female Innovative SMEs		Non Female Innovative SMEs	
	Cons.	Conv.	Cons.	Conv.
R&D	0.472	0.740	0.467	0.753
~R&D	0.834	0.695	0.847	0.704
QT	0.645	0.588	0.650	0.593
~QT	0.447	0.604	0.440	0.606
IP	0.701	0.582	0.702	0.583
~IP	0.391	0.617	0.389	0.628

Outcome: ROS; Note: ~ represents the absence of a condition ; Source(s): Created by authors

2.3.3.3 Analysis of sufficient conditions

Although no single condition is necessary for any cluster of SMEs to achieve high performance levels (ROS), fs-QCA enables us to investigate whether combinations of conditions can be sufficient for SMEs to be inside the outcome set (Ragin, 2008; Schneider & Wagemann, 2012). In line with the best practices in fsQCA (Ragin, 2008), we applied a raw consistency thresholds of 0.80 to identify sufficient combinations of conditions associated with high ROS (Schneider & Wagemann, 2010). A combination is considered sufficient when, in most of the cases where it occurs, the outcome is also observed. The threshold of 0.80 is widely accepted in fsQCA literature as a reliable cut-off to claim sufficiency, especially in firm-level studies where causal complexity is expected (Di Paola et al., 2025; Greckhamer et al., 2018; Llach et al., 2023; Torres & Augusto, 2020). Additionally, we ensured that each solution exceeded the recommended consistency (>0.75) and coverage (>0.25) benchmarks for meaningful empirical relevance (Pappas & Woodside, 2021). This procedure strengthens the interpretability and robustness of our configurational findings. Best practices in fs-QCA analysis provide some guidelines for sufficient condition analysis, particularly to report the truth table (see Table 3 and 4) to transparently display which combinations of conditions are present in the empirical data and which are absent (Greckhamer et al., 2018; Torres & Augusto, 2020; Zoppelletto & Orlandi, 2022) across both samples. This approach is suitable for effectively representing data patterns (Cheng & Wang, 2022; Llach et al., 2023; Llopis-Albert et al., 2021; Porfirio et al., 2021; Yin & Yu, 2022; Zoppelletto & Orlandi, 2022),

and it allows for the inclusion of possible logical combinations of conditions that do not empirically exist in the dataset. Combinations associated with the outcome's presence are labelled as 1, conversely with 0.

Table 5 shows the intermediate solution that is superior to other solutions (complex solution, parsimonious solution) because it does not allow the removal of necessary conditions (Ragin, 2008), and it is widely used in literature and academic research (Jiao et al., 2020; Llach et al., 2023; Poorkavoos et al., 2016; Vizcaíno & Chousa, 2016). Black circles “●” represent the presence of the causal condition, white circles “○” represent the absence of causal conditions, and the dashed line represents “doesn't matter” conditions. In both solutions, the solution coverage and consistency values exceed the recommended minimum values of 0.25 and 0.75 respectively (Pappas & Woodside, 2021).

Table 3. Truth table Female Innovative SMEs

R&D	QT	IP	number	ROS	raw consist.	PRI consist.	SYM consist
0	0	0	1	1	0.993554	0	0
1	0	0	8	1	0.969692	0.102893	0.188235
1	1	1	152	1	0.818269	0.380328	0.606947
1	1	0	183	1	0.806301	0.295858	0.477093
1	0	1	280	0	0.783175	0.283397	0.452008
0	0	1	381	0	0.757465	0.424768	0.815557
0	1	0	363	0	0.737453	0.415589	0.765646
0	1	1	333	0	0.706735	0.361102	0.656582

Source(s): Created by authors

Table 4. Truth table non-Female Innovative SMEs

R&D	QT	IP	number	ROS	raw consist.	PRI consist.	SYM consist
1	0	0	16	1	0.998572	0.520549	0.725521
0	0	0	44	1	0.990647	0.534536	0.937261
1	1	0	2310	1	0.825057	0.346103	0.520387
1	1	1	2086	1	0.812701	0.295795	0.480431
1	0	1	3249	0	0.793079	0.315575	0.494204
0	0	1	4697	0	0.748295	0.419917	0.759449
0	1	0	4282	0	0.746288	0.437687	0.780288
0	1	1	3975	0	0.73244	0.397336	0.736516

Source(s): Created by authors

2.3.3.4 Robustness Analysis

Following the best practices in fs-QCA (Di Paola et al., 2025), we conducted a series of robustness checks to ensure the stability and validity of our configurational results. First, we re-estimated the fsQCA models using alternative calibration thresholds to the sensitivity of our findings to variations in set membership criteria (Skaaning, 2011). Specifically, we adopted two recalibration criteria: (i) one based on the 90th, 50th, and 10th percentiles of each variable for each cluster of Female Innovative SMEs and Non-female Innovative SMEs (Guedes et al., 2016), (ii) and one based on the 95th, 50th, and 5th percentiles (Llach et al., 2023; Pappas & Woodside, 2021; Woodside, 2013) for full membership, crossover point, and full non-membership, respectively following the best practices in fsQCA Management and Business field (Di Paola et al., 2025; Zoppelletto & Orlandi, 2022). These more restrictive thresholds allow for a stricter definition of high and low levels of the conditions and outcome, thus testing the consistency of the solutions under more conservative assumptions (Huang et al., 2016; Jia et al., 2024; Nijssen & Ordanini, 2020; Subramanian et al., 2022). The results remained qualitatively stable across both calibration schemes. Second, we conducted an analysis of the absence of the outcome (i.e. low financial performance) using the sufficient conditions analysis and intermediate solution approach following prior research (Greckhamer et al., 2018; Zoppelletto & Orlandi, 2022). These types of reverse analysis allow us to assess whether the configurations associated with the absence of the outcome are asymmetrical to those explaining its presence (Zoppelletto & Orlandi, 2022). In line with the principal causal

asymmetry (Ragin, 2008), the findings confirm that the causal configurations leading to low performance differ from those leading to high performance, thereby supporting the analytical distinctiveness of the two pathways. Third, we examined internal consistency of each sufficient configuration by ensuring that the product of raw consistency and PRI exceeded the established threshold of 0.6, following the recommendation in the literature (Grofman & Schneider, 2009; Schneider & Wagemann, 2010, 2012). This dual criterion ensures that each solution is not only empirically consistent but also not contradicted by deviant cases. These robustness checks strengthen the reliability and consistency of our findings demonstrating that the observed configurations are not sensitive to alternative calibration.

2.4. Research findings

The results of the sufficient conditions analysis (Table 5) seem to partially support our hypotheses for both female-led and non-female-led innovative SMEs. To obtain acceptable results, we set the cutoffs for both clusters at 0.8, following established practices (Cheng & Wang, 2022; Kyrrododa et al., 2023; Pappas & Woodside, 2021; Porfirio et al., 2021; Ragin, 2008; Valaei et al., 2017; Wang & Esperança, 2023; Woodside, 2013; Zoppelletto & Orlandi, 2022). According to the literature, a consistency level of 0.75 is considered significant (Ragin, 2008; Woodside, 2013) along with a coverage level of 0.3 (Cheng & Wang, 2022; Guedes et al., 2016; Woodside, 2013). In our case, the overall solution coverage and consistency exceed this minimum level of acceptance. Specifically, the non-female subset exhibited a consistency of 0.775 and a coverage of 0.310, while the female subset showed a slightly lower consistency but higher coverage, still meeting the acceptance criteria (consistency of 0.761 and coverage of 0.311).

We identified two configurations for each cluster of sufficient conditions to promote a high level of financial performance as reported in Table 5. Contrary to our initial hypotheses (H1;H2), not all strategic intangible resources are necessary to achieve higher profitability, and the two clusters exhibit minimal differences, both in overall values (solution coverage and consistency) and in individual paths. The results are essentially equivalent, differing only in the frequency cutoff point due to the smaller sample size of female firms compared to the total number of firms and the sample of non-female firms. The established cutoff allows us to analyze the two samples of firms

heterogeneously while accounting for their differences, which do not affect the overall outcome. This is evident when examining the consistency cutoff, which is similar for both groups (0.806 for women-led SMEs and 0.813 for non-women-led SMEs). Regarding solution coverage and consistency, innovative women-led SMEs have an overall coverage of 31.1% and consistency of 76.1%, whereas non-women-led SMEs have values of 31.0% and 77.5%, respectively.

There are four configurations that constitute sufficient conditions to enhance financial performance (ROS). R&D emerges as a core condition that, when combined with others, leads to high performance levels in innovative SMEs. Among the four configurations, Configuration #3 stands out with the highest consistency score among the four configurations (0.980) but conversely has the lowest raw coverage (0.094). In this configuration, no core conditions are identified, and R&D is considered a peripheral condition since it is not mentioned. Configurations #2 and #4 are noteworthy because they are identical. This suggests that the presence of R&D and a Qualified Team are sufficient conditions to achieve successful financial performance, while patents are not essential. Moreover, we do not observe significant differences in financial performance between female-led and male-led SMEs across the identified innovation pathways, thus confirming Hypothesis 3 (H3).

2.5. Discussion and conclusions

Our configurational analysis offers novel insights into the relationship between intangible resources and financial performance in innovative SMEs, with a particular focus on gender structure of the board of directors. Our findings reveal that not all intangible resources legally required to obtain innovative SMEs status contribute equally to profitability. Although R&D serves as a fundamental and consistent driver for achieving superior financial performance within SMEs, aligning with the literature and academic debate (Albis Salas et al., 2023; Rodríguez-Pose & Crescenzi, 2008), only the combination of R&D and QT appears to stimulate higher performance in innovative SMEs. Nonetheless, our findings reveal no significant differences between female-led SMEs and their counterparts in combining effective innovation resources or achieving higher profitability. This suggests that a critical mass of female representation on the boards of innovative SMEs substantially reduces differences in innovation outcomes,

thereby supporting the notion of a gender-neutral dimension in innovation (Sundermeier & Mahlert, 2023).

Specifically, both women-led SMEs (1b) and non-women-led SMEs (1d) show similar results in coverage and consistency, and they exhibit equifinal pathways to high financial performance, characterized by the combination of R&D and QT, despite the absence of IP. This suggests that these dynamic intangible resources represent a strategic configuration that supports profitability regardless of gender. The symmetry between configurations 1b and 1d indicates that a critical mass of female representation in decision-making positions does not alter how innovation resources affect financial outcomes, at least when SMEs have equal access to innovation levers. While structural gender disparities may still exist in areas such as access to finance or social capital, our findings show that, when institutional settings mitigate resource-based inequalities, and when women have decision-making authority and access to resources comparable to their male counterparts, the influence of gender on innovation and entrepreneurial outcomes becomes negligible (Akter et al., 2017). This challenges stereotypical assumptions regarding gender-based differences in risk-taking and innovation strategy (Bannò & Filippi, 2024; Lee & Chung, 2022; Yang et al., 2019) and supports more inclusive views of entrepreneurial effectiveness (Foss et al., 2022; Wang et al., 2022).

Conversely, configurations 1a and 1c, where both QT and IP are absent, display high consistency but low coverage, indicating that these combinations are rare and may reflect context-specific or exceptional strategies within SMEs. The absence of IP in these configurations raises issues about the strategic relevance of formal IP in SMEs compared to rapid innovation and the introduction of new products and services. This aligns with emerging literature suggesting that SMEs often deprioritize formal IP protection due to limited resources, time constraints, and doubts about its cost-benefit ratio (Ben Arfi et al., 2018; Doh & Kim, 2014; Jafari-Sadeghi et al., 2021).

Table 5. Sufficient conditions - Intermediate Solution

Conditions				
	Solution Female Innovative SMEs		Solution non-Female Innovative SMEs	
	1a	1b	1c	1d
R&D				
QT				
IP				
Raw coverage	0.096	0.307	0.094	0.307
Consistency	0.950	0.769	0.980	0.777
Solution Coverage	0.311		0.310	
Solution Consistency	0.761		0.775	
Frequency cutoff	1		16	
Consistency cutoff	0.806		0.813	

Legend:  presence;  absence;  no show

Source(s): Created by authors

The absence of necessary conditions for either female-led or non-female-led SMEs further confirms the value of a configurational approach to understanding innovation in SMEs. This aligns with the theoretical premise of causal complexity and equifinality (Ragin, 2008; Woodside, 2013), recently systematized by Di Paola et al., (2025) which suggests that innovation outcomes are often the result of complex interactions among multiple factors rather than isolated variables and investments, underscoring that no single resource or managerial characteristic is universally required to achieve financial success. Different firms can attain the same outcome through multiple, non-exclusive paths, depending on how internal resources are combined and leveraged. Finally, this study offers empirical evidence that the pathways to financial success through innovation are largely gender-neutral in the SME context. Adopting critical mass theory and observing innovative female-led Innovative SMEs, our results suggest that gender does not influence per se the effectiveness of innovation on financial performance in those firms, challenging prior literature on gender studies. While previous research has demonstrated that gender diversity at the board level can influence strategic innovation (García-Meca et al., 2024; Lee & Chung, 2022; Yang et al., 2019), our results suggest that once innovation inputs are equally available and control over those resources is significant, both male and female leaders exhibit similar capabilities in converting those

inputs into performance. This supports the notion that, in the context of SMEs, female leaders and male leaders are equally capable of leveraging innovation inputs to achieve greater profitability, challenging stereotypical views of gender-based managerial differences (Foss et al., 2022; Wang et al., 2022). These conceptual insights also lay the foundation for developing inclusive innovation strategies that focus on leadership effectiveness rather than identity-based assumptions.

2.5.1 Theoretical implications

This study contributes in three ways to the ongoing debate on gender, innovation, and SMEs, by providing new evidence on how different configurations of intangible resources, especially R&D, human capital, and intellectual property, can lead to high financial performance, regardless of the gender composition of top management teams. First, we extend literature on SMEs (Aldieri et al., 2019; Arcuri et al., 2023; Hassan et al., 2024; Sebuwufu & Timilsina, 2023; Troise et al., 2022; Zhang et al., 2023; Zhang et al., 2022), focusing on innovative SMEs, showing that these firms represent a distinct and under investigated subset of SMEs but valuable to provide a deeper understanding of innovation drivers, to test the relationship between specific innovation drivers, performance in line with Merín-Rodrigáñez et al. (2024, 2025) and gender issue (Schifilliti & La Rocca, 2024).

Second, theoretically, this work supports the dynamic evolution of the Resource-Based View (RBV), by showing that it is not the presence of a single static resource (i.e. IP), but the specific recombination of dynamic intangibles that matters most for achieving sustainable competitive advantage (Barney, 1991; Di Paola et al., 2025; Haddoud et al., 2023).

Third, by employing a recent methodology as fuzzy-set qualitative comparative analysis (fs-QCA), we embrace a configurational approach to theorizing firm performance, which complements and expands traditional RBV assumptions, demonstrating that the fsQCA method moves beyond the traditional cause-effect relationship between innovation drivers and performance, embracing a systemic view of innovation. As Di Paola et al. (2025) emphasized, fsQCA is particularly suited for exploring causal complexity, asymmetry, and equifinality in business and management research. It allows for the identification of multiple equifinal paths leading to the same outcome, acknowledging that SMEs can achieve high performance through different

combinations of resources (Ragin, 2008; Woodside, 2013). Our findings empirically validate these principles, revealing that multiple pathways can lead to financial success in SMEs, and that no single condition is necessary across the board. This reinforces the view that innovation outcomes are shaped by interdependent bundles of resources, rather than isolated variables (Arcuri et al., 2023; Di Paola et al., 2025; Haddoud et al., 2023).

Fourth, our study contributes to the literature on corporate governance and gender in innovation by examining whether the significant presence of women in decision-making positions alters the relationship between innovation inputs and firm performance. While previous studies have explored gender diversity as a simple variable that can influence innovation strategy and environmental outcomes (Adams & Ferreira, 2009; Arcuri et al., 2023; García-Meca et al., 2024; Schifilliti & La Rocca, 2024), our results suggest that gender is a social construct created by practices and may generate different impacts depending on the contextual factors. Profitability does not significantly differ between male-led and female-led innovative SMEs when women possess equal access to strategic resources and exercise decision-making power equivalent to that of their male counterparts. Rather than reinforcing the narrative of women as subordinate entrepreneurs or innovators, this analysis supports the recent discourse suggesting that women can strategically navigate and manage the constraints imposed by gender stereotypes in the context of innovation (Sundermeier & Mahlert, 2023). This challenges long-standing gendered assumptions about leadership and strategic behaviour (Lee & Chung, 2022; Yang et al., 2019) and adds support to the idea that female leaders are equally capable of translating innovation investments into financial performance (Cheng & Wang, 2022; Foss et al., 2022; Javed et al., 2023). By integrating critical mass theory, we further contextualize the neutrality of gender not merely as an absence of difference, but as a reflection of parity in managerial capability once female representation reaches a significant threshold. Moreover, this study bridges distinct theoretical domains such as RBV, the configurational approach, and gender governance, offering a richer and more integrative understanding of how Innovative SMEs can leverage intangible assets for financial success.

2.5.2 Practical implications

The findings of this study provide several implications for SME managers, policymakers, and institutions supporting business innovation as well. First, the results indicate that

strategic investments in R&D and skilled human capital are more critical than formal intellectual property protection in driving financial performance among Innovative SMEs. Managers should prioritize the development of dynamic innovation capabilities, invest strategically in R&D, and enhance both the technical and creative competencies of employees. These practices are particularly valuable in resource-constrained environments, where agility and rapid adaptation often matter more than codified protection.

Second, the configurational nature of our results highlights that there is no single path to success. Innovation strategies should therefore be tailored to each firm's internal structure and competitive context, with a focus on complementarities among resources rather than on imitation of best practices. This implies that SME managers need to adopt a systemic and context-sensitive approach to innovation management.

Third, our findings highlight the need for policymakers to ensure and enhance equitable access to innovation-related resources to reduce gender disparities in achieving financial success. Furthermore, for managers and business owners of SMEs, these findings emphasize the critical role of maintaining organizational control, articulating a strategic vision, and ensuring adequate resource allocation to address and reduce gender bias in innovation outcomes. It also suggests the need to foster an inclusive culture and individual empowerment both in innovation systems and within organizations, where both women and men in upper management roles are equally empowered to lead innovation initiatives. In this sense, innovation strategy should aim to capitalize on diversity in skills and perspectives, not to segment roles based on gender. The evidence from our study supports a managerial approach rooted in equity, inclusion, and strategic alignment, where innovation stems from the quality of resource configurations rather than the profile of individual decision-makers.

Fourth, in line with this perspective, public support programs should avoid reinforcing gender stereotypes or focusing exclusively on traditionally female sectors (i.e. social care or education). Instead, they should promote equal access to resources, networks, and innovation opportunities across all industries. This requires going beyond numeric representation and actively support women's strategic roles in innovation-oriented leadership.

Fifth, the consistently marginal role of IP in high-performing configurations suggests a potential misalignment between the formal innovation policy framework and the operational realities for SMEs. Policymakers, especially in the contexts like Europe, where SMEs constitute the backbone of the economy, should reconsider how IP-related incentives are designed and delivered. More effective support could include for simplifying IP procedures, offering customized advisory services, or creating alternative mechanisms to protect and leverage innovation such as fast-track grants, open innovation platforms, or collaborative protection models.

2.5.3 Limitations and future directions

This study has several limitations that also open promising avenues for future research. First, our analysis focuses on a single country-setting (Italy), which while rich in innovative SMEs and highly relevant due to the weight of SMEs in its economic fabric (Arcuri et al., 2023; European Commission, 2021), may limit the generalizability of the findings to non-European institutional environments (i.e. China). However, Italy represents a suitable test case for Europe, where similar institutional frameworks for innovative SME exist (i.e. Spain, France, Netherlands) context allows for objective comparison between innovative SMEs across European countries. Future studies could incorporate institutional and regulatory variables to better understand how national context shape the relationship between innovation inputs and financial performance, extending the analysis to non-European settings.

Second, although we focus on three key innovation drivers (R&D, QT, IP), we acknowledge that industry characteristics, such as sector specificities (i.e. manufacturing vs service), regulatory pressure, or individual leadership traits, may shape the effectiveness of these inputs. Future research could stratify the analysis by industry or include moderating variables such as firm age, internationalization, digital maturity, or leadership profile to assess how they interact with innovation pathways.

Third, while, our dataset spans a ten-year period, the research does not fully exploit the temporal dimension of innovation strategies. Longitudinal studies could enrich this analysis by evaluating the interaction between variables and the degree of the impact on performance, offering richer insight into the evolution of configurations over time, and highlighting whether and how the combination of intangible resources that lead to

performance may shift during periods of crisis, growth, or transition. This would deepen our understanding of causal complexity and temporal equifinality in innovation.

This study focuses on a subset of SMEs, which have specific characteristics. Future research could explore whether the same configurations of innovation drivers hold among the overall SMEs, or whether their impact varies across sectors with different technological intensities. Additionally, future research may expand sample by including academic spin-offs and innovative startups and by comparing them with innovative SMEs.

Future research could explore how managers' perceptions of intersecting stereotypes, such as gender, race and age, influence their ability to recognize, mobilize, and prioritize innovation-related assets, particularly within the innovation pipeline. Additionally, incorporating further corporate governance attributes, including age, educational background, cultural diversity and international experience, may enrich the analysis of leadership's impact on innovation performance. Moreover, while fsQCA is particularly suited for uncovering causal complexity and pathways, its reliance on calibration thresholds and the dichotomous interpretation of combinations may limit the granularity of variance captured in the data. Future research might complement the configurational approach with mixed methods, combining QCA with ethnographic research or longitudinal quantitative study to deepen the understanding of mechanisms underlying the configurations identified. Additionally, future studies could further explore the direct and moderating effects of R&D investment, qualified human capital, and intellectual property, or other innovation drivers such as inter-firm collaborations and strategic orientation on financial performance. Testing these relationships empirically through alternative methodological approaches would provide a complementary perspective to the configurational approach adopted in this study, enhancing the granular understanding of how these drivers affect financial performance in innovative SMEs.

3. Digital orientation and performance in innovative SMEs: exploring the (curvi)linear effects

3.1. Introduction

Digital orientation (DO) has become a central issue in understanding how firms can harness digital transformation to achieve competitive advantage and sustain growth (Kindermann et al., 2021, 2024). Defined as a firm's proactive alignment and integration of digital technologies into its operations, DO is not only a means of embracing technological advances, but it is also a strategic posture that shapes how firms operate, create value, and sustain competitive advantage (Ardito et al., 2021; Mishra et al., 2024; Ranjan, 2024).

This new strategic orientation is based on four dimensions - digital technology scope, digital capabilities, digital architecture configuration, and digital ecosystem coordination - that collectively enhance an organisation's potential to innovate and remain resilient in the face of technological shifts (Kindermann et al., 2021, 2024). They are interrelated and mutually reinforcing (Kindermann et al., 2021). Adjustments in a firm's digital technology scope will therefore naturally influence its digital infrastructure and integration processes, shaping its overall digital architecture (Kindermann et al., 2024).

Through the lens of the resource-based view (RBV) and the dynamic capabilities (DC) framework, DO is considered a critical driver that allows firms to leverage digital assets and quickly respond to environmental changes (Bendig et al., 2023), thereby reinforcing their competitive positioning (Y. Liu, Guo, et al., 2023; Nasiri et al., 2022). Specifically, DO can enhance operational efficiencies (Maurer et al., 2023), facilitate innovation (Wang et al., 2024), and enable firms to respond dynamically to market changes, thereby driving financial performance (Ardito et al., 2021; Li & Zhang, 2025; Ranjan, 2024).

