



When less is more: resource constraints and radical innovation in family firms and non-family firms

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ABSTRACT

While radical innovation is crucial for long-term organizational success, resource constraints often challenge endeavors toward novel ideas, products, and services. Although there is increasing evidence of the positive impact of resource constraints on radical innovation performance, much still needs to be uncovered regarding the conditions that facilitate this positive impact. Drawing on the recombinative innovation perspective, we explicate the positive impact of knowledge and financial constraints on radical innovation. Moreover, we identify firm type—specifically the distinction between family and non-family firms—as a crucial organizational contingency that sheds more light on the focal relationship. Using data from a broad sample of Belgian firms, we find support for our hypothesis that financial constraints can spur a higher likelihood of introducing radical innovation. Moreover, family firms can better transform knowledge constraints into radical innovation, whereas non-family firms are better at generating radical innovation from financial constraints. By considering the impact of organizational characteristics on firms' ability to innovate from specific constraints radically, we deliver more detailed results on the link between resource constraints and radical innovation.

1. Introduction

Can resource constraints promote radical innovation (RI)? This question has profound implications for both academia and practitioners because RI can drive organizational success by producing “fundamental changes in the firm's products, processes, technologies and organizational structure and methods” (Forés & Camisón, 2016, p. 833). RI can reshape a competitive landscape by considerably reducing costs, rendering current offerings obsolete, or creating new markets (de Groot et al., 2021; Gomes et al., 2019), leading to long-term organizational success (McDermott & O'Connor, 2002), stronger growth, and higher profitability after global crises (Ali, 2021; Roper & Turner, 2020).

Resource constraints are one of the major topics in RI research, as evidenced by their discussion in 44 out of 103 articles in Sandberg and Aarikka-Stenroos's (2014) systematic review. Traditionally, strategic management scholars portrayed resource constraints as inhibitors of innovation, suggesting that resource abundance fosters willingness to take risks and ability to invest (e.g., Barney, 1991; Cyert & March, 1963). This perspective, however, contrasts with many observations of organizations thriving despite significant resource constraints. Thus, scholars from the

entrepreneurship field have contested this view, pointing to the potential cognitive benefits of resource limitations such as the enhancement of creativity (Acar et al., 2018). An increasing body of research also underscores the application of entrepreneurial strategies to exploit resource constraints, such as bricolage and resource recombination, not only in startups but also within established organizations (Chang et al., 2022).

Amidst the tension between these opposing theoretical perspectives, two pivotal questions emerge: can resource constraints promote RI and if so, under what conditions does resource scarcity foster innovation (Gibbert et al., 2014)? As highlighted by Gibbert et al. (2014), “if we found an answer to this question [i.e., under what conditions], product innovation management and even management at large would have to be rewritten” (p.199). With this study, we would like to join this important conversation by investigating if and under which conditions resource constraints in innovation activities can become advantageous, particularly in advancing organizational RI.

Emerging evidence suggests that the effects of resource constraints on innovative performance are pertinent to industry conditions (e.g., market size, market competitiveness) and individual- or team-level characteristics (e.g., novelty-seeking individuals, high team climate for

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innovation) (Katila & Shane, 2005; Scopelliti et al., 2014; Voss et al., 2008; Weiss et al., 2011). However, firm type—specifically, the distinction between family and non-family firms—as a contingency has been largely overlooked. By definition, “family firms are those characterized by high levels of family control, realized, for instance, through voting rights, managerial involvement, or family values and culture” (Duran et al., 2016, p. 1227). Unlike non-family firms, they often prioritize non-financial goals (Gomez-Mejia et al., 2011), which shapes their decision-making in high-risk activities such as acquisitions (Hussinger & Issah, 2019), internationalization (Arregle et al., 2017), and discontinuous innovations (König et al., 2013). This focus on nonfinancial goals may also influence how family firms convert resource constraints into RIs differently from non-family firms.

Existing studies on resource constraints in family firms are fragmented, focusing on how *each* firm type, i.e., family and non-family firms, can manage their resources to enhance RI (e.g., Chirico et al., 2022; Covin et al., 2016; Hu et al., 2022). Furthermore, the findings are equivocal. Some studies find that resource-constrained family firms are more adept at pursuing RI (Hu et al., 2022), while others indicate the opposite (Covin et al., 2016). These mixed results highlight the need for a more comprehensive theoretical and empirical examination of whether family firms differ from non-family firms in their likelihood of introducing RIs under different types of resource constraints. Such an inquiry could broaden our understanding of when resource constraints become advantageous and provide deeper insights into the competitive advantage of family firms—the most prevalent organizational form worldwide (La Porta et al., 1999)—in driving RI.

Our theoretical arguments are developed by integrating two streams of management science: the entrepreneurship literature and family business research. Entrepreneurship literature directs us to the recombinative innovation perspective, rooted in Schumpeter's (1934, p. 68) idea that innovation is the “result of carrying out new combinations.” This perspective has been increasingly adopted to describe the innovation process as creating something new out of existing elements (Savino et al., 2017; Xiao et al., 2021), with RIs frequently stemming from a recombination of already existing knowledge rather than completely new knowledge (Hargadon, 2003; Schoenmakers & Duysters, 2010). It thus provides a strong foundation for theorizing how firms under resource constraints repurpose resources for RI. Moreover, as firms vary tremendously in their resource recombination ability (Baker & Nelson, 2005; Savino et al., 2017), we build on this perspective to further theorize how family and non-family firms differ in leveraging different types of resource constraints.

Family business research guides us to the idiosyncrasies of family firms, especially what could cause the variance in firms' resource recombination ability. Specifically, family firms are typically distinct from non-family firms regarding their stewardship orientation toward stakeholders (Davis et al., 2010; Huybrechts et al., 2011; Miller et al., 2008) and the families' exceptional levels of wealth concentration in the firms (Anderson et al., 2003). Therefore, we further delve into how these idiosyncrasies influence family and non-family firms' resource recombination abilities to manage the specified resource challenges to achieve RIs.

Empirically, we analyzed data from 320 Belgian potential innovators (hereafter, firms)¹ in the Flemish Community Innovation Survey

(2008–2012). Our lagged variable models reveal that financial constraints can, in fact, increase the likelihood of introducing RIs. Importantly, we uncover a key contingency: family firms are more effective in transforming knowledge constraints, whereas non-family firms are better at converting financial constraints into RIs.

Our contributions are threefold. First, we enrich entrepreneurship research that sees constraints not merely as limitations but also as potential sources of innovation by theorizing and testing the direct effects of both knowledge and financial constraints on RIs. Moreover, we advance this line of inquiry by pinpointing how a crucial yet overlooked condition—family versus non-family firms—can shed further light on the relationship between specified resource constraints and RIs (Acar et al., 2018). As such, we heed the call to examine how the governance context such as ownership structure can facilitate or suppress resource constraint situations (Miller & Le Breton-Miller, 2021). Second, by zooming in on specific types of constraints and showing how these constraints can spur RI in family and non-family business contexts, we pinpoint the nuances across different resource constraints and their implications on RI in different governance contexts. Third, we advance family business research by embracing an approach of contradiction: rather than conforming to the conventional strategic management perspective, that more resources lead to better performance for family firms, we show when resource scarcity can enhance RI performance (Le Breton-Miller & Miller, 2023). This is indeed an understudied topic. Extant studies have reported cases wherein family firms can achieve high innovation performance despite their often precarious situations (De Massis et al., 2018; Lambrechts et al., 2017), but also that abundant market knowledge may reduce their willingness to pursue RI (Hu et al., 2022). Hence, we still know little about “which resources erode [innovation] performance” (Le Breton-Miller & Miller, 2023, p. 2) and how family and non-family firms may cope with—and at times even capitalize on—specific constraints (Heider et al., 2022) to generate RI. We provide new insights and evidence regarding the types of resource constraints that family firms transform more or less efficiently into RIs compared to non-family firms.

2. Literature review and hypothesis development

2.1. Impact of resource constraints on RIs

While resource constraints were traditionally perceived as a hindrance to innovation (e.g., Barney, 1991; Cyert & March, 1963), entrepreneurship literature increasingly provides compelling evidence that resource constraints can trigger, rather than inhibit, RIs. For instance, resource constraints, such as knowledge and financial constraints, are reported to promote RI performance (Du et al., 2007; Keupp & Gassmann, 2013; Kyriakopoulos et al., 2016). Likewise, Baker and Nelson (2005) report multiple cases where exceptional innovation outputs can be attained with limited resources. Firms can radically innovate by circumventing the constraints or uncovering opportunities within them (Gibbert & Scranton, 2009; van Burg et al., 2012). Conversely, perceived resource adequacy is linked to a decrease in the novelty of new products (Weiss et al., 2014). Building on this research stream, our study highlights the potential of resource constraints to enable RI (Keupp & Gassmann, 2013) and examines the specific conditions under which such constraints act as enablers of RI (Gibbert et al., 2014).

