Collaborative Innovation and Performance of Family Firms: A Meta-Analysis

ABSTRACT

The relationship between collaborative innovation and performance of family firms has been subject to significant scholarly debate due to contradictory findings. While multiple studies identify a positive relationship between collaborative innovation and family firm performance, the factors shaping this relationship remain ambiguous. To address this gap, this meta-analysis synthesizes 65 studies with observations of 173.274 family firms across 21 countries between 1997 and 2021. Our findings confirm that collaborative innovation positively influences performance in family firms, yet this relationship is significantly moderated by the type of collaboration partner. Indeed, collaborations with R&D partners serve to strengthen the positive relationship by providing access to advanced knowledge and external technologies. In addition, we demonstrate how different governance structures affect the collaborative innovation-firm performance relationship, with family ownership strengthening the relationship, whereas family management introduces constraints tied to control and alignment concerns. In conclusion, our meta-analytic results provide novel insights into the collaborative innovation processes of family firms and underscore the significance of partner selection and governance structures in optimizing performance outcomes.

Keywords: Collaborative Innovation, Family Business, Firm Performance, Collaboration Types, Meta-Analysis

INTRODUCTION

In recent years, the concept of collaborative innovation has emerged as a management imperative for obtaining competitive market positions in response to rapidly changing demands and technological advancements (Rauter, Globocnik, Perl-Vorbach, & Baumgartner, 2018). Organizations have increasingly embraced collaborative innovation as it drives dynamic change and disruptive technology adoption (Aiello, Cardamone, Mannarino, & Pupo, 2021). Defined as the creation of innovation beyond the boundaries of a firm through the exchange and sharing of knowledge, ideas, resources and capabilities, information, expertise, experience, and opportunities (Miles, Miles, & Snow, 2005), collaborative innovation has imposed itself as a source of economic growth and survival (Alberti, Ferrario, Papa, & Pizzurno, 2014; Rauter et al., 2018; Xie, Liu, & Chen, 2023).

In the context of family businesses, collaborative innovation assumes a distinctive significance, as it is shaped by the paradoxical tension between the capacity for generating innovative ideas and the reluctance to implement them (Duran, Kammerlander, Van Essen, & Zellweger, 2016). Although research recognizes that collaboration with external partners offers family firms benefits, such as enhanced innovation potential, risk mitigation, and improved capabilities (Aiello et al., 2021), it also highlights how family firms' willingness to engage in such collaborations is often constrained by concerns over control, trust, and alignment with family values (Feranita, Kotlar, & De Massis, 2017). Consequently, this leads to conflicting views on the relationship between collaborative innovation and family firms' performance.

On the one hand, a considerable amount of research reports a positive relationship between collaborative innovation and family firm performance, focusing on the benefits, new ideas, reduced innovation risks, increased profitability, and improved innovation processes (Muñoz-Bullón, Sanchez-Bueno, & De Massis, 2020; Scaliza et al., 2022; Sorenson, Folker, & Brigham, 2008). On the other hand, other studies demonstrate that family firms are often

restrained by their high level of socio-emotional wealth and risk aversion, which outweighs the benefits of collaborations (Abdulmuhsin & Tarhini, 2022; Gómez-Mejía, Takács Haynes, Núñez-Nickel, Jacobson, & Moyano-Fuentes, 2007; Spriggs, Yu, Deeds, & Sorenson, 2013). Despite the necessity to consider potential measurement differences (Feranita et al., 2017), the conflicting results highlight the possible effects of different contextual factors in collaborative partnerships. Thus, we seek to answer the following research question: *How do different types of collaborative innovation partnerships influence the organizational performance of family businesses?*