DO may be even more critical for the success and survival of SMEs (Y. Liu, Guo, et al., 2023; Nasiri et al., 2022) because of these firms' likely resource constraints and the challenges they face in effectively adopting digital technologies (Park et al., 2022). Their structural characteristics such as flexibility, agility, and adaptability to new trends (Levy & Powell, 1998) could make them more reliant on agile (Li & Shao, 2023) and resource-efficient strategies (Escoz Barragan & Becker, 2025; Ranjan, 2024). For these reasons,

even a low level of DO in SMEs may have the potential to generate *valuable, rare, and inimitable sets of digital technologies* (Kindermann et al., 2024), which in turn could contribute to performance improvements through internal process optimisation (Mishra et al., 2024; Nasiri et al., 2022), better stakeholder engagement (Kindermann et al., 2021), and increased innovation and competitiveness (Ranjan, 2024).

However, these benefits are not automatic, as SMEs still face significant barriers in effectively implementing DO and translating digital investment into tangible performance benefits. The well-known IT Paradox (Brynjolfsson, 1993) suggests that despite increasing investments in digital technologies, firms do not always experience proportional improvements in productivity or financial performance.

This paradox is particularly relevant in the context of innovative SMEs, defined as a subset of SMEs actively engage in technological advancements, R&D, and strategic digitalisation efforts (Alegre & Pasamar, 2018; Merín-Rodríguez et al., 2024; OECD, 2019). While they are more adaptable and responsive to technological change than their counterparts, (Sawers et al., 2008), they may encounter difficulties in managing tensions that arise from leveraging these digital resources and capabilities. The intrinsic characteristics of these firms may limit the benefits of a high level of DO (Kindermann et al., 2024) due to the complexity involved in managing the interrelationship between the four DO dimensions, as well as high dependence on costly external resources (Kindermann et al., 2021, 2024).

This is especially important in the context of SMEs, which are the backbone of the global economy, accounting for more than 90% of companies worldwide (SMEs - WorldBank) and 99% in Europe (SMEs - European Commission), playing a crucial role in job creation, innovation, and economic resilience (Katsinis et al., 2024). Innovative SMEs are critical to the economic advancement of any country (Abubakar et al., 2019).

Despite the recognised importance of both DO and SMEs, and the growing body of research on this topic, the extent and impact of DO on SMEs over time is still contested. This has prompted calls for further investigation, with prior empirical studies finding mixed results (Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Escob Barragan & Becker, 2025; Ranjan, 2024). In this respect, Ranjan's (2024) examination of the role of DO in SMEs as a linear and unidimensional driver of innovation performance provides limited insight into whether and how the effect of DO may evolve or be lost. Furthermore,

while Escoz Barragan and Becker (2025) explore a non-linear relationship between DO and financial performance, their analysis does not consider whether the former may eventually lose its explanatory power beyond a certain threshold.

The literature also suggests that the strategic opportunities and value associated with DO differ between SMEs and large firms, the latter operating under differential conditions in terms of structure, resource availability, digitalisation, and strategic flexibility (Kindermann et al., 2021). Current research has primarily focused on large firms (Kindermann et al., 2021, 2024; Koski et al., 2019; Li & Zhang, 2025; Li et al., 2023), leaving a gap in understanding how DO is deployed in SMEs, and particularly in innovative SMEs.

The focus on the latter not only enriches the literature on DO, but also allows for verifying whether previous findings on large firms and SMEs generally apply to innovation-driven businesses, or if innovative SMEs require distinct approaches. Furthermore, most existing studies on SMEs have examined either innovation performance or financial performance in isolation. Escoz Barragan and Becker (2025) focus on financial performance and Ranjan (2024) explores innovation performance, while innovative SMEs face the dual challenge of sustaining innovation while ensuring financial viability. Investigating innovation and financial performances simultaneously allows for a more comprehensive understanding of the possible trade-off and value added in the DO process.

The present study aims to fill the research gaps in the relationship between DO, innovation, and financial performance in innovative SMEs. Addressing the theoretical and empirical gaps is relevant because a deeper understanding of DO in SMEs can shed light on how these firms with their unique constraints and advantages navigate digital opportunities. Without this knowledge, we lack insights into whether and how SMEs can effectively leverage DO to enhance their innovation and financial performances, optimise resource allocation, and sustain competitive advantage in an increasingly digital economy.

Considering the current debate and these research gaps, we formulate the following two research questions: RQ1, “What is the effect of DO on innovation performance in the context of innovative SMEs?”, and RQ2, “What is the effect of DO on financial performance in the context of innovative SMEs?”.

We move beyond the dominant assumption of a linear relationship between DO and performance in the SME literature (i.e. Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Ranjan, 2024), expanding prior research on the nonlinear effects of DO (Escoz Barragan & Becker, 2025), and extending the analysis to innovation performance. In doing so, we hypothesise a positive effect of DO on both innovation and financial performance up to a certain point, beyond which investing in more DO becomes counterproductive since it reduces both types of performance, in line with the IT paradox (Brynjolfsson, 1993). However, the findings uncover the existence of two opposite curvilinear effects: a U-shaped relationship between DO and innovation, and an inverted U-shaped effect on financial performance in innovative SMEs.

To test our hypotheses, this research uses a dynamic panel data model and original tools such as the Wayback Machine to examine 250 innovative Italian SMEs over a 10-year period (2013–2022).

Italy is a suitable and representative setting because of the dominance of SMEs in its economy, as in most European countries. In fact, SMEs represent 99.9% of all firms in Italy, 94.6% of micro-enterprises (considered within the SME category following EU Recommendation 2003/361), 4.8% of small enterprises, and 0.6% of medium enterprises ([European Commission, 2024](#)). SMEs are widely recognised as being the backbone of the European economy (Ranjan, 2024), and a driver of both employment and value creation globally (Muhammad et al., 2024b). This structural similarity to its European neighbours in terms of the predominance of SMEs, their central role in economic development, and their increasing engagement in digital transformation, combined with Italy's institutional and digital alignment with European Union (EU) policies, positions the country as an illustrative case within the European context.

According to the Eurostat report, as of 2023, SMEs in Europe employ more than 75% of the workforce and account for 63.7% of added value (Schulze et al., 2025). Moreover, European SMEs have demonstrated notable progress in their digital transformation efforts, with at least 55% of them across the EU having a basic level of digital intensity ([DESI Index 2022](#)). Among them, and with the highest number of SMEs in Europe (Di Bella et al., 2023), Italy has shown significant advancement in key dimensions such as digital technology integration and connectivity ([DESI Index 2022](#)), in line with the leading EU countries in terms of digital development. These factors make

Italy a prime setting to study the relationship between DO, innovation, and financial performance in innovative SMEs, with findings relevant to Europe as a whole.

This paper contributes to the literature on DO and business performance in three ways. First, we identify DO as a strategy with two opposite curvilinear effects, thereby moving beyond the dominant linear assumptions in the DO literature, helping reconcile mixed results, and clarifying the mechanisms through which increasing DO produces both benefits and costs in innovative SMEs.

Second, our research reveals the nuanced role of boundary conditions in elucidating the nonlinear effect of DO on performance. Specifically, the limited size of innovative SMEs constrains the positive impact of increasing investments in DO on financial performance. However, boundary conditions do not extend to the relationship between DO and innovation performance, as the results indicate a significant U-shaped effect. Conversely, our findings suggest that some characteristics of innovative SMEs amplify the influence of DO on innovation outcomes.

Third, beyond integrating the IT paradox (Brynjolfsson, 1993) into the RBV and DC perspectives, our results offer only partial support for IT paradox, revealing a potential trade-off between the limiting constraints and enabling factors that coexist within innovative SMEs.

The article is structured as follows. This introduction (Section 3.1) is followed by a theoretical background (Section 3.2), which includes the conceptual definition of DO and the theories underpinning our reasoning. Section 3.3 develops the hypotheses based on extant research on DO and its associations with innovation and financial performances in the context of innovative SMEs. The methodology is described in Section 3.4, which includes the description of the variables, the construction of the DO variable, and the methods used to test the hypotheses. The results are presented in Section 3.5. Section 3.6 discusses the research, analysing the contribution of the main findings and formulating implications for theory and practice. Last, Section 3.7 provides final remarks.

3.2. Theoretical background

DO has emerged as a pivotal concept at the intersection of strategic orientation and digital transformation research, offering a framework for aligning organisational resources and capabilities with digitalisation demands (Kindermann et al., 2021; Quinton et al., 2018).

It is defined as “an organisation’s guiding principle to pursue digital technology-enabled opportunities to achieve competitive advantage” (Kindermann et al., 2021).

This new strategic orientation integrates strategic intent and operational readiness, enabling firms to adapt to and shape their technological environments (Quinton et al., 2018). It encompasses four interconnected dimensions, namely digital architecture configuration, digital capabilities, digital technology scope, and digital ecosystem coordination, which are briefly described as follows.

Digital architecture configuration refers to the underlying IT infrastructure and systems that support digital transformation. It includes technologies such as cybersecurity tools, data infrastructures, real-time systems, robotics, and automation platforms. Digital architecture configuration is critical for SMEs, enabling scalable and secure operation despite resource constraints (Kindermann et al., 2021; Y. Liu, Guo, et al., 2023). A robust digital architecture not only supports internal efficiencies, but also ensures that SMEs are structurally ready to adopt more advanced technologies (Escoz Barragan & Becker, 2025).

Digital capabilities capture the firm’s internal know-how, technological competencies, and digital human capital necessary to operationalise digital transformation. They include expertise in artificial intelligence (AI), machine learning, user interface design, and data analytics (Maurer et al., 2023). Developing these capabilities is often a challenge for SMEs. However, those that succeed gain a substantial edge over competitors in innovating and responding flexibly to changing markets (Li & Shao, 2023).

These capabilities should be understood as operational or low-level capabilities (i.e., technical expertise in AI, machine learning, and data analytics), which enable the practical implementation of digital technologies (Kindermann et al., 2021). They differ from Teece et al’s (1997) definition of dynamic capabilities, which operate at higher-order level and allow firms to reconfigure, integrate, and renew resources over time. While DO captures the firm’s current orientation and resource-capability alignment toward digitalisation (Kindermann et al., 2021), dynamic capabilities are the meta-capabilities that enable these efforts to be adjusted as conditions change. Dynamic capabilities in the digital context includes the ability to sense new technological

opportunities, seize them through timely investments, and reconfigure digital resources to sustain competitiveness.

Digital technology scope reflects the breadth of digital tools adopted within the organisation. This may range from cloud computing and blockchain to IoT and telemedicine, reflecting the SME's technological ambition and ability to diversify digitally. A wide digital technology scope allows SMEs to tailor their digital strategies to customer needs and operational contexts, enhancing both innovation and competitiveness (Ranjan, 2024; Wang et al., 2024).

Digital ecosystem coordination emphasises how well firms integrate processes with external actors via digital means, such as APIs, online platforms, e-commerce systems, and social media. This dimension reflects the ability of the SME to engage in digital co-creation with suppliers, customers, and partners (Quinton et al., 2018), in a context where external resources are often critical for scaling innovation. In this way, effective digital ecosystem coordination facilitates knowledge exchange, new revenue streams, and collaborative innovation (Ardito et al., 2021).

These four dimensions are deeply interrelated and mutually reinforcing (Kindermann et al., 2021, 2024). A wider scope of digital technologies often requires a more robust digital architecture and advanced capabilities to ensure integration and usability (Kindermann et al., 2024; Ranjan, 2024). Similarly, developing a strong digital ecosystem presupposes not only the adoption of appropriate platforms, but also internal capabilities to manage them. Achieving balance and synergy across these dimensions can therefore be critical for both innovation and growth in the SME context.

Resonating with the desired synergy, the interplay between the RBV (Barney, 1991) and dynamic capabilities (Teece et al., 1997) is particularly relevant to DO. The RBV focuses on leveraging unique and inimitable resources, aligning closely with elements such as IT infrastructure and advanced analytics capabilities, which are foundational to the digital architecture and digital capabilities that drive firm performance (Barney, 1991).

With increasingly dynamic technological and market environments, reliance on a static view and resource management only is nowadays insufficient. Accordingly, the dynamic capabilities approach highlights the agility required to adapt these resources to changing technological landscapes by emphasising the processes through which firms

sense opportunities and threats, and seize them through targeted investments (Teece et al., 1997).

Fostering digital ecosystem coordination, for example, requires firms to continuously sense and respond to evolving stakeholder needs while integrating external innovations into their value chains. Similarly, embracing a broad digital technology scope necessitates the ability to seize and effectively transform the firm's resource base. The integration of RBV and dynamic capabilities therefore provides a compelling lens to understand the role of DO in enabling firms, including innovative SMEs, to navigate complexity.

SMEs are often constrained by limited resources (Park et al., 2022; Zhang & Zhu, 2021), but may benefit from the ability of DO to balance resource efficiency adaptability (Levy & Powell, 1998), positioning them to harness digital transformation for competitive advantage (Escoz Barragan & Becker, 2025). This perspective bridges a critical gap in the literature by linking broad strategic constructs such as resource-based advantages and dynamic capabilities to concrete organisational practices (Li & Zhang, 2025; Li et al., 2023) that innovative SMEs can implement to enhance their digital transformation. Specifically, innovative SMEs can leverage DO through specific actions, including investing in cost-effective cloud-based IT infrastructure, adopting scalable digital tools, upskilling employees in data analytics and AI, and building strategic partnerships within digital ecosystems (Ardito et al., 2021; Escoz Barragan & Becker, 2025; Ranjan, 2024).

By doing so, innovative SMEs can not only adapt to technological change, but they can proactively shape their competitive position by means of innovation and strategic agility (Merín-Rodríguez et al., 2024). This refined understanding lays the groundwork for empirical research that examines how DO contributes to innovative SMEs' innovation capabilities and performance, exploring whether there are optimal levels of DO that enhance this performance in their resource-constrained context.

Despite growing recognition of the strategic role of DO, its impact on SMEs remains under debate, particularly considering the complex nature of digital transformation and its dynamic evolution (Merín-Rodríguez et al., 2024; Quinton et al., 2018). In SMEs, this complexity is inherently shaped by the interplay between valuable

but constrained resources (RBV) and the firm's ability to dynamically adapt to technological shift (dynamic capabilities).

From an RBV perspective, SMEs often have limited access to and disposal of financial and human capital (Barney, 1991), which may impede their ability to fully exploit digital technologies (Elia et al., 2020). Nevertheless, their structural flexibility can be a valuable strategic asset in volatile environments (Merín-Rodríguez et al., 2024; Ranjan, 2024). Given their intrinsic characteristics, SMEs may experience the effects of DO differently from large firms.

While DO is expected to drive innovation and financial outcomes in large companies (Bendig et al., 2023; Kindermann et al., 2021, 2024; Li & Shao, 2023; Li & Zhang, 2025; Maurer et al., 2023; Nasiri et al., 2022; Wang et al., 2024), it is unclear whether innovative SMEs can sustain these benefits over time without facing diminishing returns or operational inefficiencies. This reflects a broader challenge in the digital age, where the presence of valuable resources is insufficient to guarantee long-term performance improvements (Brynjolfsson, 1993), with digital resource misalignment and overload potentially generating inefficiencies or strategic tensions over time in SMEs with limited integration capabilities (Escoz Barragan & Becker, 2025). However, this digital transformation process is rarely linear.

Recent studies grounded in the RBV and DC perspective (J. Chen & Liu, 2025; Merín-Rodríguez et al., 2024) have shown that digital transformation in SMEs often follows irregular trajectories, where initial investments may generate returns, and advanced digital maturity may trigger inefficiencies, tensions, or coordination burdens. These diminishing returns can stem from misalignment between complex digital architectures and limited internal absorptive capacity (Ranjan, 2024) constrained by resource limitations.

There is a knowledge gap in determining whether DO consistently enhances SME performance (Ardito et al., 2021; Ranjan, 2024), or whether its impact diminishes beyond a certain point (Escoz Barragan & Becker, 2025). The above-mentioned contributions underline that resource-based advantages must be matched by the firm's dynamic ability to integrate, reconfigure, and realign digital assets as complexity increases.

As the IT paradox suggests (Brynjolfsson, 1993), DO may lose its effect and performance gains may eventually no longer be anchored to DO as the primary driver of

SMEs' performance, thereby reducing its contribution. This theoretical framing strengthens the rationale for testing the existence of a non-linear relationship between DO and performance in innovative SMEs. This will be argued in the following section.

3.3. Hypothesis development

3.3.1 Digital orientation and innovation performance in innovative SMEs

DO represents a deliberate organisational effort to align strategies and processes with digital technologies to foster innovation and adaptability (Ardito et al., 2021; Kindermann et al., 2024; Ranjan, 2024; Wang et al., 2024). In innovative SMEs, characterised by flexibility (Sawers et al., 2008) and agility (Levy & Powell, 1998), DO can serve as a critical enabler of innovation by facilitating the development of rare and inimitable digital resource configurations (Lin & Wu, 2014). By integrating digital tools, innovative SMEs can enhance their innovation capabilities by means of two primary mechanisms (Merín-Rodríguez et al., 2024). First, digital technologies streamline internal processes, enabling firms to optimise operations, improve efficiency, and allocate resources more effectively (Eller et al., 2020). Second, they inspire creative problem-solving, allowing innovative SMEs to develop novel products and services that align with evolving market demands (Nasiri et al., 2022).

Empirical evidence supports that SMEs achieve significant improvements in innovation performance by leveraging digital tools to create novel products and services (Nasiri et al., 2022), although few studies explore this relationship in the innovative SME context (Merín-Rodríguez et al., 2024). In this regard, SMEs in manufacturing sectors have successfully implemented digital twin technologies to simulate production processes, leading to faster prototyping and reduced time-to-market for innovative products (Nasiri et al., 2022). This highlights how DO not only improves operational efficiency but also fosters a culture of innovation by providing new tools for experimentation and value creation.

Moreover, innovative SMEs may efficiently leverage DO to explore new business models (Li et al., 2018), leading to an initial boost in innovation outcomes (Ardito et al., 2021). They may also focus on creating foundational digital capabilities and adopting scalable digital tools that enable incremental innovations (Nijssen & Ordanini, 2020), or integrate AI-driven solutions to enhance decision-making. Powered inventory

management systems allow SMEs to reduce waste and improve supply chain efficiency, directly boosting profitability, and additionally and ultimately strengthening their ability to innovate (Z. Yang et al., 2024). This integration not only optimises internal processes but also fosters a collaborative innovation environment, where employees and stakeholders work together to generate ideas, enhancing innovative SMEs' innovative potential (Kindermann et al., 2024; Merín-Rodrigáñez et al., 2024; Verhoef et al., 2021).

Nonetheless, the extant literature presents mixed results on the relationship between DO and innovation performance in the context of SMEs (Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Ranjan, 2024), and research explicitly examining DO in innovative SMEs remains limited. While some studies provide evidence of either a positive or insignificant effect (Ardito et al., 2021; Ranjan, 2024), they typically conceptualise DO as a linear and unidimensional driver of innovation (Wang et al., 2024), leaving important gaps regarding the potential for a non-linear relationship in the context of innovative SMEs.

A recent study by Ardito et al. (2021) examines two types of strategic orientation, digital and environmental, and their effect on innovation performance in a sample of American SMEs, providing no conclusive evidence as to whether and how DO enhances innovation outcomes. Ranjan et al. (2024), however, highlight the positive link between DO and innovation performance in Indian SMEs within a linear framework. This leaves open the question as to whether increasing levels of DO continue to generate innovation outcomes, lead to diminishing returns, or reach a point where innovation is no longer anchored to DO, suggesting that there is an optimal threshold.

Although previous research predominantly argues in favour of a positive effect of DO on innovation in SMEs (Ranjan, 2024), and while mechanisms such as process optimisation and digital capabilities may provide an initial boost to innovation, we suggest that DO may also generate diminishing returns when excessively intensified, hindering innovation for several reasons. First, the same internal processes that benefit from streaming can become rigid and over-standardised at high DO levels, stifling creativity and limiting flexibility.

Second, the management of advanced digital tools and platforms across the four dimensions of DO becomes increasingly complex (Quinton et al., 2018). Given SMEs managerial and financial resource constraints, this complexity in innovative SMEs may

cause misallocation of resources and operational inefficiencies, leading to suboptimal use of capabilities and hindering innovation (Kindermann et al., 2024). Similarly, building extensive digital capabilities may lead to cognitive overload and fragmented innovation efforts, especially when SMEs lack the absorptive capacity to manage complexity.

Third, high levels of digital ecosystem engagement, initially fostering co-creation, may overwhelm SMEs' coordination abilities, reducing the effectiveness of collaborative innovation (Kindermann et al., 2021). To this effect, a small technology firm that extensively expands its digital ecosystem through external partnerships may experience delays in product development due to misaligned goals with partners. These issues can be exacerbated by a lack of internal expertise to manage these relationships effectively, ultimately stalling innovation efforts (Kindermann et al., 2024).

These challenges highlight how excessive DO managerial and resource strains may reduce the ability of SMEs to maintain the experimentation and flexibility required for sustained innovation (Ardito et al., 2021). In this regard, while a moderate DO is likely to enhance innovation through optimised processes, collaboration and responsiveness, an excessive adoption of DO may impose costs and complexities that hinder creative adaptability. The dual effect of DO, boosting innovation at moderate levels but constraining it at higher levels, underpins a curvilinear relationship. Accordingly, we hypothesise that:

H1: In innovative SMEs, digital orientation has a curvilinear effect (inverted U-shape) on innovation performance.

3.3.2 Digital orientation and financial performance in innovative SMEs

The benefits of DO should translate into financial gains as firms use digital resources strategically across the whole organisation to optimise internal processes and enhance capabilities and resources to strengthen their competitive advantage (Kindermann et al., 2021). By aligning digital technologies with organisational strategies, firms can enhance their ability to integrate digital tools across business functions, improving internal coordination and responsiveness to market change (Bharadwaj et al., 2013). This strategic integration enables firms to refine their products and services to better meet customer needs (Volberda et al., 2021), fostering competitive positioning (Li & Zhang, 2025; Li et al., 2023; Nasiri et al., 2020).

Moreover, DO supports the development of valuable, rare, inimitable, and organised (VRIO) resources by embedding digital capabilities into core operations (Kindermann et al., 2021). In turn, these resources strengthen a firm's ability to sustain a competitive advantage in dynamic environments (Ghosh et al., 2022). DO also facilitates the continuous development of digital competencies, allowing firms to explore new applications of digital technologies (Ranjan, 2024). By leveraging these competencies, firms can optimise processes, improve decision-making, and ultimately drive firm performance (Kindermann et al., 2024). The extant literature suggests that DO can enhance interactions with customers (Eller et al., 2020; Escobarragan & Becker, 2025; Kindermann et al., 2021), streamline business processes (Bendig et al., 2023), and enhance engagement with stakeholders (Lin et al., 2024), leading to positive outcomes over time.

The financial implication of DO in innovative SMEs appears to follow a twofold perspective. At low levels, DO enables operational efficiency and stakeholder engagement, which enhances financial performance. However, when pushed beyond a certain threshold, the same mechanisms may produce adverse effects that may limit or decrease these benefits.