Concretely, our study theoretically and empirically examines whether family firms differ from non-family firms in their likelihood of introducing RIs from *perceived knowledge* and *financial constraints* (hereafter referred to as knowledge and financial constraints, respectively) (Chen & Shen, 2023; Keupp & Gassmann, 2013; Weiss et al., 2011). Knowledge constraints entail the lack of qualified personnel, the lack of information on technology/markets, and difficulty in finding cooperation partners for innovation. Financial constraints encompass the lack of funds within/outside the enterprise or group, and the high innovation costs. We focus on these specific constraints for three

¹ In line with established practices for studying the relationship between innovation barriers and innovation performance (e.g., D'Este et al., 2012; Pellegrino & Savona, 2017; Savignac, 2008), we do not include the so-called “non-innovators.” These are firms that, by deliberate choice, had not introduced any product or process innovations, were not in the process of doing so, and reported no barriers to innovation. “This exclusion is based on the rationale that these firms are unlikely to have any aspirations to innovate (at least, in the period considered in the survey)” (D'Este et al., 2012, p. 485). Thus, “it could be assessed that this group of firms did not wish to innovate and thus, that those firms were not concerned by obstacles to innovation in general” (Savignac, 2008, p.13) and by financial or knowledge constraints in particular.

reasons. First, knowledge and financial constraints are commonly seen as barriers to innovation performance (D'Este et al., 2012; Pellegrino & Savona, 2017) but can also catalyze RIs (Keupp & Gassmann, 2013). Such contradictions render them highly relevant for studying the conditions that influence their impact on RIs. Second, research has demonstrated how resource recombination can empower firms to transform resource constraints into drivers of innovation success, particularly in the context of knowledge and financial limitations (Chen & Shen, 2023; Keupp & Gassmann, 2013). As we build on the recombinative innovation perspective, our focus naturally centers on these specific constraints. Lastly, given the fragmented research on resource constraints in family firms' RIs predominantly focused on these two types of resources (Chirico et al., 2022; Covin et al., 2016; Hu et al., 2022), examining them may yield a more cohesive understanding of their roles.

Moreover, the fact that organization members reported these constraints enabled us to measure resource constraints as *perceived* constraints. This approach conforms with the literature showing that perceived resource adequacy leads individuals to adopt default solutions, whereas perceived constraints encourage broader search and more creative outcomes (Ward, 1994; Weiss et al., 2014). Furthermore, compared with industry-based benchmarks, perceived measures may more accurately capture the actual constraints of family businesses whose wealth is often concentrated in the business and thus underestimated by indirect measures.

Following Keupp and Gassmann (2013), who examine the impact of perceived knowledge and financial constraints on RIs, we draw on the recombinative innovation perspective to develop our baseline hypotheses. Compared to other perspectives, e.g., the "path of least resistance" model² (Ward, 1994), the recombinative innovation perspective directly demonstrates how firms act, i.e., mobilize resources at hand to generate RIs. Moreover, as firms differ in their recombination ability (Baker & Nelson, 2005; Savino et al., 2017), this lens is further suitable to examine the difference between family and non-family firms in their resource recombination ability to transform specified constraints into RIs.

An increasing number of entrepreneurship studies view novelty as arising from the recombination of existing components (e.g., Brown et al., 2001; Galunic & Rodan, 1998). Accordingly, the recombinative innovation perspective frames innovation as the outcome of recombining existing elements embedded within clusters of resources (e.g., machine, human, financial capital, know-how) (Fleming, 2001; Galunic & Rodan, 1998; Henderson & Clark, 1990). Firms are full of such clusters of resources due to their organizing activities (Grant, 1996), and recombination often results in technological or RI (Carnabuci & Operti, 2013; Katila & Ahuja, 2002). This recombination logic underpins much of entrepreneurship research (Acar et al., 2018; Xiao et al., 2021).

This logic has further been employed to explain how innovative products and services can be achieved given resource limitations (Baker & Nelson, 2005; Salunke et al., 2013), such as knowledge and financial constraints (Keupp & Gassmann, 2013). The knowledge pool of actors in the innovation process can be deemed a set of independent components; since components are highly malleable, they can be recombined in numerous ways to build new inventions (Kok et al., 2020). Knowledge constraints, in the forms of the lack of qualified personnel, lack of information on technology/markets, or difficulty in finding cooperation

partners for innovation, indicate the absence of established knowledge holders who might otherwise reinforce path dependency (Schreyögg & Sydow, 2011). Since path dependency often impedes novel ideas (Håkansson & Waluszewski, 2002), these constraints may open space for experimentation and knowledge recombination.

Researchers have repeatedly found strong evidence of knowledge recombination as a mechanism for RIs when studying innovative patents (Ahuja & Morris Lampert, 2001; Kaplan & Vakili, 2015; Rosenkopf & Nerkar, 2001), reinforcing the idea that RIs come from a recombination of already existing knowledge and are rarely based on completely new knowledge (Schoenmakers & Duysters, 2010). Furthermore, perceptions of knowledge constraints drive firms to enact entrepreneurial approaches such as resource recombination (Baker & Nelson, 2005), with higher perceived knowledge constraints positively correlating with increased resource recombination and innovation outcomes (Chen & Shen, 2023).

While several scholars suggest that the combination of limited resources at hand may lead to imperfect outcomes ("good enough"), or more incremental rather than radical departures (Senyard et al., 2009; Senyard et al., 2014), effective recombination of components at hand often requires experiments and experience with failures (Fleming & Sorenson, 2004; Xiao et al., 2021). This process generates experience-based knowledge, gradually extending a firm's knowledge scope and enabling it to identify both existing but overlooked and entirely new opportunities (Desa & Basu, 2013; Duymedjian & Rüling, 2010). Moreover, due to its trial-and-error and locally emergent characteristics, resource recombination often generates subjective, unexpected, tacit, and hard-to-imitate knowledge (Duymedjian & Rüling, 2010), shaping firms' idiosyncratic cognitive frameworks and enabling them to identify heterogeneous opportunities (Baron, 2006). Therefore, recombining limited resources at hand may expand both the quantity and diversity of opportunities (An et al., 2018), facilitating new idiosyncratic combinations (Di Domenico et al., 2010) and increasing the chance of RIs.

Given the mounting evidence on the positive impacts of knowledge constraints on RI and accounting for the theoretical explanations above, we develop the baseline hypothesis that:

Hypothesis 1. *The extent to which firms perceive knowledge constraints will be positively related to their likelihood of introducing radical innovations.*

Keupp and Gassmann (2013) note that firms facing financial constraints must strategically decide which innovation activities to prioritize, delay, or discontinue (Galia & Legros, 2004). When financial resources fall below desired levels, firms often become more risk-tolerant as they strive to reach the targets (Bowman, 1982), which increases their willingness to experiment. Overall, these firms are compelled to maximize their scarce financial resources, often leading to more entrepreneurial and innovative strategies (Mosakowski, 2002).

Resource recombination also helps explain how financially constrained firms mobilize resources to engender RIs (Keupp & Gassmann, 2013). Kalogerakis et al. (2010) highlight the use of inventive analogies as a powerful strategy for new product idea generation under financial constraints. In this process, firms actively search for situations, processes, or structures in other domains that can serve as analogies to the problem at hand, then adapt the underlying principles or mechanisms to their context. Since analogies draw on existing knowledge rather than new development, they allow innovation without substantial financial investment. Moreover, the solution novelty depends on the analogical distance: analogies of medium distance (i.e., other-product category analogies) can yield new-to-the-market RIs without compromising budget. In this case, firms collect experiences/knowledge from the same/different domains to creatively innovate under budget constraints (Savino et al., 2017).

The development of the Danish wind turbine (Garud & Karnøe, 2003) illustrates how innovators deal with financial hurdles through resource recombination. Due to limited resources, the Danish wind turbine was the result of the combination of available materials "such as

² According to the "path of least resistance" model (Ward, 1994), the default approach in creative tasks is to implement the most intuitive ideas, which is often similar to previous solutions, rather than undergoing the search process for creative solutions which requires more cognitive effort and constitutes a higher level of uncertainty in the outcomes. Consequently, the tendency of taking the path of least resistance may prevent the individual from discovering other superior solutions, probably only a little way off the path (Hoegl et al., 2008).

wood and lorry gears,” other “modest resources,” some from “scrap dealers,” and miscellaneous “embedded” individuals. Yet, their innovation competed effectively against much better-financed product development efforts in the United States and eventually commanded a high market share in the global wind turbine industry (Senyard et al., 2014). Overall, financial constraints have been shown to prompt firms to recombine resources at hand, enhancing innovation performance (Chen & Shen, 2023). Hence, we hypothesize that:

Hypothesis 2. *The extent to which firms perceive financial constraints will be positively related to their likelihood of introducing radical innovations.*

2.2. The moderating role of family firms

Extant family business literature remains fragmented, focusing on how each firm type, i.e., family and non-family firms, can manage their resources to enhance RI (e.g., Chirico et al., 2022; Covin et al., 2016; De Massis et al., 2018; Hu et al., 2022). For example, while Hu et al. (2022) find that lower levels of marketing resources (e.g., market knowledge, relational resources) increase family firms’ willingness and capability to pursue RI, their study focuses exclusively on family firms. While family firms are often argued to have an advantage in knowledge combination (Patel & Fiet, 2011), this claim remains untested. Therefore, an empirical examination of whether family firms can transform knowledge constraints into RI more efficiently than non-family firms is warranted.

Similarly, non-family firms under financial constraints have been shown to exhibit risk-taking behaviors leading to radical innovativeness, a pattern less evident in family firms (Covin et al., 2016). Prior literature suggests that family firms may only adopt risky strategies when there is financial slack (Le Breton-Miller & Miller, 2006), raising the question of whether they are less efficient than non-family firms in transforming financial constraints into RI.

In short, we still lack theoretical understanding and empirical evidence about the types of resource constraints where family firms have a relative advantage or disadvantage in converting them into RI compared to non-family firms.

