Financial Innovation

RESEARCH

Open Access

The influence of CEO's financial literacy on SMEs technological innovation: the mediating effects of MCS and risk-taking

Antonio Duréndez[1*], Julio Dieguez-Soto[2] and Antonia Madrid-Guijarro[3]

*Correspondence:
antonio.durendez@upct.es

[1] Department of Economics, Accounting and Finance, Universidad Politécnica de Cartagena, Calle Real, 3, 30201 Cartagena, Spain
[2] Finance and Accounting Department, Universidad de Málaga, Calle El Ejido, 29071 Malaga, Spain
[3] Cátedra de Emprendimiento Santander-UPCT, Department of Economics, Accounting and Finance, Universidad Politécnica de Cartagena, Calle Real, 3, 30201 Cartagena, Spain

Abstract

Previous literature showed mixed results about the impact of CEOs' financial literacy (CFL) on small and medium-sized enterprises' (SMEs) innovation. This relationship can be motivated by relevant variables, which are missing in the previous literature and make a difference as mediators. In this sense, based on the theoretical framework related to upper echelon theory and resource-based view, this study focuses on the mediating effect of risk-taking attitude and management control systems (MCS) variables. Empirical data from 310 SMEs gathered using a qualitative research questionnaire are analyzed using structural equation modeling methodology. Specifically, estimations are carried out considering the partial least square method. Findings show that MCS and managers' risk attitudes fully mediate the relationship between financial literacy (FL) and innovation. Between these two mediating variables, the implementation of MCS stands out because it also enables the mediating effect of CEOs' risk-taking in the CFL–technological innovation relationship. As the results do not support the significant direct relationship between FL and risk attitude, they confirm an indirect effect through MCS. Furthermore, based on the study findings, SMEs' directors and owners, business associations, and public authorities can improve SMEs' technological innovation by implementing training programs and policies to foster CFL. They can also acknowledge the interdependency between organizational factors and individual characteristics to enhance SMEs' technological innovation.

Keywords: Financial literacy, Technological innovation, Small and medium-sized enterprises, Risk-taking, Management control systems

Introduction

Research focusing on small and medium-sized enterprises (SMEs) is an increasing trend worldwide because of their unquestionable importance to emerging and developed economies in terms of employment and gross product. This behavior remains in different cross-cultural contexts, in occidental (European Union, Ireland, Italy, and Sweden) (Barrett et al., 2021; Cosenz and Bivona, 2021; Hilmersson and Hilmersson, 2021; Kraus et al., 2020) and oriental economies (China, Indonesia, Japan, and Korea) (Arsawan et al., 2022; Colovic, 2021; Lee, 2021). In Spain, SMEs also have an essential role in the economy, considering that the official figures show they represent 99% of global firms,

62% of gross value added, and 66% of employment. SMEs are also very relevant in job creation, with more than eight million people (DIRCE, 2020).

Given the relevant role of SMEs in the economy, the competitiveness of such kinds of firms needs to be maintained or even improved. In that sense, research on the factors that promote competitiveness in SMEs is essential. In particular, we consider technological innovations as they have been linked to firm competitiveness, sustainable and firm growth, or business success, among other critical aspects (Chatzoglou and Chatzoudes, 2018; Martínez-Alonso et al., 2022; Razavi et al., 2016; Santana et al., 2015). Over the last six decades, considerable technological innovation research has existed. In recent years, studies in the field of technological innovation mainly focused on research and development (R&D), technological innovation management, models of technological innovation, and impacts of technological innovation (Akbari et al., 2020). Previous literature recognized the need for research on the technological innovation behavior of SMEs as the innovative capacity, speed, and frequency of innovations are definitively essential for SMEs in a global context subject to a complex and changing environment (Hilmersson and Hilmersson, 2021). Existing research highlighted the importance of technological innovation to SMEs' competitiveness and permanence in the market (Sharif and Huang, 2012). Most importantly, for SMEs that are often resource-restrained (Musteen et al., 2010), technological innovation is considered a remarkable driver of environmental sustainability practices (Ramírez-Orellana et al., 2022), expansion into other markets and, finally, SMEs' performance (García-Lopera et al., 2022) and growth (Donbesuur et al., 2020). However, most previous literature paid scarce attention to technological innovation in SMEs (Akbari et al., 2020; Arsawan et al., 2022).

Additionally, knowing the relevance of considering technological innovations when researching on competitive factors of SMEs, we also consider other variables related to technological innovations. An example is the individual characteristics of CEOs, who are the leaders and responsible for the decision-making process in SMEs. In that sense, an emerging stream of research focused on the influence of the features of individuals managing the firm on the technological innovation outcomes of SMEs instead of considering firms' characteristics only (Geyer, 2016). There has been a recent spike in interest regarding financial literacy (FL) in SMEs (Molina-García et al., 2020, 2022). This case is motivated by the observation that FL diminishes financial restrictions (Nkundabanyanga et al., 2014), increases firm performance (Eniola and Entebang, 2017), and could bring benefits in terms of the recognition of opportunities (Anwar et al., 2020), the attitude and management of corporate risk (Kulathunga et al., 2020; Ye and Kulathunga, 2019), or entrepreneurship (Riepe et al., 2022). Thus, in the framework of the innovation capacity of SMEs, the present study focuses on CEOs' FL (CFL), which is becoming a relevant factor to be considered. CFL comprises the financial knowledge related to resources, markets, risks, management, legal, or tax issues related to financial matters (Koropp et al., 2013). CFL also includes making suitable financial decisions (Tian et al., 2020). In this sense, literature exploring the impact of managers' FL on innovation capacity in SMEs is limited (Hutahayan, 2021; Liu et al., 2021; Tian et al., 2020). The scarce previous literature showed that CFL has a double effect (direct and indirect, by alleviating financial constraints) on the technological innovation of SMEs (García-Pérez-de-Lema et al., 2021). Specifically, based on upper echelon theory (UET), this study emphasizes how

the specific characteristics of CEOs, namely, their FL, positively impact firm innovation, bettering expenses and income management, and/or long-term planning. Furthermore, the study shows that financially literate CEOs can alleviate financial constraints by gaining more access to existing financing, which may notably enhance the firm's likelihood of undertaking technological innovation.

Furthermore, we consider the role of some mediating variables that connect a CFL with technological innovations, which is the case for management control systems (MCS) and CEOs' risk-taking. Accordingly, the implementation of MCS plays an essential role in stimulating technological innovation (Henri, 2006), and CFL may be vital to develop and implement MCS in SMEs (Rostamkalaei et al., 2022). Similarly, CFL is one of the attributes for unraveling CEOs' risk-taking (e.g., Buratti and Allwood, 2018). CEO risk-taking propensity has been demonstrated to be a driver of technological innovation (García-Granero et al., 2015; Kraiczy et al., 2014). However, no research has measured the mediating effect of MCS and the risk-taking attitude of CEO on the relationship between FL and SME technological innovation (Molina-García et al., 2022). In this vein, the current study responds to the following research questions: Does MCS have a mediating effect on the relationship between CFL and the technological innovation of SMEs? Does MCS have a mediating effect on the relationship between CFL and CEOs' risk-taking? Does CEOs' risk-taking have a mediating effect on the relationship between CFL and technological innovation of SMEs? Is the relationship between CFL and technological innovation sequentially mediated by MCS and CEOs' risk-taking?

We draw in UET and resource-based view (RBV) to answer the former questions. According to UET, agents' features and behaviors are associated to organizational outcomes (Hambrick and Mason 1984). In this vein, CFL and CEOs' risk-taking, as two of SME CEOs' upper echelon characteristics, can impact the implementation of MCS and technological innovation performance, respectively. Based on the RBV, the implementation of MCS can be considered a source of competitive advantage (Barney, 1991; Songling et al., 2018). Then, the implementation of MCS can be a source or capability that might be a precursor of CEOs' risk-taking and, ultimately, SME technological innovation.

To fill this research gap, we developed an empirical study addressed to 310 managers of SMEs. Research analysis follows the structural equation modeling (SEM) method based on partial least squares (PLS) path modeling. Our findings indicate that MCS and CEOs' risk attitude have a full mediating effect on the relationship between CFL and technological innovation of SMEs, conceding an essential role to both variables. The results also show that CFL affects risk-taking behavior through MCS. Therefore, the use of MCS becomes fundamental because it not only mediates the effect of the CFL on SMEs' technological innovation but also allows the mediating influence of CEOs' risk-taking on the former relationship.

This study has several contributions to the literature and practice. First, this study is particularly intriguing because the previous research is almost silent regarding the indirect effects on the relationship between CFL and SME technological innovation. This research thereby extends and challenges the current literature by analyzing two particular factors that mediate the CFL–technological innovation relationship, namely MCS and CEOs' risk-taking. Second, by relying on UET (Hambrick and Mason, 1984), this

study is one of the first to use CEOs' novel individual-level characteristic, CEOs' FL, as a determinant of technological innovation in SMEs, contributing to developing this theoretical view further. Third, the findings of this study also yield relevant practical implications for innovation policies that can foster the competitiveness and performance of SMEs. SME CEOs can generate more technological innovation by increasing their FL, which enables organizations to build and enhance MCS and affect the risk-taking behavior of CEOs. Thus, governments can develop policies that encourage SMEs to augment CFL. Eventually, this case will lead to a higher implementation of MCS and better CEO risk-taking behavior, which in turn will increase the technological innovation of SMEs. Therefore, improving technological innovations in SMEs would lead to gaining competitiveness and business growth, maintaining the essential role of SMEs to sustain the welfare state of economies worldwide.

Empirical and theoretical background

Our study attempts to create novelty by analyzing two factors that mediate CFL–technological innovation, namely MCS and CEOs' risk-taking. The current section is devoted to examining briefly the scarce studies focusing on the effects of CFL on technological innovation to back our research with previous empirical research results. This section also explains the theory that supports the mediating role of MCS and CEOs' risk-taking.

FL and technological innovation

Research focusing on the FL-technological innovation relationship is at a very early stage. Thus, Győri et al. (2019) studied specific aspects of the innovation activities of SMEs by considering entrepreneurial financial culture and social–economic environment. They found that, among other considerations, employing a full-time financial expert positively contributes to carrying out implemented and planned innovation in SMEs. Hutahayan (2021) analyzed how SMEs adjust and further develop business competencies, innovations, and performance using market orientation, learning orientation behaviors, and FL. Their findings confirmed the positive influence of CFL on firm innovation. Hasan et al. (2021) demonstrated that CFL promotes the usage of most innovative financial instruments as financing alternatives (FinTech) based on the use of technologies.