In the context of innovative SMEs, the benefits derived from DO stem from the application of digital technologies to promote this strategic orientation, which enables stronger relationships with suppliers and stakeholders, leading to higher financial returns (Quinton et al., 2018). Innovative SMEs tend to begin their digital transformation journey by adopting basic digital tools to address immediate operational needs (Merín-Rodríguez et al., 2024; Müller et al., 2018; Verhoef et al., 2021). These tools allow firms to achieve incremental financial benefits by streamlining internal processes and reducing costs (Pagani, 2016), thereby supporting innovative SMEs in enhancing the entire business process, capturing market opportunities (Ardito et al., 2021), and better positioning themselves to improve operational efficiency (Ranjan, 2024).

At a low level of DO, innovative SMEs are capable of fully integrating digital tools into their operations, achieving significant financial gains. In this direction, some empirical studies confirm that innovative SMEs with DO experience improved financial performance through enhanced customer retention, market responsiveness, and cost-efficiency (Kindermann et al., 2024). Despite these potential benefits, the academic

understanding of the impact of DO on SMEs is fragmented and underexplored. Research on SMEs is also concentrated on innovation outcomes (Ardito et al., 2021; Ranjan, 2024), raising calls for further empirical research on the relationship between DO, SMEs, and their performance outcomes (Escoz Barragan & Becker, 2025).

While DO is increasingly recognised as a key driver of innovation in SMEs, studies investigating its relationship with financial performance are still limited and offer mixed evidence. In a recent study, Escoz Barragan and Becker (2025) identify a curvilinear (U-shaped) relationship between DO and performance in SMEs, suggesting that digital investments may initially strain financial outcomes before generating returns. This implies that there may be unique phases or challenges on the DO journey for SMEs, distinct from those of larger firms, highlighting the need for targeted research that can unpack these nuances and explore whether the initial financial benefits of DO diminish or even eventually stop, making further DO investment unprofitable (inverted U-shaped effect).

Further, the specific case of innovative SMEs, a subgroup characterised by “superior technological competencies” (Merín-Rodrigáñez et al., 2024, p. 2), remains largely overlooked. For example, Merín-Rodriganez et al., (2024) examine the effects of digital transformation on innovative SMEs, but do not fully capture DO as a strategic construct. These firms are especially likely to encounter tensions between strategic business and resource limitations, which may cause the marginal utility of DO investments to decrease as complexity increases.

While continuing to offer innovative SMEs the promise of increased adaptability, innovation, and competitive advantage, as DO intensifies the same mechanisms and the intrinsic characteristics of these firms may limit the sustained benefits of a high level of DO (Mishra et al., 2024; Nasiri et al., 2022).

First, process optimisation can become counterproductive if increased digital complexity overwhelms management structures, reducing operational efficiency (Kindermann et al., 2021; Y. Liu, Guo, et al., 2023). Specifically, while innovative SMEs are generally faster to adopt digital technologies (Alegre & Pasamar, 2018; Escoz Barragan & Becker, 2025; Kraus et al., 2022; Merín-Rodrigáñez et al., 2024), they must strategically leverage competencies to reinvent their business processes (Kindermann et al., 2021; Maurer et al., 2023). This adaptation is an ongoing process (Nasiri et al., 2022)

that can erode profitability, particularly for resource-constrained innovative SMEs that lack the managerial and financial capacity to sustain such extensive digital infrastructures (Park et al., 2022; Zhang & Zhu, 2021).

Second, DO often requires specialised knowledge and capabilities (Li & Shao, 2023), increasing the dependency of SMEs on external expertise, thereby inflating expenditure and reducing returns. These effects are especially pronounced in innovative SMEs, which often face resource and managerial constraints (Park et al., 2022; Zhang & Zhu, 2021).

Third, extensive and initially beneficial stakeholder engagement may lead to dissonance or incoherence if digital ecosystem coordination becomes misaligned with the existing business model. This misalignment may further erode financial performance by switching attention and resources away from core competencies and creating operational inefficiencies. Furthermore, excessive digital integration may lead to organisational rigidity as firms become overly reliant on digital systems, reducing their ability to adapt to market changes (Escobarran & Becker, 2025; Lin et al., 2024).

Coordinating the four dimensions of DO also requires careful management (Kindermann et al., 2021). Innovative SMEs that fail to manage these interrelated dimensions risk generating friction, including misalignment with ecosystem partners struggling to adapt to changes in digital technology scopes, and customer difficulty in accessing the intended value (Kindermann et al., 2021). As DO intensifies, the costs of integration, coordination, and capability renewal may outweigh the financial benefits, echoing the IT paradox.

While the literature supports the positive role of DO in driving early financial gains, the former arguments suggest that an inverted U-shaped relationship may better capture its effects over time in innovative SMEs. As innovative SMEs expand their DO, they may face practical constraints that limit the financial benefits derived from further digital investments. To this effect, we expect an increase in the financial performance of innovative SME's with DO up to a threshold point, after which, because of limited resources and increased complexity, financial performance will no longer be anchored to DO. Therefore, we hypothesise that:

H2: In innovative SMEs, digital orientation has a curvilinear effect (inverted U-shape) on financial performance.

Figure 1 illustrates the conceptual model of the study, highlighting the two hypotheses for the inverted U-shaped effect.

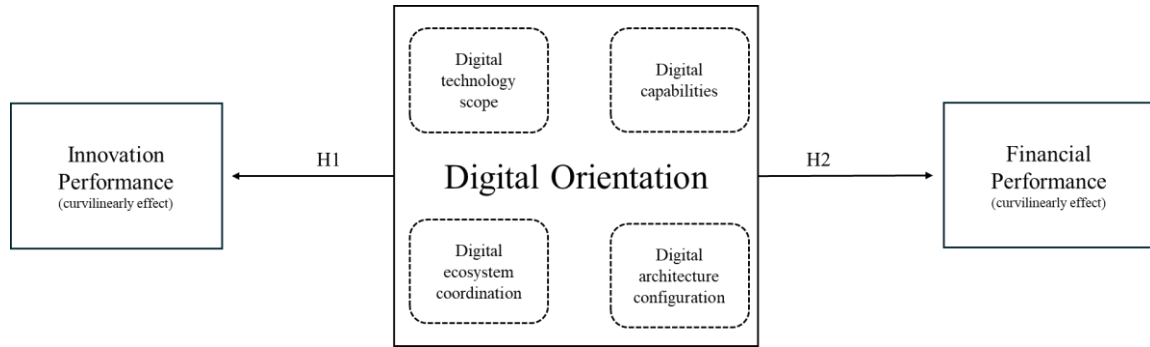


Figure 1. Conceptual framework

3.4. Methodology

3.4.1 Data, sample of analysis, and variable description

A database of 250 innovative Italian SMEs selected from the Chamber of Commerce's register for SMEs (SME register) was constructed for this study. This sample size was chosen to contribute to the growing debate on innovative SMEs (Alegre et al., 2013; Barrett et al., 2021; Nunes et al., 2012), in line with prior studies such as Nunes et al. (2012), who examine a sample of 133 innovative SMEs. The sample initially consisted of a larger number of innovative SMEs, but it was reduced to 250 to enhance high representativeness and ensure proportionality and heterogeneity across key dimensions of the SME population.

We employed a probability-proportional-to-size (PPS) sampling strategy (Levy & Lemeshow, 2013). This approach is widely recognised in the management field, as illustrated by Marchesani and Ceci (2025), who applied PPS to 30 Italian cities, and is aligned with European Commission standards. We identify four key stratification criteria: (i) the location where the SMS operates based on NUTS2 regions, geographically classified into North, Centre, and South according to the EU scheme (<https://ec.europa.eu>), with the islands of Sardinia and Sicily merged into the South

classification; (ii) corporate status, referring to the legal form of the firm; (iii) firm size (micro, small, medium), and (iv) industry sector (manufacturing, services)¹³.

The PPS method allows firms with a higher prevalence in the population to have a greater probability of selection, without excluding those in less represented strata, thereby preserving diversity and proportionality. This strategy enhances both the statistical robustness of the sample and the generalisability of our findings across Italy and for the European SME context, which is characterised by high SME density and heterogeneity as the core typology of business in the economic system of most countries. To this effect, the sample is suitable to investigate the impact of DO on organisational performance in innovative SMEs, and to enhance the external validity of our results to the other countries.

Our sample is a panel data relying on different sources: the AIDA database, Crunchbase Pro, the innovative SME's website tracked with the Wayback Machine tool, and the Italian Chamber of Commerce's register for SMEs. Both primary and secondary data on organisational performance and DO in innovative SMEs were collected. Table 6 contains a detailed variable description and measures. The final panel dataset relies on 2,500 observations from 250 SMEs over a 10-year period (2013-2023), ensuring the robustness of the empirical study.

3.4.2 Variable and measures

3.4.2.1 Dependent variables

Our dependent variables are innovation performance and financial performance. *Innovation performance* is measured using patents and is deemed appropriate for innovative SMEs. Patents are widely used as indicators of a “firm's effort in the innovation process” (Dahlstrand, 1997), encompassing both the quantity and economic significance of innovation outputs (Rahko, 2016; Zhang et al., 2022).

As Garcia and Calantone (2002) state, patents are one of the possible outcomes of innovation. They are instrumental in research analysing innovation performance in longitudinal analyses (Taglialatela & Barontini, 2024) as they reflect technological advancements and creative efforts within organisations (Link & Scott, 2018; Rahko,

¹³ The category of micro, small, and medium-sized enterprises (SMEs) is made up of enterprises that employ fewer than 250 people and have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million, “Commission Recommendation of 6 May 2003 concerning the definition of micro, small, and medium-sized enterprises” <https://ec.europa.eu/smes/>.

2016; Zhang et al., 2022). Moreover, as highlighted by Rahko (2016), patents are useful to analyse innovation outcomes. Given that the specific focus of this study is innovative SMEs, patents can be considered an appropriate measure for innovation. As Audretsch (2002) point out, the patenting rate for small firms is typically higher than that for large firms when measured on a per-employee basis.

In this study, and following Taglialatela and Barontini (2024), we quantify innovation performance by counting the number of patents registered annually from 2013 to 2022 by innovative SMEs. Patents registered represent innovations that have successfully undergone the examination process and have been officially approved by the patent office (Taglialatela & Barontini, 2024). This procedure ensures that inventions meet established standards of novelty, originality, and applicability, thereby reflecting a firm's ability to translate ideas into concrete, recognised outputs. According to Alegre and Pasamar (2018), who state that “the number of patents granted to a given firm may reflect its technological dynamism”, and following Maresch et al., (2016), who argue that the full benefits of patent protection can only be captured once the patent is formally granted, patents registered provides a conservative but robust measure of realised innovative capacity, particularly in the context of SMEs.

To construct the longitudinal measure of innovation performance, we applied a pioneering data collection method that leverages archival internet resources. Specifically, we used the Internet Archive's Wayback Machine (<https://archive.org>), a digital tool repository that captures and stores historical versions of websites, allowing retrospective access to firm-level online content (Arora et al., 2016; Ogden et al., 2024). This approach has gained growing recognition in management research for reconstructing data over time (Halberstadt et al., 2022; Lam et al., 2016; Marchesani & Ceci, 2025; Quarles III & Crudo, 2014). It allowed us to create a comprehensive dataset of patents disclosed by the firms, capturing their innovation activities over a decade.

The data collection process involved four meticulous steps. First, we identified the official websites of the innovative SMEs in the sample to ensure the authenticity and reliability of our data sources.

Second, we used the Wayback Machine to collect retrospective data for the 10-year period and retrieve yearly snapshots of each SME's official website between 2013 and 2022. For each year, we selected the latest available snapshot (typically from the last

quarter of the year) to ensure the fullest information. We then manually examined each page to identify sections dedicated to innovation or intellectual property, from which we extracted information on patents granted. Capturing concrete innovation outputs as opposed to intentions or activities, they were counted and used as a proxy for innovation performance. This enabled us to document the patents disclosed by each firm annually, providing a temporal perspective on their innovation trajectories.

Third, to address potential limitations such as incomplete archives or missing data, we cross-validated the collected information with external databases, notably Crunchbase Pro (Crunchbase.com), a widely recognised business intelligence platform (Brush et al., 2019; De Reuver et al., 2018; Ghezzi et al., 2016; Lou & Wu, 2021; Yee & Choi, 2025) that aggregates firm-level information from authoritative sources. Specifically, for each of the 250 innovative SMEs in our sample, we accessed their company profiles on Crunchbase Pro and manually verified the patents section to cross-check the authenticity and timing of the granted patents reported on their official website.

This triangulation enhanced the accuracy of our dataset by confirming the consistency of patent information across multiple sources. While databases such as WIPO and Orbis IP provide comprehensive access to internationally registered patents, these sources often lack detailed and standardised coverage for SMEs, particularly those operating within national boundaries or engaging in early-stage innovation. The decision to rely on firm-reported patents extracted via the Wayback Machine was therefore rooted in methodological practicality. This approach reflects the evolution of patent-disclosures over time directly from the firm's own digital records of their innovation activity (Escobarragan & Becker, 2025; Link & Scott, 2018), providing a complementary source to traditional databases.

Fourth, we weighted the patent counts by calculating each firm's share of the total patents held by all the innovative SMEs in the sample for each year. This weighting facilitates relative and more meaningful comparison of innovation performance across firms and over time.

By integrating these methodological steps, we established a robust and dynamic measure of innovation performance that reflects the longitudinal development of the output of innovative SMEs, and is transparent and replicable. This metric not only provides insights into individual firms' innovation efforts, but it also contributes to a

deeper understanding of how innovation performance can be effectively quantified in innovative SMEs as an indicator of innovation activities (Escoz Barragan & Becker, 2025).

Table 6. Variable description and measures

Variable	Model	Description	Measurement	Source
Financial performance	DV	Return on sale (ROS) of SMEs operationalized over the total ROS in the sample for each year	Constant	AIDA database
Innovation performance	DV	Number of patent of SMEs over the total patents in the sample for each year as an indicator of innovation activities (Barragan et al., 2024; Mendonca et al., 2024)	Constant	Wayback; Crunchbase Pro
Digital orientation (DO)	IV	Principal component analysis of the four dimensions of the digital orienation	Constant	Italian Chambre of commerce register for SMEs
Digital technology scope	IV (DO)	The number of times words on a digital technology scope's word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital capabilities	IV (DO)	The number of times words on a digital capabilities' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital ecosystem coordination	IV (DO)	The number of times words on a digital ecosystem coordination' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital architecture coordination	IV (DO)	The number of times words on a digital architecture coordination' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Firm age	CV	Number of the years the SMEs has been in operation operationalized by the natural logarithm of the variable	Constant	AIDA database
Firm size	CV	Number of employees in each SMEs operationalized by the natural logarithm of the variable	Constant	AIDA database
Manufacturing industry	CV	Dummy variable of the manufacturing industry. 1 if firm is manufacturing, 0 otherwise	Binary	AIDA database
Innovation intensity	CV	Dummy variable related to the innovation intensity of firms based on the sectoral taxonomy. 1 if firm have high, medium-high, and medium innovation intensity, 0 otherwise	Binary	Peneder et al., 2010
Total assets	CV	Aggregate value of all assets owned by a company operationalized by the natural logarithm of the variable	Constant	AIDA database

Notes: DV: Dependent Variable; IV: Independent Variable; CV: Control Variable; DO: Digital Orientation

The *Financial performance* of innovative SMEs is measured using the Return on Sales (ROS) ratio. ROS is an established accounting-based indicator and is widely recognised as an objective metric and effective indicator of financial performance (Chan et al., 2008; Kafouros et al., 2021; Lückerath-Rovers, 2013; Rosenbusch et al., 2011; Shaner & Maznevski, 2011). ROS is one of the most commonly used measures for profitability (Kafouros et al., 2021), reflecting a firm's operational efficiency and its ability to convert sales into profits (Lin & Wu, 2014). This metric is particularly relevant as it is less affected by capital structure variations than ROI and ROA, and is widely available in financial disclosures (Artz et al., 2010; Caputo et al., 2022; Lu & Beamish, 2006).

In the case of innovative SMEs, ROS is especially suitable as it reflects the firm's ability to translate its sales efforts into profits, which is a critical aspect for firms operating under limited financial resources. For this reason, ROS offers a reliable measure for evaluating financial outcomes in SMEs (Kafouros et al., 2021; Park et al., 2022). Specifically, this variable captures the percentage of ROS for a 10-year period, from 2013 to 2022, weighted over the total ROS in the sample for each respective year to ensure comparability and mitigate cross-firm volatility.

3.4.2.2 *Independent variables*

Our independent variable, *Digital orientation* (DO) in innovative SMEs, was measured following the approaches of Kindermann et al., (2021) and Escoz Barragan and Becker, (2025). Given the limited state of the art on constructing this variable, as highlighted by Escoz Barragan and Becker, (2025), we focused on the mission statement of individual innovative SMEs provided by the Italian Chamber of Commerce register for SMEs, the official website containing information on each SME.

There was a three-fold motivation for selecting this website. First, an individual company website may lack detailed, up-to-date information or may be inaccessible. Second, annual reports and shareholders' letters are not consistently available for innovative SMEs. And third, these mission statements are mandatory for innovative SMEs, with Italian regulations requiring regular updates in this regard for firms listed in the official register for innovative Italian SMEs.

As such, this source ensures standardised and current textual content that reflects the firms' strategic orientation regarding innovation and digitalisation. These institutional requirements add rigour and consistency to the data, strengthening their suitability for

keyword-based content analysis. Using the official register meant we could systematically capture relevant terms associated with each dimension of DO, in line with the pioneering approach of Kindermann et al., (2021).

Since prior studies have identified relevant keywords in English, and considering that our study involved innovative Italian SMEs with available information in Italian, we translated all the keywords for each dimension into this language to maintain methodological consistency. We used the back-translation method to add rigour to the methodological approach (Zhang & Zhu, 2021). The word list and their translation are presented in Table 7.

Table 7. World list of DO dimensions (English-Italian)

Constructs for Digital Orientation	Word list for Digital Orientation (Kindermann et al., 2021)	Italian traslation
Digital technology scope	Advanced communications, advanced technology, advanced technologies, app, apps, bandwidth, blockchain, bot, broadband, cloud, cloudbased, control system, control systems, drone, drones, electronics, high-speed, information management, internet of things, IoT, internet, IT solutions, network services, programmed, sensor, sensors, software, telematics, telemedicine, virtual, virtualize, virtualized, virtualization, wifi, wi-fi	“Comunicazioni avanzate”, “tecnologia avanzata”, “tecnologie avanzate”, “app”, “larghezza di banda”, “blockchain”, “bot”, “banda larga”, “cloud”, “basato su cloud”, “sistema di controllo”, “sistemi di controllo”, “drone”, “droni”, “elettronica”, “alta velocità”, “gestione delle informazioni”, “internet delle cose”, “IoT”, “internet”, “soluzioni IT”, “servizi di rete”, “programmato”, “sensore”, “sensori”, “software”, “telematica”, “telemedicina”, “virtuale”, “virtualizzare”, “virtualizzato”, “virtualizzazione”, “wifi”, “wi-fi”
Digital capabilities	Analytics, artificial intelligence, AI, autonomous, big data, Bluetooth, compute, computing, connectivity, customizable, deep learning, designer, designers, developer, developers, electronic, engineer, engineers, functionality, functionalities, informatics, integrated solutions, interface, machine learning, mobile, programmable, programmer, programmers, self-driving, smart, streaming, technologist, technologists, technology-enabled, ubiquitous, user experience, user interface, wireless	“Analytics”, “intelligenza artificiale”, “AI”, “autonomo”, “big data”, “Bluetooth”, “compute”, “computing”, “connettività”, “personalizzabile”, “deep learning”, “designer”, “sviluppatore”, “sviluppatori”, “elettronico”, “ingegnere”, “ingegneri”, “funzionalità”, “informatica”, “soluzioni integrate”, “interfaccia”, “machine learning”, “mobile”, “programmabile”, “programmatore”, “programmatori”, “self-driving”, “smart”, “streaming”, “tecnologo”, “tecnologi”, “technology-enabled”, “ubiquo”, “esperienza utente”, “interfaccia utente”, “wireless”
Digital ecosystem coordination	Application programming interface, API, APIs, desktop, desktops, device, devices, ecommerce, e-commerce, enterprise resource planning, ERP, multi-channel, network infrastructure, omnichannel, online, on-line, open source, phone, resource planning system, SaaS, smartphone, social media, software as a service, tablet, tablets, technology platform, technology platforms, web, webs, website, websites	“Interfaccia di programmazione dell'applicazione”, “API”, “desktop”, “dispositivo”, “dispositivi”, “ecommerce”, “e-commerce”, “pianificazione delle risorse aziendali”, “ERP”, “multicanale”, “infrastruttura di rete”, “omnichannel”, “online”, “on-line”, “open source”, “telefono”, “sistema di pianificazione delle risorse”, “SaaS”, “smartphone”, “social media”, “software come servizio”, “tablet”, “piattaforma tecnologica”, “piattaforme tecnologiche”, “web”, “sito web”, “siti web”
Digital architecture configuration	3-D printed, 3-D printing, 3D printing, additive manufacturing, advanced manufacturing, algorithm, algorithms, analytical tool, analytical tools, automated, automating, automation, chief digital officer, chiefinformation officer, CIO, computer, computers, cyber, cybersecurity, data, database, databases, digital, digitalization, digitally, digitization, fintech, hardware, information security, information systems, information technology, IT infrastructure, IT infrastructures, IT system, IT systems, operating system, operating systems, real time, real-time, remote monitoring, robot, robots, robotics, standardize	“Stampato in 3D”, “stampa 3-D”, “stampa 3D”, “produzione additiva”, “manifattura avanzata”, “algoritmo”, “algoritmi”, “strumento analitico”, “strumenti analitici”, “automatizzato”, “automatizzare”, “automazione”, “chief digital officer”, “chief information officer”, “CIO”, “computer”, “cyber”, “cybersicurezza”, “dati”, “database”, “digitale”, “digitalizzazione”, “digitalmente”, “digitalizzazione”, “fintech”, “hardware”, “sicurezza dell'informazione”, “sistemi informativi”, “tecnologia dell'informazione”, “infrastruttura IT”, “infrastrutture IT”, “sistema IT”, “sistemi IT”, “sistema operativo”, “sistemi operativi”, “tempo reale”, “monitoraggio remoto”, “robot”, “robotica”, “standardizzare”

To extract these keywords, we used the software MaxQDA, which efficiently counts the frequency of word occurrences within texts. For each dimension of DO, we calculated a frequency score by counting the number of times words associated with that dimension

appeared annually, weighted by the total number of occurrences across the sample. To synthesise these dimensions into an overall *DO* variable, we applied non-parametric principal component analysis (PCA), thereby enhancing the robustness of our findings. Last, the *DO* variable, constructed using this methodology, aligns with previous research in the field (Escoz Barragan & Becker, 2025; Kindermann et al., 2021; Li & Shao, 2023; Maurer et al., 2023; Ranjan, 2024; Saesen et al., 2024), strengthening its validity for examining the impact on organisational performance in innovative SMEs.

3.4.2.3 Control variables

Aligning with the academic debate on DO in SMEs, we included in our model some relevant theoretically grounded and empirically validated control variables that may influence the relationship between DO and performance in the SME context. We considered the *Firm age* and *Firm size* of each SME to account for SME characteristics, adding a dummy variable to control for *Manufacturing industry* (Ardito et al., 2021; Escoz Barragan & Becker, 2025; Kindermann et al., 2024). Furthermore, following Peneder's (2010) sectoral taxonomy, we controlled for *Innovation intensity* across sectors. Last, we controlled for *Total assets* that may affect organisational performance, as suggested by Liu et al. (2023).