In line with Miller et al.’s (2014) call, we adopt a multi-theory approach to gain a comprehensive understanding of family firm behavior. Literature highlights that the concentration of the family’s wealth and family owners’ pursuit of non-financial goals, particularly the desire to build and maintain enduring, trusted relationships with internal and external stakeholders (i.e., stewardship orientation), are the key elements distinguishing family firms from non-family firms in their attempts to convert innovation input into output (see Duran et al., 2016, pp. 1242–1243, for more detail). Since these elements provide a clear explanation of how family and non-family firms differ in their innovation recombinative abilities, we build upon them to explore the moderating role of family firms.

Concretely, family firms exhibit unique characteristics of stewardship, stemming from the unusual amount that leaders have at stake, for example, economic dependence, family capital, reputation, and future security for the family (Davis et al., 2010; Huybrechts et al., 2011). Stewardship in family firms often manifests itself in a culture of nurturing the workforce or enduring relationships with external stakeholders (Miller et al., 2008; Miller et al., 2009). Furthermore, a large share of family owners’ wealth is often invested in one firm and in an undiversified way (Anderson et al., 2003), heightening their sensitivity toward uncertainty and influencing their innovation behaviors, such as investment spending (Duran et al., 2016).

Meanwhile, entrepreneurship literature highlights that firms vary enormously in their ability to recombine resources (Baker & Nelson, 2005), as recombinative ability—the ability to “generate new applications from existing knowledge” (Kogut & Zander, 1992, p. 391)—is “strongly affected by organizational routines for coordinating the various components and putting them to productive and market use” (Savino et al., 2017, p. 55). Owing to the above idiosyncrasies, family

and non-family firms differ in their recombination abilities to successfully create RIs when incurring knowledge or financial constraints. We next explicate how family firms’ stewardship orientation will facilitate the coordination of knowledge components, enforcing family firms’ recombinative ability when facing knowledge constraints. By contrast, the concentration of family wealth in the firm limits experiment with recombining limited resources at hand when encountering financial constraints, attenuating the link between financial constraints and RI outputs relative to non-family firms.³

2.2.1. Family firms and the relationship between knowledge constraint and radical innovation

Facing knowledge constraints, firms can recombine internal and/or external knowledge elements at hand to innovate (Baker & Nelson, 2005; Chen & Shen, 2023). Yet, the effectiveness of this recombination depends substantially on the coordination and communication among organizational members and with external parties (Savino et al., 2017). Given their typically higher stewardship governance, especially in terms of organizational culture with heightened care-oriented employment practices and prolonged relationships with external stakeholders (Lambrechts & Gnan, 2022), family firms are advocated to possess greater knowledge recombination ability than non-family firms (Patel & Fiet, 2011).

Empirical studies broadly show that higher family ownership is associated with higher employee-centered work practices, as manifested in job security, training, compensation, or inclusive work cultures (Miller et al., 2008; Neubaum et al., 2016), with family owners sometimes accepting pay cuts to safeguard their employees’ jobs (Block, 2010; Lambrechts et al., 2017). Compared with non-family firms, family firms often invoke more help, care, loyalty, and perceived organizational support from their employees (Bormann et al., 2020; Pearson & Marler, 2010), fostering innovative work involvement like cooperation, knowledge sharing, and experimentation (Bammens et al., 2014; Rhoades & Eisenberger, 2002). The elevated commitment of employees, cultivated through stewardship governance, provides family firms with a significant competitive edge, particularly when facing internal resource constraints, such as the lack of qualified personnel. While both family and non-family firms attempt to recombine their limited internal knowledge bases to foster innovation, the stronger engagement in knowledge sharing and collaborative efforts within family firms can offset personnel shortage, enabling more efficient recombination and a higher likelihood of RIs.

Along the same lines, the ability to integrate external knowledge elements to create new knowledge recombinations depends on firms’ links with suppliers, customers, and the networks of collaborating

³ We apply the stewardship arguments to theorize about knowledge constraints and the wealth concentration arguments to address financial constraints because of their relevant connections. Specifically, we refrain from using wealth concentration arguments to explain the moderating effect of firm status on the relationship between knowledge constraints and RIs. Although high owner wealth concentration might discourage family firms from recombining knowledge resources to overcome knowledge constraints, the low financial risk inherent in knowledge-recombination activities—such as asking suppliers to contribute extra effort or creativity—makes such a deterrent unlikely. Accordingly, we propose that knowledge constraints—measured by the perceived lack of qualified personnel, lack of information on technology and markets, and difficulty in finding cooperation partners for innovation—along with the efforts to recombine knowledge to overcome these constraints, are less likely to be directly influenced by the wealth concentration of firm owners. Additionally, while the stewardship perspective might suggest that family firms have superior recombinative abilities under financial constraints, this advantage is limited if family firms are hesitant to act, such as experimenting with available resources, due to concerns about preserving their wealth. In such cases, the potential benefits of their recombinative abilities may not be fully realized, making the stewardship perspective less relevant.

organizations (Savino et al., 2017). While family firms may collaborate with fewer partners, the collaboration intensity is generally higher (Lazzarotti et al., 2017). In this respect, family firms demonstrate greater stewardship over their connections with external stakeholders compared to non-family firms (Miller et al., 2008; Miller et al., 2009), reflected in frequent contacts, personal friendship, prolonged relations through generations, and unconditional support during difficult times (Hoover & Hoover, 1999; Miller et al., 2008). These long-term, trust-based ties with external stakeholders provide family firms with further advantages compared to non-family firms when incurring external knowledge constraints, such as difficulties in finding cooperation partners for innovation. As both family and non-family firms strive to leverage their limited external knowledge, the valuable support embedded in the networks of family firms facilitates more effective knowledge exchange and recombination beyond the firm's boundary (Lambrechts et al., 2022; Shu et al., 2012). Furthermore, as the combination-related knowledge is often dispersed among inventors (Yayavaram & Ahuja, 2008), stronger relationships facilitate joint problem-solving and knowledge transfer, enabling family firms to refine and adapt existing technological combinations for new applications, even when market or technology information is scarce (Carnabuci & Operti, 2013). Taken together, family firms will be more efficient in converting external knowledge constraints to RIs compared to non-family firms.

Although there can be heterogeneity among non-family firms, their typically lower levels of stewardship towards internal and external stakeholders compared to family firms may attenuate their ability to coordinate the knowledge integration process, reducing their chance to generate RI from limited knowledge resources.

Overall, we postulate that:

Hypothesis 3. *The positive relationship between perceived knowledge constraints and the likelihood of introducing RIs is stronger for family firms than for non-family firms.*

2.2.2. Family firms and the relationship between financial constraints and radical innovation

Financial scarcity may also propel firms to implement entrepreneurial practices, i.e., take on more innovation challenges by leveraging and recombining existing resources, enabling them to achieve higher innovation performance (Baker & Nelson, 2005; Chen & Shen, 2023). Although family firms excel in knowledge recombination, they may be less inclined than non-family firms to pursue high-risk/high-return activities under financial constraints, such as RI. This hesitation arises because failure in such ventures could further exhaust the limited funding of not only the firm but also of the family whose wealth is often tied to the business.

Family owners are often characterized as large and undiversified shareholders who tie the majority of their personal wealth to one single asset: the family business (Schmid et al., 2015). Hence, family firms' owners tend to bear more of the burden of their failed innovation efforts compared with their non-family counterparts, who usually have a more diversified portfolio (Gedajlovic et al., 2004). Wealth concentration raises sensitivity toward uncertainty, discouraging high-risk activities (Sciascia et al., 2015). We expect that the more financial constraints (i.e., lack of internal/external funding, unduly high innovation costs) family firms experience, the less they will tinker with other available resources at hand or experiment with various resource recombinations. This hesitation stems from a concern that these efforts will not come to full fruition and dampen the wealth of not only the firm but also the whole family. Non-family firms, whose owners are likely to have less concentrated wealth in the firm, are more willing to experiment with the limited resources at their disposal and explore different recombinations.

In summary, due to family owners' exceptional wealth concentration in the firms and their undiversified investment portfolio, family firms are likely to experiment with resource recombinations to a lesser extent

than non-family firms under financial constraints. This cautious approach, in turn, reduces their ability to engender RI compared to non-family firms.

Hypothesis 4. *The positive relationship between perceived financial constraints and the likelihood of introducing RIs is weaker for family firms than for non-family firms.*

Fig. 1 below presents the study's conceptual model.

3. Data and methods

3.1. Sample

Our analysis is based on firm-level data extracted mainly from the Flemish Community Innovation Survey (CIS). The CIS is conducted by several EU member states by the European Commission, and Eurostat. The Flemish CIS is a stratified (according to sector and size class) random sample that follows the guidelines of the Oslo Manual (OECD, 2005) for surveys on innovation activities and covers both production and service firms. The questionnaire is usually completed by the owner or CEO. In larger firms, one or more top management team members typically fill it out, with different members often responding to different sections (Stephan et al., 2019). We combine the CIS surveys conducted in 2011 and 2013, which collected the data for the period 2008–2010 and 2010–2012, respectively, because our variables of interest are available only for these two consecutive waves. Moreover, utilizing data from the 2008–2010 period offers a distinct advantage, as it coincides with the 2008 global financial crisis. This allows us to capture greater variance in the level of resource constraints during this turbulent period (Campello et al., 2010).