Studies focused on the relationship between CFL and technological innovation (García-Pérez-de-Lema et al., 2021; Liu et al., 2021; Tian et al., 2020). Liu et al. (2021) analyzed the impact of CFL on SMEs' innovation using a large survey database of Chinese SMEs in 2015 and 2017. They found that an entrepreneur's FL is positively associated with firm innovation engagement and that risk tolerance is a transmission mechanism for the influence of FL on innovation (Liu et al., 2021). From another aspect, Tian et al. (2020) examined the relationship between CFL and firm innovation based on a dataset obtained from surveys of Chinese SMEs in 2019. They confirmed that CFL significantly enhances R&D investments by alleviating financial constraints and improving risk management. Finally, García-Pérez-de-Lema et al. (2021) analyzed how CFL influences a firm's technological innovation and the mediating role of alleviating financial constraints of SMEs using a sample of Spanish SMEs in 2016–2017. Their results showed

that by alleviating financial constraints, CFL exerts a direct and an indirect impact on a firm's technological innovation.

UET and RBV

This study adopts UET and RBV to explain the mediating role of MCS and CEOs' risk-taking on the CFL–technological innovation relationship. Upper echelon theorists highlight the relevance of examining the executives' roles and attitudes because organizational outcomes are considered consequences of the features of powerful actors in the organization (Hambrick and Mason, 1984). Thus, according to UET, CEOs' idiosyncrasies can shape firm strategic decisions. The impact of CEOs' disposition, expertise, and resulting behavior on the organization outcomes is even more intense in SMEs, where decision-making is concentrated in the CEO's hands, and the number of TMT members is often reduced (Kraiczy et al., 2014). Accordingly, CEOs' decisions and actions are led by their own analysis of the strategic choices they face, which in turn is conditioned by their experiences, values, and personalities (Calabrò et al. 2019). Hence, CEOs' risk-taking and CFL may be identified as drivers of CEOs' actions and organizational outcomes. The former refers to the willingness of a CEO to devote important resources to exploit opportunities or to get involved in behaviors with undetermined results (Gilley et al., 2002). The latter comprises both financial knowledge and making financial decisions (Koropp et al., 2013; Tian et al., 2020). In this vein, CFL and CEOs' risk-taking, as two of the SME CEOs' upper echelon attributes, can eventually affect SMEs' organizational choices (e.g., the design of MCS) and results (e.g., technological innovation performance), respectively.

From another aspect, research based on RBV emphasizes that SMEs have distinctive capabilities and resources that may be sources of competitive advantage (Barney, 1991) and, in particular, may contribute to innovation success (Sirmon and Hitt, 2003). In this sense, the implementation of MCS usually involves applying formalized routines and procedures using information to maintain or change patterns in organizational activity and adopt suitable decision-making (Simon 1987). MCS can be considered a particular organizational resource and capability that can help improve risk management, changing CEOs' risk-taking. MCS can also be utilized to generate technological innovation (Simons, 1995).

Hypothesis development

The mediating effect of MCS on the CFL–technological innovation relationship

Knowledge is crucial for firm performance (Serra and Kunc, 2015) in large organizations and SMEs (Ganesh and Mehta, 2010). Similarly, the use of MCS plays a vital role in the firm performance, making possible managers' appropriate decisions through proper planning, budgeting, analyzing, measuring, and evaluating organizational information (Cosenz and Noto, 2015). However, the use of MCS is particularly challenging in SMEs, and much remains to be learned about it in these organizations (Goffee, 1996; Chepngetich, 2016). Additionally, proper knowledge can contribute to the better utilization of MCS, improving the performance of SMEs (Kulathunga et al., 2020).

Mainly, FL is a multifaceted construct that usually comprises knowledge about funding, financial markets, management systems, financial risks management, legal or tax

issues related to financial matters, and so on (Koropp et al., 2013). Drawing on UET arguments, we propose that the CEO's behavior regarding the implementation of MCS is a function of his/her possession of substantial FL, as one of his/her key possible characteristics. Thus, financially literate CEOs having an appropriate level of understanding of MCS can improve the use of MCS in SMEs. CFL may be vital to develop and implement MCS in SMEs, such as budgeting (Rostamkalaei et al., 2022), contributing to better decision-making and operations (Li et al., 2021), and finally, increasing SME performance (Iramani et al., 2018). In this vein, recent research supported the significant impact of higher financially literate CEOs adopting MCS, particularly enterprise risk management practices and systems (Kulathunga et al., 2020; Mabula and Dong, 2018). However, SMEs tend to reject investing in and devoting time to MCS, such as accounting systems (Kou et al., 2021) as they are not sure of their benefits for the organization (McMahon, 2001). In short, CFL is an efficient means to use MCS in SMEs.

From another aspect, according to Henri and Wouters (2020), research studies paying attention to the relationship between MCS and technological innovation are still insufficient. Nevertheless, previous literature identified that one of the core challenges when implementing an influential MCS is to deal with the trade-off between innovation and planned goal achievement by finding the balance between control and flexibility (Simons, 1995). In that sense, Ahrens and Chapman (2004) proposed enabling control when MCS (planning and administrative controls) allow the company to achieve a balance between efficiency and flexibility. Then, this balance of MCS fosters technological innovation. Furthermore, according to Henri (2006), the correct implementation of MCS becomes a condition to stimulate technological innovation as it is a valuable distinctive and imperfectly imitable capability, a source of competitive advantage following the RBV.

The present study clearly uses RBV to illuminate the MCS–technological innovation relationship in SMEs. We argue that the implementation of MCS is a starting point for catalyzing superior technological innovation and provides SMEs with the ability to manage their resources and risks more effectively than their competitors, leading to sustained competitive advantages (Barney, 1991; Colbert, 2004). In this vein, recent studies revealed the essential role of MCS in innovation processes by exploring how CEOs use MCS in different innovation contexts (Bedford, 2015; Chenhall and Moers, 2016). Thus, proper management controls increase the potential benefits from technological innovation (Bedford, 2015; Bisbe and Otley, 2004; Feranita et al., 2021). In particular, Bisbe and Otley (2004) found that an interactive use of MCS improves the performance effect of technological innovations in mature and manufacturing SMEs, mainly in an exploratory innovation context that requires a more straightforward diagnostic system and fewer resources than exploitative innovations. In particular, for SMEs, the managing director or CEO plays a critical position in the relationship between MCS and technological innovations. In that sense, the interactive use of MCS, particularly concerning customer relationships, promotes technological innovations in the case of SMEs (Pešalj et al., 2018). This previous study also highlighted the critical role of the CEO in balancing the diagnostic and interactive MCS continuously. Similarly, MCS based on cost information and non-financial performance indicators strongly influences technological (product) innovations in SMEs (Henri and Wouters, 2020). Furthermore, these authors showed

that this influence is particularly relevant in contexts of environmental unpredictability, helping to promote technological innovations for SMEs.

In short, financially literate CEOs will likely lead to an increase in technological innovation. Their FL allows them to implement MCS, which may notably enhance the organization's capacity to obtain technological innovation. Therefore, this study proposes that more excellent CFL will lead to higher technological innovation outcomes through a higher implementation of MCS. Based on the above arguments, we propose the following hypothesis:

H1*: MCS positively mediates the relationship between CFL and technological innovation.*

The mediating effect of MCS on the CFL–CEO risk-taking relationship

In the preceding sub-section, this study showed that prior research confirmed the positive effect of CFL on implementing MCS in SMEs. Based on the arguments of UET, prior research suggested that CFL can be reckoned as a factor that characterizes CEOs and has beneficial implications on the organization (Hambrick and Mason 1984), namely, through the higher use of MCS.

From another aspect, based on RBV, we argue that a positive association exists between the application of MCS—an organizational resource or capability—and CEOs' risk-taking—an executive characteristic. CEOs' risk-taking (propensity), defined as CEOs' present predisposition to take or avoid risks, is a function of CEOs' psychological, social, and cognitive abilities (Hambrick and Mason, 1984). CEOs' risk-taking is an attitude that is simultaneously persistent and changeable over time because the CEO faces a continuous decision-making process (Sitkin and Weingart, 1995). Organizational control systems, such as MCS, can affect CEOs' risk-taking because they focus on different aspects of the decision-making process (Giaccone and Magnusson, 2022; Kou et al., 2019; Sitkin and Pablo 1992). MCS makes more likely proper CEOs' diagnoses and choices, affecting CEOs' risk propensity. In this vein, the literature studied the relationship between the importance of the design and adequate implementation of MCS to drive businesses effectively and CEOs' risk-taking propensity (Liem and Hien, 2020). The authors explored the connection between the use of MCS and CEO managerial risk propensity during the decision-making process. In particular, the authors considered that within MCS, management accounting systems have a relevant function in measuring top managers' risks, which can be divided into risk aggregation, risk reporting, and risk monitoring. In that sense, MCS lessens uncertainty in the decision-making process and support risk management (Collier et al., 2004). A direct link exists between MCS and CEOs' risk-taking as one of the purposes of MCS is to control the risks in the organization's activities. In that sense, Sandino (2007) suggested a classification in terms of the objectives of MCS (basic, costs, revenue, and risk) in which "Risk MCS" are established to reduce risks and protect asset integrity. As part of MCS, internal audit quality is also related to CEOs' personality in risk management. In this sense, implementing MCS, both the interactive and diagnostic use of budgets in conjunction with performance indicators, has favorable effects on risk awareness within the organization (Braumann et al., 2020). Organizational control systems can also affect the risk behavior of CEO and

top managers through the mediating effect of risk perceptions of top managers (Sitkin and Pablo, 1992).

In sum, financially literate CEOs will likely augment CEOs' risk-taking, given that their FL allows them to easily use MCS—this was explained in the previous sub-section, which may significantly improve CEOs' risk-taking by diminishing uncertainty in decision-making and backing risk management. Therefore, this study proposes that more excellent CFL will lead to higher CEOs' risk-taking through increased use of MCS. For the previous reasoning, the following hypothesis is considered:

H2*: MCS positively mediates the relationship between CFL and CEOs' risk-taking.*

The mediating effect of CEOs' risk-taking on the CFL–technological innovation relationship

On the one hand, CFL has been proven to have a positive effect on risk diversification and risk management (Bannier and Neubert, 2016). Financially literate CEOs are more likely to understand risks, have better risk perception and assessment (Buratti and Allwood, 2018), and be more prone to take risks (Hsiao and Tsai, 2018). Therefore, CFL is expected to increase CEOs' motivation to take risks and affects CEOs' risk-taking (Liu et al., 2021).

On the other hand, technological innovation usually requires considerable time, effort, and resources, is often linked to sharp learning curves, and is essentially risky as the chances of success are uncertain and small. However, if successful, then the high potential profitability associated with technological innovation makes many managers prone to pursue it (Wu et al., 2005; Zhou, 2006). Firms' managers, mainly CEOs in SMEs, have to deal with the uncertainty inherent in technological innovation. In this vein, the attitude of CEOs when facing risks influences technological innovation results. Prior entrepreneurship and leadership research has been considerably interested in analyzing the risk-taking–innovation association (Latham and Braun, 2009). Similarly, studies on creativity have addressed this relationship (Gilson and Shalley, 2004). Managers' risk-taking is often recognized as an important determinant of innovation outcomes (Craig et al., 2014; Gilley et al., 2002), as risk management implies to handle with innovation activities that usually involve potentially high-rewarding investments but are also very risky. Based on UET, some studies analyzed how managers' and TMT's risk-taking behaviors, depending on unique features, such as tenure or age, affect innovation performance (e.g., Liu et al., 2012). CEOs who are more prone to take risks value the potential benefits of technological innovation generation more favorably than more risk-averse CEOs (Pérez-Luño et al., 2011). Thus, by and large, scholars showed that CEOs oriented toward risk-taking generate more and better technological innovation outcomes (Gilley et al., 2002; Ling et al., 2008). Similarly, the literature focusing on creativity highlighted risk-taking as a relevant aspect to stimulate creativity and experimentation (Martins and Terblanche, 2003) and, in turn, improve innovation performance (Yuan and Woodman, 2010). More recently, Giaccone and Magnusson (2022) re-emphasized the significant positive effect of risk-taking on innovation performance, underscoring results from previous research (Cabrales et al., 2008; Craig et al., 2014; Gilley et al., 2002; Guimaraes and Paranjape, 2017; O'Connor et al., 2008).