These control variables were selected through a stepwise regression procedure (Hooper et al., 2008), ensuring that only the consistently significant variables aligned with the scope of our theoretical framework were retained in the final models. Other variables were evaluated but excluded due to inconsistent significance and limited availability across the panel dataset. Notably, the adopted control variables are those most widely used in the existing literature on DO in SMEs, further enhancing the comparability and robustness of our results (Escoz Barragan & Becker, 2025; Kindermann et al., 2021; Ranjan, 2024).

The description and operationalisation of the control variables are shown in Table 6. These control variables are crucial for enhancing the robustness of our analysis and for offering a nuanced understanding of the factors that affect performance in innovative SMEs.

3.4.3 Estimation model

We employed the Generalised Method of Moments (GMM) with the two-step estimation process to evaluate our hypotheses, a methodological approach widely adopted in strategy and innovation studies (Belderbos et al., 2021; Zhang et al., 2025). Following Roodman (2009a) and Zhang et al (2025), we used a one-year lagged dependent variable as an instrument. This approach mitigated issues of panel-specific heteroscedasticity and autocorrelation while maintaining the robust covariance matrix.

To further validate and ensure the robustness of our model and in line with recent studies (Belderbos et al., 2021), we compared the GMM results with several alternative estimation techniques, including Ordinary Least Squares (OLS), Generalised Least Squares (GLS), and Fixed Effects/Random Effects (FE/RE) models (Roodman, 2009b). This comparative analysis enhances confidence in our findings by demonstrating the consistency of our statistical methods.

We assessed the model's appropriateness using the Akaike Information Criterion (AIC) (Sakamoto et al., 1986), which indicated that the GMM model was the most suitable for our panel data. We also conducted the Hausman test to compare the efficiency of the GMM estimator with FE/RE models, finding no significant discrepancies in the estimated coefficients (Bond & Arellano, 2012). Both the AIC and the Hausman test provided statistical support for the selection of the GMM model. The GMM model is particularly effective for balanced panel datasets of the size and duration of the one used in the present study, as it handles endogeneity, heteroscedasticity, and other inherent data characteristics adeptly.

Specifically, our panel comprised 250 innovative SMEs over a 10-year period (2013-2022), incorporating both time and firm-fixed effects. This method aligns with the current trends in DO research, and especially with studies analysing performance with evident time-lag effect (Kindermann et al., 2021, 2024). We implemented a series of control and diagnostic tests (see Section 3.4) to further address potential endogeneity issues and validate our two-step GMM estimations.

Tables 8 and 9 present the correlation matrices for the two dependent variables and the descriptive statistics, none of them indicating multicollinearity concerns of the coefficients in the regression analysis, which was further confirmed by Variance Inflation Factor (VIF) analysis. The mean VIF values across the various models were below 5.15,

suggesting that multicollinearity did not pose a threat to the validity of our model. Last, we conducted a stepwise robust regression analysis (Agostinelli, 2002), incrementally adding main effects, control variables, and interaction terms to ensure the robustness of our findings.

Table 8. Descriptive statistics and correlation matrix (Innovation performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Innovation performance _(n-1)	1.06	0.004	0	0.113	1.000						
[2] Digital orientation	1.07	0.036	0	0.154	0.010	1.000					
[3] Manufacturing industry	1.13	0.275	0	1	0.163***	-0.148***	1.000				
[4] Innovation intensity	1.10	0.795	0	1	0.038*	0.163***	0.179***	1.000			
[5] Firm size	1.06	0.004	0	0.348	0.110***	-0.033*	0.024	-0.011	1.000		
[6] Firm age	1.08	0.244	0	0.439	0.055**	-0.016	0.112***	-0.023	0.116***	1.000	
[7] Total assets	1.18	0.040	0	0.978	0.165***	-0.104***	0.162***	-0.114***	0.245***	0.260***	1.000

Notes: Dependent variable: Innovation performance; ***p < 0.001; **p < 0.05; *p < 0.1

Table 9. Descriptive statistics and correlation matrix (Financial performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Financial performance _(n-1)	1.04	0.004	-0.041	0.025	1.000						
[2] Digital orientation	1.07	0.036	0	0.154	0.041**	1.000					
[3] Manufacturing industry	1.12	0.275	0	1	-0.004	-0.148***	1.000				
[4] Innovation intensity	1.12	0.795	0	1	0.150***	0.163***	0.179***	1.000			
[5] Firm size	1.06	0.004	0	0.348	0.008	-0.033*	0.024	-0.011	1.000		
[6] Firm age	1.10	0.244	0	0.439	0.118***	-0.016	0.112***	-0.023	0.116***	1.000	
[7] Total assets	1.17	0.040	0	0.978	0.035*	-0.104***	0.162***	-0.114***	0.245***	0.260***	1.000

Notes: Dependent variable: Financial performance; *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$

The descriptive statistics and correlations among all key variables are displayed in Tables 10 and 11, where innovation performance and financial performance, respectively, are the dependent variables.

As shown in the correlation matrices in Tables 10 and 11, the coefficient between the *Digital technology scope* variable and the *Digital capabilities* variable exceeds 0.700, and all other key variables almost reach this level. Trespassing this threshold is theoretically justified because the concept of DO is inherently multidimensional, comprising the four interrelated dimensions that collectively capture a firm's digital strategic posture (Kindermann et al., 2021). Although these dimensions are distinct, they are expected to be positively associated as they jointly represent a single, cohesive construct.

Moreover, the overall value of the VIF is less than 10 (O'Brien, 2007), at 1.53 for innovation performance and 1.57 for financial performance, confirming that the model does not have multicollinearity issues.

Table 10. Descriptive statistics and correlation matrix for key variables (Innovation performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
[1] Innovation performance _(n-1)	1.07	0.004	0.000	0.113	1.000									
[2] Digital architecture configurations	2.17	0.028	0.000	0.120	-0.032	1.000								
[3] Digital capabilities	2.85	0.056	0.000	0.250	0.047**	0.681***	1.000							
[4] Digital technology scope	2.43	0.037	0.000	0.150	-0.009	0.647***	0.725***	1.000						
[5] Digital ecosystem coordination	1.55	0.016	0.000	0.130	-0.012	0.437***	0.539***	0.494***	1.000					
[6] Manufacturing industry	1.15	0.275	0.000	1.000	0.163***	-0.190***	-0.121***	-0.073***	-0.154***	1.000				
[7] Innovation intensity	1.12	0.795	0.000	1.000	0.038*	0.053***	0.194***	0.158***	0.073***	0.179***	1.000			
[8] Firm size	1.06	0.004	0.000	0.348	0.110***	-0.048**	-0.023	-0.011	-0.047**	0.024	-0.011	1.000		
[9] Firm age	1.13	0.244	0.000	0.439	0.055***	-0.023	0.008	0.035*	-0.167***	0.112***	-0.023	0.116***	1.000	
[10] Total assets	1.19	0.040	0.000	0.978	0.165***	-0.108***	-0.065***	-0.084***	-0.147***	0.162***	-0.114***	0.245***	0.260***	1.000

Notes: Dependent variable: Innovation performance; *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$

Table 11. Descriptive statistics and correlation matrix for key variables (Financial performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
[1] Financial performance _(n-1)	1.05	0.004	-0.041	0.025	1.000									
[2] Digital architecture configurations	2.17	0.028	0.000	0.120	0.039*	1.000								
[3] Digital capabilities	2.85	0.056	0.000	0.250	0.040*	0.686***	1.000							
[4] Digital technology scope	2.43	0.037	0.000	0.150	0.068***	0.647***	0.725***	1.000						
[5] Digital ecosystem coordination	1.56	0.016	0.000	0.130	-0.045**	0.437***	0.539***	0.494***	1.000					
[6] Manufacturing industry	1.13	0.275	0.000	1.000	-0.004	-0.190***	-0.121***	-0.073***	-0.154***	1.000				
[7] Innovation intensity	1.15	0.795	0.000	1.000	0.150***	0.053***	0.194***	0.158***	0.073***	0.179***	1.000			
[8] Firm size	1.06	0.004	0.000	0.348	0.008	-0.048**	-0.023	-0.011	-0.047**	0.024	-0.011	1.000		
[9] Firm age	1.14	0.244	0.000	0.439	0.118***	-0.023	0.008	0.035*	-0.167***	0.112***	-0.023	0.116***	1.000	
[10] Total assets	1.18	0.040	0.000	0.978	0.035**	-0.108***	-0.065***	-0.084***	-0.147***	0.162***	-0.114***	0.245***	0.260***	1.000

Notes: Dependent variable: Financial performance; *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$

3.4.4 Endogeneity and robustness checks

We conducted a series of tests and made specific assumptions to identify potential endogeneity and assess the robustness of the GMM approach (Belderbos et al., 2021; Zhang et al., 2025). Initially, we adopted the dynamic GMM methodology proposed by Roodman (2009a, 2009b), incorporating the lagged dependent variable as an instrument to test the persistence of the dependent variable and mitigate over-identification issues (Windmeijer, 2005; Zhang et al., 2025).

To further validate the robustness of our model and results, we conducted several diagnostic tests to ensure the reliability of our dynamic GMM estimations. We applied the Hansen test (1958) for the over-identification of the GMM model, indicating that the null hypothesis could not be rejected, thereby affirming the consistency of our estimates. We also employed the Arellano and Bond test (Arellano & Bond, 1991; Roodman, 2009a, 2009b) to detect autocorrelation in the idiosyncratic disturbance term of the model.

Specifically, we used the AR(2) test to control for potential autocorrelation issues, in line with recent dynamic panel studies that rely on similar GMM-based diagnostic procedures (Zhang et al., 2025). The results confirm the absence of autocorrelation and provide no evidence of endogeneity concerns in our findings. The outcomes of the model are presented in Table 12. As another robustness test, we also considered an alternative proxy for DO. The results are presented and discussed in Appendix A.

3.5. Results

The results of the GMM regression are presented in Table 12. Model I and Model IV show the interactions between the solely dependent variables and the independent variables. Model II and Model V highlight our empirical model estimated for all the control variables included. Model III and Model VI represent the interaction between the dependent variables and the independent variable, including the U-shaped effect in the proposed model. No significant discrepancies were found in the direction or magnitude of the relationships across these regression analyses. For each step, we also accounted for the incremental contribution of the added variables.

Table 12. GMM Regression (Innovation performance and Financial performance as DVs)

	Innovation performance as a DV			Financial performance as a DV		
	Model I	Model II	Model III	Model I	Model II	Model III
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Innovation performance (n-1)	0.866*** (0.005)	0.869*** (0.004)	0.870*** (0.003)			
Financial performance (n-1)				0.528*** (0.141)	0.214*** (0.034)	0.245*** (0.031)
Digital orientation	-0.106*** (0.039)		-0.085** (0.036)	0.684** (0.305)		0.495*** (0.131)
Digital orientation^2	0.104*** (0.030)		0.097*** (0.031)	-0.540** (0.250)		-0.204** (0.081)
Manufacturing industry		0.001** (0.001)	0.001** (0.001)		0.008*** (0.002)	0.015*** (0.002)
Innovation intensity		-0.001 (0.001)	-0.001 (0.001)		-0.059*** (0.009)	-0.082*** (0.011)
Firm size		0.020* (0.010)	0.019* (0.010)		0.850*** (0.097)	0.954*** (0.080)
Firm age		0.006 (0.005)	0.002 (0.005)		-0.041*** (0.010)	-0.018*** (0.005)
Total assets		-0.004 (0.005)	-0.004 (0.003)		-0.020*** (0.006)	-0.019*** (0.006)
Firm fixed effect	Included	Included	Included	Included	Included	Included
Year fixed effect	Included	Included	Included	Included	Included	Included
Arellano-Bond (2)	-0.54	-0.55	-0.55	1.43	1.33	1.55
p-value	0.593	0.584	0.584	0.153	0.183	0.120
Hansen test	48.35	49.55	56.86	40.61	44.54	48.44
p-value	0.145	0.297	0.266	0.202	0.129	0.263
Number of Observation	2250	2250	2250	2250	2250	2250
Number of Firms	250	250	250	250	250	250

Notes: Dependent variable (DV): Financial performance; Innovation performance *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$ Observations are reduced by one year (250) due to the one-year lag (-1) of the dependent variable. Arellano-Bond test for AR (2) and Hansen Test are used to control for possible autocorrelation issues. Standard errors in parentheses.

The results given by Model III do not provide support for Hypothesis 1 (*In innovative SMEs, digital orientation has a curvilinear effect (inverted U-shape) on financial performance*), showing the quadratic term *Digital orientation*² to be positive and statistically significant ($\beta = 3.10$ $p=0.001$). Specifically, our result suggests a rejection of the inverted U-shape, but provides evidence of the existence of a curvilinear relationship between *Digital orientation* and *Innovation performance*.

Model VI provides support for Hypothesis 2 (*In innovative SMEs, digital orientation has a curvilinear effect (inverted U-shape) on financial performance*), highlighting that the quadratic term of DO (*Digital orientation*²) is negative and statistically significant ($\beta = -2.50$ $p=0.011$). Specifically, our results suggest that DO assumes a positive effect on financial performance in innovative SMEs up a certain point, after which this effect on financial performance diminishes, as shown in Figure 2. Figure 3 also shows the result of the relationship between DO and innovation performance in innovative SMEs (Model III), which does not provide support for Hypothesis 1.

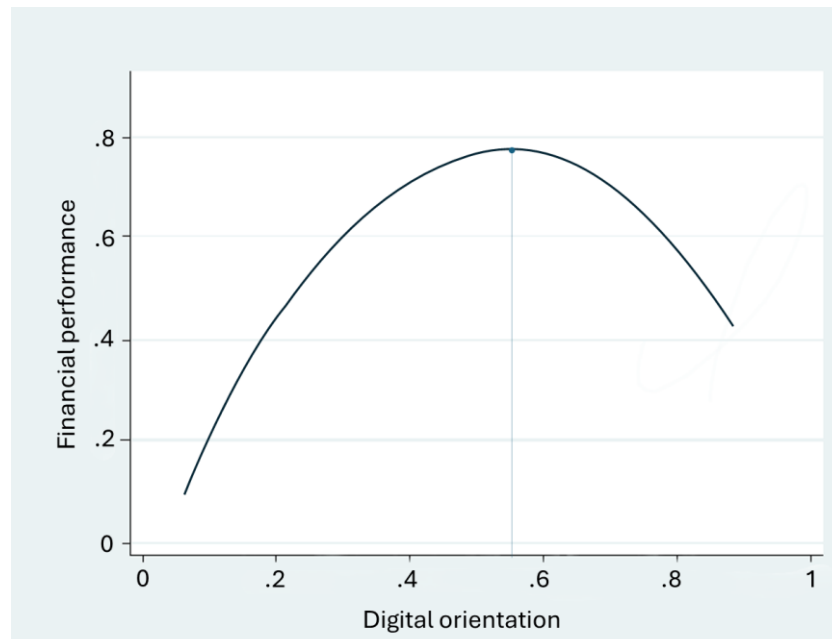


Figure 2. Predicted relationship between financial performance and digital orientation in innovative SMEs

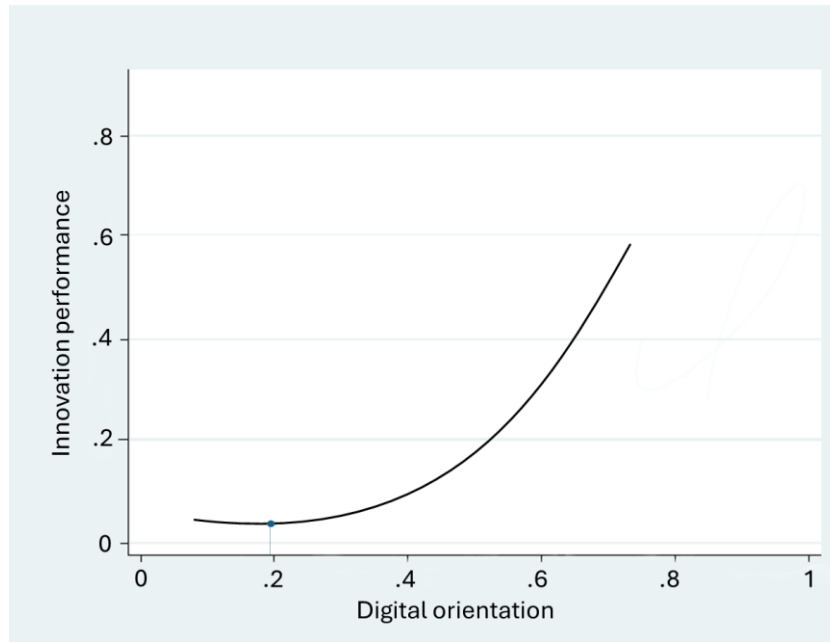


Figure 3. Predicted relationship between innovation performance and digital orientation in innovative SMEs

3.6. Discussion and implications

The present study set out to explore the role of DO, a critical strategic orientation, in innovative SME business performance, and more specifically in innovation and financial performances. Our analytical framework is based on RBV and dynamic capabilities (Barney, 1991; Teece et al., 1997).

Our findings provide empirical support for an inverted U-shaped relationship between DO and financial performance in innovative SMEs. As DO advances, innovative SMEs experience an initial boost in financial performance, with improvements in ROS driven by enhanced efficiency, market reach, and operational agility. However, in line with our theoretical argumentation and the concept of the IT Paradox (Brynjolfsson, 1993), we also find that beyond a certain point the financial benefits of DO begin to diminish. This decline can be attributed to the resource constraints of innovative SMEs, which may struggle to manage increasing digital investments due to limited financial capital, expertise, and organisational capacity.

While moderate levels of DO allow innovative SMEs to leverage their flexibility and responsiveness, excessive investment can lead to diminishing returns, operational complexity, and an inability to sustain digital transformation efforts effectively. These

results challenge previous research that assumes a continuous positive effect of DO on financial performance (Escobarragan & Becker, 2025; Kindermann et al., 2021, 2024). Instead, our findings highlight the importance of a balanced and strategic digital adoption approach tailored to innovative SME-specific constraints.

Contrary to our theoretical arguments, we did not find empirical support for an inverted U-shaped relationship between DO and innovation performance. Instead, our results indicate that innovation in SMEs continues to increase with higher levels of investment in DO. This finding suggests that sustained DO helps innovative SMEs overcome early adoption challenges. This may be explained by the cumulative and compounding nature of innovation processes and outcomes such as product development and process improvement, which are less resource-intensive than large-scale financial commitments and may benefit continuously from enhanced digital capabilities. Moreover, the high degree of strategic flexibility in innovative SMEs allows them to learn from and adapt to successive waves of digital adoption and strengthen their position within digital ecosystems.

Unlike financial performance, where excessive digital investment can create inefficiencies, innovation appears to benefit from continuous digital advancements. These findings underscore the importance of long-term digital strategies that promote ongoing learning, experimentation, and adaptive capability development because innovation outcomes may take longer to reach a saturation point. For innovative SMEs, this means that investing in digital tools, talent, and collaborative networks fosters an environment where digital transformation translates into sustained innovation. However, achieving high innovation outcomes requires innovative SMEs to navigate initial barriers such as skill shortages, integration challenges, and technological uncertainty. These results challenge traditional assumptions about the direct and positive relationship between DO and innovation in SMEs (Ardito et al., 2021; Ranjan, 2024).

Furthermore, our study suggests that innovative SMEs should adopt a strategic approach to digital resource management. This is in line with previous studies on innovative SMEs (Merín-Rodríguez et al., 2024). Rather than simply increasing digital investment, innovative SMEs should focus on optimising their digital assets to sustain both innovation and financial performance. In this sense, the concept of an optimal zone of DO equips managers with a guiding logic, suggesting that innovative SMEs should not

conceptualise digital expansion as a linear progression of technologies, but rather as a process requiring frequent calibration in line with organisational capabilities, digital ecosystem coordination, and evolving performance objectives. The managerial ways in which these firms can identify and manage this balance are discussed in Section 6.2.

3.6.1 Theoretical contribution

This study contributes to the literature in three ways. First, it contributes to prior studies on SMEs (Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Escoz Barragan & Becker, 2025; Ranjan, 2024) focusing on innovative SMEs. Our findings suggest that innovative SMEs are affected by specific boundary conditions such as size, but they benefit from other characteristics such as those suggested by Merín-Rodrigáñez et al. (2024), linked to their R&D intensity, high technological orientation, and resource dependencies. By emphasising these firms' higher absorptive capacity while considering their structural constraints, we argue that curvilinear effects of DO on performance may differ from those observed in general SMEs.

Second, we extend the literature on DO and its effects on financial and innovation performances by identifying two opposite curvilinear effects. This dual finding advances the ongoing debate, as prior studies have predominantly reported linear effects (Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Kindermann et al., 2024; Li & Zhang, 2025; Ranjan, 2024; Wang et al., 2024) or, at most, a single nonlinear pattern (Escoz Barragan & Becker, 2025).

Our study potentially contributes to a better understanding of the management of resources and capabilities that build DO, which is crucial to the digital transformation journey of SMEs (Escoz Barragan & Becker, 2025). In particular, we find that the same process that initially strengthens financial outcomes, possibly through process optimisation, capability enhancement, and ecosystem engagement (Pagani, 2016), may eventually trigger rigidity, cost escalation, and coordination burdens even when resource constraints are reduced (Kindermann et al., 2021).

Our results contrast with those of Escoz Barragan and Becker (2025), who found a positive and curvilinear relationship (U-shape) between DO and financial performance. This divergence can be explained by several factors: (i) our empirical setting focuses exclusively on innovative SMEs, compared to the broader SME population analysed by Escoz Barragan and Becker (2025); (ii) we use a more targeted indicator of financial

performance, as opposed to an aggregated composite measure, and (iii) our longitudinal panel spans ten years, allowing the increasing coordination and maintenance costs to be captured, and revealing the shortcomings of excessive digital investment. Escoz Barragan and Becker's (2025) analysis covers a shorter three-year period. These contextual and methodological differences help explain why excessive digital investment, while initially beneficial, as found by Escoz Barragan and Becker (2025), may ultimately not enhance financial performance in innovative SMEs.

At the same time, our findings extend the prior assumption that DO is an increasing source of proactive strategic behaviour and an indicator of technological readiness to exploit digital opportunities (Ardito et al., 2021; Arias-Pérez & Vélez-Jaramillo, 2022; Li & Zhang, 2025; Ranjan, 2024; Wang et al., 2024), by revealing a U-shaped DO-innovation relationship, thereby adding novelty to the established theoretical framing. While early DO adoption may impose costs and organisational friction for innovation (Kindermann et al., 2021), given their technological orientation, risky processes, and sustained investments, innovative SMEs can generate cumulative learning, stronger digital capabilities, and more effective ecosystem coordination (Merín-Rodrigáñez et al., 2024), allowing them to overcome initial barriers and progressively enhance their innovation outcomes.

Third, this study extends the application of RBV (Barney, 1991) and dynamic capabilities (Teece et al., 1997) theories, emphasising the role of sustained digital adoption in fostering resilience and adaptability in SMEs. Our findings suggest that while valuable digital resources can generate innovation and financial benefits, they may lose their positive effect, especially on financial performance, if they exceed firms' reconfiguration capacity, leading to inefficiencies.

This contribution extends the IT paradox (Brynjolfsson, 1993) by applying its logic specifically to DO in SMEs, theorising that while valuable resources can enable sustained innovation, they may lose financial effectiveness if the digital expansion exceeds the SME's adaptive capacity. Our results offer only partial support for this paradox, suggesting a potential trade-off between limiting constraints and enabling factors that coexist within innovative SMEs. This theoretical refinement may help explain why some prior studies argue and report inconsistent effects of DO on performance, as the impact

appears to vary across different performance dimensions, involving curvilinear effects that have so far been largely overlooked.