To identify and test the effect on the collaborative innovation-firm performance relationship in family firms, we conduct a meta-analysis based on 65 quantitative studies investigating collaborative innovation in family firms. For contradictory empirical findings meta-analyses are a powerful tool to summarize the findings and underlying moderators of a relationship of interest (Gonzalez-Mulé & Aguinis, 2018). Based on a sample of 173.274 family firms in over 21 countries and covering 20 years of family business research, our results demonstrate an overall positive relationship between collaborative innovation and firm performance in family firms. In line with extant literature (Basco & Calabrò, 2016; Classen, van Gils, Bammens, & Carree, 2012; Laursen & Salter, 2006), we investigate the moderating role of different partnership types, namely (1) close network partners, (2) wide network partners, (3) business group affiliated partners, and (4) R&D partners, on the positive relationship. Our findings reveal substantial variations across the partnership types, showing that collaborating with R&D partners significantly strengthens the positive association between collaborative innovation and firm performance. At the same time, the relationship is considerably weaker when engaging with close network partners.

Our study contributes to the family firm literature by complementing existing meta-analyses on family firms' innovation input and output (Block, Hansen, & Steinmetz, 2023;

Duran et al., 2016), internationalization strategies (Arregle, Duran, Hitt, & van Essen, 2017), or financial behavior (Hansen & Block, 2021; Wagner, Block, Miller, Schwens, & Xi, 2015), offering findings that focus exclusively on the collaborative behavior of family firms on their innovative and financial performance. Overall, our study advances the literature on family firm innovation by integrating contradictory findings and confirming the positive relationship between collaborative innovation and firm performance in family businesses. Our analysis demonstrates the robustness of the beneficial effect of CI on firm performance, despite variations in the conceptualizations of family firms. The study enhances understanding of diverse partnership contexts, highlighting that R&D partnerships provide the greatest benefits to family firms through the sharing and complementing of innovative capabilities. In this regard, we suggest that family firm executives need to be aware of the potential benefits and drawbacks of specific partnerships, to reduce the costs of innovation processes and enhance performance outputs.

THEORETICAL BACKGROUND

Collaborative innovation in the era of open innovation

Research on collaborative innovation in general management literature dates back to the 1990s (Das & Teng, 2000; Gulati, 1995), however, it was not until the spread of the open innovation paradigm (Chesbrough, 2003), that the concept gained prominence among innovation practitioners. The open innovation paradigm describes a knowledge-based business model that aims to enhance innovation capabilities through the acquisition of external technologies (inbound dimension) and the dissemination of core competencies and knowledge to external organizations (outbound dimension) (Chesbrough, 2003; Enkel, Gassmann, & Chesbrough, 2009). The open innovation paradigm is thus an appropriate underlying paradigm for our research endeavor, as it explains the underlying mechanism of collaborating with external partners to leverage and complement internal resources (Aiello et al., 2021).

Consequently, the concept of collaborative innovation is closely associated with and evolves from the body of literature on open innovation (Brinkerink, Gils, Bammens, & Carree, 2017; Rauter et al., 2018).

Collaborative innovation can be identified as an important dimension for successful OI adoption (Scaliza et al., 2022). Following the definitions of prior research (Bigliardi & Galati, 2018; Feranita et al., 2017), collaborative innovation is a form of inter-firm relationship, involving the exchange and sharing of resources (financial, technological, managerial) and knowledge with external partners to achieve innovation (Miles et al., 2005). The search for and integration of external resources is vital to accelerate internal innovation, including product or service innovation, and process or management innovation (Najafi-Tavani, Najafi-Tavani, Naudé, Oghazi, & Zeynaloo, 2018; Xie et al., 2023). Firms that engage in collaborative innovation, for example, create networks that allow them to both share knowledge and assets and gain novel technologies to amplify performance outcomes (Xie, Fang, & Zeng, 2016), reinforcing the strategic value of open innovation as a foundational paradigm.

Extant literature demonstrates that collaboration in OI activities with a diverse range of partners has a positive influence on a firm's innovation success (Rauter et al., 2018). While search breadth is defined as the number of external collaboration partners, search depth refers to the intensity of use of these external sources. Extant research claims that firms who encompass a broad number of partners and search deeply tend to be more innovative (Classen et al., 2012; Laursen & Salter, 2006), showing that SMEs that interact with a broad number of partners (e.g., with suppliers, customers, competitors, universities) can effectively participate in new product development, alternative innovation processes, and help to exploit solutions for internal problems (Basco & Calabrò, 2016; Feranita et al., 2017). Whilst prior studies have indicated a positive association between collaborative innovation and firm performance (e.g., Najafi-Tavani et al., 2018), this correlation may not be applicable to family businesses.