In short, the above arguments suggest that CFL is a crucial antecedent for explaining CEOs' risk-taking (Buratti and Allwood, 2018). Similarly, the positive influence of

CEO risk-taking propensity on technological innovation is well established in previous literature (García-Granero et al., 2015; Kraiczy et al., 2014). Following the last literature review reasoning, we consider the next hypothesis:

H3: *CEOs' risk-taking positively mediates the relationship between CFL and technological innovation.*

Finally, in the organizational innovation context, the logic of interdependency implies that CEOs' characteristics, such as the CFL and risk-taking, are likely to contribute to changes in the organizational resources and capabilities, namely, MCS, and vice versa. Previous research considered separately how organizational factors (Crossan et al., 1999) and CEO characteristics (Mumford and Licuanan, 2004) contribute to innovation performance. Therefore, new empirical research would be desirable regarding how the interplay and reciprocal influence between organizational elements and CEOs' features affect innovation performance (Crossan and Apaydin, 2010). Based on our evaluation of the contents of the preceding subsections, we conclude that the interdependency between organizational factors and CEOs' features might offer even more significant potential to enhance our understanding of SMEs' technological innovation.

Therefore, based on the former sub-sections, CFL has a positive impact on MCS, which has a positive effect on CEOs' risk-taking. Similarly, CEOs' risk-taking positively impacts technological innovation outcomes. Therefore, we hypothesize the following:

H4: *The relationship between CFL and technological innovation is sequentially mediated by MCS and CEOs' risk-taking.*

Methods

This section is devoted to (1) explaining how the information was gathered, providing information on the sample used in the estimation and the population it belongs to; (2) defining the variables included in the research model and the measures considered based on previous literature; and (3) introducing the statistical technique used in the estimation.

Sample and data

The selection of the sample was made considering the regional structure of Spanish SMEs according to official business information (DIRCE) provided by the National Statistical Institute. According to Spanish National Statistics Institute, SMEs are very relevant in Spain because the official figures indicated that they account for 99% of the total population of firms, 62% of gross value added, and 66% of employment (DIRCE, 2020). The population of SMEs in Spain with at least one employee accounts for 1,307,634 (Ministerio de Industria, Comercio y Turismo, 2022).

Therefore, the selection process was based on the stratified sampling principles in finite populations, considering the segmentation according to industry and size. When a firm refused to collaborate, a replacement was made on similar randomly selected companies. We design a qualitative research questionnaire as an instrument to collect the information. The questionnaire was developed to include constructs previously tested and based on previous literature. All items of the questionnaire have been built through closed-ended questions following a Likert's scale ranging from 1 to 5 points to measure the degree of agreement from participants.

The fieldwork to collect the data took place in 2017. Finally, the valid answers corresponded to 310 managers of Spanish SMEs. We control for possible bias in the responses from participants. Non-response bias was controlled by comparing the first round of questionnaires collected (15% of the sample) with those responding to the follow-up (15% of the sample). In that sense, t-Student showed that responses were not significantly different between the two groups for any variable (Nwachukwv et al., 1997). No nonresponse biases were found. Additionally, common method variance bias was tested following Podsakoff and Organ's (1986) proposal. As a result, the common method variance was not significant.

Responses show that 31.6% of the sample comprises SMEs in the manufacturing sector, 19.35% in construction, 20% in retail, and 29% in services. Of the sample, 41.9% are small-sized firms with fewer than 25 employees, and 22.3% are medium-sized firms. We consider SMEs following the EU recommendation issued in 2003 (EU Commission Recommendation concerning the definition of micro-, small-, and medium-sized enterprises 2003/361/EC) (Table 1).

Definition of variables

The scales used in this research have been previously validated by the literature (Table 2) and are based on a five-point Likert's scale ranging from one (strongly disagree) to five (strongly agree).

FL can be considered as *"A combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial wellbeing"* (OECD 2018, p.4). Additionally, according to Bay et al. (2014, p. 42), FL *"is seen either as (1) an individual capability that can be acted upon in relation to experience, vocabulary and skills (the autonomous model), or (2) a socially situated issue where financial literacy in itself must always be debated (the situated model)."* The CFL scale was adopted from García-Pérez-de-Lema et al. (2021). This construct is calculated in the estimation as a reflective composite, in line with the proposal made by García-Pérez-de-Lema et al. (2021), which considers different dimensions of the same construct that can be related (level of information of

Table 1 Sample characteristics

Activity sector	%
Manufacturing	31.6
Services	29
Retail	20
Construction	19.35
Size	
Micro	35.8
Small	41.9
Medium	22.3
Number of employees	Mean: 37.15 SD: 12.45
Firm age	Mean: 24.30 SD: 12.45
Total number of observations	310

SD standard deviation

Table 2 Indicators and constructs

Authors	Constructs and items
García-Pérez-de-Lema et al. (2021)	CEO's financial literacy CFL *Indicate your degree of agreement with the following statements (where 1 is 'totally disagree' and 5 is 'totally agree')*
	CFL1 I am well informed of the evolution of the economy
	CFL2 I am well informed about alternative financial sources
	CFL3 I am well informed of the financial assets to invest in
	CFL4 The company management uses the economic information
Duréndez et al. (2016); Hiebl (2014); Simons (1990)	Management Control System MCS *Indicate the degree of use of the following formal internal control systems (where 1 is 'little use' and 5 is 'a lot of use')*
	MCS1 ERP management information systems Balance Scorecard
	MCS2 Cost Accounting Implementation
	MCS3 Budget control
	MCS4 Financial economic analysis
	MCS5 Strategic planning
	MCS6 Internal audit
	MCS7 Implementation of quality controls
Covin and Slevin (1989) and Yang (2012)	Risk-taking *Indicate your degree of agreement with the following statements (where 1 is 'totally disagree' and 5 is 'totally agree')*
	RT1 I bet on research and development leadership
	RT2 I have a strong propensity for high-risk projects
	RT3 I think that knowing the environment, courageous and wide-ranging actions are necessary to achieve the objectives of the company
	RT4 When faced with uncertain decision-making, I usually take a courageous and aggressive stance in order to maximize the likelihood of exploiting potential opportunities
Madrid-Guijarro et al. (2021)	Technological innovation *The evolution of your company during the last two years, and comparing it with the rest of the companies in your sector, can be rated in relation to your company's products and services, and processes (where 1 is 'very unfavourable' and 5 'very favourable')*
	I1 The number of new products or services introduced by your company per year
	I2 The pioneering nature of your company when introducing new products or services
	I3 The speed of response to the introduction of new products or services by other companies in the sector
	I4 The number of modifications in the processes introduced by your company per year
	I5 The pioneering nature of your company when it comes to introducing new processes
	I6 The speed of response to the introduction of new processes by other companies in the sector

the manager about the evolution of the economy, the alternative financing funds, the financial assets to invest in, and the financial information about the company).

To contextualize the concept of MCS, we have chosen a definition recognized by previous literature: *"management control systems are the formalized procedures and*

systems that use information to maintain or alter patterns in organizational activity... these systems broadly include formalized procedures for such things as planning, budgeting, environmental scanning, competitor analyses, performance reporting and evaluation, resource allocation and employee rewards" (Simons, 1990, p.128). In the research, the MCS measure is based on the proposal of Duréndez et al. (2016). This construct is also considered a reflective composite, as it includes the use of ERP systems, cost accounting, budget control, financial analysis, strategic planning, internal audits, and quality controls.

We followed Covin and Slevin (1989) and Yang (2012) to account for risk-taking propensity, considering a factor construct built of four items. The four items comprise the following information: (1) I bet on R&D leadership; (2) I have a strong propensity for high-risk projects; (3) I think that knowing the environment, courageous and wide-ranging actions are necessary to achieve the objectives of the company; (4) When faced with uncertain decision-making, I usually take a courageous and aggressive stance to maximize the likelihood of exploiting potential opportunities.

Finally, to consider *innovation* in SMEs, we opted for a subjective measure as it is more appropriate for innovation in SMEs (Hughes, 2001). Consequently, in this investigation, a subjective output innovation perspective is considered using the scale used by Madrid-Guijarro et al. (2021). Respondents were asked to indicate the firm's situation concerning its competitors with regard to the number of new products launched and processes implemented, the firm's pioneering nature concerning introducing new products and processes, and the rapid response to their competitors' product/service and process innovations.

In the model, control variables, such as firm age, size (number of employees), and activity sector (three dummy variables: construction, trade, and service industry, manufacturing the hidden category), have been introduced following previous literature (Choi et al., 2011; Duran et al., 2016; Kammerlander et al., 2015; Werner et al., 2018).

Statistical technique

We estimate the proposed model using PLS path modeling, a variance-based SEM method (Roldán and Sánchez-Franco, 2012), SmartPLS 3.3.3. PLS simultaneously assesses the reliability and validity of the variables (outer model) and the estimation of the paths among these constructs (inner model) (Barroso et al., 2010). The PLS technique is appropriate in this research because: (1) No specific distribution is required in the indicators in PLS (Chin, 2010); (2) The proposed research model has great complexity as we pay attention to the existence of mediating effects (Hair et al., 2017); (3) The model makes use of reflective composite constructs (Sarstedt et al. 2016; Chin, 1998). As in our model, one construct (risk-taking propensity) is a factor. In this case, we use the consistent PLS estimation algorithm (Dijkstra and Henseler, 2015).

After verifying the psychometric properties of the outer model (measurement model), we continued estimating the structural model proposed in Fig. 1. Control variables, such as firm age, industry, and size, have also been introduced into the analysis.