3.6.2 Practical implications

This study provides several managerial and policy implications that can help innovative SMEs avoid the pitfalls of DO, and enhance both innovation and financial performances. First, our findings highlight that innovative SMEs should pay more attention to selective and capability-aligned digital investments, focusing on technologies that strengthen their core characteristics, competences, and innovation potential, rather than pursue comprehensive digitalisation. Adopting a strategic focus on specific tools (i.e., cloud-based systems, data analytics, and digital platforms) may allow these firms to sustain innovation and competitiveness without a downturn in financial performance.

Second, the findings suggest that the relationship between DO and performance exhibits an optimal zone, spanning from a zero level of DO to the level of DO producing the maximum financial performance. Within this zone, innovative SMEs are in a win-win position because as they increase their DO, they enhance both innovation and financial outcomes. Identifying and managing this optimal zone requires the joint monitoring of innovation outcomes and financial indicators.

In practice, managers should track whether additional digital investments continue to generate innovation benefits while maintaining financial returns, or whether they begin to introduce coordination costs, complexity, or margin pressure. Observing this shift provides an early signal that firms are approaching or exiting the optimal zone. Managing this balance therefore requires an iterative alignment between digital investments, organisational capabilities, and short versus long-term performance objectives. This involves adjusting the pace and scope of digital initiatives as costs and complexity evolve, and relying on regularly performance monitoring rather than one-off digitalisation decisions.

However, beyond this level, while innovation performance continues to increase, financial performance decreases. Outside the optimal zone, managers thereby face a trade-off between the two performance dimensions, prioritising between them according to their firm's goals and risk propensity (safeguarding financial stability or pushing for innovation-led growth). To effectively manage this trade-off, a dynamic approach to managing digital strategies is needed. For example, practices such as investment pacing,

periodic performance reviews, and cross-functional digital steering teams can help align activities in line with the evolution of costs, complexity, and external conditions. These mechanisms may enable innovative SMEs to progress within the DO optimal zone, or to optimise their position within the DO trade-off zone.

Third, the results suggest that achieving sustained improvements in innovation requires long-term digital commitment and firm learning. Even when frictions are generated in the early phase of DO, persistence in developing digital capabilities and fostering a culture of experimentation can translate into cumulative innovation benefits. In this regard, if innovative SMEs want to enhance innovation performance, it is recommended that managers prioritise internal skills development and knowledge diffusion.

Last, the results have important implications for policymakers, who can play a crucial role in supporting SMEs by designing initiatives that facilitate progressive digital adoption, aligning national and EU policies. They can create a cohesive and competitive environment, reducing disparities in digital infrastructures and innovation support, providing subsidised training programmes, targeting funding for incremental technology upgrades, and providing access to digital infrastructures that reduce the burden of large upfront investments. Business support organisations, industry associations, and technology providers can also contribute by offering SMEs access to shared digital platforms, expert guidance, and best practices to optimise digital transformation outcomes.

3.6.3 Limitations and future research avenues

This study is not without limitations. First, due to the complexity of the data collection process and comparability requirements, the analysis focuses on a single country and a sample of 250 innovative SMEs. Although Italy and the other European countries are considered prominent in research on DO and organisational performance in SMEs (Escobarragan & Becker, 2025; Kindermann et al., 2024; Nasiri et al., 2022), this focus may limit the generalisability of the findings. Future research could extend the analysis to other national or cross-country settings to assess whether the observed relationships hold under different institutional and competitive conditions.

Second, the operationalisation of DO relies on mission statements retrieved from the official register of innovative SMEs and analysed through a keyword-based content

analysis. While this approach follows established methodologies (Escob Barragan & Becker, 2025; Kindermann et al., 2021) and ensures standardised and comparable data across firms, mission statements may primarily reflect formal strategic intentions with sometimes latent digital practices. In addition, keyword-based measures may limit contextual depth. Future research could complement this approach with qualitative methods, such as interviews or managerial surveys, or integrate alternative digital traces to capture the dynamic evolution of DO more granularly.

Third, innovation performance is measured through registered patents, which represents a widely accepted and appropriated proxy in the context of innovative SMEs but does not fully capture the multidimensional nature of innovation outcomes (Alegre & Pasamar, 2018; Flor & Oltra, 2004; Santarelli & Piergiovanni, 1996). As such, this study considers patents as one of the diverse aspects of innovation performance. Although we adopted a rigorous and replicable methodology for measuring the phenomenon, we acknowledge that discrepancies between disclosed and officially registered patents may persist in our approach, especially among SMEs that do not formalise all innovation outputs through patent offices.

Future research could explore the integration of institutional datasets such as WIPO, Orbis IP, or the Global Corporate Patent Dataset to cross-reference registered patent activity. Additionally, further studies could enrich this perspective by incorporating additional indicators, such as new product or process innovation, trademarks, or survey-based innovation scores, to offer a more holistic view of innovation performance in SMEs.

Despite the inherent limitations of the quantitative approach, this study strengthens the strategic role of DO in shaping innovative SMEs' innovation and financial performances, opening the way for future research on its evolving impact in an increasingly digitised economy.

In particular, additional research could investigate how governance characteristics and dynamic capabilities shape the evolution of DO over time and influence firm's ability to balance innovation and financial performance. Extending the temporal scope of analysis would also allow researchers to examine the persistence or evolution and long-term implications of the relationships identified in this study.

3.7. Conclusion

This study contributes to a more nuanced understanding of how DO unfolds within innovative SMEs. By revealing distinct non-linear effects on innovation and financial performances, it challenges the prevailing assumption of uniformly positive performance returns on digital adoptions. Instead, we show that while innovation outcomes benefit from sustained digital investments, financial returns require a balanced and strategically coordinated digital trajectory. These insights encourage a reconsideration of DO as a dynamic construct, whose value-generation capacity depends on the firm's ability to integrate and adapt capabilities over time.

Moreover, from a managerial perspective, these findings suggest that innovative SMEs benefit from recognizing the existence of an “optimal zone” of DO in which innovation and financial performance reinforce each other. Beyond this zone, digital expansion no longer produces symmetric returns, requiring managers to navigate the trade-off between innovation ambitions and financial discipline. DO emerges not as a matter of continuous expansion, but as a strategic posture that must be aligned with firm's priorities, risk tolerance, and long-term vision.

This research contributes to bridging the RBV-DC and the IT paradox, empirically confirming and demonstrating how implementing and maintaining a DO posture can contribute to the competitiveness of innovative SMEs in the present dynamic contexts characterised by continuous technological challenges.

APPENDIX A

As an alternative operationalization of Digital Orientation, we employed a measure of social media adoption, derived from the presence and activity level of firms across major platforms (i.e., Facebook, LinkedIn, X, YouTube). This variable was constructed based on longitudinal data retrieved from the Wayback Machine (2013-2022), following the classification framework proposed by prior literature (Bendig et al., 2023; Escroz Barragan & Becker, 2025; Geissinger et al., 2023; Zhang & Zhu, 2021).

Table 13 Appendix A1. Descriptive statistics and correlation matrix (Social media as IV; Innovation performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Innovation performance _(n-1)	1.05	0.004	0.000	0.113	1.000						
[2] Social media	1.13	0.079	0.000	0.720	0.012	1.000					
[3] Manufacturing industry	1.10	0.005	0.000	0.348	0.163***	-0.050**	1.000				
[4] Innovation intensity	1.06	0.245	0.000	0.440	0.038*	-0.028	0.179***	1.000			
[5] Firm size	1.48	0.796	0.000	1.000	0.110***	0.240***	0.026***	-0.073***	1.000		
[6] Firm age	1.10	0.276	0.000	1.000	0.055***	-0.119***	0.112***	-0.023	0.174***	1.000	
[7] Total assets	1.48	0.040	0.000	0.978	0.165***	0.002	0.162***	-0.114***	0.496***	0.260***	1.000

Notes: Dependent variable: Innovation performance; *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$

Table 14 Appendix A2. Descriptive statistics and correlation matrix (Social media as IV; Financial performance as a DV)

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Financial performance _(n-1)	1.03	0.004	-0.041	0.025	1.000						
[2] Social media	1.13	0.079	0.000	0.720	0.040*	1.000					
[3] Manufacturing industry	1.49	0.005	0.000	0.348	-0.067***	-0.050**	1.000				
[4] Innovation intensity	1.11	0.245	0.000	0.440	-0.103***	-0.028	0.179***	1.000			
[5] Firm size	1.07	0.796	0.000	1.000	-0.082***	-0.240***	0.026	-0.073***	1.000		
[6] Firm age	1.09	0.276	0.000	1.000	-0.038*	-0.119***	0.112***	-0.023	0.174***	1.000	
[7] Total assts	1.47	0.040	0.000	0.978	-0.011	0.002	0.162***	-0.114***	0.496***	0.260***	1.000

Notes: Dependent variable: Financial performance; *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$

Table 15 Appendix A3. Robustness Test, GMM Regression (Social media as IV), 2013-2022

	Innovation performance as a DV		Financial performance as a DV	
	Model III		Model III	
	Coeff.	S.E.	Coeff.	S.E.
Innovation performance (n-1)	0.856***	(0.007)	0.149***	(0.002)
Financial performance (n-1)			0.168***	(0.039)
Social media	-0.058***	(0.013)		
Social media ²	0.214***	(0.029)	-0.263***	(0.052)
Manufacturing industry	0.010*	(0.001)	0.163***	(0.017)
Innovation intensity	0.001	(0.001)	-0.020	(0.015)
Firm size	0.090	(0.055)	0.421***	(0.011)
Firm age	0.045***	(0.011)	-0.058***	(0.011)
Total assets	-0.005	(0.006)	-0.044***	(0.016)
Firm fixed effect	Included		Included	
Year fixed effect	Included		Included	
AR(2)	-0.64		1.86	
p-value	0.524		0.064	
Hansen test	54.95		50.87	
p-value	0.147		0.221	
Number of Observation	2250		2250	
Number of Firms	250		250	

Notes: Dependent variable (DV): Financial performance; Innovation performance *** $p < 0.001$; ** $p < 0.05$; * $p < 0.1$ Observations are reduced by one year (250) due to the one-year lag (-1) of the dependent variable. Arellano–Bond test for AR (2) and Hansen Test are used to control for possible autocorrelation issues. Standard errors in parentheses.

The results of this additional analysis confirmed the inverted U-shaped relationship between digital strategy (via social media adoption) and financial performance. This reinforces the robustness of our main findings and indicates that the curvilinear effect persists even when focusing on a single digital lever.

4. Digital Orientation and Gender Diverse Boards: Unpacking the Performance Link in Innovative SMEs

4.1 Introduction

In the digital transformation era, small and medium-sized enterprises (SMEs) face increasing pressure to adopt digital strategies to remain competitive. Accounting for over 99% of all businesses in the European Union and a key driver of global economic development (Gorgels et al., 2022), SMEs and especially those oriented toward innovation, are central to the technology-driven evolution of global markets (Abubakar et al., 2019; Merín-Rodrigáñez et al., 2024). Despite their key role, research on digital innovation and firm performance often focuses on larger firms (Kindermann et al., 2024; Li & Shao, 2023; Yang et al., 2024), leaving a significant gap in our understanding of innovative SMEs (Bhatti et al., 2025). Innovative SMEs are highly relevant in this context because they are more flexible, learn quickly, and often respond faster to technological change than larger firms (Sawers et al., 2008).

To navigate this transformation, the concept of digital orientation (DO) has emerged as a pivotal strategic posture. It guides firms in leveraging digital technologies to create value and achieve competitive advantage (Ardito et al., 2021; Kindermann et al., 2024; Ranjan, 2024). It is often conceptualized through four interconnected dimensions: digital technology scope, digital capabilities, digital architecture configuration, and digital ecosystem coordination (Quinton et al., 2018). When applied effectively, these dimensions allow SMEs to optimize internal processes (Li et al., 2023), build advanced digital capabilities (Escoz Barragan & Becker, 2025), and increase responsiveness in dynamic markets (Bendig et al., 2023), ultimately enhancing performance (Kindermann et al., 2021, 2024).

Innovative SMEs are particularly well-suited to capitalize on DO because of their structural flexibility and adaptive capacity. Unlike larger firms that are often constrained by bureaucratic layers, SMEs can adjust more rapidly to technological shifts and evolving market demands (Sawers et al., 2008). This adaptability is further strengthened by their culture of continuous learning and their ability to develop advanced technological competencies (Hervas-Oliver et al., 2016). Such characteristics create favourable

conditions for embracing digitalization (Rhee et al., 2010) and help sustain competitive advantages in resource-constrained environments (Bhatti et al., 2025). Yet the relationship between DO and financial performance is far from straightforward. Empirical evidence remains inconclusive, with some studies reporting positive outcomes while others find weak or non-significant effects (Escoz Barragan & Becker, 2025; Nasiri et al., 2022). These inconsistencies suggest that DO alone does not guarantee higher performance but instead depends on specific contextual factors and strategic conditions. Understanding these strategic pathways and boundary conditions is therefore essential for clarifying how DO translates into financial success in innovative SMEs (Ardito et al., 2021; Escoz Barragan & Becker, 2025; Ranjan, 2024).

One promising explanation lies in the governance structures that guide how SMEs interpret and act upon digital opportunities (Muhammad et al., 2024a, 2024b). SMEs often operate under resource constraints (Bhatti et al., 2025) and rely on governance systems that are less formalized and more personalized than those of larger firms (Teixeira & Carvalho, 2024). In such contexts, the composition and cognitive diversity of the board become especially critical in determining how effectively digital strategies are implemented. Without governance that supports digitalization, prioritizes long-term strategic goals, and remains receptive to change, SMEs may struggle to unlock the potential of DO. Drawing on upper echelons theory (UET) (Hambrick & Mason, 1984), the demographic and cognitive characteristics of top decision-makers can significantly influence firm strategy. Gender diversity, in particular, has been linked to richer boardroom deliberation, a stronger inclination toward innovation, and a greater openness to transformative change (Bannò & Filippi, 2024; Triana et al., 2019; Xie et al., 2020). Female directors have also been associated with governance processes that emphasize long-term value creation and stakeholder engagement rather than short-term gains (Nair, 2020).

Although recent research has started to examine how governance influences digitalization in large firms (Li & Shao, 2023; Teixeira & Carvalho, 2024), its role as a contingent factor in shaping the digital orientation-performance link in innovative SMEs remains largely overlooked. Addressing this gap is crucial, since SMEs operate under unique resource constraints and governance structures that may alter how digital strategies affect outcomes. To advance this understanding, we integrate two

complementary theoretical perspectives. The resource-based view (RBV) (Barney, 1991) highlights digital capabilities as strategic assets that enable value creation, while the UET emphasizes how the demographic and cognitive characteristics of top decision-makers shape strategic choices and firm results (Hambrick & Mason, 1984). Together, these perspectives provide a robust lens through which to investigate two central research questions:

RQ1: *“How does digital orientation influence innovative SME financial performance?”* and RQ2: *“How does gender diversity on corporate boards affect this relationship?”*.

Our research contributes to ongoing debates on digitalization, governance, and SME performance in three ways. First, we extend the literature beyond large firms (Kindermann et al., 2024; Li & Shao, 2023) by examining innovative SMEs, which represent the majority of firms worldwide yet remain underexplored despite their structural flexibility and resource constraints (Bhatti et al., 2025; Teixeira & Carvalho, 2024). By focusing on this context, we provide fresh insights into how DO functions under conditions of limited resources and structural flexibility, thereby extending the external validity of prior findings. Second, we clarify the inconsistent evidence on the digital orientation–performance link (Escobarragan & Becker, 2025; Nasiri et al., 2022) by introducing board gender diversity as a key moderating factor. In line with recent calls to integrate governance diversity into digital transformation research (Bannò & Filippi, 2024; Muhammad et al., 2024a), we show that board gender diversity acts as a decisive factor in shaping whether DO leads to stronger financial performance or falls short of its potential. Finally, we advance theory by integrating the RBV and the UET. This combined framework explains how digital capabilities as strategic assets and leadership diversity as a governance condition jointly influence SME outcomes. By integrating resource-based and governance perspectives, our study advances a more comprehensive theoretical understanding of the digital orientation-performance relationship, while highlighting governance as a critical boundary condition in this nexus.

The structure of the paper is as follows: Section 4.2 covers the theoretical framework and literature review. Section 4.3 outlines the study’s data and methodology. Section 4.4 presents and discusses the results. Finally, Section 4.5 provides the study’s conclusions, implications, and limitations.

4.2 Theoretical Framework and Hypotheses Development

Building on the RBV (Barney, 1991) and the dynamic capabilities perspective (Teece et al., 1997), DO can be understood as a strategic posture that leverages digital resources to enhance growth opportunities. The RBV posits that a firm's sustainable competitive advantage stems from its bundle of valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities (Barney, 1991). In the digital age, DO represents a critical strategic posture that enables firms to develop such VRIN resources (Kindermann et al., 2021). For innovative SMEs, DO is not merely about adopting technology but involves proactively building a unique configuration of digital assets, skills, and processes that are difficult for competitors to replicate, thereby creating a foundation for increased performance (Ardito et al., 2021; Escoz Barragan & Becker, 2025; Ranjan, 2024).

Complementing the RBV, the concept of dynamic capabilities (Teece et al., 1997) explains *how* firms effectively manage and reconfigure these resources in rapidly changing environments. It refers to a firm's ability to integrate, build, and reconfigure internal and external competencies to address evolving markets. DO is fundamentally a dynamic capability; it empowers innovative SMEs, renowned for their agility and adaptability (Sawers et al., 2008), to sense digital opportunities, seize them by investing in new technologies, and transform their business models accordingly (Merín-Rodríguez et al., 2024). This adaptive function is particularly significant for SMEs, which often operate under resource constraints yet benefit from structural flexibility that allows them to reconfigure digital resources rapidly (Bhatti et al., 2025).

However, resources and capabilities do not deploy themselves; their effectiveness is shaped by the strategic choices of a firm's leadership. This is where upper echelons theory (UET) (Hambrick & Mason, 1984) provides a crucial lens. UET contends that organizational outcomes are reflections of the values, cognitive frames, and experiences of its top managers. The demographic composition of the board, including gender diversity, serves as a proxy for these cognitive perspectives and influences strategic decision-making processes (Bannò & Filippi, 2024; Xie et al., 2020). When applied to digital transformation, diverse boards can guide SMEs in balancing the risks and opportunities of digital investment, improving decision-making, and shaping the extent to which DO enhances performance (Muhammad et al., 2024a). Taken together, these

theoretical perspectives provide a multidimensional foundation: RBV clarifies the value of digital resources, dynamic capabilities explain adaptability and transformation, and UET highlights the governance conditions that shape how these digital strategies are implemented.

4.2.1. Digital Orientation and Financial Performance

DO is defined as the strategic intent and operational readiness to leverage digital technologies for value creation (Quinton et al., 2018). It is typically captured across four interrelated dimensions: digital architecture configuration, digital capabilities, digital technology scope, and digital ecosystem coordination (Kindermann et al., 2021, 2024). Collectively, these dimensions provide SMEs with a foundation for adopting, integrating, and scaling digital technologies.

Existing research shows that DO enhances operational (Bhatti et al., 2025; Pucci et al., 2023), improves customer interaction and responsiveness (Quinton et al., 2018), and strengthens innovation processes through advanced data analytics, automation, and AI (Ardito et al., 2021; Ranjan, 2024). By aligning digital resources with firm strategy, SMEs can reduce costs (Pagani, 2016), develop new business models, and build resilience in uncertain markets (Merín-Rodríguez et al., 2024).

From an RBV standpoint, digital resources and capabilities act as VRIN assets that sustain competitive advantage (Barney, 1991). From a dynamic capabilities perspective, DO allows SMEs to adapt to volatile environments by reconfiguring resources in line with technological and market changes (Escob Barragan & Becker, 2025; Teece et al., 1997). Innovative SMEs, in particular, are well positioned to benefit from DO because of their flexibility, shorter decision cycles, and strong R&D orientation (Hervas-Oliver et al., 2016; Sawers et al., 2008).

However, digital adoption also requires significant investment in infrastructure (Merín-Rodríguez et al., 2024; Müller et al., 2018; Verhoef et al., 2021), skills (Bharadwaj et al., 2013), and cultural change (Nasiri et al., 2020), which SMEs may find challenging. Moreover, prior studies show mixed evidence on the link between DO and performance (Ardito et al., 2021; Ranjan, 2024), with some reporting strong positive effects while others find limited or no impact. These inconsistencies highlight the importance of investigating SMEs separately from larger firms, since their structural characteristics, resource constraints, and governance mechanisms differ markedly (Bhatti

et al., 2025; Kindermann et al., 2024). We contend that for innovative SMEs, where adaptability is a core strength, the strategic deployment of a DO will positively impact financial outcomes. Thus, we hypothesize:

H1: Digital orientation has a positive impact on the financial performance of innovative SMEs.

4.2.2. Digital Orientation, Board Gender Diversity, and Financial Performance

Although it is acknowledged that DO provides the strategic roadmap and capabilities (Bannò & Filippi, 2024; Li & Shao, 2023), its execution is filtered through the lens of governance mechanisms. UET suggests that the characteristics of top decision-makers significantly influence how strategies are formulated and implemented. Board gender diversity, defined as the presence of women on corporate boards (Torchia et al., 2011), is a key governance attribute that introduces greater cognitive diversity, reduces groupthink, and promotes more comprehensive debate (Bannò & Filippi, 2024; Triana et al., 2019).

In the specific context of digital transformation, gender-diverse boards bring distinct advantages. Research indicates that female directors often promote long-term strategic thinking over short-term gains (Javed et al., 2023), exhibit stronger stakeholder orientation (Torchia et al., 2011), and demonstrate a greater openness to innovation and transformative change (Li & Shao, 2023). These traits are critically aligned with the long-term, iterative, and often disruptive nature of digital initiatives (Lepore et al., 2023; Martín-Rojas et al., 2023). For innovative SMEs, where governance is often less formalized, the inclusion of women can enhance board effectiveness by improving monitoring functions (Rossignoli et al., 2021) and supporting more balanced, yet deliberate, risk-taking in digital investments (Alegre et al., 2013; Chen et al., 2018; Merín-Rodrigáñez et al., 2024).

Therefore, we posit that board gender diversity acts as a potential moderating factor. A gender-diverse board is better equipped to scrutinize, guide, and support the implementation of a DO. It can ensure that digital investments are aligned with long-term value creation, promote an inclusive culture that is receptive to digital change, and provide a wider range of perspectives to navigate the complexities of digital transformation (Muhammad et al., 2024b, 2024a; Teixeira & Carvalho, 2024). We believe that a gender diverse board can serve as a potential moderating factor in the relationship between DO and financial performance. Consequently, we hypothesize:

H2: Board gender diversity moderates the relationship between digital orientation and financial performance in innovative SMEs.

Figure 4 illustrates the conceptual model of the study, highlighting the two hypotheses.