Collaborative innovation in family businesses

Although engaging in collaborative innovation has increasingly been considered a source of sustainable competitive advantage for organizations (Gloor, 2006), in the family businesses context this phenomenon assumes a distinctive connotation (Bigliardi & Galati, 2018; Feranita et al., 2017; Gjergji, Lazzarotti, Visconti, & García-Marco, 2019; Pütz & Werner, 2023). On the one hand, collaboration with external partners offers family businesses an opportunity to enhance their innovation potential, mitigate risks, and improve their innovative capabilities (Aiello et al., 2021). On the other hand, extant research shows that, for family firms, the willingness to engage in collaborations is hindered by concerns over control, trust, and alignment with family values (Feranita et al., 2017).

This duality is embedded in the idea of *'family innovation dilemma'* (Duran et al., 2016), which refers to the paradoxical tension between family firms' ability to generate innovative ideas, and their tendency to be reluctant to implement them. This contradiction constitutes the theoretical underpinning of a stream of literature that highlights how family firms' intrinsic traits, such as long-term orientation, risk aversion, and desire for control, shape their unique approach to collaborative innovation (Feranita et al., 2017; Kotlar, De Massis, Frattini, Bianchi, & Fang, 2013; Miller, Lee, Chang, & Le Breton-Miller, 2009). From one angle, family firms possess unique resources (e.g., social capital, tacit knowledge) that affect their willingness to collaborate with external partners due to the risk of control and reputation loss. In this regard, some studies suggest that family firms, often concerned about maintaining control, identity, and legacy, selectively engage in collaborative innovation to avoid jeopardizing family influence. Conversely, other studies show the ability of family businesses to solve the dilemma between conservative tendencies and openness to collaboration, capitalizing on values (Sorenson et al., 2008) and social capital (Acquaah, 2012).

More broadly, the literature on family firms and collaborative innovation can be divided in two main streams of research, one focusing on innovation inputs and one on innovation outputs. Starting from the assumption that family firms suffer resource constraints, such as limited financial capital and restricted access to external expertise (Feranita et al., 2017; Kotlar et al., 2013), a first stream highlights the need for family businesses to rely on collaborative partnerships to access additional resources and capabilities for innovation. These studies show how family firms use external partnerships to acquire new knowledge, diversify their capabilities, and manage their inherent risk aversion (Bendig, Foege, Endriß, & Brettel, 2020; Martínez-Alonso, Martínez-Romero, & Rojo-Ramírez, 2022). Alliances with institutions such as universities or R&D-intensive firms can provide family firms with external knowledge and introduce new technological opportunities (Dinh, Calabrò, Campopiano, & Basco, 2021; Gjergji, Lazzarotti, & Visconti, 2022).

A second stream of research focus on the innovation outputs resulting from collaborative activities. These studies show that, although, collaborative innovation allows family firms to develop competitive advantages through new products, services, and processes (Serrano-Bedia, López-Fernández, & Garcia-Piqueres, 2016; Zahra, Hayton, & Salvato, 2004), the success of these collaborations is influenced by family firms' peculiar characteristics, such as governance structure and generational involvement (Nieto, Santamaria, & Fernandez, 2015; Werner, Schröder, & Chlosta, 2018). For this reason, outputs often reflect a blend of tradition and innovation, ensuring that the partnerships are consistent with the firm's identity and culture (Filser, De Massis, Gast, Kraus, & Niemand, 2018; Sorenson et al., 2008). For instance, Guenther et al. (2023) and Duong et al. (2022) highlight that family firms prioritize long-term, sustainable outcomes over short-term gains, shaping the types of innovations they pursue.