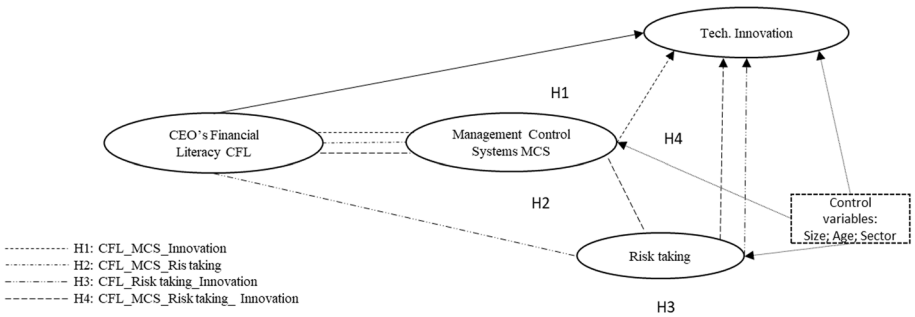

Fig. 1 The conceptual model

Table 3 Measurement model

CEO's financial literacy (CFL)			Loads	p-value		Management Control System (MCS)			Loads	p-value	Q^2
α	0.856	*CFL1*	0.795	0.000		α	0.884	*MCS1*	0.648	0.000	0.167
ρA	0.859	*CFL2*	0.858	0.000		ρA	0.896	*MCS2*	0.722	0.000	0.115
CR	0.902	*CFL3*	0.875	0.000		CR	0.910	*MCS3*	0.813	0.000	0.208
AVE	0.698	*CFL4*	0.812	0.000		AVE	0.594	*MCS4*	0.860	0.000	0.357
						Q2	0.225	*MCS5*	0.863	0.000	0.310
								MCS6	0.758	0.000	0.191
								MCS7	0.707	0.000	0.225
Risk-taking			**Loads**	**p-value**	**Q^2**	**Technological innovation**			**Loads**	**p-value**	**Q^2**
α	0.768	*RT1*	0.741	0.000	0.140	α	0.867	*I1*	0.673	0.000	0.084
ρA	0.777	*RT2*	0.764	0.000	0.047	ρA	0.882	*I2*	0.785	0.000	0.194
CR	0.849	*RT3*	0.804	0.000	0.118	CR	0.900	*I3*	0.756	0.000	0.122
AVE	0.585	*RT4*	0.749	0.000	0.102	AVE	0.601	*I4*	0.752	0.000	0.152
Q2	0.102					Q2	0.16	*I5*	0.861	0.000	0.251
								I6	0.813	0.000	0.155

Convergent validity and reliability

Significance and t statistic performed by 10,000 rep. Bootstrapping procedure. Cross-validated redundancies Stone-Geisser Q^2 performed by a 9 Distance-Blindfolding procedure. α Cronbach's alpha, ρA Dijkstra-Henseler's rho, CR Jöreskog's composite reliability, AVE average variance extracted

Data analysis

Model assessment

We consider Dijkstra–Henseler's indicator (Rho_A), composite reliability (CR), factor loadings, and average variance extracted (AVE) to assess the reliability, convergent, and discriminant validities of reflective composite and factor constructs (Table 3). These indicators are chosen because reflective composite and factors are characterized by important correlations among their indicators (see Table 8 in Appendix) (Dijkstra and Henseler, 2015). The measurement model assessment shows acceptable outcomes. In this sense, Cronbach's alpha levels vary between 0.768 and 0.867, and Dijkstra–Henseler's indicator (Rho_A) ranges between 0.777 and 0.896, exceeding both indicators' acceptable threshold of 0.7. Similarly, CR also reaches the appropriate threshold varying between 0.849 and 0.910.

The AVE shows evidence of the convergent validity of the measurement model. In this sense, this indicator ranges between 0.585 and 0.698, exceeding 0.5 (Hair et al., 2009). Furthermore,

loads are higher than 0.7 except for one item that belongs to the MCS construct, which has a load equal to 0.648 (higher than 0.5) (Arzubiaga et al., 2019; Hair et al., 2017).

The heterotrait-monotrait (HTMT) ratio of Henseler et al. (2016) is used to assess the discriminant validity among constructs. Table 4 reports that the HTMT between each pair of variables varies from 0.357 to 0.690, with bootstrapping analysis demonstrating that the HTMTs are significantly lower than 1, thereby verifying the discriminant validity of the variables (Henseler et al., 2016). Therefore, we find evidence that all the constructs in the proposed model are distinctive ones.

Structural model estimation and results

As the estimations of the path coefficients are based on OLS, the antecedent variables of each of the endogenous constructs must avoid multicollinearity. Table 5 shows that all inner VIF values are under 5. Therefore, our model has no multicollinearity problems (Hair et al., 2017).

Chin (2010) proposed that the structural model can be evaluated considering the algebraic sign, the significance and magnitude of the path coefficients, and the adjusted coefficient of determination values. The significant paths (t-values higher than 1.64) oscillate between 0.360 and 0.675. However, unexpected findings are revealed in two paths that are not significant in the model. These paths are the relationship between CFL and innovation and the one between CFL and risk-taking. The adjusted coefficient of determination values is high, ranging between 0.32 and 0.5 (Hair et al., 2011; Henseler et al., 2009). Stone-Geisser Q^2 (Chin, 2010; Sarstedt et al., 2014) is also an indicator used to evaluate the model's predictive power. Q^2 values larger than zero for redundancy indicate that a model has predictive power for a certain endogenous construct. In this model, Q^2 for endogenous variables ranges from 0.102 and 0.225.

The results show nonsignificant values for the relationship between CFL and innovation (path: − 0.048, t-value: 0.543) and CFL and risk-taking (path: − 0.009, t-value: 0.083).

The findings show evidence favoring the relationship between CFL and MCS as the path is positive and significant (path: 0.674, t-value: 13.881). Therefore, the more information the manager has about finance in different aspects, the higher the likelihood that the company implements tools related to MCS. The results also verify that MCS is a key variable to promote firm innovation (path: 0.320; t-value: 3.249) and a positive attitude toward risk-taking (path: 0.490; t-value: 5.370). Consequently, these positive relationships advocate for the mediating effect exerted by MCS. The analysis of the indirect effect reports positive and significant effects. Thus, MCS fully mediates the relationship between CFL and innovation (indirect effect: 0.216; t-value: 3.197) and CFL and risk-taking (indirect effect: 0.330; t-value: 4.780), verifying H1 and H2. The full mediation is confirmed as the total effects that CFL exerts on innovation are significant (total effect: 0.283, t-value: 3.966), whereas the direct

Table 4 Discriminant validity. Fornel & Larcker and *HTMT ratio*

	1	2	3	4
1 CEO's financial literacy CFL	**0.836**	*0.690*	*0.357*	*0.317*
2 Management Control System MCS	0.614	**0.771**	*0.510*	*0.470*
3 Risk-taking	0.291	0.435	**0.765**	*0.542*
4 Technological Innovation	0.275	0.425	0.468	**0.775**

HTMT ratio over the diagonal (cursive). Fornell-Larcker criterion: squared-root of AVE in diagonal (bold) and construct correlations below diagonal

Table 5 Structural model estimation (PLSc)

Paths	Path	t-value	p-value	95% confidence interval		f^2	VIF
CEO's financial literacy (CFL) → Tech. Innovation	− 0.048	0.543	0.293	− 0.193	0.097	0.001	1.987
CEO's financial literacy (CFL) → Risk-taking (RT)	− 0.009	0.083	0.467	− 0.182	0.160	0.000	1.987
Risk-taking (RT) → Tech. Innovation	0.359	5.278	0.000	0.247	0.471	0.157	1.282
CEO's Financial Literacy (CFL) → Management Control System (MCS)	0.674	13.881	0.000	0.596	0.755	0.863	1.064
Management Control System (MCS) → Tech. Innovation	0.320	3.249	0.001	0.158	0.482	0.065	2.33
Management Control System (MCS) → Risk-taking (RT)	0.490	5.370	0.000	0.345	0.643	0.151	2.026
Control variables significant paths only							
Size → Risk-taking (RT)	− 0.089	1.688	0.046	− 0.175	− 0.003		
Construction → Tech. innovation	− 0.181	2.768	0.003	− 0.288	− 0.073		
Indirect effects	**Path**	**t-value**	**p-value**	**95% confidence interval**			
CFL → MCS → Innovation H1	0.216	3.197	0.001	0.103	0.329	Supported	
CFL → MCS → Risk-taking H2	0.330	4.780	0.000	0.223	0.446	Supported	
CFL → Risk-taking → Tech. Innovation H3	− 0.001	0.042	0.473	− 0.068	0.057	Not supported	
CFL → MCS → Risk-taking → Tech. Innovation H4	0.118	3.47	0.000	0.072	0.181	Supported	
Total effects	**Path**	**t-value**	**p-value**	**95% confidence interval**			
CFL → Tech. innovation	0.283	3.966	0.000	0.171	0.411		
CFL → Risk-taking	0.322	5.023	0.000	0.206	0.418		
MCS → Tech. innovation	0.496	5.723	0.000	0.336	0.63		
Endogenous variable	**Adjusted R^2**	**Q^2**					
Technological Innovation	0.346	0.160					
Risk-taking	0.202	0.102					
SCI	0.498	0.225					

VIF inner model variance inflation factors. Q^2 Stone-Geisser Q^2

Significance, t statistic and 95% bias-corrected confidence interval performed by 10,000 rep. Bootstrapping procedure

effect is not. The same reasoning is valid for the full mediation exerted by MCS in the relationship between CFL and risk-taking. The results relating to H1 and H2 align with recent literature defending that FL is an essential driver of budgeting and financial planning (Rostamkalaei et al., 2022). The results regarding H1 also agree with a bit earlier study proving that MCS practices positively affect innovation (Henri and Wouters, 2020; Feranita et al., 2021). Then, the results for H2 concur with the findings obtained by Braumann et al. (2020), showing that the use of budgets and performance measures increases risk awareness.

Finally, risk-taking attitude positively affects firm innovation (path: 0.359; t-value: 5.278). This result involves a double mediating effect on the relationship between CFL and innovation (total effect: 0.283, t-value: 3.966). The effect of CFL on innovation is transmitted using the MCS and the risk attitude of the firm, verifying H4. This finding is in line with recent studies showing independently that CFL is an important driver of MCS implementation (Rostamkalaei et al., 2022), MCS influences risk-taking (Braumann et al., 2020), and risk-taking has a significant effect on innovation performance (Giaccone and Magnusson 2022). However, our result refined the former works by interacting with the former research models and showing that MCS and CEOs' risk-taking play a mediating role in the understanding of the relationship between CFL and innovation performance. The key variable in this mediating relationship is MCS as the direct relationship between CFL and risk-taking attitude is not significant when MCS is included in the model. Thus, H3 is not confirmed. The result related to H3 does not support previous research, suggesting that risk-taking is a transmission mechanism for the effect of FL on innovation (Liu et al., 2021). A possible explanation of this result is that risk-taking per se does not always produce an increase in innovation. Nevertheless, when CEOs' risk-taking is promoted by an organizational factor, namely, the implementation of MCS, it leads to a higher innovation performance (Giaccone and Magnusson, 2022), thereby confirming H4. Table 5 shows only the significant paths related to the control variables. In this sense, the results show that firm size in terms of the number of employees negatively affects risk-taking, whereas construction firms develop less technological innovation compared with manufacturing companies. Figure 2 shows the main results.