Since innovation strategies often take time to translate into RI outputs, we estimate a lagged variable model in which the independent and control variables are all lagged by one survey wave (i.e., by two years). This two-year lag is appropriate, as research demonstrates that “the total lag associated with the innovation process varied between 1.17 and 2.62 years” (Goel, 1999, p. 54). Such lagged-variable models are shown to possess superior predictive validity, particularly when innovative outcomes are measured (Keupp & Gassmann, 2013). Furthermore, this approach helps mitigate concerns about common method bias because the temporal precedence of the predictor variables is firmly established before the outcomes are observed (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Our final sample comprises 320 firms.

3.2. Dependent variable

Our dependent variable is a binary variable measuring whether a firm introduced a new or significantly improved product (service) to the market before its competitors between 2010 and 2012. This operationalizing of RIs aligns with prior research (D'Este et al., 2016; Fitjar & Rodríguez-Pose, 2013; Sandberg & Aarikka-Stenroos, 2014) as it signifies a fundamental change in technology, products and/or services that may considerably transform existing markets and industries. Since our dependent variable is a discrete response, we use logistic regression to estimate our empirical models (Greene, 2003).

3.3. Independent and moderator variables

Resource constraints. Respondents were asked to rate how important specified factors prevented the firms from innovating during the period of 2008–2010 on a scale from 0 to 3 (“factor not experienced,” “low,” “medium,” or “high,” in that order). Given the focus of our paper, we focus on those items that explicitly refer to knowledge and financial constraints. This approach aligns with extant research that uses CIS to examine such constraints (e.g., D'Este et al., 2012; Keupp & Gassmann, 2013; Pellegrino & Savona, 2017).

We used principal component factor analysis with oblique rotation to

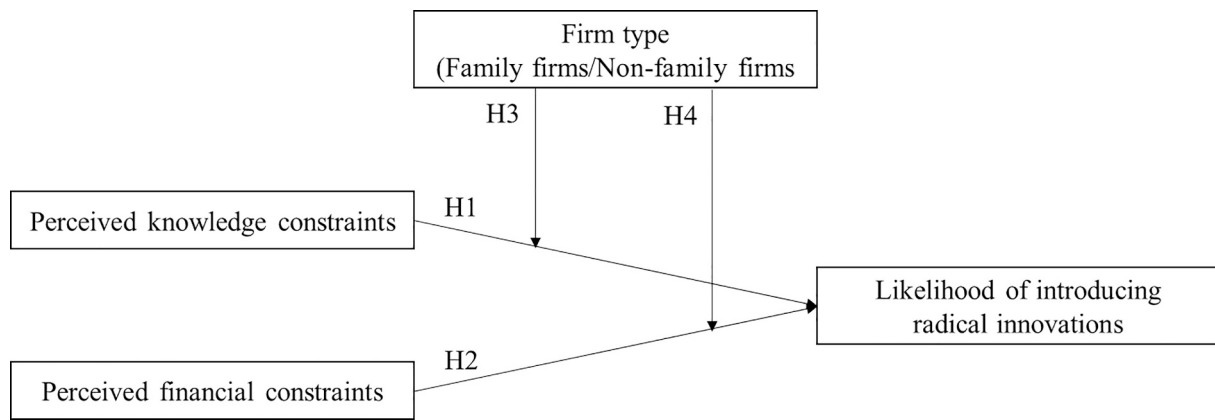


Fig. 1. Conceptual model.

Table 1
Exploratory Factor Analysis: Rotated Factor Loadings and Significance Tests^a.

Survey items	Factor 1 Perceived knowledge constraints	Factor 2 Perceived financial constraints
Lack of funds within your enterprise or group	0.071	0.915
Lack of finance from sources outside your enterprise	0.021	0.889
Innovation costs too high	0.071	0.836
Lack of qualified personnel	0.739	0.077
Lack of information on technology	0.821	0.053
Lack of information on markets	0.817	0.037
Difficulty in finding cooperation partners for innovation	0.733	0.114

^a Notes: $n = 320$. Extraction method: Principal component analysis. Rotation method: Oblimin with Kaiser normalization. Kaiser-Meyer-Olkin measure of sampling adequacy: 0.790. Bartlett's test of sphericity: approx. chi-square: 868.928. Sig.: $p < 0.000$.

construct scales for knowledge and financial constraints from these items.⁴ Table 1 shows that these seven items could be attributed to two distinct underlying factors: knowledge constraints (Cronbach alpha = 0.782) and financial constraints (Cronbach alpha = 0.859). Together, these two factors explain 68.85 % of the variance.

Family firm. The family firm variable is constructed based on ownership (Leitterstorf & Rau, 2014) and on whether the firm is perceived as a family business (Zellweger et al., 2010). Specifically, a business is considered a family firm (coded “1”) when a family owns at least 50 % of the company's shares and when the firm is perceived as a family business during the examined period as indicated on the company website, in newspaper articles, or other public sources. In all other cases, the business is classified as a non-family firm (coded “0”).⁵

⁴ We applied oblique rotation because we expected the emerging factors, which both refer to resource constraints, to be theoretically related (Keupp & Gassmann, 2013).

⁵ Respondents were asked: “Was part of your company owned by an individual or a family? (Yes/No).” If they answered Yes, they were further asked: “What was their share (if divided among different family members, please add up the shares)? 1. Less than 25%, 2. Between 25% and 49%, 3. 50% or more.” We then cross-referenced information for firms that reported at least 50% ownership by a family or an individual. If these firms also identified as family firms on their company website, in newspaper articles, or other public sources during the examined period, we classified them as family firms. If we could not find proof of such identification, we assumed that these firms were majority owned by an individual instead of a family, which led us to regard them as non-family firms in the sample.

Following this operationalization, 41 % of the sample meet the family firm criterion.

3.4. Control variables

Export. A firm operating in an international context should be more likely to engage in RI activities due to the high level of competition in the global market (Narula & Zanfei, 2003). Therefore, we use a binary variable to control for whether firms export internationally.

Firm age. Young firms are often associated with high innovativeness (Klepper, 1996). Nonetheless, firm age is also deemed a proxy for a firm's accumulated knowledge and experiences over the years, thus linked to higher innovation likelihood (Galende & de la Fuente, 2003). Firm age is measured as the number of years since incorporation.

Firm size. Large companies might resist RI due to their bureaucratic structure (Sathe, 2003), whereas small firms might outperform larger firms in creativity, speed, and flexibility—especially when new, disruptive technologies emerge (Bower & Christensen, 1995). Yet, large firms can be more likely to introduce RIs because of their larger pool of resources (Fitjar & Rodríguez-Pose, 2013). We measure firm size using the number of employees in the firm.

Firm growth. Since highly entrepreneurial firms are likely to overcome resource constraints more effectively and efficiently than firms that have not developed such entrepreneurial responses (Hitt et al., 2001), we control for firms' previous level of entrepreneurship. Entrepreneurial orientation is often reflected in growth orientation (Lumpkin & Dess, 1996), and sales growth is a widely used indicator of firm growth in entrepreneurship studies (Achtenhagen et al., 2010). Accordingly, we measured firm growth by taking the difference (in percentages) between sales in 2008 and 2010.

Research and development (R&D) intensity. R&D investment enhances innovation output by improving a firm's ability to absorb external knowledge (Cohen & Levinthal, 1990). We measure R&D intensity as the ratio of R&D expenditure to firm sales.

Since the distribution of firm age, firm size, firm growth, and R&D intensity is skewed, we take the natural logarithm of these variables prior to further analysis.

Industry. The industry tends to capture various technological dimensions (e.g., technological opportunity, appropriability regimes) and dynamic aspects (e.g., cumulativeness or the emergence of dominant designs, technology life cycle), which influence a firm's innovation behavior (Teece, 1986). Following Eurostat's guidelines, we use the companies' main NACE code to classify the industries into five categories: high-tech and medium-high tech manufacturing; low-tech and medium-low tech manufacturing; high-tech knowledge-intensive services; less-knowledge intensive services; electricity and water supply. Overall, 26 %, 35 %, 25 %, 10 %, and 4 % of the sample firms fall into these categories, respectively.

4. Analysis and findings

4.1. Descriptive statistics and results of hypothesis testing

Table 2, which presents descriptive statistics and correlations, shows that 45 % of the firms in the sample introduced RIs. On average, the levels of perceived knowledge and financial constraints were 1.15 and 1.25, respectively. Table 2 also shows that the likelihood of introducing RIs is positively associated with the increasing levels of financial constraints, whereas no significant relationship is observed between the propensity to yield RIs and the levels of knowledge constraints. The latter result corroborates the contradictory findings in the literature concerning the impact of knowledge constraints on RIs and implies that firms may differ in their abilities to convert constrained knowledge into RIs effectively. Moreover, the family firms in our sample also present a lower propensity to introduce RIs than non-family firms.

Table 3 displays the estimation results of the logit regressions. The models were constructed gradually by entering only the control variables in Model 1 and then adding independent variables and interaction effects step by step. Hypotheses 1 and 2 posit a positive impact of knowledge and financial constraints on the likelihood of introducing RIs, respectively. As shown in Models 2 and 3, Hypothesis 1 is not supported, whereas Hypothesis 2 receives support at the 1 % level.

Model 4 includes all the independent variables, namely, knowledge constraints, financial constraints and firm type, the main findings remain unchanged. Finally, Model 5 includes the interaction terms. Hypotheses 3 and 4 predict that knowledge and financial constraints have different impacts on the probability of introducing RIs in family and non-family firms. Hypotheses 3 and 4 receive support at the 5 % and 1 % levels, respectively. These findings seem to support our prevailing notions that the relationship between knowledge constraints and the likelihood of producing RIs is stronger for family firms than for non-family firms, while the relationship between financial constraints and the propensity to introduce RIs is weaker for family firms than for non-family firms.