A recent stream of research has shed new light on the relation between innovation inputs and outputs in family businesses. In their highly influential meta-analytical study on family

businesses, Duran et al. (2016) demonstrated that, surprisingly, for this type of organizations, a lower innovation input leads to a higher innovation output. This unexpected finding suggests that family businesses can benefit from higher levels of tacit knowledge, which in turn leads to effective innovation processes. Block et al. (2023) extended these valuable insights by adding additional firm-specific variables such as firm size and contradicted the initial results. In their analysis the authors did not find full support for the "doing more with less" phenomenon (Duran et al., 2016). Further, other studies highlight the challenges associated with inconsistent measurements and the imprecise findings concerning the impact of collaborative innovation on family firm performance (Feranita et al., 2017). To sum, despite the growing insights on the measure and the effect of collaborative innovation on family firm performance, it is clear that the discussion is far from settled.

Hypotheses Development

Collaborative innovation and the performance of family businesses

The majority of papers measure collaboration performance using the effect of innovation performance at a firm level, operationalized by items such as new products or services developed (Amato, Ricotta, & Basco, 2022; Martínez-Alonso et al., 2022), new patents registration or patent citations (Hsieh, Yeh, & Chen, 2010; Sánchez-Sellero, Rosell-Martínez, & García-Vázquez, 2014), modified products, services, processes (Yeoh, 2014), and management and business model innovations (Del Vecchio, Secundo, Rubino, Garzoni, & Vrontis, 2020). In these studies, innovative performance is theorized as a significant driver of firm performance, with its outcomes contributing to the achievement of overall organizational goals (Scaliza et al., 2022). For instance, through collaboration, firms can leverage external technologies and ideas with internal knowledge during all stages of the innovation process, including primary R&D investments to market launch (Hagedoorn & Cloodt, 2003). Consequently, a firm's performance is influenced not only by its internal resources and R&D

processes, but also by external competencies and knowledge acquired outside the company, particularly during the initial R&D stages (Filippetti & Guy, 2020).

In addition, a positive effect of collaborative innovation can also be produced by increased financial performance at the firm level. For instance, higher profitability and financial measures may lead to higher innovation investments and higher family firm innovation capability, which may ultimately translate into improved firm performance (Feranita et al., 2017). It is important to note that financial performance encompasses a broader range of measures beyond profitability-based indicators, including market-based and growth-based metrics (Ahuja & Novelli, 2017; Combs, Crook, & Shook, 2005; Hult et al., 2008). Sorenson et al. (2008), for instance, identify a positive effect of collaborative networks on firm's performance by comparing the growth or decline of profitability, industry share, growth and market share with competitors over a five-year period. In addition, Muñoz-Bullón et al. (2020) confirm a positive significant relationship between collaboration in external R&D activities and innovation performance as well as economic performance, measured by the return on assets (ROA) and market share, respectively. The authors posit that the innovation performance of family firms is contingent upon their firm economic performance. This underscores the significance of considering both performance dimensions to obtain a comprehensive understanding of the collaborative innovation outcomes. Consequently, family firms may be able to leverage external and internal assets to develop sustainable competitive advantage resulting from financial and innovative performance outcomes.

Building on these arguments, we argue that collaborative innovation plays a crucial role in enhancing firm performance in family businesses and develops sustainable competitive advantages. By fostering innovation through collaborative efforts, family firms not only enhance their capacity to create novel products, services, and processes but also strengthen their

financial performance in terms of profitability, growth, and market share. We therefore propose the following hypothesis:

H1: Collaborative innovation is positively related to the performance of family firms.

The moderating effect of collaboration partner types

The concept of collaborative innovation encompasses business partnerships with multiple external partners, including suppliers, customers, research institutions, and partners from existing collaboration networks (Basco & Calabrò, 2016; Laursen & Salter, 2006; Xie et al., 2023). Building on previous findings, it can be posited that a firm's capacity to access innovative resources and novel knowledge depends on its network of collaborations, with different types of partners exerting varied impacts on the relationship between collaborative innovation and firm performance (Najafi-Tavani et al., 2018; Xie et al., 2023). In the following, we theorize how different collaboration partners affect the performance outcomes that family firms reap from collaborative innovation. In response to the call by Block et al. (2023) for further research on contextual factors explaining the innovation input-output relationship in family firms, we focus on four different collaboration partner types (close network, wide network, business group partner, R&D partner) and elaborate on how these different types shape the firm performance output associated with the innovative collaboration input.