Control for endogeneity and nonlinearity

Assessment of endogeneity

Our assessment of potential endogeneity follows Hult et al.'s (2018) systematic procedure, starting with the application of Park and Gupta's (2012) Gaussian copula approach, using the latent variable scores of the original model estimation as input. We first verified if the variables, which potentially exhibit endogeneity, were non-normally distributed. That is, we run the Kolmogorov–Smirnov test with Lilliefors correction (Sarstedt and Mooi, 2019) on the latent variable scores of FL and MCS from the PLS path model. The construct latent variables were built considering the weighted average of indicators using the weights that provide consistent PLS. The results show that none of the constructs had normally distributed scores, allowing us to proceed with Park and Gupta's (2012) Gaussian copula approach. The results in Table 6 show that none of the Gaussian copulas was significant (p value > 0.05). We consequently concluded that endogeneity was not present in this study, which supported the robustness of the structural model results (Hult et al., 2018; Sarstedt et al., 2020).

Assessment of nonlinear effects

We used Ramsey's (1969) RESET on the latent variable scores extracted after the convergence of the original model's PLS-SEM algorithm to test for potential nonlinearities in the structural model relationships. We found that neither the partial regression of MCS on FL ($F(3.305) = 1.01$; $p = 0.389$), the one related to RT on MCS and FL ($F(3.304) = 1.32$; $p = 0.267$), nor the partial regression of I on RT, MCS, and FL ($F(3.303) = 0.92$; $p = 0.430$) is subject to nonlinearities. Next, we included interaction terms to represent the quadratic effects among (1) FL on MCS; (2) FL and MCS on RT; and (3) FL, MCS, and RT on I. The results indicate that neither of the nonlinear effects is significant (Table 7). We, therefore, conclude that the linear effects model is robust.

Discussion and conclusion

The findings of this study add new evidence to very recent previous literature connecting CFL and technological innovation in SMEs. The importance of organizational management systems when analyzing technological innovation outcomes of SMEs is reflected in the results of this study, which show a full mediation effect exerted by implementing MCS within the organization. This full mediation effect of MCS, either through its use alone or through its impact on CEOs' risk-taking, on the relationship between CFL and the technological innovation of SMEs plays an essential role in the utilization of the MCS.

The results show a first mediation effect of MCS on the relationship between CFL and the technological innovation of SMEs. This result suggests that CEOs of SMEs with the proper financial education and competencies for the funding and investment decision-making process are better prepared for implementing MCS based on budgeting (Rostamkalaei et al., 2022) and another control mechanism within the organization (e.g., Kulathunga et al., 2020). Then, CEOs trained in finance skills (financial planning, cost accounting, financial analysis, cash-flow management, risk analysis, investment options, etc.) would foster the proper usage of MCS, which becomes a condition to stimulate innovation (Henri, 2006). MCS also plays a second significant mediation effect between the CFL and CEOs' risk-taking behavior of SMEs. This result supports the idea that MCS influences CEOs' risk propensity, lessening uncertainty in decision-making and improving risk management (Collier et al., 2004). Thus, the mediating effect involves that CFL affects risk-taking behavior through MCS. Finally, the results also indicate that the implementation of MCS in the organization—in addition to its mediating effect in the CFL–technological innovation relationship—exerts another impact on technological innovation. This latest influence may be an indirect mediating result of technological innovation through its effect on CEOs' risk-taking. Hence, the results align with previous studies identifying the critical role of running MCS in supporting technological innovations (Chenhall and Moers, 2016).

The study makes several contributions to the existing research on FL and innovation in SMEs by exploring the relationships among CFL, implementation of MCS, CEOs' risk-taking, and technological innovation. The study sheds new light on the effects of CFL on technological innovation in SMEs, exploring the mediating effects of MCS and CEOs' risk-taking. Our findings show that CFL has a positive impact on MCS, thereby having a positive effect on technological innovation and CEOs' risk-taking. Thus, the favorable effect on technological innovation is enhanced. These results complement scholars' previous findings, suggesting that executive FL promotes technological innovation inputs

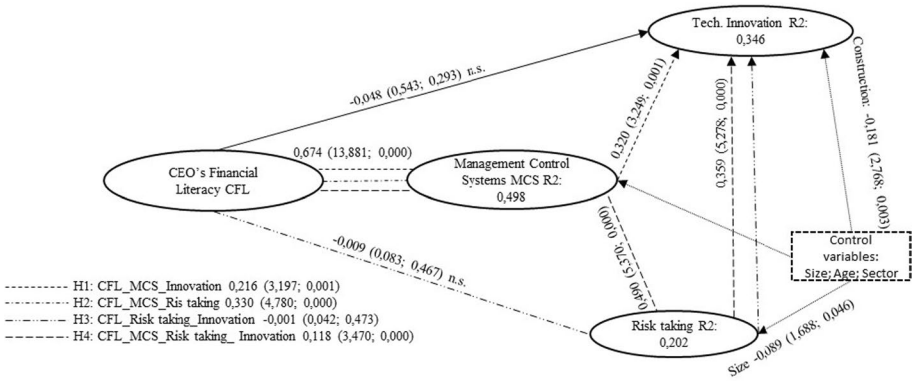

Fig. 2 Structural model results

Table 6 Assessment of endogeneity test using the Gaussian copula approach

Dependent variable innovation	Construct	Coefficient	p value
Model 1	lvRT	0.340	0.000
	lvMCS	0.256	0.000
	lvCFL	− 0.010	0.848
Model 2	lvRT	0.346	0.000
	lvMCS	0.493	0.030
	lvCFL	− 0.015	0.782
	^{C}MCS	− 0.436	0.277
Model 3	lvRT	0.342	0.000
	lvMCS	0.245	0.000
	lvCFL	0.450	0.076
	^{C}CFL	− 0.805	0.062

C indicates the copula term in the model. *Lv* latent variable; *RT* risk taking; *MCS* Management Control System; *CFL* CEO's financial literacy

(R&D expenditures) by alleviating financial constraints and bettering risk management (Tian et al., 2020). To further refine the assessment of CFL influencing technological innovation, this study uses objective and subjective qualitative questions to assess technological innovation. This study goes beyond previous research that also analyzed the effect of FL on innovation but measured whether innovation output is involved rather than the level of innovation outcomes achieved (Liu et al., 2021). This study also goes beyond input–output models and extends the results of prior research (García-Pérez-de-Lema et al., 2021) by showing that the use of both MCS and CEOs' risk-taking plays a mediating role in the understanding of the relationships between CFL and technological innovation in SMEs. Nevertheless, the essential key is in the use of MCS. If the CFL does not materialize in MCS utilization, the CFL will not affect CEOs' risk-taking and ultimately technological innovation of SMEs. Our study expands our knowledge about the relationship between CFL and technological innovation performance. The study advances this research by testing the connection between identified innovation determinants. Specifically, the study explores the effect of CFL—a leadership feature, its consequences for MCS implementation—an organizational factor, the feedback loop from MCS back to another leadership characteristic—CEOs' risk-taking, and its final influence on technological innovation performance—an organizational outcome. Thus, this

Table 7 Assessment of nonlinear effects

Nonlinear relationship	Coefficient	p value	Ramsey's RESET
CFL*CFL → MCS	− 1.30	0.195	F (3, 304) = 0.95; p = 0.415
CFL*CFL → RT	− 0.018	0.623	F (3, 302) = 0.90; p = 0.443
MCS*MCS → RT	0.064	0.068	
CFL*CFL → I	0.002	0.949	F (3, 300) = 0.97; p = 0.408
MCS*MCS → I	− 0.004	0.878	
RT*RT → I	0.006	0.846	

RT risk taking; *MCS* Management Control System; *CFL* CEO's financial literacy; *I* technological innovation

study applied a systemic view of the variables driving innovation performance having a multi-level approach (in this case, individual and organizational levels) Crossan and Apaydin (2010), as demanded by very recent colleagues (Giaccone and Magnusson, 2022), noted that these factors have solid inter-relationships.

UET has previously been used to justify that firm innovation performance results from the idiosyncrasies of the top managers (Hambrick, 2007; Hambrick and Mason, 1984). Top managers' decision-making regarding innovation often depends on their education, financial background, experience, and values (Smith et al., 1994; Talke et al., 2010). The concept of CFL has received minimal attention (García-Pérez-de-Lema et al., 2021; Li et al., 2021; Tian et al., 2020). Therefore, this study is one of the first to use CEOs' novel individual-level characteristic, CFL, as a determinant of technological innovation in SMEs, contributing to the further development of UET. Furthermore, this study confirms that specific executive characteristics—namely, the CFL and risk-taking—ensemble well with MCS, following previous studies requiring identifying those certain managerial features that better suit MCS than others (Hiebl 2014). This study also highlights that upper echelon characteristics may interact with organizational resources and capability choices to explain technological innovation, which allows combining UET and RBV, adopting a complementary and enriched multi-theoretic approach (Crossan and Apaydin, 2010).

To sum up, our findings confirm that the empirical support of a direct link between CFL and firm innovation outcomes is inconsistent. From these results, we can conclude that it is impossible to assume a pure, simple relationship between CFL and technological innovation in SMEs without considering at least a crucial variable that affects this relationship, namely, the use of MCS.

There are also important implications for SMEs. Directors and owners should be aware of the need to develop formalized training programs and human resource policies to foster FL within executives and managers. Acquired finance skills of CEOs would help promote innovation in SMEs by improving the use of MCS and boosting risk-taking behavior. Thus, this study suggests that FL, through the mediating roles of MCS (direct and indirect) and risk-taking attitude, makes SMEs pioneers when introducing new products/services/processes and having a higher speed to develop innovations. Furthermore, managers should promote the implementation of MCS in SMEs whose use is still underdeveloped because the adequate use of formalized MCS also promotes the correct risk-taking behavior of CEOs, which helps to foster innovation. This study also has implications for industry associations. According to the results of this article, leaders of

business associations should promote financial education and learning programs to foster CFL and employees and drive SMEs toward innovation.

Regarding implications for public authorities, the need to promote FL through the education of CEOs of SMEs should be highlighted. Thus, public policies to extend finance knowledge and skills to employees, or at least middle responsible executives, through university education and specific programs, become necessary to improve the decision-making process (corporate risk management) and promote innovation in SMEs. Particularly, colleges and universities should regularly organize FL competitions, courses, and similar events to promote financial education (Tian et al. 2020).

The study also has some limitations that provide avenues for future research. The results are focused on the case of SMEs, so they cannot be extrapolated to large or even quoted companies. In that respect, formal R&D processes that facilitate innovation and governance models of large companies should condition the conceptual model outlined. Therefore, extending the research to large companies would be interesting. Considering that most SMEs are family firms (Price et al., 2013), future studies should consider how family influence and family character of CEOs can affect the FL—innovation relationship. It can be expected that the family CEO maintains a lower FL level as, traditionally, previous literature confirmed that they have less training and professionalized profile (De Kok et al., 2006). These new research hypotheses can offer different findings from those obtained for SMEs. Additionally, this research is based on cross-sectional data with new evidence collected through primary sources, so its scope is limited. Further research can be planned with a longitudinal methodology to reach more robust results. Another relevant issue for future research is the institutional setting of analyzed companies. Cross-cultural differences can influence the study results and provide significant differences among SMEs. Extension of research in distinct institutional contexts would help have a complete and comprehensive overview of SMEs' behavior regarding FL, innovation, and their determining factors. This extension of research could consider the sources of risk in different organizations of the financial system as the modern banking system and the global financial market have formed a complex network (Kou et al., 2019). This complexity can have a relevant impact on the relationship between FL and innovation, identifying a significant moderating effect. Finally, the lack of FL is one of the key challenges affecting the business growth of women entrepreneurs (Baporikar and Akino, 2020). Previous literature confirmed the moderating role of CEOs' gender on the financial constraint alleviation–innovation relationship (Ruiz-Palomo et al., 2022). Another interesting research direction related to the effect of FL on technological innovation concerns the impact of gender on the former relationship. Consequently, we suggest examining if the influence of FL on technological innovation is different for SMEs managed by female CEOs than for SMEs managed by male CEOs. Finally, considering the findings obtained by Kou et al. (2021), which highlighted the significant role played by no financial information on bankruptcy prediction for SMEs, the FL variable is a relevant candidate to be introduced in the design of these models.