Additionally, the estimation results for the control variables in Model 1 suggest that the propensity to introduce RIs is higher for export firms ($p < 0.001$), large firms ($p < 0.10$), and firms in high-tech and medium-high tech manufacturing industries or high-tech knowledge-intensive services ($p < 0.10$).

Fig. 2 compares the likelihood of introducing RIs between family and non-family firms under knowledge constraints. At low levels of knowledge constraints, family firms have a lower likelihood of introducing RIs. As knowledge constraints increase, family firms seem to display a higher likelihood of introducing RIs than non-family firms. At the high levels of knowledge constraints, the confidence intervals overlap. Hence, we will run more robustness tests to examine this result.

Fig. 3 compares the likelihood of introducing RIs between family and non-family firms under financial constraints. In line with Hypothesis 4, compared to non-family firms, family firms appear to have a lower propensity to release RIs as they perceive higher financial constraints.

4.2. Robustness tests and alternative specifications

Recent methodological research urges caution in interpreting the significance of interaction terms within non-linear regressions, including logistic models (Long & Mustillo, 2018; Mize, 2019). Following their recommendations, rather than interpreting the statistical significance of the coefficient of the product terms alone, we discussed the moderating effects by plotting the marginal effect of firm type across the range of resource constraints (Figs. 4 and 5), and presenting the first differences and second differences in Appendix A.

As Figs. 2 and 3 show that the confidence intervals of family and non-family firms overlap at some levels of constraints, we further plot the differences between these two groups across the range of knowledge and financial constraints using the marginal effects command (Mize, 2019).

Fig. 4 shows the difference between family and non-family firms regarding their likelihood of introducing RIs across the range of knowledge constraints. The difference increases as the level of knowledge constraints rises, suggesting that family firms are more likely to introduce RIs than non-family firms as knowledge constraints increase. As the zero line was situated outside the boundary of the confidence interval at the high levels of knowledge constraint, it suggests that the likelihood of family firms generating more RIs than non-family firms is statistically significant at the high levels.

Similarly, Fig. 5 displays the difference between family and non-family firms concerning their likelihood of introducing RIs across the range of financial constraints. The difference diminishes as the level of financial constraints rises, indicating that family firms have a lower likelihood of introducing RI than non-family firms as financial constraints increase. As the zero line was situated outside the boundary of the confidence interval at the high levels of financial constraints, it suggests that the likelihood of family firms generating more RIs than non-family firms is significantly lower.

Furthermore, the literature suggests that the positive relationship between innovation obstacles and innovation output may stem from sample selection bias (D'Este et al., 2012; Pellegrino & Savona, 2017; Savignac, 2008). “Non-innovators,” i.e., firms that by deliberate choice had not introduced a product and/or process innovation and were not in the process of doing so and did not experience any barriers to innovation (Savignac, 2008), are typically considered to have no aspirations or intentions to innovate (D'Este et al., 2012). Including these firms in the sample may induce a spurious positive correlation between innovation outputs and innovation barriers. For this reason, prior research often excludes these firms from their primary analyses to avoid selection bias (e.g., D'Este et al., 2012; Pellegrino & Savona, 2017; Savignac, 2008). As an additional robustness check, we add non-innovators to our current sample.⁶ Then, we re-run all models with this new sample. The results remain the same.

We also estimate the specifications of alternative models. Several studies have suggested an inverted U-shaped relationship between resource levels and innovation outputs (Acar et al., 2018). To account for this possibility, we model knowledge and financial constraints in curvilinear form. However, we do not find support for such curvilinear effects.

Some researchers advocate that due to the distinct nature of knowledge and financial resources, firms may benefit from certain combinations, e.g., knowledge constraints and financial abundance (Paeleman & Vanacker, 2015). Hence, we test the interaction between knowledge and financial constraints while controlling for the firm type (family firm versus non-family firm). The interaction term is not statistically significant, suggesting the absence of potential interactions between knowledge and financial constraints. Likewise, since the family's involvement is often acknowledged as a unique resource (Carnes & Ireland, 2013), we assess the three-way interaction among firm type, knowledge constraints, and financial constraints. This interaction term does not yield significant results either.

We also applied a stricter family firm definition: in addition to the ownership and perception criteria, at least one of the firm's executive managers had to be a member of the owning family in order for a firm to be considered a family business (Brinkerink, 2018).⁷ Approximately 33 % of the firms meet these criteria. This alternative operationalization of

⁶ There are 228 observations of non-innovators. The mean and standard deviation of knowledge constraints of this sample are 0.755 and 0.820, respectively. The mean and standard deviation of financial constraints are 0.756 and 0.924, respectively. Since non-innovators did not have to report R&D expenditure, we assume they did not spend on R&D expenditure so that we can apply the same models to this new sample.

⁷ Information about the firm's executive managers was also collected via public sources.

Table 2
Descriptive Statistics and Correlations.

Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9
1. Radical innovations	0.450	0.498	0	1	1								
2. Firm type (FF/non-FF)	0.406	0.492	0	1	−0.109	1							
3. Perceived knowledge constraints	1.146	0.679	0	3	0.037	0.148**	1						
4. Perceived financial constraints	1.253	0.936	0	3	0.174**	−0.045	0.337***	1					
5. Export	0.822	0.383	0	1	0.224***	0.019	0.154**	0.100	1				
6. Firm age ^b	26.450	19.018	2	114	−0.037	0.139*	0.024	−0.111*	0.094	1			
7. Firm size ^b	223.806	571.993	5	4825	0.090	−0.161**	0.016	−0.069	0.072	0.390***	1		
8. R&D intensity ^b	0.154	0.722	0	10.41	0.108	−0.186***	−0.040	0.166**	0.021	−0.189***	−0.069	1	
9. Firm growth ^b	1.196	1.430	0.10	19.47	0.020	−0.112*	0.040	0.015	−0.080	−0.260***	−0.182**	0.287***	1

Notes: $n = 320$. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

^b Log-transformed variables. In order to enhance readability, correlations are computed from logged variables, while descriptive statistics are shown for the raw form of each variable.

Table 3
Estimation results for dependent variable Likelihood of introducing radical innovations.

Dependent variable (DV) = Likelihood of Introducing radical innovations, unless otherwise stated	Model 1 (controls only)	Model 2 (main model)	Model 3 (main model)	Model 4 (main model)	Model 5 (interaction model)
<i>Independents</i>					
Perceived knowledge constraints		0.048 (0.177)		−0.097 (0.183)	−0.566 (0.252)
Perceived financial constraints			0.351** (0.136)	0.375** (0.142)	0.829*** (0.199)
Firm type (family/non-family firms)				−0.279 (0.267)	−0.430 (0.603)
Firm type * Perceived knowledge constraints					1.131** (0.417)
Firm type * Perceived financial constraints					−1.023*** (0.309)
<i>Controls</i>					
Export	1.273*** (0.367)	1.261*** (0.371)	1.249*** (0.367)	1.269*** (0.371)	1.354*** (0.385)
Firm age	−0.207 (0.209)	−0.206 (0.209)	−0.167 (0.209)	−0.141 (0.209)	−0.132 (0.220)
Firm size	0.254* (0.104)	0.255* (0.104)	0.274** (0.106)	0.249* (0.109)	0.221 (0.114)
R&D intensity	0.381 (0.787)	0.382 (0.778)	0.136 (0.709)	−0.066 (0.697)	−0.147 (0.679)
Firm growth	0.127 (0.524)	0.118 (0.526)	0.200 (0.520)	0.184 (0.515)	0.115 (0.550)
Constant	−3.156** (1.115)	−3.213*** (1.120)	−3.983*** (1.181)	−3.708** (1.182)	−3.301** (1.202)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Log likelihood	−198.960	−198.925	−195.521	−194.780	−187.775
(McFadden)R-squared	0.097	0.097	0.112	0.116	0.147
Observations	320	320	320	320	320

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

family firms does not change the results.

Finally, to address concerns regarding the potential endogeneity of certain control variables, specifically export, firm size, and firm growth, we excluded these variables from both the main and interaction models and re-ran the analyses. The results remain unchanged.

4.3. Endogeneity

Although our lagged-variable model may help alleviate concerns about the reversed causality whereby more innovative firms are more likely to perceive knowledge or financial constraints, following the literature (Wang et al., 2013; Zhang et al., 2021), we re-ran our Models 2 and 3 in Table 3 using the two-stage least squares (2SLS) method to address this endogeneity issue further. In the first stage, the possible

endogenous variables, i.e., knowledge constraints, financial constraints,⁸ served as the dependent variables in the first-stage columns of Models 1 and 2 in Table 6 (Appendix B). Each of them was regressed against variables that are thought to affect a firm's allocation of knowledge (financial) resources to its innovation activities. The fitted value of knowledge (financial) constraints was thus created and used in the second-stage RI regressions in the second-stage columns of Models 1 and 2 in Table 6.

Based on the literature, we selected two instrumental variables for each possible endogenous regressor.⁹ Specifically, financial constraints were “instrumented” by self-financing ratio and current ratio in the

⁸ Firm type (family/non-family firms) is less likely to cause an endogeneity problem in our dataset because about 96% of our sample are unlisted firms. As the costs of adjusting ownership tend to be high in these firms, reverse causality, such as between corporate governance and innovation (O'Connor & Rafferty, 2012), is less of a problem (Voordeckers et al., 2023).