Close and wide collaboration networks

When firm actively seek external collaboration partners, they tend to adopt so-called open innovation search strategies (Laursen & Salter, 2006), which consider the proximity and extent of external partners (Classen et al., 2012). Consequently, partner search strategies can be categorized into two distinct groups: related and unrelated collaborative innovation strategies, each of which indicates a specific innovation outcome. A related open innovation search strategy, for example, includes collaboration partners within a close commercial and competitive network, thus compromising similar knowledge and resources that are mainly related to incremental innovation strategies (Basco & Calabrò, 2016; Laursen & Salter, 2006).

The involvement of key suppliers in the innovation process has been identified as a strategy of considerable efficacy for the purpose of sustaining competitive advantage (Najafi-Tavani et al., 2018). Suppliers grant access to their products, equipment, and technologies, thereby enabling firms to gain a more profound understanding of the products and technologies utilized, thus enhancing their usability and application (Menguc, Auh, & Yannopoulos, 2014). In fact, a symbiotic relationship facilitates effective communication of the firms' needs, which in turn assists suppliers in acquiring specific information to provide advanced technologies and results in reduced costs and lower risks (Yang & Chen, 2017).

Similarly, customers' feedback and assessment of products and services are identified as crucial drivers of innovation outputs. Indeed, firms that facilitate customer participation during launch phases, thereby incorporating customer feedback into product usability and prototyping considerations, can maximize their collaborative innovation (Chang & Taylor, 2016). Finally, firms that collaborate with potential competitors typically strive for R&D cost sharing and potential synergy effects (Classen et al., 2012; Das & Teng, 2000), which speed up innovation processes, leading to significant advancements in collaboration performance outcomes (Yang & Chen, 2017). In this study, we therefore refer to customers, competitors, and suppliers as close or related network partners, who offer similar knowledge, technologies and ideas within the close network of a firm (Basco & Calabrò, 2016)

Conversely, the acquisition of knowledge and technologies from a wider range of network partners, including research institutions, universities, and public institutions, is classified as an unrelated collaboration strategy. This implies the capture of new knowledge and ideas beyond the current knowledge possessed by a firm. In this regard, the motivations of firms are dominated by risk-seeking and economic goals, which are often related to more radical innovative approaches (Basco & Calabrò, 2016; Katila & Ahuja, 2002).

The development of sustainable innovations might also require expert knowledge and contributions from research institutions or universities to gain wide societal acceptance and first-hand information (Rauter et al., 2018). In this regard, partnerships with universities and research institutes grant access to first-hand expertise and scientific knowledge, both of which are crucial for the development of innovative capabilities. This is especially true in the context of technological innovation, where the complexity of knowledge innovation processes increases. firms therefore benefit from expert knowledge during the entire innovation process (Brettel & Cleven, 2011; Najafi-Tavani et al., 2018). Collaborations with academic and research institutions thus play a pivotal role in facilitating access to cutting-edge information and technologies, in addition to providing support for the enhancement of innovation performance (Yang & Chen, 2017).

Collaboration with unrelated network partners, such as local institutions and other organizations, may also assist in achieving market presence and acceptance (Rauter et al., 2018). Administrative institutions, for instance, have been shown to support firms in the promotion of their innovation activities, the provision of venture capital and funding, the acquisition of new technologies, and the safeguarding of intellectual property (Classen et al., 2012; Shu, Wang, Gao, & Liu, 2015). However, these partnerships often require higher costs and a higher risk-taking propensity, resulting in improved performance, at the cost of lower efficiency (Nieto & Santamaría, 2007; Xie et al., 2023).