Appendix

See Table 8.

Table 8 Descriptive and correlations of measures

	Mean	SD	CFL1	CFL2	CFL3	CFL4	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	RT_1	RT2	RT3	RT4	I1	I2	I3	I4	I5	I6
CFL1	30.58	10.193	1																				
CFL2	30.24	10.290	0.637**	1																			
CFL3	30.11	10.318	0.568**	0.719**	1																		
CFL4	30.67	10.228	0.500**	0.525**	0.634**	1																	
MCS1	30.11	10.369	0.275**	0.374**	0.294**	0.361**	1																
MCS2	30.50	10.253	0.197**	0.277**	0.273**	0.365**	0.497**	1															
MCS3	30.68	10.251	0.336**	0.390**	0.373**	0.412**	0.411**	0.622**	1														
MCS4	30.77	10.189	0.486**	0.474**	0.483**	0.580**	0.473**	0.545**	0.690**	1													
MCS5	30.47	10.232	0.415**	0.431**	0.459**	0.557**	0.490**	0.524**	0.652**	0.780**	1												
MCS6	30.07	10.502	0.341**	0.352**	0.334**	0.415**	0.369**	0.460**	0.522**	0.553**	0.595**	1											
MCS7	30.55	10.442	0.383**	0.400**	0.355**	0.397**	0.341**	0.384**	0.509**	0.500**	0.494**	0.555**	1										
RT1	30.12	10.343	0.164**	0.133*	0.177**	0.205**	0.332**	0.304**	0.243**	0.301**	0.397**	0.328**	0.224**	1									
RT2	20.08	10.163	0.168**	0.197**	0.229**	0.167**	0.163**	0.091	0.140*	0.188**	0.257**	0.226**	0.168**	0.400**	1								
RT3	30.20	10.191	0.156**	0.156**	0.181**	0.220**	0.216**	0.269**	0.257**	0.268**	0.345**	0.252**	0.191**	0.389**	0.524**	1							
RT4	30.02	10.164	0.114*	0.201**	0.218**	0.281**	0.266**	0.258**	0.236**	0.259**	0.311**	0.253**	0.193**	0.302**	0.520**	0.580**	1						
I1	30.20	10.154	0.113*	0.160**	0.181**	0.160**	0.133*	0.152**	0.130*	0.213**	0.298**	0.243**	0.288**	0.233**	0.157**	0.229**	0.103	1					
I2	30.33	10.183	0.171**	0.126*	0.167**	0.180**	0.185**	0.166**	0.181**	0.258**	0.315**	0.327**	0.307**	0.437**	0.323**	0.281**	0.258**	0.550**	1				
I3	30.09	10.068	0.168**	0.195**	0.218**	0.115*	0.106	0.090	0.137*	0.206**	0.259**	0.208**	0.248**	0.337**	0.236**	0.270**	0.220**	0.478**	0.540**	1			
I4	20.60	10.242	0.139*	0.205**	0.219**	0.203**	0.255**	0.223**	0.156**	0.212**	0.228**	0.195**	0.295**	0.414**	0.279**	0.228**	0.221**	0.408**	0.459**	0.311**	1		
I5	30.13	10.216	0.239**	0.263**	0.274**	0.199**	0.261**	0.204**	0.310**	0.343**	0.411**	0.346**	0.373**	0.397**	0.336**	0.313**	0.288**	0.475**	0.605**	0.504**	0.437**	1	
I6	20.96	10.012	0.167**	0.220**	0.185**	0.168**	0.201**	0.154**	0.213**	0.297**	0.268**	0.272**	0.313**	0.356**	0.200**	0.261**	0.190**	0.383**	0.486**	0.674**	0.362**	0.645**	1

SD standard deviation

**p-value < 0.01; *p-value < 0.05

Abbreviations

CEO	Chief executive officer
CFL	CEOs' financial literacy
FL	Financial literacy
MCS	Management control systems
PLS	Partial least squares path-modelling
RBV	Resources based view
SEM	Structural equation modelling
SMEs	Small and medium enterprises
UET	Upper echelon theory

Acknowledgements
Not applicable.

Author contributions
AD contributed to the development of the conceptual idea, recruited participants, design of the study, performed literature review, writing results and discussion and drafted the manuscript. JDS contributed to the development of the conceptual idea, design of the study, helped to recruit participants and performed writing of results and discussion. AMG participated in the design of the study, contributed to the development of the experiment and conducted the statistical analysis. All authors read and approved the final version of manuscript.

Funding
No specific source of funding.

Availability of data and materials
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests
No potential competing interest was reported by the authors.

Received: 29 March 2022 Accepted: 1 November 2022
Published online: 08 January 2023

References

Ahrens T, Chapman CS (2004) Accounting for flexibility and efficiency: a field study of management control systems in a restaurant chain. Contemp Acc Res 21(2):271–301. https://doi.org/10.1506/VJR6-RP75-7GUX-XH0X
Akbari M, Khodayari M, Danesh M, Davari A, Padash H (2020) A bibliometric study of sustainable technology research. Cogent Bus Manag 7(1):1751906. https://doi.org/10.1080/23311975.2020.1751906
Anwar M, Shuangjie L, Ullah R (2020) Business experience or financial literacy? Which one is better for opportunity recognition and superior performance? Bus Strat Dev 3(3):377–387. https://doi.org/10.1002/bsd2.103
Arsawan IWE, Koval V, Rajiani I, Rustiarini NW, Supartha WG, Suryantini NPS (2022) Leveraging knowledge sharing and innovation culture into SMEs sustainable competitive advantage. Int J Product Perform Manag 71(2):405–428. https://doi.org/10.1108/IJPPM-04-2020-0192
Arzubiaga U, Maseda A, Iturralde T (2019) Exploratory and exploitative innovation in family businesses: the moderating role of the family firm image and family involvement in top management. Rev Manag Sci 13:1–31. https://doi.org/10.1007/s11846-017-0239-y
Bannier CE, Neubert M (2016) Gender differences in financial risk-taking: the role of financial literacy and risk tolerance. Econ Lett 145:130–135. https://doi.org/10.1016/j.econlet.2016.05.033
Baporikar N, Akino S (2020) Financial literacy imperative for success of women entrepreneurship. Int J Innov Digit Econ 11(3):1–21. https://doi.org/10.4018/IJIDE.2020070101
Barney J (1991) Firm resources and sustained competitive advantage. J Manag 17(1):99–120. https://doi.org/10.1177/014920639101700108
Barrett G, Dooley L, Bogue J (2021) Open innovation within high-tech SMEs: a study of the entrepreneurial founder's influence on open innovation practices. Technovation 103:102232. https://doi.org/10.1016/j.technovation.2021.102232
Barroso C, Cepeda G, Roldán JL (2010) Applying maximum likelihood and PLS on different sample sizes: studies on SERVQUAL model and employee behavior model. In: Esposito VV, Chin WW, Henseler J, Wang H (eds) Handbook of partial least squares. Springer, Berlin
Bay C, Catasús B, Johed G (2014) Situating financial literacy. Crit Perspect Acc 25(1):36–45. https://doi.org/10.1016/j.cpa.2012.11.011
Bedford DS (2015) Management control systems across different modes of innovation: implications for firm performance. Manag Acc Res 28:12–30. https://doi.org/10.1016/j.mar.2015.04.003
Bisbe J, Otley D (2004) The effects of the interactive use of management control systems on product innovation. Acc Org Soc 29(8):709–737. https://doi.org/10.1016/j.aos.2003.10.010