⁹ The instruments were extracted from CIS and the Bel-first database.

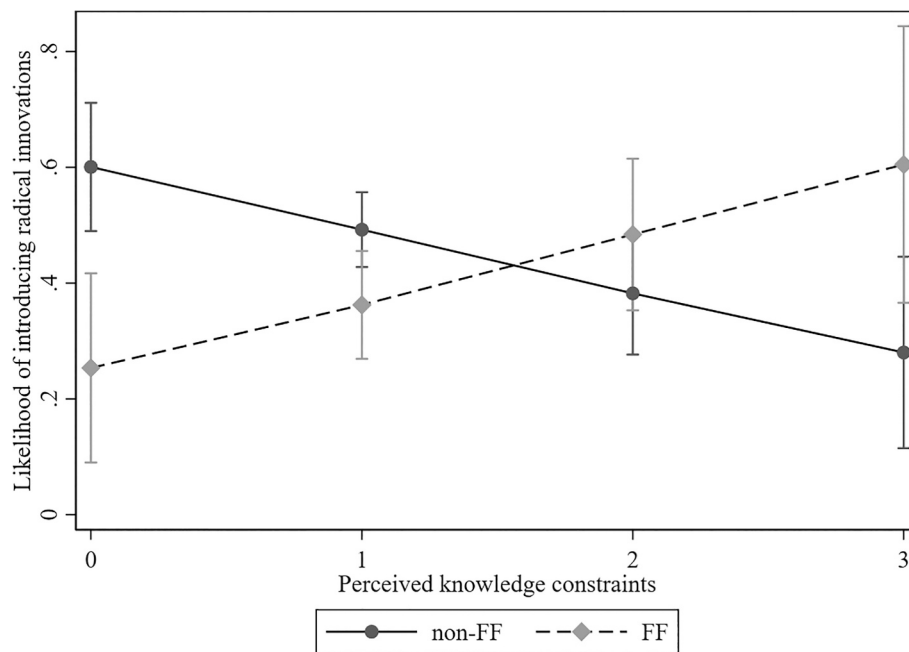


Fig. 2. Perceived knowledge constraints and the likelihood of introducing RIs for family firms (FFs) versus non-family firms (non-FFs).

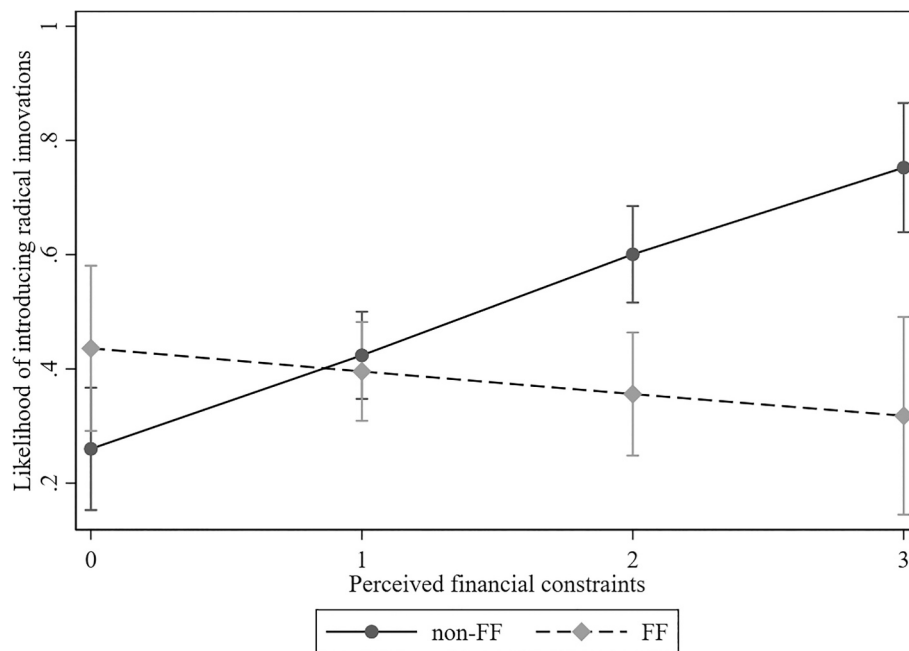


Fig. 3. Perceived financial constraints and the likelihood of introducing RIs for family firms (FFs) versus non-family firms (non-FFs).

period before firms experienced financial constraints because a firm's ex-ante financing structure tends to affect its funding allocation to innovation but not necessarily results in higher RIs (Savignac, 2008; Wang et al., 2013). Knowledge constraints were "instrumented" by firms' goal multiplicity and banking debt ratio in the period before firms experienced financial constraints. The pursuit of multiple goals tends to consume more resources (Kung & Scholer, 2020), and the amount of debt used to finance a firm's assets is reported to be negatively related to the investments in human capital (Liu et al., 2013), thus it can increase knowledge constraints. Moreover, the impact of these instruments on innovation performance is shown to be mixed (Leiponen, 2012; Leiponen & Helfat, 2010; Sternberg & Arndt, 2001).

As the first condition, Sargan's J tests indicated that the instruments

are uncorrelated with the error term (in Model 4: Sargan chi-squared test: 0.86, p-value = 0.35; in Model 5: Sargan chi-squared test: 0.087, p-value = 0.768), supporting that these variables are appropriate instrumental variables. As to the second condition, the left columns of Models 1 and 2 (first stages) indeed show that these instrumental variables are statistically significant predictors of the potentially problematic predictors "Knowledge constraints" and "Financial constraints." Next, the F values of the first stage of estimations are greater than the critical value of the 10 % bias level, indicating that the IVs are not weak. Finally, for both models, we ran Durbin-Wu-Hausman tests (implemented using Stata's `ivendog` command), suggesting that endogeneity is not a concern in our study (in Model 1 in Table 6: Durbin-Wu-Hausman chi-squared test: 3.758, p-value = 0.052; in Model 2 in Table 6:

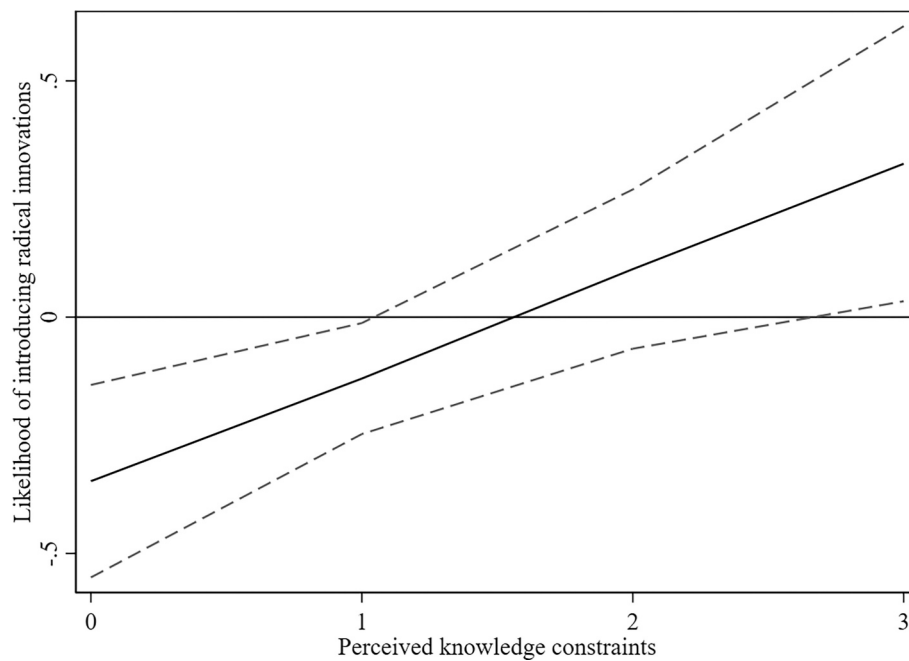


Fig. 4. Average marginal effects of firm type (family firms – non-family firms) across the range of perceived knowledge constraints on the likelihood of introducing radical innovations.

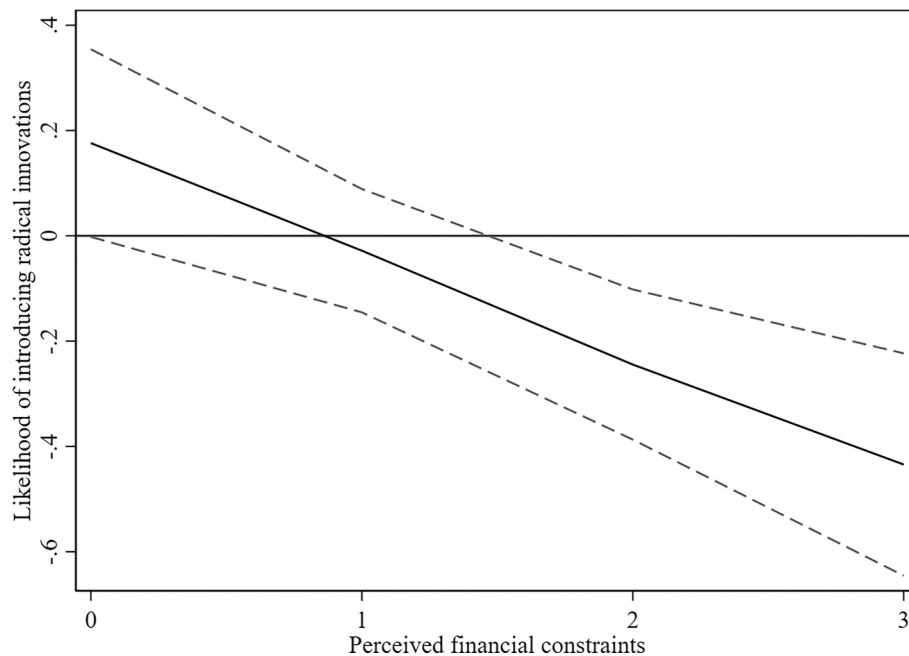


Fig. 5. Average marginal effects of firm type (family firms – non-family firms) across the range of perceived financial constraints on the likelihood of introducing radical innovations.