In family businesses, we observe the tendency to seek knowledge that is analogous to the ideas and resources that they already possess, as they aim to mitigate risks and potential misalignments in their innovation processes. Furthermore, by collaborating with customers, suppliers, or close competitors, family firms can leverage existing competencies to introduce innovative solutions that address market needs, thereby enhancing innovation performance (Wang & Hu, 2020; Xie et al., 2023). The preference in terms of close network partnerships

enables family firms to discern emerging opportunities in customer needs, establishing a distinct competitive position within their network (Basco & Calabrò, 2016; Xie et al., 2023). Consequently, elevated levels of collaboration with close network partners are imperative for the development of sustainable innovation capabilities, thereby ensuring the attainment of robust market positions (Rauter et al., 2018).

Building on these insights, we argue that, although family firms benefit both from close and wide collaboration networks, they demonstrate a pronounced preference for close collaboration networks, driven by their inherent focus on risk mitigation, alignment with existing competencies, and leveraging established relationships. By engaging with customers, suppliers, and competitors within their close network, family firms can capitalize on incremental innovation opportunities that align with their strategic objectives and resource base. This typically leads to mere incremental changes rather than radical innovations and improved firm performance (Basco & Calabrò, 2016; Xie et al., 2023) Following these arguments, we elaborate the following hypotheses:

H2a: The positive relationship between collaborative innovation and the performance of family firms is positively moderated by a collaboration partner in a close collaboration network.

H2b: The positive relationship between collaborative innovation and the performance of family firms is positively moderated by a collaboration partner in a wide collaboration network.

H2c: The positive moderating effect of collaboration partners in a close collaboration network in family firms is stronger than the moderating effect of collaboration partners in a wide collaboration network.

Collaboration with business group affiliated partners

Business groups can be defined as networks (or clusters) of legally independent firms that form formal ownership ties or informal social relations to coordinate business activities and resources to create common value (Granovetter, 1995). The majority of these interfirm ties are subject to common financial and administrative control (Chang & Chen, 2016) and ownership

(Choi, Zahra, Yoshikawa, & Han, 2015). Business group networks are characterized by facilitated interconnections and knowledge transfer between heterogenous partner firms (Basco & Calabrò, 2016), as well as enhanced transfer of resources and assets between the group firms (Ashwin, Krishnan, & George, 2015). Indeed, partners within business group networks may benefit from enhanced information flows and cross-firm learning, thus increasing their learning capabilities and reduced environmental uncertainties (Chang & Chen, 2016). With regard to innovation capabilities, interfirm ties within the group networks function as innovation enablers, thereby reinforcing access to complementary resources, foreign technologies, and technical talent (Dyer & Singh, 1998). However, affiliated partners do not merely share innovative capabilities and resources, but also valuable financial support for potential R&D investments and human capital among members (Ashwin et al., 2015; Mahmood, Zhu, & Zajac, 2011). The use of common financial control procedures facilitates the involvement of affiliated partners in group-wide investment decisions and a common resource allocation, thereby enabling partners to obtain inter-group financial support for innovative projects. This, in turn, serves to promote common capabilities to develop new products and services (Choi et al., 2015; Yiu, Bruton, & Lu, 2005).

In the context of family business research, business groups are characterized by networks comprising numerous affiliated family firms. Consequently, the control exercised by family firms is more effectively safeguarded by all constituents within the group. However, extant literature indicates that family ownership may exert an adverse effect on R&D investments and growth opportunities (Choi et al., 2015). This phenomenon can be explained by the concept of 'creative self-destruction' (Schumpeter, 2013), which suggests that family firms may avoid innovation in an affiliated firm to protect their other inter-firm R&D investments (Ashwin et al., 2015). Additionally, the tendency of controlling shareholders who exploit their position within the network may also have a negative effect on the firms' performances. Investment

decisions and activities may be influenced by controlling partners to generate appropriate wealth for private use (Chang & Chen, 2016). On the contrary, recent studies provide evidence for multiple positive effects on the financial and innovation performance of family firms that are affiliated with business group networks. Singh and Delios (2017), for instance, postulate that collaboration within business group networks enhances family firms' growth strategies in emerging markets. The findings of Ashwin et al. (2015) and Chang and Chen (2016) demonstrate a significant positive relationship between business group collaboration and the number of new patent filings or new product announcements, respectively. Nevertheless, based on these positive effects, we hypothesize a positive moderating effect of collaboration with affiliated partners in business groups.