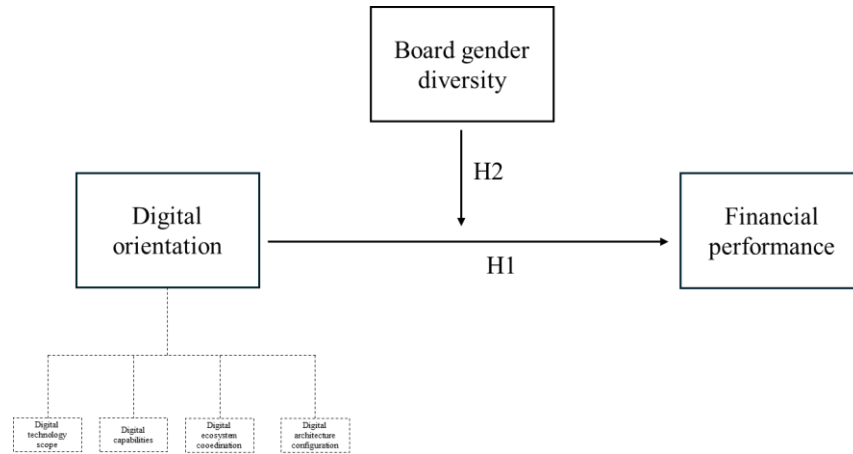


Figure 4. Conceptual framework

4.3. Research method

4.3.1. Sample and Data Collection

This study focuses on innovative SMEs in Italy, a context where digitalization is a critical strategic imperative for maintaining long-term competitiveness. Italy provides an ideal empirical setting due to its SME-dominated economy, which aligns with the broader European landscape where SMEs constitute over 99% of all businesses (Gorgels et al., 2022). Italian innovative SMEs are particularly relevant for this investigation as they are characterized by the structural flexibility and adaptive capacity theorized to be essential for leveraging DO (Bhatti et al., 2025). Furthermore, according to the Digital Economy and Society Index¹⁴ (DESI), a significant proportion of Italian SMEs are actively engaged in digital adoption, providing a fertile ground for studying the interplay between DO, board gender diversity, and performance.

¹⁴ [DESI INDEX 2022](#)

The sample was constructed following the European Commission's definition of SMEs¹⁵, ensuring both heterogeneity and cross-context relevance to enhance the generalizability of the findings to similar European economies. The final sample comprises a longitudinal panel of 250 Italian innovative SMEs, observed over 10 years from 2013 to 2022, resulting in 2,500 firm-year observations. This longitudinal design is crucial for capturing the dynamic nature of digital transformation and its lagged effect on financial performance (Muhammad et al., 2024a).

Data comes from multiple sources to minimize single-source bias. Financial data and governance variables are from the AIDA Bureau van Dijk database. DO is reconstructed from firm websites using the Internet Archive Wayback Machine¹⁶, which provides dated snapshots for each year in the panel. Legal identifiers, sector classification, and the status of “innovative SME” are taken from the Italian Chamber of Commerce register¹⁷.

Combining these sources permits a joint view of financial performance, strategic communication about digitalization, and board composition. All variables, their operational definitions, and sources are reported in Table 16.

¹⁵ The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 people, and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million, “Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises” <https://ec.europa.eu/smes/>

¹⁶ [Wayback Machine](#)

¹⁷ [Italian Chambre of commerce register for SMEs](#)

Table 16. Description of the variables and operationalisation

Variable	Model	Description	Measurement	Source
Financial Performance (ROA)	DV	Return on asset of SMEs operationalized over the total ROA in the sample for each year	Constant	AIDA database
Financial Performance (TQ)	DV	Total liabilities plus market capitalization divided by total assets for each year	Constant	AIDA database
Digital orientation	IV	Principal Component Analysis of the four dimensions (DA, DTS, DEC, DAC)	Constant	Italian Chambre of commerce register for SMEs
Digital technology scope	IV (DO)	the number of times words on a digital technology scope's word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital capabilities	IV (DO)	the number of times words on a digital capabilities' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital ecosystem coordination	IV (DO)	the number of times words on a digital ecosystem coordination' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Digital architecture coordination	IV (DO)	the number of times words on a digital architecture coordination' word list are used in that year operationalized by the total number of times words list on our sample	Constant	Italian Chambre of commerce register for SMEs
Gender diversity	IV	% of women on board of directors in SMEs operationalized on the total board of directors in the sample for each years	Constant	AIDA database
Firm age	CV	Number of the years the SMEs has been in operation operationalized by the natural logarithm of the variable	Constant	AIDA database
Firm size	CV	Number of employees in each SMEs operationalized by the natural logarithm of the variable	Constant	AIDA database
Innovation Intensity	CV	Dummy variable related to the innovation intensity of firms based on the sectoral taxonomy (Peneder, 2010). 1 if firm have high, medium-high, and medium innovation intensity, 0 otherwise	Binary	AIDA database
Patents	CV	Number of patent of SMEs over the total patents in the sample for each year as an indicator of innovation activities (Barragan et al., 2024; Mendonca et al., 2024)	Constant	Wayback; Crunchbase
Financial Leverage	CV	Aggregate value of all assets owned by a company operationalized by the natural logarithm of the variable	Constant	AIDA database
Board age	CV	Age of board of directors operationalized by the total age of BOD in the sample each year	Constant	AIDA database
Board size	CV	Number of board of directors operationalized by the total number of BOD in the sample each year	Constant	AIDA database
Board independence	CV	Percentage of independent directors on board operationalized by the total number of independent directors in the sample each year	Constant	AIDA database

4.3.2. Variables Measurement

4.3.2.1. Dependent Variable

Consistent with prior research on SME performance and corporate governance (La Rocca et al., 2024; Robb & Watson, 2012; Yang et al., 2019; Yee & Choi, 2025), financial performance is measured by *Return on Assets (ROA)*, calculated as net income divided by total assets. ROA is an accounting-based measure that effectively captures the efficiency of a firm's management in using its assets to generate earnings, making it a highly suitable metric for performance comparisons across firms and time (Yee & Choi,

2025). To complement ROA, *Tobin's Q* (TQ) is employed as a market-based measure of firm value, defined as total liabilities plus market capitalization divided by total assets for each year (Bhagat & Bolton, 2019; Muhammad et al., 2024a). Tobin's Q reflects investors' expectations about a firm's future growth opportunities and governance quality, thereby offering insights that extend beyond historical accounting outcomes.

4.3.2.2. *Independent Variable*

The key independent variable, *digital orientation* (DO), was measured using a validated word-based methodology developed by Kindermann (2021, 2024). Given that SMEs rarely publish formal shareholder communications, their official business descriptions serve as a primary source for disclosing strategic posture (Escobarragan & Becker, 2025). We identified a comprehensive set of keywords aligned with the four dimensions of digital orientation: digital technology scope, digital capabilities, organizational configuration, and ecosystem coordination (Kindermann et al., 2021). To ensure linguistic and contextual accuracy, validated English keywords were translated into Italian using a rigorous back-translation procedure (Zhang & Zhu, 2021). The annual textual data for each firm were coded and analyzed using MaxQDA software, which computed keyword frequency scores, normalized by the total word count of each description to control for document length.

The four DO dimension scores were synthesized into a single, composite Digital Orientation Index using non-parametric Principal Component Analysis (PCA) based on a co-graduation matrix of rank-order correlations. This approach is more robust to outliers and non-normality than traditional parametric PCA, enhancing the reliability and validity of the composite measure.

4.3.2.3. *Moderator and Control Variables*

Board gender diversity (*gender diversity* in tables) serves as the moderating variable in this study. Reflecting UET (Hambrick & Mason, 1984) and recent governance studies (Muhammad et al., 2024a), board gender diversity is operationalized as the percentage of women directors on corporate boards.

To further isolate the effects of DO and gender diversity on performance, we include several firm- and governance-level control variables. Firm level controls include: firm age, measured as years since founding (Muhammad et al., 2024b, 2024a); firm size,

measured as the natural logarithm of the number of employees (Barge-Gil et al., 2011); financial leverage, measured as total debt over total assets, given its potential effect on performance (Liu et al., 2023; Muhammad et al., 2024b, 2024a). To account for innovative activity and sectoral context, we add patent counts as a proxy for inventive output (Escoz Barragan & Becker, 2025; Mendonça et al., 2004), based on the Peneder taxonomy of innovation intensity (Peneder, 2010). Governance variable controls include board size, measured as the total number of directors (Muhammad et al., 2024a; Zona, 2016); board age, measured as the average age of directors (Gardiner, 2024); and board independence, measured as the percentage of independent directors on the board (Muhammad et al., 2023). These controls help isolate the specific contribution of DO and gender diversity to financial outcomes while holding constant known drivers of SME performance.

4.3.3. Estimation Models and Endogeneity Concerns

To test our hypotheses, we employed a sequential modelling approach, beginning with baseline estimators and progressing to more sophisticated techniques to ensure robust and unbiased results. We begin with OLS regression as a baseline. This provides an initial benchmark of the association between DO, board gender diversity, and performance. OLS is straightforward and transparent, but it is vulnerable to endogeneity from omitted variables and reverse causality.

To address these concerns, we then estimate the dynamic specification using two-step system GMM with finite sample corrected standard errors (Bond & Arellano, 2012). GMM controls for unobserved heterogeneity, autocorrelation, and the endogeneity of both the lagged dependent variable and the focal regressors (Roodman, 2009b, 2009a). DO and governance variables may also be endogenous since they can both influence performance and be influenced by it. System GMM employs internal instruments derived from deeper lags of endogenous variables in both differences and levels (Bond & Arellano, 2012), thereby producing more consistent estimates in the presence of feedback between performance and governance variables. Our baseline dynamic model is specified as follows:

$$Performance_{it} = \alpha + \beta_1(Performance_{it-1}) + \beta_2(DO_{it}) + \beta_3(Gender\ Diversity_{it}) + \beta_4(DO_{it} \times Gender\ Diversity_{it}) + \gamma(Control\ Variables_{it}) + \eta_i + \tau_t + \varepsilon_{it}$$

Where η_i and τ_t represent firm- and year-fixed effects, respectively. All the remaining variables are defined in Table 16.

Finally, we conduct two-stage least squares (2SLS) estimations with external instruments as an additional check. Consistent with extant literature (Muhammad et al., 2024a) we use industry average gender diversity and industry peer globalization averages as instruments. These instruments capture exogenous shifts in the governance and strategic environment that are plausibly unrelated to firm-specific shocks, yet relevant for our potentially endogenous regressors. This approach helps isolate exogenous variation and provides an additional layer of validation.

4.4. Empirical Results

Tables 17 and 18 present the descriptive statistics and correlation matrix for the variables used in this study. The mean values and standard deviations are consistent with prior research on innovative SMEs. The correlations among the independent variables remain well below common thresholds for multicollinearity concerns. Moreover, all the VIF values are low, which indicates that multicollinearity is unlikely to bias the estimated results (Wooldridge, 2010).

Table 17. Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Return on Assets (ROA)	2,500	2.071	3.029	-5.13	10.34
Tobin Q (TQ)	2,500	1.892	2.943	0.935	4.374
Digital Orientation	2,500	13.824	9.984	0.00	60.00
Gender Diversity	2,500	0.201	0.250	0.00	90.44
Board Size	2,500	6.348	5.293	1.00	27.00
Board Independence	2,500	49.462	37.754	0.00	94.86
Board Age	2,500	52.558	28.439	27.00	80.50
Innovation Intensity	2,500	0.796	0.447	0.00	1.00
Patent	2,500	0.071	0.039	0.00	0.133
Firm Size	2,500	0.568	0.390	0.051	19.00
Firm Age	2,500	15.052	11.215	-3.00	81.00
Financial Leverage	2,500	31.36	37.12	19.64	81.08

Note. This table reports the descriptive statistics for the variables used in this study. *Obs.* denotes observation. *Std.Dev.* denotes standard deviation. *Min.* denotes minimum. *Max.* denotes maximum.

Table 18. Correlation Analysis

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
1. ROA	1											
2. TQ	0.062**	1										
3. Digital Orientation	0.238**	0.019**	1									
4. Gender Diversity	0.077**	0.038***	0.229***	1								
5. Board Size	-0.0820*	-0.037*	-0.149***	-0.040	1							
6. Board Independence	0.092*	0.060**	-0.068**	-0.012	0.620***	1						
7. Board Age	-0.082**	-0.037***	-0.114***	-0.054	0.818***	0.453***	1					
8. Innovation Intensity	0.067**	0.032**	0.287***	0.118***	-0.045*	-0.058**	-0.027	1				
9. Patent	0.051*	0.029*	-0.029	0.011	0.037	-0.086*	-0.049*	0.021**	1			
10. Firm Size	0.265***	0.025**	0.169***	0.113***	0.011	0.091**	0.055*	-0.027	-0.305***	1		
11. Firm Age	-0.052*	0.037	-0.071**	0.0349	0.672***	0.697***	0.916***	0.018*	-0.0241	0.067**	1	
12. Financial Leverage	-0.168**	-0.028**	-0.117***	-0.030	0.427***	0.471*	0.681***	-0.032	-0.103***	-0.049	0.507*	1
Observation	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500

Note. This table shows the Pearson's correlation analysis. All variables are defined in Table 1. Sig. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As discussed earlier, we estimated baseline models using OLS, then used system GMM and 2SLS as additional checks on endogeneity.

Table 19 presents the OLS regression results for the direct effects of *digital orientation* and *gender diversity* on SME performance. Model (1) uses *ROA* as the dependent variable, and Model (2) employs *TQ*. All models include governance controls, namely board size, board independence, and board age, as well as SME characteristics, namely innovation intensity, patent, firm size, firm age, and financial leverage. Year and firm fixed effects are included.

The results indicate that *digital orientation* has a positive and significant effect on both ROA ($\beta = 0.656, p < 0.05$) and TQ ($\beta = 0.589, p < 0.10$). This provides initial support for Hypothesis 1, suggesting that a strategic focus on digital technologies is associated with enhanced financial performance. The results are consistent with the RBV and dynamic capabilities perspectives, which frame DO as a bundle of firm-specific digital resources and reconfiguration routines that raise efficiency and market valuation (Kindermann et al., 2021; Ranjan, 2024). Similarly, *gender diversity* shows a positive and significant relationship with both ROA ($\beta = 0.454, p < 0.05$) and TQ ($\beta = 0.735, p < 0.05$), which accords with UET about decision quality and monitoring in the boardroom.

Table 19. Direct Effects of Digital Orientation and Gender Diversity on SME Performance

Dependent Variables →	ROA	TQ
Explanatory Variables↓	(1)	(2)
Constant	0.669*** (0.026)	0.857*** (0.031)
Digital Orientation	0.656** (0.327)	0.589* (0.333)
Gender Diversity	0.458** (0.197)	0.735** (0.329)
Board Size	-0.096* (0.055)	-0.158* (0.085)
Board Independence	0.982*** (0.274)	0.699** (0.309)
Board Age	0.072* (0.041)	0.162** (0.075)
Innovation Intensity	0.163** (0.067)	0.353*** (0.121)
Patent	0.035* (0.021)	0.135* (0.075)
Firm Size	1.649*** (0.643)	0.932* (0.545)
Firm Age	-0.081* (0.043)	-0.118* (0.061)
Financial Leverage	-1.281* (0.707)	-1.273* (0.695)
Year Fixed Effects	Included	Included
Firm Fixed Effects	Included	Included
R ²	0.263	0.231
F-Value	47.87***	39.82***
Obs.	2,500	2,500

Note. This table presents *OLS* regression, examining the direct effects of digital orientation and gender diversity on SME performance, along with a set of control variables. All variables are defined in Table 1. ***, **, *, significant at the 1 %, 5 %, and 10 % levels, respectively.

Table 20 reports the OLS results for interaction models. The interaction term *Digital Orientation* $\times$ *Gender Diversity* is negative and significant for ROA in Model (1) ($\beta = -0.098$, $p < 0,05$) and for TQ in Model (2) ($\beta = -0.105$, $p < 0,05$). These results suggest that the positive effect of DO on performance is attenuated in the presence of higher gender diversity on the board. The findings hint at a more complex moderating role than initially hypothesized, possibly reflecting more deliberate or cautious decision-making processes within gender-diverse boards. A possible explanation is that broader perspectives and heightened monitoring associated with diverse boards lead to stricter scrutiny of investment decisions. In the SME context, where resources are limited, this heightened caution may slow the implementation of fast-moving digital strategies and constrain short-term financial returns. The evidence, therefore, reflects a tension between the positive governance role of diverse boards and the agility required for digital transformation. These findings connect to the ongoing debate on gender in governance and are consistent with prior studies that report mixed effects of gender diversity on firm risk-taking and performance, particularly in smaller firms (Muhammad et al., 2024b).

Table 20. Interaction Effects of Digital Orientation and Gender Diversity on SME Performance

Dependent Variables →	ROA	TQ
Explanatory Variables ↓	(1)	(2)
Constant	0.839*** (0.088)	1.027*** (0.105)
Digital Orientation	0.444** (0.201)	0.390* (0.223)
Gender Diversity	0.381** (0.191)	0.605** (0.259)
Digital Orientation × Gender Diversity	-0.098** (0.041)	-0.105** (0.049)
Board Size	-0.266** (0.115)	-0.428** (0.183)
Board Independence	1.152** (0.504)	0.869** (0.439)
Board Age	0.242* (0.129)	0.333* (0.195)
Innovation Intensity	0.373* (0.203)	0.523** (0.249)
Patent	0.205* (0.119)	0.332** (0.167)
Firm Size	1.819*** (0.473)	1.102*** (0.375)
Firm Age	-0.251** (0.127)	-0.288** (0.145)
Financial Leverage	-1.451** (0.637)	-1.443** (0.625)
Year Fixed Effects	Included	Included
Firm Fixed Effects	Included	Included
R ²	0.345	0.326
F-Value	52.01***	48.85***
Obs.	2,500	2,500

Note. This table presents *OLS* regression, examining the interaction effects of digital orientation and gender diversity on SME performance, along with a set of control variables. All variables are defined in Table 1. ***, **, *, significant at the 1 %, 5 %, and 10 % levels, respectively.

Table 21 reports the system GMM estimations, which are consistent with the OLS results. As shown in Models (1) and (2), *digital orientation* has a positive and statistically significant coefficient for ROA ($\beta = 0.426$, $p < 0,05$) and for Tobin's Q ($\beta = 0.398$, $p < 0,05$). Models (3) and (4) introduce the interaction term. The coefficient for *Digital Orientation* $\times$ *Gender Diversity* is negative and statistically significant for both ROA ($\beta = -0.052$, $p < 0.05$) and TQ ($\beta = -0.125$, $p < 0.05$).

Although gender diversity introduces cognitive diversity and reduces groupthink, it may also lead to more extensive debate and a broader evaluation of risks (Triana et al., 2019). UET suggests that diverse boards expand information processing and enhance monitoring. In digital projects that require rapid resource reconfiguration and swift execution, more cautious deliberation can slow commitment or lead to staged rollouts that curb immediate financial gains, especially where slack is limited. This mechanism is consistent with the mixed evidence reported in the governance literature for smaller firms and helps explain why we observe a positive main effect of gender diversity, but a negative interaction with DO in this specific context (Robb & Watson, 2012).

Table 21. GMM Regression Results

Dependent Variables → Explanatory Variables↓	Direct Effects		Interaction Effects	
	ROA	TQ	ROA	TQ
	(1)	(2)	(3)	(4)
ROA (t-1)	0.336*** (0.021)		0.703*** (0.112)	
TQ (t-1)		0.443*** (0.046)		0.797*** (0.125)
Digital Orientation	0.426** (0.202)	0.398** (0.201)	0.314* (0.167)	0.360** (0.153)
Gender Diversity	0.228** (0.105)	0.513** (0.259)	0.251** (0.123)	0.375** (0.183)
Digital Orientation × Gender Diversity			-0.052** (0.025)	-0.125** (0.054)
Control Variables	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included
Firm Fixed Effects	Included	Included	Included	Included
Diagnostics Tests				
Wald Chi ²	245.37***	218.54***	239.61***	229.48***
AR (1)	-3.981***	-4.153***	-3.892***	-4.059***
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
AR (2)	-0.852	-1.019	-0.738	-0.912
(p-value)	(0.396)	(0.308)	(0.458)	(0.364)
Sargan test	34.152	32.893	35.269	33.912
(p-value)	(0.124)	(0.142)	(0.110)	(0.130)
Hansen test	28.633	26.772	29.542	27.882
(p-value)	(0.213)	(0.236)	(0.195)	(0.219)
Observations	2,250	2,250	2,250	2,250

Note. This table shows the replication of our main results using the system GMM method. All variables are defined in Table 1. Standard errors are in parentheses. Sig. *** p<0.01, ** p<0.05, * p<0.1

As discussed earlier, endogeneity is a persistent challenge in corporate governance research (Wintoki et al., 2012) especially when examining the effects of DO and board gender diversity on SME performance. Although *OLS* and *GMM* were applied, *OLS* cannot handle simultaneity, omitted variable bias, or reverse causality, and *GMM* often suffers from weak instruments in panel data (Roodman, 2009a; Wooldridge, 2010). To address this, we also apply *2SLS* in Table 22, which replaces endogenous regressors with exogenous fitted values using external instruments. Consistent with extant literature (Muhammad et al., 2024b) in this study, industry average gender diversity is used as the instrument for board gender diversity, and industry peer digitalization average is used as the instrument for DO, producing *Gender diversity*[^] and *Digital orientation*[^] variables. These instruments reflect exogenous peer-driven variation rather than firm-specific shocks, allowing a clearer causal interpretation. These instruments are also theoretically sound because firms often emulate industry norms (peer effects) (Tuo et al., 2020) yet industry-level averages are unlikely to be directly influenced by individual firm performance, satisfying the exclusion restriction.

The diagnostic tests in Table 22, *Sargan* and *Wald C-statistics*, validate the *2SLS* model. The *Sargan test* checks whether instruments are exogenous. The non-significant *p-values* (0.294 and 0.247) confirm instrument validity and correct model specification.

The *Wald C-statistic* examines the joint significance of excluded instruments in the first stage. The highly significant *p-values* (0.000) show that instruments strongly predict the endogenous variables, reducing concerns about weak instruments. These results support the credibility of the *IV* approach, as discussed in econometric literature (Angrist & Pischke, 2009; Wooldridge, 2010). The *2SLS* results show that both *Gender diversity*[^] and *Digital orientation*[^] improve SME performance, but their interaction is negative, suggesting diminishing returns when both are simultaneously high. Importantly, these findings are consistent with our baseline results, strengthening confidence in the empirical relationships. Thus, *2SLS* complements baseline models and ensures robustness by introducing stronger external instruments.

Table 22. 2SLS Regression Results

Dependent Variables → Explanatory Variables↓	1 st Stage		2 nd Stage	
	DO	BGD	ROA	TQ
	(1)	(2)	(3)	(4)
Constant	2.465*** (0.352)	2.398*** (0.333)	0.439*** (0.056)	0.627*** (0.061)
INSTRUMENTS	1.634*** (0.527)	1.553*** (0.535)		
Digital Orientation [^]			0.426* (0.244)	0.359** (0.163)
Gender Diversity [^]			0.328*** (0.127)	0.535** (0.259)
Digital Orientation [^] × Gender Diversity [^]			-0.034** (0.015)	-0.109* (0.065)
Control Variables	Included	Included	Included	Included
Year Fixed Effects	Included	Included	Included	Included
Firm Fixed Effects	Included	Included	Included	Included
Diagnostics Tests				
Sargan Statistics			1.101	1.342
(p-value)			(0.294)	(0.247)
Wald C-Statistics			25.41	30.18
(p-value)			(0.000)	(0.000)
R ²	0.345	0.367	0.281	0.314
Obs.	2,500	2,500	2,500	2,500

Note. This table shows the 2SLS regression results. For gender diversity, the INSTRUMENT is the industry average gender diversity, whereas the INSTRUMENT for digital orientation is industry peer digitalization average. Gender diversity[^] is the percentage of women instrumented with industry average gender diversity, where as Digital orientation[^] is instrument with industry peer digitalization average. All variables are defined in Table 1. Standard errors are in parentheses below the coefficients. Sig. *** p<0.01, ** p<0.05, * p<0.1

4.5. Discussion and Conclusion

4.5.1. Theoretical implications

This study advances research on strategic orientation and SME performance by examining how DO works together with board gender diversity in innovative SMEs. Taken as a whole, the results indicate that DO is associated with stronger financial performance, while the interaction between DO and gender diversity is negative. These results deepen current debates on digital transformation and governance in smaller, innovative settings (Bhatti et al., 2025; Escoz Barragan & Becker, 2025; Kindermann et al., 2021, 2024; Merín-Rodrigáñez et al., 2024; Muhammad et al., 2024a). Our findings yield several important theoretical contributions.