Durbin–Wu–Hausman chi-squared test: 1.632, p -value = 0.201). The results of the 2SLS regression analyses show that the identified relationships remained in the same direction. There is no material change in the significance of financial constraints, while the instrumented knowledge constraints become significant at the 5 % level. Overall, these results alleviate endogeneity concerns.

Finally, to further address the endogeneity issue, we used another approach, i.e., the Stata module *konfound*, to quantify how much bias there must be to invalidate inference from a Rubin causal model framework (Xu et al., 2019). The results show that to invalidate the inference of there being a positive impact of financial constraints on the

likelihood of introducing radical innovations, 28.86 percent of the observed cases would have to be replaced with cases with an effect of zero. Hence, this test regarding the sensitivity of causal inference provides additional evidence that our finding is robust.

5. Discussion and conclusions

This study investigates whether resource constraints spur RIs under the condition of firm type. Grounded in the recombinative innovation perspective, we developed the baseline hypotheses on knowledge and financial constraints, arguing that both can increase the likelihood of

introducing RIs. Our data support the hypothesis on financial constraints but not that on knowledge constraints. The first bolsters prior findings (Du et al., 2007; Keupp & Gassmann, 2013), while the latter aligns with studies that found no association between knowledge constraints and innovation outcomes (e.g., Pellegrino & Savona, 2017). Thus, our results on knowledge constraints are particularly important in reconciling prior mixed evidence, which has alternately reported non-significant (Pellegrino & Savona, 2017) or positive effects (Keupp & Gassmann, 2013). This reinforces the pivotal quest to uncover the contingency factors that shape when resource constraints spur RIs (Gibbert et al., 2014; Weiss et al., 2011, 2017).

Regarding the moderating effect of firm type, the results support our theoretical argument that distinct types of resource constraints can impact RI performance in family and non-family firms differently. Particularly, the relationship between knowledge constraints and RIs is stronger for family firms than for non-family firms. This can be attributed to family firms' stewardship orientation toward internal and external stakeholders, which supports knowledge recombination within and beyond the firms' boundaries. Thereby, family firms seem to possess stronger recombination abilities than non-FFs, empowering them to manage knowledge constraints more successfully to attain RIs. In contrast, financial constraints are less conducive to RIs in family firms than in non-family firms, plausibly due to the high and undiversified concentration of owners' wealth in family firms. These idiosyncrasies of family firms attenuate their abilities to experiment with different resource recombinations when incurring financial obstacles. Therefore, firm type emerges as a crucial factor shaping how different resource constraints influence RIs.

5.1. Theoretical contribution

The research contributes to the longstanding theoretical debate between the traditionally strategic management perspective, whereby having more resources is generally considered beneficial, and the entrepreneurship perspective, whereby resource scarcity is advantageous for innovation. Our findings offer partial support for the latter perspective, particularly in demonstrating the positive impact of financial constraints on RI. Nonetheless, the absence of a similar effect for knowledge constraints, together with the significant moderating role of firm type, suggests that resource constraints do not uniformly promote RIs. A lack of attention to contingency factors may explain why prior studies have sometimes found only partial support for the relationship between resource constraints and RI (e.g., Keupp & Gassmann, 2013). Consistent with recent scholarship, we therefore advocate moving beyond this debate and toward a more nuanced approach that examines the specific conditions under which resource constraints become enablers to innovation (Gibbert et al., 2014).

As Gibbert et al. (2014, p. 199) note, "If we found an answer to this question [i.e., when resource constraints constitute an enabler of innovation], product innovation management and even management at large would have to be rewritten." In line with this agenda, we contribute to two research streams: the recombinative innovation perspective and the contingency approach to resource constraints. From the recombinative innovation perspective, our arguments and findings suggest that the recombination ability is not only subject to firms' characteristics, such as the ability to coordinate the recombination activities, but also the type of resource constraints they are managing. Specifically, under knowledge constraints, firms with a stronger stewardship orientation, and thereby a higher recombination ability, are more likely to generate RIs. In contrast, under financial constraints, firms with a high concentration of owners' wealth in the business, despite their strong resource recombination ability, might experiment with recombination to a lesser extent than those with a lower concentration of owners' wealth, reducing their chances of generating RI. Simultaneously, our study extends the contingency literature on innovation under resource constraints by underlining firm type, particularly the family firm/non-family firm

distinction, as an important yet underexplored organizational characteristic shaping innovation under resource scarcity. While prior research has emphasized conditions such as environmental munificence (Desa & Basu, 2013) or team characteristics (Hoegl et al., 2008), our study reveals how family/nonfamily firm status, along with their differences in recombination ability, determines when resource constraints become advantageous. Moreover, prior contingency studies tend to focus on the impact of financial constraints on innovation outcomes under specific conditions (e.g., Hoegl et al., 2008; Scopelliti et al., 2014; Weiss et al., 2014), overlooking how different types of constraints interact with the same contingency. By considering both financial and knowledge constraints, we enhance understanding of how distinct resource limitations affect organizational ability to recombine resources and generate RIs (Bicen & Johnson, 2015; Busch & Barkema, 2021). To our knowledge, our study is among the first to show how integrating contingency with different constraint types produces more fine-grained results.

Finally, our research advances innovation research in the family business field. We shed light on the mixed findings regarding the conversion of innovation inputs into outputs between family and non-family firms (Block et al., 2022; Duran et al., 2016). Duran et al.'s (2016) meta-analysis reveals that family firms "do more with less" when it comes to innovation output relative to input, whereas Block et al. (2022) find no evidence of this phenomenon in their extended study. Likewise, in the specific context of resource constraints and RIs, whereas studies highlight that family firms under resource constraints are more adept at pursuing RI (Hu et al., 2022), others report the opposite (Covin et al., 2016). Our study helps reconcile these contradictory findings by disaggregating different types of innovation inputs, namely, knowledge and financial resources, and demonstrating that the ability to convert resource constraints into RI varies not only by firm type, but also by the nature of the constraint. We argue that certain characteristics of family firms, particularly the concentration of the family's wealth and their stewardship orientation, may confer specific advantages in leveraging particular types of resource constraints (e.g., knowledge-based) for RI, while posing challenges in others (e.g., financial constraints). This nuanced view moves the discussion beyond the debate of whether family firms innovate more efficiently to the more meaningful question of under what conditions they do so.

As such, our study provides a more holistic view of the resource-specific strengths and limitations of family firms in driving RI. Prior studies provide fragmented insights, such as family firms being excellent in knowledge combination (Patel & Fiet, 2011) or being committed to risky decisions (e.g., experimenting with various recombinations to identify a novel one) only when abundant financial resources are available (Covin et al., 2016). Our findings bring these strands together, offering concrete evidence of how different constraints interact with family firm characteristics to shape innovation outcomes. Ultimately, we shift the discussion from *whether* family firms do more with less to the more critical and contextually grounded question of *when* and *under what types of resource constraints* family firms are able to do more with less. This shift holds significant implications for both theory and practice in the context of family firm innovation management, paralleling the importance previously emphasized in the broader innovation literature (Gibbert et al., 2014).

5.2. Implications for practice

The research shows that managers can harness financial constraints to increase the probability of achieving RIs. Our theoretical reasoning suggests that restricted financial resources can motivate firms to deviate from conventional solutions and adopt creative resource recombination approaches, ultimately enhancing RI outputs. Thus, firms should not deem financial constraints as a hindrance to RIs. Managers may even strategically impose financial constraints on innovation projects to stimulate novel ideas, echoing the "creativity loves constraint" principle practiced by tech giants like Google and Apple through mechanisms

such as time or output constraints (Acar et al., 2019). Our findings extend this logic by showing how input constraints—particularly financial ones—can also spur RI.

At the same time, resource constraints are not universally beneficial. Their effectiveness depends on the underlying mechanisms (e.g., resource recombination) and organizational characteristics (e.g., family firms versus non-family firms) that shape how specific constraints translate into RIs. In detail, our study provides implications for family and non-family firms to remove resource barriers—or even take advantage of them to develop RIs. For instance, non-family firms can remove knowledge hurdles by implementing a stewardship orientation toward their stakeholders, like family firms, which will augment knowledge recombination ability and enhance the likelihood of producing RIs. Conversely, family firms, given their knowledge recombination ability, should view knowledge constraints as opportunities, while mitigating financial risk by structuring their ownership in ways that reduce the personal financial risk of RI investments.