Braumann EC, Grabner I, Posch A (2020) Tone from the top in risk management: a complementarity perspective on how control systems influence risk awareness. Acc Org Soc 84:101128. https://doi.org/10.1016/j.aos.2020.101128
Buratti S, Allwood CM (2018) The effect of knowledge and ignorance assessments on perceived risk. J Risk Res 22(6):1–14. https://doi.org/10.1080/13669877.2018.1459795
Cabrales ÁL, Medina CC, Lavado AC, Cabrera RV (2008) Managing functional diversity, risk-taking and incentives for teams to achieve radical innovations. R&D Manag 38(1):35–50. https://doi.org/10.1111/j.1467-9310.2007.00501.x
Calabrò A, Vecchiarini M, Gast J, Campopiano G, De Massis A, Kraus S (2019) Innovation in family firms: a systematic literature review and guidance for future research. Int J Manag Rev 21(3):317–355. https://doi.org/10.1111/ijmr.12192
Chatzoglou P, Chatzoudes D (2018) The role of innovation in building competitive advantages: an empirical investigation. Eur J Innov Manag 21(1):44–69. https://doi.org/10.1108/EJIM-02-2017-0015
Chenhall RH, Moers F (2016) The role of innovation in the evolution of management accounting and its integration into management control. Acc Org Soc 47(1):1–13. https://doi.org/10.1016/j.aos.2015.10.002
Chepngetich P (2016) Effect of financial literacy and performance SMEs. Evidence from Kenya. Am Based Res J 5(11):26–35
Chin WW (1998) Issues and opinion on structural equation modeling. MIS Q 22(1):7–16
Chin WW (2010) How to write up and report PLS analyses. In: Vinzi VE, Chin WW, Henseler J, Wang H (eds) Handbook of partial least squares: concepts, methods and applications. Springer, New York
Choi SB, Lee SH, Williams C (2011) Ownership and firm innovation in a transition economy: evidence from China. Res Policy 40:441–452. https://doi.org/10.1177/0001839216674457
Colbert BA (2004) The complex resource-based view: implications for theory and practice in strategic human resource resource management. Acad Manag Rev 29(3):341–358. https://doi.org/10.5465/amr.2004.13670987
Collier PM, Berry AJ, Burke G (2004) Risk and control: drivers, practices and consequence. Chartered Institute of Management Accountant, Oxford
Colovic A (2021) Leadership and business model innovation in late internationalizing SMEs. Long Range Plan. https://doi.org/10.1016/j.lrp.2021.102083
Cosenz F, Bivona E (2021) Fostering growth patterns of SMEs through business model innovation. A tailored dynamic business modelling approach. J Bus Res 130:658–669. https://doi.org/10.1016/j.jbusres.2020.03.003
Cosenz F, Noto L (2015) Combining system dynamics modelling and management control systems to support strategic learning processes in SMEs: a dynamic performance management approach. J Manag Control 26(2–3):225–248. https://doi.org/10.1007/s00187-015-0208-z
Covin JG, Slevin DP (1989) Strategic management of small firms in hostile and benign environments. Strateg Manag J 10:75–87. https://doi.org/10.1002/smj.4250100107
Craig JB, Pohjola M, Kraus S, Jensen SH (2014) Exploring relationships among proactiveness, risk-taking and innovation output in family and non-family firms. Creat Innov Manag 23(2):199–210. https://doi.org/10.1111/caim.12052
Crossan MM, Apaydin M (2010) A multi-dimensional framework of organizational innovation: a systematic review of the literature. J Manag Stud 47(6):1154–1191. https://doi.org/10.1111/j.1467-6486.2009.00880.x
Crossan MM, Lane HW, White RE (1999) An organizational learning framework: from intuition to institution. Acad Manag Rev 24:522–537. https://doi.org/10.5465/amr.1999.2202135
De Kok JM, Uhlaner LM, Thurik AR (2006) Professional HRM practices in family owned-managed enterprises. J Small Bus Manag 44(3):441–460. https://doi.org/10.1111/j.1540-627X.2006.00181.x
Dijkstra TK, Henseler J (2015) Consistent partial least squares path modeling. MIS Q 39(2):297–316
DIRCE (2020) Directorio central de empresas. Instituto Nacional de Estadística, Madrid
Donbesuur F, Ampong GOA, Owusu-Yirenkyi D, Chu I (2020) Technological innovation, organizational innovation and international performance of SMEs: The moderating role of domestic institutional environment. Technol Forecast Soc Change 161:120252. https://doi.org/10.1016/j.techfore.2020.120252
Duran P, Kammerlander N, van Essen M, Zellweger T (2016) Doing more with less: innovation input and output in family firms. Acad Manag J 59(4):1224–1264. https://doi.org/10.5465/amj.2014.0424
Duréndez A, Ruíz-Palomo D, García-Pérez-de-Lema D, Diéguez-Soto J (2016) Management control systems and performance in small and medium family firms. Eur J Fam Bus 6(1):10–20. https://doi.org/10.1016/j.ejfb.2016.05.001
Eniola AA, Entebang H (2017) SME managers and financial literacy. Glob Bus Rev 18(3):559–576. https://doi.org/10.1177/0972150917692063
Feranita F, Ruiz-Palomo D, Diéguez-Soto J (2021) The role of family management and management control systems in promoting technological innovation in family SMEs. Eur J Fam Bus. https://doi.org/10.24310/ejfbejfb.v11i2.10901
Ganesh L, Mehta A (2010) Critical success factors for successful enterprise resource planning implementation at Indian SMEs. Int J Bus Manag Soc Sci 1(1):65–78
García-Granero A, Llopis O, Fernández-Mesa A, Alegre J (2015) Unraveling the link between managerial risk-taking and innovation: the mediating role of a risk-taking climate. J Bus Res 68(5):1094–1104. https://doi.org/10.1016/j.jbusres.2014.10.012
García-Lopera F, Santos-Jaén JM, Palacios-Manzano M, Ruiz-Palomo D (2022) Exploring the effect of professionalization, risk-taking and innovation on business performance. PLoS ONE 17(2):e0263694. https://doi.org/10.1371/journal.pone.0263694
García-Pérez-de-Lema D, Ruiz-Palomo D, Diéguez-Soto J (2021) Analysing the roles of CEO's financial literacy and financial constraints on Spanish SMEs technological innovation. Technol Soc 64:101519. https://doi.org/10.1016/j.techsoc.2020.101519
Geyer A (2016) Family decision makers in FBs, their growth intentions and actual firm growth: the influence of different levels of family and personal involvement in the firm. The growth behavior of family firms. Springer Gabler, Wiesbaden, pp 231–291
Giaccone SC, Magnusson M (2022) Unveiling the role of risk-taking in innovation: antecedents and effects. R&D Manag 52:93–107. https://doi.org/10.1111/radm.12477

Gilley KM, Walters BA, Olson BJ (2002) Top management team risk- taking propensities and firm performance: direct and moderating effects. J Bus Strateg 19(2):95–114
Gilson LL, Shalley CE (2004) A little creativity goes a long way: an examination of teams' engagement in creative processes. J Manag 30(4):453–470. https://doi.org/10.1016/j.jm.2003.07.001
Goffee R (1996) Understanding family businesses: issues for further research. Int J Entrep Behav Res 2(1):36–48. https://doi.org/10.1108/13552559610110709
Guimaraes T, Paranjape K (2017) The effect of organization innovativeness on company innovation success. Int J Acad Bus World 11(2):81–94
Győri Á, Czakó Á, Horzsa G (2019) Innovation, financial culture, and the social-economic environment of SMEs in hungary. East Eur Polit Soc 33(4):976–1004. https://doi.org/10.1177/0888325419844828
Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL (2009) Análise multivariada de dados. Bookman, New Delhi
Hair J, Ringle C, Sarstedt M (2011) PLS-SEM: indeed a silver bullet. J Mark Theory Pract 19:139–151. https://doi.org/10.2753/MTP1069-6679190202
Hair JF, Hult GTM, Ringle CM, Sarstedt M, Thiele KO (2017) Mirror, mirror on the wall: a comparative evaluation of composite-based structural equation modeling methods. J Acad Mark Sci 45(5):616–632. https://doi.org/10.1007/s11747-017-0517-x
Hambrick DC (2007) Upper echelons theory: an update. Acad Manag Rev 32(2):334–343. https://doi.org/10.5465/amr.2007.24345254
Hambrick DC, Mason PA (1984) Upper echelons: the organization as a reflection of its top managers. Acad Manag Rev 9(2):193–206. https://doi.org/10.5465/amr.1984.4277628
Hasan M, Le T, Hoque A (2021) How does financial literacy impact on inclusive finance? Financ Innov 7(1):1–23. https://doi.org/10.1186/s40854-021-00259-9
Henri JF (2006) Management control systems and strategy: a resource-based perspective. Acc Org Soc 31(6):529–558. https://doi.org/10.1016/j.aos.2005.07.001
Henri JF, Wouters M (2020) Interdependence of management control practices for product innovation: the influence of environmental unpredictability. Acc Org Soc 86:101073. https://doi.org/10.1016/j.aos.2019.101073
Henseler J, Ringle CM, Sinkovics RR (2009) The use of partial least squares path modelling in international marketing. Adv Int Mark 20:277–320. https://doi.org/10.1108/S1474-7979(2009)0000020014
Henseler J, Hubona G, Ray PA (2016) Using PLS path modeling in new technology research: updated guidelines. Ind Manag Data Syst 116(1):2–20. https://doi.org/10.1108/IMDS-09-2015-0382
Hiebl MRW (2014) A finance professional who understands the family: family firms' specific requirements for non-family chief financial officers. Rev Manag Sci 8:465–494. https://doi.org/10.1007/s11846-013-0112-6
Hilmersson FP, Hilmersson M (2021) Networking to accelerate the pace of SME innovations. J Innov Knowl 6(1):43–49. https://doi.org/10.1016/j.jik.2020.10.001
Hsiao YJ, Tsai WC (2018) Financial literacy and participation in the derivatives markets. J Bank Financ 88:15–29. https://doi.org/10.1016/j.jbankfin.2017.11.006
Hughes A (2001) Innovation and business performance: small entrepreneurial firms in the UK and the EU. New Econ 8(3):157–163
Hult GT, Hair JF, Proksch D, Sarstedt M, Pinkwart A, Ringle CM (2018) Addressing endogeneity in international marketing applications of partial least squares structural equations modeling. J Int Mark 26(3):1–21. https://doi.org/10.1509/jim.17.0151
Hutahayan B (2021) The relationships between market orientation, learning orientation, financial literacy, on the knowledge competence, innovation, and performance of small and medium textile industries in Java and Bali. Asia Pac Manag Rev 26(1):39–46. https://doi.org/10.1016/j.apmrv.2020.07.001
Iramani NA, Fauzi AA, Wulandari DA, Lutfi NA (2018) Financial literacy and business performances improvement of micro, small, medium-sized enterprises in East Java Province, Indonesia. Int J Educ Econ Dev 9(4):303–323. https://doi.org/10.1504/IJEED.2018.096069
Kammerlander N, Burger D, Fust A, Fueglistaller U (2015) Exploration and exploitation in established small and medium-sized enterprises: the effect of CEOs' regulatory focus. J Bus Ventur 30:582–602. https://doi.org/10.1016/j.jbusvent.2014.09.004
Koropp C, Grichnik D, Kellermanns F (2013) Financial attitudes in family firms: the moderating role of family commitment. J Small Bus Manag 51(1):114–137. https://doi.org/10.1111/j.1540-627X.2012.00380.x
Kou G, Chao X, Peng Y, Alsaadi FE, Herrera-Viedma E (2019) Machine learning methods for systemic risk analysis in financial sectors. Technol Econ Dev Econ 25(5):716–742. https://doi.org/10.3846/tede.2019.8740
Kou G, Xu Y, Peng Y, Shen F, Chen Y, Chang K, Kou S (2021) Bankruptcy prediction for SMEs using transactional data and two-stage multiobjective feature selection. Decis Support Syst 140:113429. https://doi.org/10.1016/j.dss.2020.113429
Kraiczy ND, Hack A, Kellermanns FW (2014) New product portfolio performance in family firms. J Bus Res 67(6):1065–1073. https://doi.org/10.1016/j.jbusres.2013.06.005
Kraus S, Kailer N, Dorfer J, Jones P (2020) Open innovation in (young) SMEs. Int J Entrep Innov 21(1):47–59. https://doi.org/10.1177/1465750319840778
Kulathunga K, Ye J, Sharma S, Weerathunga PR (2020) How does technological and financial literacy influence SME performance: mediating role of ERM practices. Information (switz) 11(6):297. https://doi.org/10.3390/INFO11060297
Latham SF, Braun M (2009) Managerial risk, innovation, and organizational decline. J Manag 35(2):258–281. https://doi.org/10.1177/0149206308321549
Lee JW (2021) Analysis of technology-related innovation characteristics affecting the survival period of SMEs: focused on the manufacturing industry of Korea. Technol Soc 67:101742. https://doi.org/10.1016/j.techsoc.2021.101742
Li T, Kou G, Peng Y, Philip SY (2021) An integrated cluster detection, optimization, and interpretation approach for financial data. IEEE Trans Cybern. https://doi.org/10.1109/TCYB.2021.3109066