First, the positive effect of DO corroborates the RBV and dynamic capabilities perspectives. DO bundles digital assets, routines, and ecosystem ties in ways that raise efficiency, adaptability, and market responsiveness, which in turn support financial outcomes for innovative SMEs (Kindermann et al., 2021, 2024; Merín-Rodrigáñez et al., 2024). Our results extend this stream by showing that the same posture continues to matter when measurement is based on firm communication and when performance is captured through both accounting and market-based indicators. In settings where SMEs face resource constraints, the ability to sense, seize, and reconfigure around digital opportunities appears to translate into economic gains, echoing RBV and dynamic capabilities reasoning (Ardito et al., 2021; Ranjan, 2024). Second, the negative interaction between DO and board gender diversity invites a more contingent view of governance in digital change. Although many studies argue that gender diverse boards enrich debate, strengthen monitoring, and support innovation, our evidence suggests that, under certain conditions, these same features can temper the short-run financial payoffs of DO in innovative SMEs (Bannò et al., 2023; Muhammad et al., 2024a, 2024b). UET offers a useful lens. Broader perspectives and stronger oversight can lengthen deliberation, encourage staged rollouts, and elevate attention to downside risks. In smaller firms with limited slack, this can slow the pace of committing resources to fast-moving digital projects and dampen immediate returns. This is in line with mixed findings on diversity and performance in smaller firms and with the idea that governance effects depend on context and task demands (Robb & Watson, 2012). Finally, bringing these points together, the study supports a contingent perspective on strategic orientations. DO is a

key driver, yet its effect varies with internal conditions, including the composition and decision processes of the leadership group. A useful way to frame this is through fit.

When boards combine diversity with clear digital expertise, agreed decision rules, and timely escalation mechanisms, diversity may still raise the quality of digital choices and protect long-term value. Where such conditions are weaker, the same diversity can produce slower decisions and muted near-term payoffs. Future research can model such contingencies more explicitly, for example, by considering digital maturity, environmental dynamism, prior digital project experience on the board, and the presence of dedicated digital committees (Bannò et al., 2023; Teixeira & Carvalho, 2024).

4.5.2. Managerial and Policy Implications

We also offer some implications for managers and policymakers. For innovative SME managers, digitalization should be viewed as a long-term strategic program that extends across business functions and external partnerships. The results suggest that successful digital transformation requires investment in digital skills at multiple organizational levels, improvements in data quality, and the redesign of processes. These efforts need to be complemented by structural and cultural changes that allow technology adoption to translate into everyday execution (Ardito et al., 2021; Merín-Rodrigáñez et al., 2024).

At the governance level, it is important to make the board's role in digital strategy explicit. Boards should establish clear criteria for digital investments, define acceptable levels of risk, and adopt mechanisms that enable projects to advance with speed while still maintaining sufficient oversight. Strengthening the board's capacity for digital oversight is equally important. This can be achieved through the recruitment or training of directors with digital expertise, the use of external experts for periodic evaluations, and the introduction of a standing agenda item that tracks digital progress and emerging risks.

Gender diversity within boards also requires careful attention. It should not be reduced to symbolic representation but instead supported by integration practices that enable diverse directors to contribute effectively to digital priorities. Structured preparatory materials, focused workshops, and explicit role expectations can help ensure that diverse perspectives are incorporated into decision-making while minimizing delays in fast-moving projects (Muhammad et al., 2024a; Triana et al., 2019). In this way, firms can preserve the benefits of gender diversity while maintaining the agility needed for digital innovation.

Policy makers can complement these managerial practices by designing governance-oriented initiatives that enhance SME capacity for digital transformation. Beyond financial incentives and digital training programs, tailored director education, leadership mentoring for gender-diverse boards, and strategic advisory services can help boards set clear rules and evaluation criteria for digital investments. Such initiatives can strengthen the fit between governance practices and digital ambitions and thereby enhance the returns to public support for SME digitalization. A policy framework that integrates both digital infrastructure and governance development is more likely to yield sustainable outcomes, ensuring that SMEs not only adopt digital technologies but also govern them effectively in ways that support long-term competitiveness.

4.5.3. Limitations and Future Research

We acknowledge several limitations that present opportunities for future research. First, the sample consists of 250 innovative SMEs from a single European country, which may affect the generalizability of the findings. Future studies could enhance external validity by examining these relationships in other national contexts, comparing low-tech and high-tech SMEs, and drawing direct comparisons with large corporations to identify size-specific effects.

Second, this study focuses exclusively on gender diversity. Other demographic and cognitive characteristics, such as age, educational background, functional expertise, or geographic origin, likely also play important roles in shaping strategic decisions. Future research could include these aspects to provide a more detailed picture of board diversity and its effects.

Finally, although we use recognized financial performance measures, future work could incorporate additional metrics. Exploring non-financial outcomes, such as innovation output, employee satisfaction, or environmental, social governance (ESG) performance, could reveal how DO and corporate governance interact differently depending on the strategic goals being measured.

5. Digital strategy for SMEs: how board diversity affects performance by leveraging social media

5.1 Introduction

The rapid digitalization of business processes has fundamentally reshaped the competitive landscape for small and medium-sized enterprises (SMEs). Among these advancements, digital strategy, a comprehensive approach to leveraging digital tools and platforms to achieve organizational goals (Bharadwaj et al., 2013), has emerged as a key enabler of performance improvement. Social media has emerged as a key component of digital strategy, ways to enhance internal communication, processes and access new market opportunities (Bharadwaj et al., 2013; Eller et al., 2020). Social media, as a prominent element of digital strategy, provides SMEs with the tools to engage with stakeholders (Lepore et al., 2023; Warnke et al., 2024) and markets in real time, reducing costs, improving decision-making efficiency (Liu et al., 2023; Zhang & Zhu, 2021).

Despite its potential, the direct impact of social media on financial performance remains inconclusive (Bhimani et al., 2019; Liu et al., 2023). While some studies suggest that social media adoption enhances financial outcomes by fostering revenue growth, operational efficiencies and knowledge sharing (Benitez et al., 2018), its direct impact on financial performance remains underexplored, especially within the SME context (Martín-Rojas et al., 2023).

At the same time, the diversity of the board of directors , particularly in terms of gender and age, has gained attention as an important factor influencing strategic decisions and performance outcomes (Aslanbeigui et al., 2025; Bannò et al., 2023; Bannò & Filippi, 2024; Chen et al., 2023; La Rocca et al., 2024; Mariani & Matarazzo, 2021; Triana et al., 2019; Xu et al., 2018). Female board members bring collaborative leadership styles (Bannò & Filippi, 2024; Xie et al., 2020) enhanced stakeholder focus (Torchia et al., 2011), and an orientation toward long-term value creation (Nair, 2020), which are especially beneficial for SMEs operating with constrained resources (Blackburn et al., 2013; Troise et al., 2022). Similarly, younger board members, often digital natives, contribute technological fluency (He et al., 2023) and a propensity for risk-taking (Hulsink & Koek, 2014; Lee et al., 2024), aligning their expertise with the demands to changes (Collevecchio & Gionfriddo, 2023; Fernández-Temprano & Tejerina-Gaite,

2020; Tejerina-Gaite & Fernández-Temprano, 2021) and tend to prioritize future-oriented goals (Lee et al., 2024).

However, despite this potential benefit, little is known about the combined impact of gender and age diversity, particularly the role of young female directors, in driving organizational performance through digital strategy (Nørreklit & Cinquini, 2023).

While the adoption of social media as part of a digital strategy holds potential benefits for SMEs (Liu et al., 2023), the inconsistent findings in existing literature suggest that the relationship is complex and influenced by various organizational factors. Similarly, the impact of young female board members on firm performance and strategic initiatives like digital adoption is not definitively established (Xu et al., 2018). This gap is particularly significant given the growing importance of digital tools for SME's competitiveness, considering that the leaders attitude towards a digital strategy might affect the operational outcomes (Troise et al., 2022).

By addressing these gaps and adopting the perspective of Resource Based-View, Dynamic Capability and the Upper Echelon theory, our study aims to contribute to the literature by providing empirical evidence on the role of digital strategy in SMEs' financial performance and examining the role of young female board members. Specifically, the research seeks to answer the following questions: *RQ:1 How does digital strategy impact SME performance?* and *RQ2: Can young-female directors enhance such relationship?*

The study examines a sample of 250 Italian SMEs over a timeframe of 10 year (2013-2022) using a dynamic panel data model and innovative tools (Wayback Machine) to collect data. To test our hypotheses Generalized Method of Moments (GMM) is employed. The results suggest that while digital strategy has a direct effect on financial performance, youth-female board members enhance this relationship, serving as a key factor in improving business outcomes.

This paper makes important contributions. First, we empirically tested and validated the positive relationship between digital strategy and financial performance using longitudinal panel database, demonstrating that using these resources helps SMEs to improve performance. Second, the study offers new perspectives on how young-female directors influence strategic decisions and performance in SMEs. This untangling of the connections among digital strategy, youth-female board of directors and financial

performance and has important implications for business and strategic management and governance literature and practice. Third, we used an innovative approach to collect data for some variables in our model through Wayback Machine.

The article is structured as follows. Section 5.2 presents a literature review highlighting the ongoing debate between social media, young and female board members and financial performance, shaping the research hypotheses. Section 5.3 outlines the methodological approach, detailing the analysis sample, variable construction and the estimation model used. Section 5.4 presents the results, relying on the estimation models. Last, Section 5.5 discusses and concludes, proposing implications for business management and governance and suggesting further research.

5.2. Literature review and hypothesis development

5.2.1 Social media and financial performance in SMEs

In today's rapidly evolving business landscape, digital technologies are critical for SMEs' competitiveness and performance (Bharadwaj et al., 2013; Nambisan et al., 2019). Digital strategy, defined as the decisions, plans and actions that leverage digital resources to achieve business objectives (Bharadwaj et al., 2013), encompasses the use of technologies to optimize business processes, improve organizational structures, and foster stakeholder engagement (Eller et al., 2020; Matt et al., 2015; Warnke et al., 2024).

SMEs are often constrained by limited financial resources and competences (Benitez et al., 2018; Park et al., 2022; Zhang et al., 2022) and they required more agility and resource optimization (Cenamor et al., 2019; Eller et al., 2020). In such context, a digital strategy can be particularly beneficial to support those limits, overcome the investment in traditional operational improvements (Nair, 2020), enhance internal communication, improve decision making (Martínez-Caro et al., 2020) to leveraging competitive advantage (Stieglitz & Heine, 2007), driving operational efficiency (Cenamor et al., 2019; Park et al., 2022; Urbano et al., 2024) and cost reduction (Proksch et al., 2024). Social media platforms have emerged as a critical component of digital strategy (Zhang & Zhu, 2021), offering SMEs versatile tools to allows the opportunity to conduct business strategically (Ainin et al., 2015; Mount & Martinez, 2014). The integration of digital tools, such as social media, can facilitate better collaboration among employees (Eller et al., 2020), more effective knowledge management (Ritala et al.,

2021), and improved stakeholder relationships (Lepore et al., 2023; Martínez-Caro et al., 2020; Warnke et al., 2024), all of which can contribute to enhanced financial performance (Eller et al., 2020; Mithas et al., 2013).

From the perspective of the Resource-Based View (RBV) (Barney, 1991) and Dynamic Capability Theory (Teece et al., 1997), social media serve as strategic technical resources and social media adoption requires dynamic skills and attitude to improve communication and networking activities, social media serve not only as channels for external communication but also as tools for enhancing internal processes (Benitez et al., 2018; Lam et al., 2016; Martín-Rojas et al., 2023). Social media can foster a collaborative culture and serve as a real-time facilitator for knowledge sharing (Liu et al., 2023; Zhang & Zhu, 2021) improving the employee engagement (Bhimani et al., 2019) and communication across different levels of the organization (Hitchen et al., 2017). Additionally, these platforms can strengthen relationships with stakeholders such as customers, suppliers, partners, and investors by providing transparent and timely information (Lam et al., 2016; Martín-Rojas et al., 2023) at a very low operational cost and a user friendly interface (Ainin et al., 2015; Mount & Martinez, 2014; Zhang & Zhu, 2021). Moreover, social media activities play a relevant role in open innovation, stimulating interactions between innovation managers, customers, research centres and these interactions enable the value co-creation within these networks (Nijssen & Ordanini, 2020).

Empirical studies have demonstrated that SMEs leveraging social media strategically achieve superior innovation performance (Bhimani et al., 2019) by enhancing knowledge acquisition and utilization (Benitez et al., 2018; Martín-Rojas et al., 2023). Improving internal and external interactions allow SMEs to expand their expertise by providing access to new market insights and facilitate the identification of growth opportunities (Wang et al., 2023) which can boost productivity (Liu et al., 2023), all of which positively influence organizational outcomes (Hitchen et al., 2017). For example, Benitez et al. (2018) with their study on 100 small US firms, note that the social media strategically managed enhance knowledge acquisition, exploration and exploitation, and in turn improve innovation performance. Additionally, Zhang and Zhu (2021) and Hitchen (2017) highlights that adopting digital strategy using social media is

more likely to identify radical ideas and revolutionise their activities, helping SMEs to overcome knowledge-shortages.

However, the link between social media adoption, as digital strategy, and organizational performance in SMEs is not always positive. While several studies emphasize the potential for operational efficiencies and innovation-driven growth, others highlight inconsistent results, suggesting that the financial outcomes of social media strategically adoption depend on contextual and implementation factors (Martín-Rojas et al., 2023; Roberts et al., 2016) that require further investigation. Furthermore, much of the existing research focuses on large enterprises or specific industries, leaving a significant gap in understanding how SMEs harness social media as part of their digital strategy to drive financial performance and calling for empirical in-depth analysis of this relationship (Bhimani et al., 2019; Chen & Liu, 2025; Corral de Zubielqui et al., 2019; Liu et al., 2023; Zhang & Zhu, 2021).

Despite these ambiguities, the potential of social media to enhance financial performance in SMEs remains marked. Social media's ability to streamline internal processes, strengthen stakeholder relationships, and generate actionable market insights positions it as a pivotal element of SME digital strategies (Eller et al., 2020; Liu et al., 2023; Triana et al., 2019).

Building this state of art and addressing existing gaps in the literature, we posit:

H1: The adoption of social media positively affects financial performance in SMEs.

5.2.2 Young-female board in SME performance

Board diversity, particularly in terms of gender and age, has been widely acknowledged as a key driver of organizational performance (Aslanbeigui et al., 2025; Bannò & Filippi, 2024; Chen et al., 2023; Fernández-Temprano & Tejerina-Gaite, 2020; Lückerath-Rovers, 2013; Tejerina-Gaite & Fernández-Temprano, 2021), especially in SMEs where resource constraints amplify the need for innovative governance and strategic oversight (Blackburn et al., 2013). Within SMEs we observe an overlapping between owners, leaders and the top management team. Strategic leaders in SMEs perform multiple roles, from identifying new opportunities and policies to organizing resources and processes and to adopting digital technologies and innovation practices (Malodia et al., 2023; Matarazzo et al., 2021). The presence of female directors brings distinct leadership styles (Bannò & Filippi, 2024; Xie et al., 2020), including collaboration (Aracil-Jordá et al.,

2023), and inclusivity (Tate & Yang, 2015), which contribute to the development and execution of effective strategic initiatives (Torchia et al., 2011). These characteristics become particularly critical for SMEs, where resource constraints demand innovative and efficient (Dohse et al., 2019; Foss et al., 2022; Lee & Chung, 2022). Gender-diverse boards may promote the adoption of forward-looking initiatives, such as digital strategies and tools, to improve internal processes (Lepore et al., 2023), stakeholder engagement (Torchia et al., 2011; Yang et al., 2019) with a greater propensity for innovation and openness to change (Triana et al., 2019), that enhance organizational processes often emphasize long-term value creation over short-term gains (Nair, 2020). Their focus on stakeholder inclusivity aligns with the collaborative nature of social media, enabling firms to engage effectively with other kind of actors - customers, suppliers, and other stakeholders (Lepore et al., 2023; Martín-Rojas et al., 2023; Nørreklit & Cinquini, 2023)- which in turn can enhance the success of the digital strategy.

In line with the Upper Echelons Theory (Hambrick & Mason, 1984) which posits that top executives' demographic characteristics shape their cognitive frameworks and strategic decisions, we assume that the presence of female directors under the age of 35 can play a significant role in shaping the adoption and implementation of digital strategies (He et al., 2023; Tejerina-Gaite & Fernández-Temprano, 2021; Triana et al., 2019). Young female board members, often considered digital natives, bring unique skills (Gardiner, 2024) and perspectives to the boardroom technological fluency (He et al., 2023) and openness to strategic change (Fernández-Temprano & Tejerina-Gaite, 2020; Tejerina-Gaite & Fernández-Temprano, 2021) can enhance the effectiveness of social media adoption (Aracil-Jordá et al., 2023), fostering improved operational and financial outcomes (Tejerina-Gaite & Fernández-Temprano, 2021). Moreover, younger board members are generally more inclined toward risk-taking and experimentation (Gardiner, 2024), which aligns with the dynamic and fast-paced nature of digital innovation (He et al., 2023). Research underscores the role of diversity in fostering creativity and resilience in decision-making processes. Female directors are often adept at balancing risk-taking with calculated decision-making (Bannò & Filippi, 2024), a skill that is particularly valuable when implementing digital strategies such as social media. For these reasons, we can assume that younger female directors, in particular, combine this cautious pragmatism with an ability to navigate the rapidly changing digital environment,

enhancing SMEs' ability to translate social media use into measurable financial outcomes.

The intersection of gender and age diversity introduces additional layers of strategic dynamism. Studies show that boards with greater gender diversity tend to adopt innovative and stakeholder-focused strategies (Lückerath-Rovers, 2013), while younger directors contribute technological fluency and risk tolerance (Fernández-Temprano & Tejerina-Gaite, 2020; Tejerina-Gaite & Fernández-Temprano, 2021) and are more sensitive to external changes (He et al., 2023). Together, these attributes enable young-female board members to strengthen the relationship between social media adoption and financial performance by ensuring digital strategies align with both operational goals and market demands. For example, Fernández-Temprano and Tejerina-Gaite (2020), studying a Spanish non-financial firms reveals that age board diversity has a positive impact on firms performance. Similarly, Collevocchio et al., (2025) show how the young board amplifies the positive effect of business sustainability.

However, the impact of youth-female board members on firm performance is not without challenges. Contextual factors such as industry characteristics, cultural norms, and board dynamics can moderate the effectiveness of gender-diverse boards on performance (Fernández-Temprano & Tejerina-Gaite, 2020). In certain cases, increased gender diversity has not led to significant improvements in performance (Tejerina-Gaite & Fernández-Temprano, 2021). Additionally, the limited experience or perceived lack of credibility of younger board members could pose potential constraints to their effectiveness (Lee et al., 2024). These complexities underline the need to empirically investigate the role of young female directors in leveraging digital strategies like social media to drive financial performance, particularly within the SME context especially due to the less explored area of young-female directors.

Despite these challenges, empirical research highlights the critical role of young and women in driving digital transformation and performance (Fernández-Temprano & Tejerina-Gaite, 2020; Lee et al., 2024; Tejerina-Gaite & Fernández-Temprano, 2021), particularly in SMEs where their contributions can counterbalance resource limitations and foster innovation. In the context of SMEs, where agility and innovation are crucial, young female directors are uniquely positioned to act as catalysts in leveraging social media to drive financial performance. Their ability to combine technological expertise

with inclusive leadership practices allows them to amplify the financial benefits of digital strategies, ultimately strengthening the organization's competitive positioning.

Building this state of art and in line with the academic debate, we posit:

H2: The young-female board (<35 years) positively affects the relationship between social media and financial performance in SMEs.

Figure 5 highlights the conceptual framework with the two hypotheses.

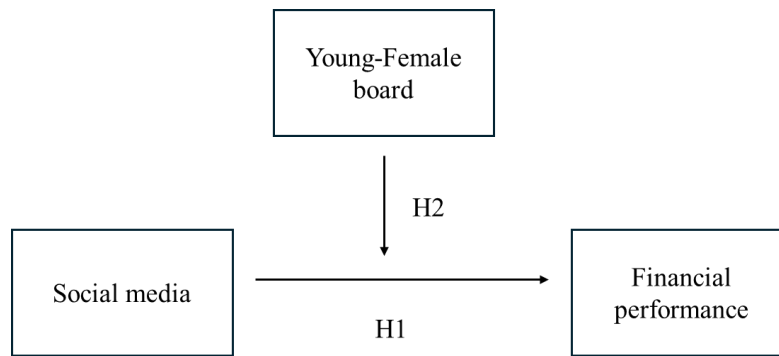


Figure 5. Conceptual framework

5.3. Methodology

5.3.1 Data, sample of analysis and variable description

The hypotheses was tested using a panel dataset over 10 years (2013-2022) of 250 Italian Innovative SMEs selected on an equal basis thought the probability-proportional-to-size-sampling (Levy & Lemeshow, 2013) in each stratum of both well and less-developed environments and type of industry within the Italian territory (Antenozio et al., 2024). The sample was selected from the special Register of Innovative SMEs by the Chambre of Commerce¹⁸ according to the definition established by the European Commission in 2003¹⁹, thereby enhance the external validity of our research findings in relation to other EU countries. The selected sample adequately represented of SMEs and is high heterogeneity for three reasons: (i) SMEs are located all over the Italian territory in

¹⁸ registriimprese.it

¹⁹ According to the “Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises” SMEs include enterprises which employ fewer than 250 people, and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million, “<https://ec.europa.eu/smes/>”

different economic context, less and well- developed area; (ii) for Italy configuration, the territory has a clear distinction at enterprises level in different sectors that constitute the basis of the economic system according to the European Commission²⁰; (iii) Italy shows the worst performance for female entrepreneurship among well-developed countries, so stimulating female leadership is a priority for policymakers (MIMIT, 2024; Statista, 2024). For this reason, the sample is considered adequate to explore the effect of innovation and gender issues on financial performance.

The panel dataset is built on data from two different sources: AIDA Database and SMEs' website. We captured primary and secondary data using a novelty approach with Wayback Machine²¹ to retrospectively access the website of each SME at the end of each year. Table 23 describes the variables, the data-source and the operationalisation. The final panel dataset was comprised of 2.500 observations, adding strength to our empirical study.

5.3.2 Variable and measures

5.3.2.1 Dependent variable

Our dependent variable is the financial performance in SMEs, measured through Return on sale (ROS). ROS is recognized as an effective indicator of financial performance, reflecting a company's operational efficiency and profitability (Lückerath-Rovers, 2013). The variable considers the percentage of return on sale for each year, from 2013 to 2022 weight over the total ROS in the sample for each year.