The distinction between which types of constraints that family and non-family firms can more or less easily transform into RI also carries important policy implications. Rather than financial subsidies, non-family firms may particularly benefit from policy instruments targeting human capital, such as the UK's publicly funded framework “Investors in People”—a scheme to improve businesses through people management (McGuirk et al., 2015). Family firms, on the other hand, would benefit from financial incentives such as grants, subsidies, or tax credits aimed at those engaged in RIs, alongside mentorship programs that connect them with successful innovators experienced in navigating financial barriers. Networking initiatives that promote collaborative innovation and resource sharing can further reduce their financial burden. Overall, recognizing the global importance of family firms, understanding their unique characteristics, and tailoring policies to address their specific challenges could unlock significant innovation potential and contribute to broader economic growth.

5.3. Limitations and future research directions

This study has several limitations. First, the data only allow us to measure RI as the newness of a product/service (or a significant improvement of an embedded feature/technology) at the market level. Specific information about the technological level of the innovation can enhance the assessment of the radicalness (Chandy & Tellis, 2000). Second, despite our efforts to alleviate concerns about the reversed causality by adopting a lagged-variable model, a longitudinal study would be more desirable to capture causality and the long-term effects of resource constraints and firm type on RIs. Third, the data were collected from firms in the Flemish part of Belgium. Belgium is an innovation-driven economy (Kelly et al., 2010), which poses difficulties in extrapolating the results to, for example, less innovation-driven economies. Fourth, while the theoretical mechanisms and existing empirical studies highlight the potential for resource-constrained firms to recombine their available resources for RI, empirical insights into the concrete processes remain scarce. Future qualitative research could unpack these mechanisms in more detail. Fifth, due to data limitations, our study does not account for the heterogeneity among family firms. Future studies could explore how variations within or between family firms, such as differences in governance structures or generational involvement, affect their ability to transform specific resource constraints into RI (Daspit et al., 2021).

Finally, this study opens several avenues for further research. First, exploring other factors with a potential moderating effect on the resource constraints–RI relationship seems worthwhile to clarify the conditions whereby resource constraints are catalysts for RIs. As our findings suggest that ownership structure and recombination ability play decisive roles in an organization's ability to transform resource

limitations into RIs, future studies could investigate factors with similar effects. Second, our study highlights that conditions facilitating the conversion of one type of resource constraint into RI may hinder the transformation of another. Hence, future research should move beyond single-constraint analyses and examine multiple types of resource constraints simultaneously to clarify how different conditions should be considered to effectively manage various constraints. Third, family firms, given their specific characteristics, appear to manage certain constraints better than others. Since constraints extend beyond inputs to include process and output constraints, future research could explore how family and non-family firms navigate a broader range of constraints, thereby offering deeper insight into when family firms can “do more with less.” Fourth, extant studies have documented how distinct configurations of resources can yield desirable RI performance in family and non-family firms (Covin et al., 2016; Hu et al., 2022). As our study does not detect significant interaction effects of knowledge, financial constraints, and firm type, future work could gather more fine-grained data to capture the full resource spectrum, from abundance to scarcity, and explore which bundles of resources family firms transform into RI more or less effectively than their non-family counterparts. Fifth, the absence of a significant direct effect of perceived knowledge constraints on RI opens avenues for further investigation. While prior research has documented a positive effect of perceived knowledge constraints using the same measure (Keupp & Gassmann, 2013), it would be valuable to examine complementary measures of knowledge constraints, for example those reflecting the more observable dimensions of the knowledge available to firms (e.g., the education level of personnel or the extent and diversity of technological expertise). Such measures could enrich our understanding by clarifying when subjective interpretations or structural realities are more consequential for RI. Lastly, it would be interesting to investigate how family firms can overcome or even leverage financial constraints to generate RI. Such findings would contribute to the burgeoning research in family firm innovation by revealing the mechanisms that allow them to turn financial constraints into a source of competitive advantage.

CRediT authorship contribution statement

Phuong-Anh Nguyen Duong: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Wim Voordeckers:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Jolien Huybrechts:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Investigation, Conceptualization. **Frank Lambrechts:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Appendix A. . Robustness test

Since we do not aim to prove whether family firms outperform non-family firms in generating RIs across all levels of specified constraints, but focus on whether family firms can better transform increasing knowledge and financial constraints into RIs than non-family firms, we need to test the equality of marginal effects, i.e., second differences.

Let $\Delta_{KC_{FF}}$ represent an average marginal effect (AME) of knowledge constraints for family firms and $\Delta_{KC_{non-FF}}$ be the AME of knowledge constraints for non-family firms. These are regarded as first differences. A test of second difference is a test as to whether two first differences are equal, that is, whether the average effect of knowledge constraints on RIs is significantly different between family firms and non-family firms.

$$z = \frac{\hat{\Delta}_{KC_{FF}} - \hat{\Delta}_{KC_{non-FF}}}{\sqrt{\hat{\sigma}_{KC_{FF}}^2 + \hat{\sigma}_{KC_{non-FF}}^2 - 2\hat{\sigma}_{KC_{FF}, KC_{non-FF}}}} \quad (1)$$

The numerator of Equation (1) represents the difference in effect size across family firms and non-family firms; the denominator shows the standard error of the difference. The value of z can then be compared to the critical value to determine whether the difference is statistically significant (i.e., the null hypothesis can be rejected).

The same applies to interpreting the interaction between financial constraints and firm type. Equation (2) explains the test of second differences for financial constraints with $\Delta_{FC_{FF}}$, $\Delta_{FC_{non-FF}}$ representing the AME of financial constraints for family and non-family firms, respectively.

$$z = \frac{\hat{\Delta}_{FC_{FF}} - \hat{\Delta}_{FC_{non-FF}}}{\sqrt{\hat{\sigma}_{FC_{FF}}^2 + \hat{\sigma}_{FC_{non-FF}}^2 - 2\hat{\sigma}_{FC_{FF}, FC_{non-FF}}}} \quad (2)$$

Accordingly, calculations in Table 4 show that the second differences, i.e., the differences between the AME of knowledge constraints for family firms and non-family firms, are positive and statistically significant. In other words, knowledge constraints have a significantly larger effect on RIs for family firms than for non-family firms across all the changes in the adjacent levels of knowledge constraints, hence bolstering support for Hypotheses 3.

Table 4

Results for how the likelihood of introducing radical innovation is associated with perceived knowledge constraints and firm type: tests of first and second differences.

	First difference		Second difference
	AME _{FF}	AME _{non-FF}	
Effect of perceived knowledge constraints			
0 → 1	0.081 (0.047)	−0.108* (0.045)	0.190** (0.062)
1 → 2	0.094 (0.063)	−0.111* (0.047)	0.205** (0.076)
2 → 3	0.095 (0.059)	−0.103** (0.037)	0.199** (0.068)

Notes: * p<=0.05, ** p<=0.01 Standard errors are in parentheses.

Likewise, Table 5 shows that the second differences, i.e., the differences between the AME of financial constraints for family firms and non-family firms, are negative and statistically significant. Put differently, financial constraints have a significantly smaller effect on RIs for family firms than for non-family firms across all the changes in the adjacent levels of financial constraints, thus strengthening the result of the interaction effect in Hypothesis 4. All in all, these post-hoc analyses confirm the hypothesized impacts of firm type on the relationship between specified constraints and RIs.

Table 5

Results for how the likelihood of introducing radical innovation is associated with perceived financial constraints and firm type: tests of first and second differences.

	First difference		Second difference
	AME _{FF}	AME _{non-FF}	
Effect of perceived financial constraints			
0 → 1	−0.016 (0.043)	0.166*** (0.034)	−0.182*** (0.053)
1 → 2	−0.012 (0.041)	0.172*** (0.040)	−0.184*** (0.054)
2 → 3	−0.014 (0.038)	0.144*** (0.025)	−0.157*** (0.043)

Notes: *** p<=0.001. Standard errors are in parentheses.

Appendix B. . Endogeneity test

Table 6

Results of the 2SLS analyses.

Dependent variable (DV) = Likelihood of Introducing radical innovations, unless otherwise stated	Model 1 (2SLS, instrumenting KC)		Model 2 (2SLS, instrumenting FC)	
	1st stage (DV = KC)	2nd stage	1st stage (DV = FC)	2nd stage
<i>Independents</i>				
Perceived knowledge constraints (KC)		0.719* (0.307)		
Perceived financial constraints (FC)				0.575* (0.256)
<i>Controls</i>				
Export	0.136 (0.107)	0.492 (0.257)	0.217 (0.155)	0.546* (0.241)
Firm age	0.050 (0.056)	−0.071 (0.129)	−0.063 (0.088)	−0.000 (0.134)
Firm size	−0.035 (0.031)	0.133* (0.061)	−0.033 (0.037)	0.159* (0.063)
R&D intensity	0.000 (0.167)	0.201 (0.355)	0.729* (0.319)	−0.184 (0.390)
Firm growth	0.197 (0.124)	−0.034 (0.330)	−0.140 (0.241)	0.156 (0.312)
<i>Instrumental variables</i>				
Goal multiplicity	0.072*** (0.012)			
Banking debt ratio	0.695* (0.290)			
Self-financing ratio			−0.004*** (0.001)	
Current ratio			−0.048*** (0.011)	
Constant	0.364 (0.325)	−2.578*** (0.614)	1.742*** (0.451)	−2.966*** (0.709)
Industry dummies	Yes	Yes	Yes	Yes
Log likelihood	—	−475.123	—	−582.962
Wald chi-squared	64.26***		62.81***	—
(McFadden)R-squared	—	0.138	—	0.121
Observations	303	303	306	306

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Robust standard errors are in parentheses.

Data availability

The authors do not have permission to share data.

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