Liem VT, Hien NN (2020) Exploring the impact of dynamic environment and CEO's psychology characteristics on using management accounting system. Cogent Bus Manag 7(1):1712768. https://doi.org/10.1080/23311975.2020.1712768
Ling Y, Simsek Z, Lubatkin M, Veiga J (2008) Transformational leadership's role in promoting corporate entrepreneurship: examining the CEO-TMT interface. Acad Manag J 21(3):557–576. https://doi.org/10.1037/0021-9010.93.4.923
Liu K, Li J, Hesterly W, Cannella A (2012) Top management team tenure and technological inventions at post-IPO biotechnology firms. J Bus Res 65:1349–1356. https://doi.org/10.1016/j.jbusres.2011.09.024
Liu B, Wang J, Chan KC, Fung A (2021) The impact of entrepreneurs's financial literacy on innovation within small and medium-sized enterprises. Int Small Bus J 39(3):228–246. https://doi.org/10.1177/0266242620959073
Mabula JB, Dong H (2018) Use of technology and financial literacy on SMEs practices and performance in developing economies. Int J Adv Comput Sci Appl 9:74–82
Madrid-Guijarro A, Martin DP, García-Pérez-de-Lema D (2021) Capacity of open innovation activities in fostering product and process innovation in manufacturing SMEs. Rev Manage Sci 15(7):2137-2164. https://doi.org/10.1007/s11846-020-00419-8
Martínez-Alonso R, Martínez-Romero MJ, Rojo-Ramírez AA (2022) Refining the influence of family involvement in management on firm performance: the mediating role of technological innovation efficiency. Bus Res Q 25(4):337–351. https://doi.org/10.1177/2340944420957330
Martins EC, Terblanche F (2003) Building organizational culture that stimulates creativity and innovation. Eur J Innov Manag 6(1):64–74. https://doi.org/10.1108/14601060310456337
McMahon RGP (2001) Business growth and performance and the financial reporting practices of Australian manufacturing SME's. J Small Bus Manag 30(2):152–165. https://doi.org/10.1177/0266242601193001
Molina-García A, Florido-Ruiz B, Campos Valenzuela M, Diéguez-Soto J (2020) The effect of family ownership and generation on financial literacy. Small Bus Int Rev 4(1):1–15. https://doi.org/10.26784/sbir.v4i1.236
Molina-García A, Diéguez-Soto J, Galache-Laza MT (2022) Financial literacy in SMEs: a bibliometric analysis and a systematic literature review of an emerging research field. Rev Manag Sci. https://doi.org/10.1007/s11846-022-00556-2
Mumford MD, Licuanan B (2004) Leading for innovation: conclusions, issues, and directions. Leadersh Q 15:163–171. https://doi.org/10.1016/j.leaqua.2003.12.010
Musteen M, Francis J, Datta DK (2010) The influence of international networks on internationalization speed and performance: a study of Czech SMEs. J World Bus 45(3):197–205. https://doi.org/10.1016/j.jwb.2009.12.003
Nkundabanyanga SK, Kasozi D, Nalukenge I, Tauringana V (2014) Lending terms, financial literacy and formal credit accessibility. Int J Soc Econ 41(5):342–361. https://doi.org/10.1108/IJSE-03-2013-0075
Nwachukwv S, Vitell S, Gilbert F, Barnes J (1997) Ethics and social responsibility in marketing: an examination of the ethics evaluation of advertising strategies. J Bus Res 39(2):107–118. https://doi.org/10.1016/S0148-2963(96)00146-4
O'Connor GC, Ravichandran T, Robeson D (2008) Risk management through learning: management practices for radical innovation success. J High Technol Manag Res 19(1):70–82. https://doi.org/10.1016/j.hitech.2008.06.003
OECD (2018) OECD/INFE toolkit for measuring financial literacy and financial inclusion. https://www.OECD.org/financial/education/2018-INFE-FinLit-Measurement-Toolkit.pdf. Accessed 10 Apr 2021
Park S, Gupta S (2012) Handling endogenous regressors by joint estimation using copulas. Mark Sci 31(4):567–586. https://doi.org/10.1287/mksc.1120.0718
Pérez-Luño A, Wiklund J, Cabrera RV (2011) The dual nature of innovative activity: how entrepreneurial orientation influences innovation generation and adoption. J Bus Ventur 26:555–571. https://doi.org/10.1016/j.jbusvent.2010.03.001
Pešalj B, Pavlov A, Micheli P (2018) The use of management control and performance measurement systems in SMEs. Int J Oper Prod Man 38(11):2169–2191. https://doi.org/10.1108/IJOPM-09-2016-0565
Podsakoff PM, Organ DW (1986) Self-reports in organizational research: problems and prospects. J Manag 12(4):531–544. https://doi.org/10.1177/014920638601200408
Price DP, Stoica M, Boncella RJ (2013) The relationship between innovation, knowledge, and performance in family and non-family firms: an analysis of SMEs. J Innov Entrep 2(1):1–20. https://doi.org/10.1186/2192-5372-2-14
Ramírez-Orellana A, Ruiz-Palomo D, Rojo-Ramírez A, Burgos-Burgos J (2022) The ecuadorian banana farm managers perception: innovation as a driver of environmental sustainability practices. Agriculture 11(3):213. https://doi.org/10.3390/agriculture11030213
Ramsey JB (1969) Tests for specification errors in classical linear least-squares regression analysis. J R Stat Soc Ser B (methodol) 31:350–371
Razavi SMH, Nargesi GR, Hajihoseini H, Akbari M (2016) The impact of technological innovation capabilities on competitive performance of Iranian ICT firms. Iran J Manag Stud 9(4):855–882. https://doi.org/10.22059/ijms.2017.59912
Riepe J, Rudeloff M, Veer T (2022) Financial literacy and entrepreneurial risk aversion. J Small Bus Manag 60(2):289–308. https://doi.org/10.1080/00472778.2019.1709380
Roldán JL, Sánchez-Franco MJ (2012) Variance-based structural equation modelling. In: Mora M, Gelman O, Steenkamp AL, Raisinghani M (eds) Research methodologies, innovations and philosophies in software systems engineering and information systems. IGI Global, Hershey, pp 193–221
Rostamkalaei A, Nitani M, Riding A (2022) Self-employment, financial knowledge, and retirement planning. J Small Bus Manage 60(1):63–92. https://doi.org/10.1080/00472778.2019.1695497
Ruiz-Palomo D, Fernández-Gámez MA, León-Gómez A (2022) Analyzing the effect of financial constraints on technological and management innovation in SMEs: a gender perspective. SAGE Open. https://doi.org/10.1177/21582440221079925
Sandino T (2007) Introducing the first management control systems: evidence from the retail sector. Account Rev 82(1):265–293. https://doi.org/10.2308/accr.2007.82.1.265
Santana NB, Rebelatto DAD, Perico AE, Moralles HF, Leal W (2015) Technological innovation for sustainable development: an analysis of different types of impacts for countries in the BRICS and G7 groups. Int J Sustain Dev World Ecol 22(5):425–436. https://doi.org/10.1080/13504509.2015.1069766
Sarstedt M, Mooi E (2019) Hypothesis testing and anova. A concise guide to market research. Springer, Berlin, pp 151–208

Sarstedt M, Ringle CM, Henseler J, Hair JF (2014) On the emancipation of PLS-SEM: a commentary on Rigdon (2012). Long Range Plan 47:154–160. https://doi.org/10.1016/j.lrp.2014.02.007
Sarstedt M, Hair JF, Ringle CM, Thiele KO, Gudergan SP (2016) Estimation Issues with PLS and CBSEM: Where the Bies Lies!. J Busi Res 69(10):3998–4010. https://doi.org/10.1016/j.jbusres.2016.06.007
Sarstedt M, Ringle CM, Cheah JH, Ting H, Moisescu OI, Radomir L (2020) Structural model robustness checks in PLS-SEM. Tour Econ 26(4):531–554. https://doi.org/10.1177/1354816618823921
Serra CEM, Kunc M (2015) Benefits realisation management and its influence on project success and on the execution of business strategies. Int J Proj Manag 33(1):53–66. https://doi.org/10.1016/j.ijproman.2014.03.011
Sharif N, Huang C (2012) Innovation strategy, firm survival and relocation: the case of Hong Kong-owned manufacturing in Guangdong Province, China. Res Policy 41(1):69–78. https://doi.org/10.1016/j.respol.2011.06.003
Simon HA (1987) Making management decisions: The role of intuition and emotion. Acad Manage Perspect 1(1):57–64. https://doi.org/10.5465/ame.1987.4275905
Simons R (1990) The role of management control systems in creating competitive advantage: new perspectives. Acc Organ Soc 15(1–2):127–143. https://doi.org/10.1016/0361-3682(90)90018-P
Simons R (1995) Levers of control: how managers use innovative systems to drive strategic renewal. Harvard Business School, Boston
Sirmon D, Hitt M (2003) Managing resources: linking unique resources, management and wealth creation in family firms. Entrep Theory Pract 27:339–358. https://doi.org/10.1111/1540-8520.t01-1-00013
Sitkin SB, Pablo AL (1992) Reconceptualizing the determinants of risk behavior. Acad Manag Rev 17(1):9–38. https://doi.org/10.5465/amr.1992.4279564
Sitkin SB, Weingart LR (1995) Determinants of risky decision-making behavior: a test of the mediating role of risk perceptions and propensity. Acad Manage J 38(6):1573–1592. https://doi.org/10.5465/256844
Smith KG, Smith KA, Olian JD, Sims HP, O'Bannon DP, Scully JA (1994) Top management team demography and process: the role of social integration and communication. Admin Sci Quart 39:412–438. https://doi.org/10.2307/2393297
Songling Y, Ishtiaq M, Anwar M (2018) Enterprise risk management practices and firm performance, the mediating role of competitive advantage and the moderating role of financial literacy. J Risk Financ Manag 11(3):35. https://doi.org/10.3390/jrfm11030035
Talke K, Salomo S, Rost K (2010) How top management team diversity affects innovativeness and performance via the strategic choice to focus on innovation fields. Res Policy 39(7):907–918. https://doi.org/10.1016/j.respol.2010.04.001
Tian G, Zhou S, Hsu S (2020) Executive financial literacy and firm innovation in China. Pac-Basin Financ J 62:101348. https://doi.org/10.1016/j.pacfin.2020.101348
Werner A, Schröder C, Chlosta S (2018) Driving factors of innovation in family and non-family SMEs. Small Bus Econ 50:201–218. https://doi.org/10.1007/s11187-017-9884-4
Wu S, Levitas E, Priem RL (2005) GEO tenure and company invention under differing levels of techno- logical dynamics. Acad Manage J 48:859–873. https://doi.org/10.5465/amj.2005.18803927
Yang J (2012) Innovation capability and corporate growth: an empirical investigation in China. J Eng Tech Manage 29(1):34–46. https://doi.org/10.1016/j.jengtecman.2011.09.004
Ye J, Kulathunga K (2019) How does financial literacy promote sustainability in SMEs? A developing country perspective. Sustainability (switz) 11(10):2990. https://doi.org/10.3390/su11102990
Yuan F, Woodman RW (2010) Innovative behavior in the workplace: the role of performance and image out- come expectations. Acad Manag J 53(2):323–342. https://doi.org/10.5465/amj.2010.49388995
Zhou KZ (2006) Innovation, imitation, and new product performance: the case of China. Ind Market Manag 35:394–402. https://doi.org/10.1016/j.indmarman.2005.10.006

Publisher's Note