5.3.2.2 Independent variables

Our independent variable, *Social Media*, refers to a company's adoption of social media platforms to enhance digital strategy and make better strategic decision-making (Zhang & Zhu, 2021). We focused on personal social media as they are more commonly used than professional platforms (Gustafson et al., 2021; Liu et al., 2023). The independent variable was measured by collecting data on the adoption of the four social media - Facebook, Instagram, YouTube, and X - over ten years (2013-2022), employing an innovative approach by utilizing the Wayback Machine to archive and analyse the presence of these platforms on SMEs' official websites over time. Websites are rich

²⁰ European Commission, "European regional innovation scoreboard 2023 - Italy," <https://ec.europa.eu/reg.innov.score.2023>

²¹ [Wayback Machine](#)

information sources for SMEs, and the Wayback Machine allows us to capture and analyse this data over time. This tool's validity has been established in prior studies (Arora et al., 2016).

Five steps were conducted to obtain the final variable *Social media*. First, corporate websites were analysed to identify social media adopted by each SME. This approach ensured that the platforms examined were those explicitly specified by the SMEs themselves, ensuring accurate capture of their strategic use. Second, focused on widely adopted or rapidly growing platforms within our sample, assessing annual adoption rates (Facebook adoption in 2022: 170/250). TikTok was exploded due to its entrance into the country in recent years and did not emerge as significant within our sample (1/250 SMEs). Third, we conducted a retrospective analysis using the “Wayback Machine” to trace social media adoption from 2013 to 2022, providing a dynamic view of trends and digital strategy adoption over time (in 2013 Facebook adoption: 102/250; Instagram adoption: 9/250). Fourth, to ensure the methodological rigour and the completeness of the data obtained through the innovative tool, we used cross-referenced Wayback Machine data with the social media platforms themselves by checking the date of the first post on each platform. For example, we evaluated the date of the first Facebook post to confirm SME adoption in 2013. Fifth, following Corral de Zubielqui et al. (2019), it is assigned '1' to indicate platform adoption and '0' otherwise for each year and platform. To provide the diversity of social media adopted by firms over ten years, Herfindahl-Hirschman Index (HHI) commonly used to measure concentration phenomena in diverse fields of research (Mastroeni et al., 2023; Nguyen et al., 2020), was adapted in our context to reflects social media platform adoption rate among the total adoption of social media by all SMEs in the sample. The HHI in our context reflects the amplitude of social media adopted over the years as a proxy for digital strategy. A low HHI (close to 0) indicates that SME adopt different social media and implies that SME leverage various channel to implement their digital strategy.

The *Young-Female Board* independent variable refers to the female directors under 35 years old that sit on corporate board. We set out the 35 years old according to the Italian Youth policy²². To have this variable we followed three steps. First, we identified all female directors under 35 years old serving on the boards of directors in the SMEs

²² Department for Youth Policies and Universal Civil Service

within our study. Second, for each SME, we calculated the ratio of young female directors (under 35) to the total number of female directors on its board. This ratio reflects the proportion of young women among all female board members.

Third, we considered the overall representation by weighting this ratio across the total number of directors within the board in all SMEs over years. This step provides a broader view of young female participation at the board level across all SMEs in the sample and ensure the methodological rigour.

5.3.2.3 Control variables

Following the academic debate on SMEs, relevant control variables are included in the proposed model. Specifically, we controlled for the characteristics of SMEs and board of director. For SMEs' characteristics we include firm size, measured by the number of employees (Hervas-Oliver et al., 2021; Martín-Rojas et al., 2023; Zhang et al., 2022), the firm age (Zhang & Zhu, 2021) measured by the number of years in operation. Both two variables are operationalised by the natural logarithm of the variables (Nunes et al., 2012) to ensure the robustness of the data in our sample. We control also for manufacturing industry using a dummy variable: 1 for manufacturing industry, 0 for services. Manufacturing is considered male-dominated and most innovative, while service industry shows more female entrepreneurs but soft innovations (Brush et al., 2019; OECD, 2023). Regarding the characteristics of board of directors, we control for the board age (Tejerina-Gaite & Fernández-Temprano, 2021) weight over the total age of BOD in the sample and for the number of BOD (La Rocca et al., 2024) weight over the total number of member of BOD in the sample.

The included control variables are critical in ensuring the robustness of our analysis and in providing a nuanced understanding of the factors that influence SME performance.

Table 23. Description of the variables and operationalisation

Variable	Model	Description	Operalization of the variable	Type of the variable	Data-source
Financial performance	DV	ROS by SMEs	ROS of SMEs operationalized over the total ROS in the sample for each year	Constant	AIDA Database
Social Media	IV	Official Social networks adopted and used by SMEs	Breadth of social media implemented by SMEs	Construct	Wayback
Young-Female board (<35)	IV	Number of women in SMEs board of directors under 35 years old	Ratio between young female member and female board member over the total member of board of directors	Constant	AIDA Database
Firm Age	CV	Number of the years the SMEs has been in operation	Natural logarithm of the variable	Constant	AIDA Database
Firm Size	CV	Number of employee in SMEs	Natural logarithm of the variable	Constant	AIDA Database
Manufacturing Industry	CV	Dummy variable of the manufacturing industry	1 if firm is manufacturing, 0 otherwise	Binary	AIDA Database
Board age	CV	Mean of board age	Average age of the board over the total age in the sample	Constant	AIDA Database
Board number	CV	Number of board of directors by SMEs	Number of board over the total board of directors in the sample	Constant	AIDA Database

DV (Dependent Variable), IV (Independent Variable), CV (Control Variable); Database: AIDA: Analisi Informatizzata delle Aziende Italiane
Source: Authors

5.3.3 Estimation model

We employed the Generalized Method of Moments (GMM) using a two-step estimation process to test our hypothesis. To ensure the robustness of our analysis we included one-year lagged dependent variable as an instrument (Roodman, 2009a). Through the two-step process, the heteroscedasticity and the correlation issue of our panel were mitigated and maintained the robust covariance matrix. To support the validity and the robustness of the GMM model, we employed several estimation techniques as Generalizes Least Square (GLS), Ordinary Least Square (OLS), Fixed effects/Random Effects (FE/RE) (Roodman, 2009b). Also, to ensure the appropriateness of GMM and to show the most suitable model for our panel, we used Akaike Information Criteria (AIC) (Sakamoto et al., 1986). In addition, the Hausman test supported the efficiency application of our model against FE/RE model founding no significant incongruence in the estimated coefficients

(Bond & Arellano, 2012). Moreover, the AIC and Hausman tests provided statistical validation for the suitability of GMM and according to Lee and Yu (2014), GMM method is especially well-suited for balanced panel datasets in terms of size and period and it can effectively handle endogeneity, heteroscedasticity and the characteristics of the dataset. This method aligns with current trends in academic research, including the analysis of performance with variable with time-lag effect. This is also supported by evidence that a company's performance is seen over the years (Tejerina-Gaite & Fernández-Temprano, 2021). Specifically, our panel-dataset comprising 250 SMEs over a relatively short period (10 years), included both time and firm-fixed effects (Lee & Yu, 2014; Roodman, 2009a; Windmeijer, 2005).

We adopted a diagnostic set of controls and tests to ensure the validity of the two-stage GMM estimates and to check for potential model overidentification (see Section 5.3.4 *Endogeneity Check*). Table 24 shows the correlation matrix and descriptive statistics. None of the correlations raised multicollinearity issues in the regression analysis. In addition, variance inflation factor (VIF) analysis confirmed the absence of criticality. The maximum VIF for the independent variables in each model was 1.15 (Social media), while the average total VIF across models was 4.02. Finally, we applied stepwise robust regression (Agostinelli, 2002) by adding main effects, control variables and interactions to ensure the robustness of our results.

Table 24. Descriptive and correlation matrix

	Vif	Mean	Min	Max	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
[1] Financial Performance (n-1)	1.02	0.002	-0.552	1.058	1.000							
[2] Social media	1.09	0.407	0.041	0.635	-0.030	1.000						
[3] Young-Female board (<35)	1.65	0.042	0.000	1.000	-0.006	-0.038*	1.000					
[4] Manufacturing Industry	1.04	0.275	0.000	1.000	-0.067***	0.035	-0.074***	1.000				
[5] Firm size	1.14	0.020	0.000	0.362	-0.082***	-0.196***	-0.119***	0.018	1.000			
[6] Firm age	1.18	0.244	0.000	0.439	-0.038*	0.139***	-0.173***	0.118***	0.157***	1.000		
[7] Board age	1.82	0.525	0.270	0.805	-0.042**	0.008	-0.621***	0.142***	0.150***	0.331***	1.000	
[8] Board number	1.07	0.063	0.010	0.350	0.031	-0.108***	-0.033*	0.099***	0.205***	0.028	-0.023	1.000

Note: ***, **, *, significant at the 1 %, 5 %, and 10 % at significance levels, respectively

5.3.4 Endogeneity Checks

Several tests are employed to check possible endogeneity and ensure the stability of the GMM model. First, following the Roodman GMM dynamic approach (Roodman, 2009b, 2009a), we included one-year lagged-dependent variable as an instrument to test preservation of the dependent variable and to prevent over-identification problems (Windmeijer, 2005). In addition, including several diagnostic tests we guarantee the consistency of GMM estimation and the robustness of our results. Second, we included the Hansen test, the Arellano and Bond test and the Wald Chi-Square (Magazzini & Calzolari, 2020) to control the consistency of the GMM model. Regarding the monitoring for over-identification presence, we employed the Hansen test (Sargan, 1958), with results indicating that the null hypothesis cannot be rejected, thereby confirming the consistency of the estimates. Third, to check for autocorrelation in the idiosyncratic disturbance term in the model we applied the Arellano and Bond test (Arellano & Bond, 1991; Roodman, 2009b, 2009a). Particularly, according to this test, we considered AR (2) tests to control for possible autocorrelation issues. The AR(2) test results confirmed that there were no endogeneity issues in our findings. The results of the model are reported in Table 25. The results and test consistently confirmed the robustness of model estimation and the absence of endogeneity problems.

5.4. Results

The results of the GMM models are presented in Table 25. Model I highlights the interaction between the solely dependent variable and independent variables. Model II represents our empirical model estimated for all control variables included. Models III represent the interaction between *Financial performance* and *Social media* by including *Young-Female board (<35)* and all control variables. Last, Model IV highlights the interaction between the financial performance and Social media, including the effect of *Young-Female board (<35)* (*Social media*Young-Female board (<35)*) to assess the complementary effect in the model. For each step, we also controlled the incremental contribution of the added variables.

Table 25. Step-wise GMM Model

	Model I Coeff.	Model II Coeff.	Model III Coeff.	Model IV Coeff.
Financial Performance (n-1)	0.245*** (0.012)	0.108*** (0.006)	0.214*** (0.006)	0.253*** (0.004)
Social Media	0.035*** (0.011)		0.031*** (0.006)	0.011*** (0.003)
Female Board (<35)	0.006*** (0.005)		0.506*** (0.167)	0.027*** (0.130)
Social media*Female board (<35)	-0.034*** (0.014)			0.411*** (0.015)
Manufacturing Industry		0.481*** (0.033)	0.451*** (0.078)	0.679*** (0.053)
Firm size		0.027*** (0.005)	0.018*** (0.005)	0.028*** (0.004)
Firm age		-0.104*** (0.022)	-0.089*** (0.009)	-0.050*** (0.008)
Board age		-0.281** (0.102)	1.781*** (0.633)	0.697 (0.455)
Board number		-0.294 (0.321)	-4.405*** (0.371)	-5.404*** (0.386)
Firm effect	Included	Included	Included	Included
Year effect	Included	Included	Included	Included
AR(2)	1.95	1.83	1.88	1.89
p-value	0.051	0.068	0.060	0.059
Hansen test	44.22	44.70	50.19	53.31
p-value	0.113	0.126	0.275	0.159
N° Observation	2250	2250	2250	2250
N° Firms	250	250	250	250

Dependent variable: Patent; ***, **, *, significant at the 1 %, 5 %, and 10 % levels, respectively.

Overall, 2.500 observation were reduced by one year (250) due to the lag in evaluating the effect of the independent variables on the dependent variable in the models.

Arellano–Bond test for AR (2) and Hansen Test are used to control for possible autocorrelation issues. Standard errors are in parentheses.

Model III provides support for Hypothesis 1 *H1: The adoption of social media positively affects financial performance in SMEs*, which assumes a direct effect of Social media adoption on financial performance in SMEs. The parameter for *Social media* is positive and significant for explaining the relationship ($\beta = 4.90$ $p=0.000$).

Model IV provides support for Hypothesis 2 *H2: The young-female board (<35 years) positively affect the relationship between social media and financial performance in SMEs*. For this, we introduced the interaction effect (*Social media*Young-Female board (<35)*). The interaction of intangible assets and social media is positively related to innovation in SMEs. Model V shows that the parameter for *Social media* directly affects *Financial performance* ($\beta=3.59$ $p= 0.000$), the parameter for *Young-Female board (<35)* show no significance in affecting *Financial performance* ($\beta = 0.21$ $p= 0.830$) and the *Social media*Young-Female board (<35)* is positive and statistically significant for *Financial performance* ($\beta = 26.33$ $p= 0.000$), suggesting that young-female board (<35) in SMEs over the year should have a dual outcome. First, we note that female board of directors under 35 years old not directly and significantly affect financial performance in SMEs. Second, advancing social media adoption in SMEs is complementary in affecting financial performance. In addition, Figure 6 provide a visual representation of these relationships, which suggest that young-female board of directors under 35 years old is able to exploit potential *Financial performance* for any given adoption of potential *Social media* in SMEs. Accordingly, this result provides support for Hypothesis 2.

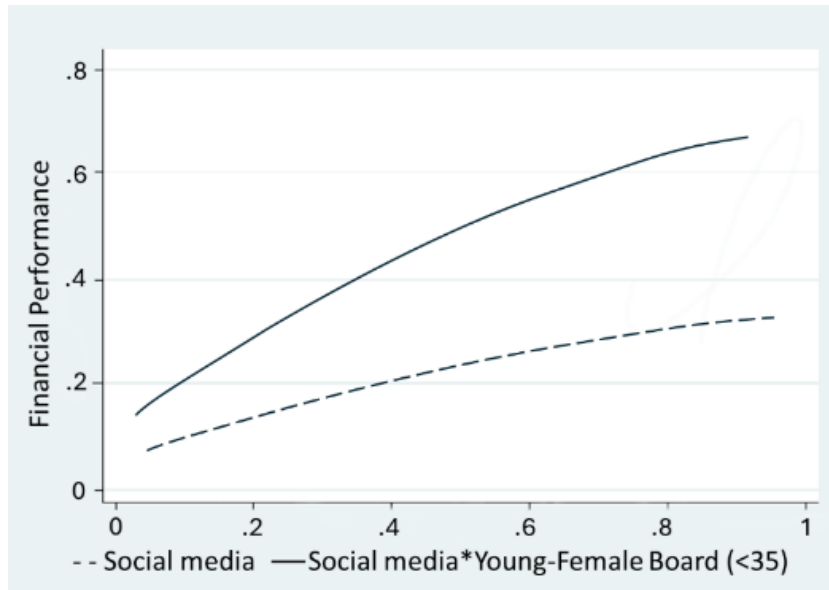


Figure 6. Relationship between performance and social media with Young-Female board (<35 years)

5.5. Discussion e conclusion

The study advances our understanding of the interplay between corporate governance and digital strategy on performance by analysing how diversity and in particular young-female board member influences the adoption and impact of social media on SME financial performance. Drawing on the resource-based view and upper echelon theory, our findings provide robust evidence on the strategic value of social media as a digital resource, highlighting the positive and direct relationship between digital strategy (social media adoption) and financial performance. Specifically, we demonstrate that social media adoption enhances financial performance by enabling SMEs to overcome traditional resource constraints and adapt to dynamic market conditions. These results harmonise with the current debate, which emphasize the emerging and strategic role of digital tools in the SMEs context (Benitez et al., 2018; Eller et al., 2020; Hitchen et al., 2017; Mithas et al., 2013). We believe that social media is a fundamental tool for SMEs that are resource-constrained, and the emerging role of this component became in the future a more strategic approach to interact with all value chain and support gradual growth of these firms. As a low-cost tool it permits SMEs to overcome limitations of established intangible resources as intangible assets and offer latent opportunities to

implement in business strategy with more flexibility and adaptability, which can in turn enhance long-term profits.

Our findings contribute to prior literature on board diversity, innovation and performance, integrating the results of Chen et al. (2023), where inherent diversity, associated to age and gender, have been considered inconclusively for innovation and, consequently for corporate performance. In our study, we find evidence of the complementary effects of diversity in corporate governance, particularly age and gender, in amplifying the strategic efficacy of digital tools, demonstrating that while young and female encompass some issue about trust and long-term vision (Lee et al., 2024; Tejerina-Gaite & Fernández-Temprano, 2021), these inherent characteristics leads to high benefits. We suggest that this is because young members contribute fresh perspectives and digital-native skills, fostering openness to innovation and a willingness to explore emerging technological opportunities. Female board members, on the other hand, bring empathetic decision-making and balanced risk management, which can complement and refine the strategic initiatives of their young age. This combination of demographic attributes creates a unique synergy and strengthening the financial performance of SMEs.

Despite potential biases concerning the presumed inexperience of young board members and the underrepresentation of women, our findings suggest that this demographic composition can serve as a catalyst for strategic initiatives. By leveraging the complementary strengths of young and female governance members, SMEs can navigate the complexities of digital age more effectively, ensuring both competitiveness and financial success.

5.5.1 Theoretical implications

This study provides theoretical contributions to the study on business strategy and corporate governance of SMEs. First, it advances the current debate on the role of social media as a strategic enabler for improving performance in SMEs (Benitez et al., 2018; Bharadwaj et al., 2013; Eller et al., 2020; Hitchen et al., 2017; Lepore et al., 2023). By addressing calls for further empirical research on the strategic integration of social media as part of a broader business strategy (Bhimani et al., 2019; Chen & Liu, 2025; Corral de Zubielqui et al., 2019; Liu et al., 2023; Zhang & Zhu, 2021) this study highlights the emerging and transformative role of these tools in the digital and competitive landscape of SMEs.

Second, this study contributes to literature on board diversity by investigating the complementary role of young-female board members in the relationship between social media adoption and financial performance. Grounded in the upper echelon theory, this study extends the understanding of how demographic diversity at the governance level influences strategic outcomes in SMEs (Fernández-Temprano & Tejerina-Gaite, 2020; Lee et al., 2024; Tejerina-Gaite & Fernández-Temprano, 2021). Specifically, we propose the unique combination of youth and female board representation fosters a governance dynamic that enhances the effectiveness of digital strategies like social media. This approach expands existing research on governance diversity (Bannò & Filippi, 2024; Fernández-Temprano & Tejerina-Gaite, 2020; Lückerath-Rovers, 2013; Tejerina-Gaite & Fernández-Temprano, 2021), by emphasizing not just the presence of women in SME governance, but its strategic interaction with their young age and technological tools. The findings suggest that young-female board members bring broad ability to adapt, moving beyond the generic emphasis on gender representation to emphasize the strategic interplay between demographic characteristics, technological tools, and governance dynamics.

Third, the study positions social media not merely as technological tool but as a strategic asset that can drive superior financial performance when combined with inclusiveness and diversity in governance. We reinforce the recent study of Aslanbeigui et al. (2025), that shows the positive relationships between media exposure of companies for gender discrimination within the board of directors and the adverse response of markets, reinforcing the importance of an inclusive work environment for performance. This aligns with and extends the calls in recent literature to consider contextual factors, such as governance composition, when analysing the performance implications of digital tools in SMEs (Troise et al., 2022; Xu et al., 2018).

Lastly, our study responds to the call to use longitudinal panel data to strategically examine social media (Bhimani et al., 2019; Martín-Rojas et al., 2023). The application of the Wayback Machine to extract data offers a novel and innovative approach to study patterns over time.

5.5.2 Practical implications

This study provides valuable practical implications for management and practitioners, emphasizing the strategic importance of integrating social media and diverse governance

to drive financial performance in SMEs. First, SMEs should reframe their perspective on social media, treating it not merely as a marketing tool but as a core component of their business strategy. Social media has a potential to unlock competitive advantages, including increased brand visibility, deeper customer engagement, and revenue growth. For these benefits, it is essential that social media strategies are aligned with the firm's overarching business objectives and actively supported at the governance level. Board should stay informed about emerging trends and digital platform opportunities, ensuring that their decisions reflect the understanding of these tools.

Second, SMEs should prioritize diversifying their boards, particularly integrating younger women who bring a distinctive combination of fresh perspectives, technological fluency, and adaptive thinking. This demographic has demonstrated a unique capacity to enhance the effectiveness of social media strategies, fostering innovation and driving financial outcomes. To fully leverage these benefits, organizations should create inclusive environments where younger and female members feel empowered to share their insights. Initiatives such as mentoring, collaborative decision-making and training opportunities can further support their active engagement in governance. At the same time, traditional governance models may need to be rethought, mitigating biases related to age and experience, enabling SMEs to fully capitalize on their strategic advantages of diversity on board.

Third, managers need to strengthen collaboration between governance and operational teams to ensure that social media strategies are integrated into business objectives.

Fourth, SMEs should adopt governance frameworks that actively support digital innovation. This includes allocating resources for social media experimentation, monitoring its impact on performance, and refining strategies based on data-driven insights. Social media should be embedded into the firm's long-term growth plans, with the board playing an active role in championing its adoption and sustainability. Young-female board members, in particular, can serve as a key contributor in designing inclusive and impactful campaigns that resonate with a broader audience, strengthening relationships with stakeholders and enhancing trust. By integrating these practices into their governance and management structures, SMEs can harness the full potential of social media and board diversity to boost sustainable growth and superior financial

performance. These findings highlight the need for SMEs to view governance and digital strategy as interconnected pillars of business success, opening the way for greater adaptability and competitiveness in the digital age.

5.5.3 Limitations and future research avenues

This study is not without limitations inherent to its quantitative nature. First, our research focuses exclusively on Italy. While this provides a deep understanding within a specific national context, it may limit the generalizability of our findings to other countries with different cultural, economic, or regulatory environments. This limitation is common among empirical studies on SMEs. However, Italy is considered a suitable setting for analysing SMEs due to its substantial and well-documented number of these firms spread across the entire national territory. Our sample was meticulously developed to rigorously represent the country in terms of geographical distribution, firm size, and economic development, enhancing the external validity of our findings. Second, due to the difficulty in gathering longitudinal data over a decade, we focused on a sample of 250 SMEs. While this sample size aligns with other empirical studies that consider smaller samples (Liu et al., 2023), it may still limit the statistical power and the ability to detect smaller effect sizes. Future research could benefit from expanding the sample size to include more SMEs, which would enhance the robustness and generalizability of the results. Third, we acknowledge that other factors, such as industry-specific dynamics, regional economic conditions, and organizational culture, may influence the relationship between digital strategy, board diversity, and financial performance. Our study did not control for all possible external and internal variables that could impact these relationships. We encourage future studies to extend our conceptual model by incorporating these additional factors to provide a more nuanced understanding of how they interact with digital strategies and board composition. Finally, our study focuses on the impact of digital strategy and board diversity on financial performance, measured by indicators like Return on Sales (ROS). However, financial performance is multifaceted, and relying on a single metric may not fully capture a firm's overall performance. Additional studies could broaden the scope by including other financial indicators or non-financial outcomes.

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