H2d: The positive relationship between collaborative innovation and performance of family businesses is negatively moderated by a business group collaboration partner.

Collaboration with R&D partners

R&D partnerships are characterized by active involvement in joint R&D projects among multiple firms (Tether, 2002) throughout the entire supply chain (Martínez-Alonso, Martínez-Romero, & Rojo-Ramírez, 2023). In the context of family firms, the long-term orientation and the prioritization of socio-emotional wealth have been found to drive efforts to establish trust-based, enduring relationships with external R&D partners (Choi et al., 2015; Duran et al., 2016a; Gomez-Mejia et al., 2014; Muñoz-Bullón et al., 2020). The long-term orientation of family firms facilitates the complementation of in-house capabilities with external knowledge, thereby enabling the overcoming of resource constraints and the mitigation of risks associated with innovation processes (Amato et al., 2022). The breadth of collaboration in R&D partnerships, defined as the range of partners engaged in joint endeavors, is pivotal in facilitating access to a diverse array of external knowledge and knowledge spillovers(Amato et al., 2022; Boschma, 2005; Laursen & Salter, 2006). Moreover, family firms have been shown

to employ a combination of both internal and external R&D strategies, leveraging their internal resources in conjunction with external expertise to achieve superior performance (Diéguez-Soto & Martínez-Romero, 2019).

Collaboration with R&D partners enables firms to access new scientific knowledge, reduces innovation costs, and shares risks, ultimately enhancing firm efficiency and increasing the likelihood of innovation success (Diéguez-Soto & Martínez-Romero, 2019). Family firms, in particular, benefit from their distinct ability to integrate external knowledge with their internal R&D through strong personal and social ties with external networks (Aiello et al., 2021). The long-term orientation of family firms fosters social capital, which supports sustained collaborative efforts, reducing coordination costs and enhancing communication with external partners (Amato et al., 2022; Muñoz-Bullón et al., 2020). This amplifies their absorptive capacity, which is their ability to acquire and apply external knowledge for their use, thereby transforming external knowledge into innovative and financial performance (Aiello et al., 2021; Cohen & Levinthal, 1990). By leveraging external R&D partnerships, family firms overcome internal resource constraints such as financial resources for R&D investments (Diéguez-Soto & Martínez-Romero, 2019), and potentially minimize the costs of innovation processes (Arzubiaga, Maseda, Uribarri, & Ruiz, 2019).

Although the positive effect of family firms' engagement in R&D relationships has been established (Aiello et al., 2021; Muñoz-Bullón et al., 2020), challenges such as high coordination complexities, potential loss of control over innovation processes, and resistance to external influences may hinder this relation (Diéguez-Soto & Martínez-Romero, 2019; Gómez-Mejía et al., 2007; Muñoz-Bullón et al., 2020). Further, the reluctance of family firms to recruit external talent or to invest heavily in R&D activities may harm their capacity to fully leverage external partnerships (Muñoz-Bullón et al., 2020). However, despite these potential negative effects, the benefits of collaborative R&D partnerships, such as shared innovation

risks, access to critical resources, and increased innovation efficiency, are particularly pronounced in family firms, suggesting a positive impact on their performance outcomes (Amato et al., 2022; Dong, Wang, & Chen, 2022; Feranita et al., 2017; Martínez-Alonso et al., 2023). Thus, we hypothesize:

H2e: The positive relationship between collaborative innovation and firm performance of family firms is positively moderated by a R&D collaboration partner.

METHOD

Sampling and coding

In line with previous studies on innovative performance in family firms (Block et al., 2023; Duran et al., 2016; Kosmidou & Philip, 2023), this study employs a meta-analysis to analyze the population of studies that quantitatively discuss the relationship between the collaborative innovation behavior of family businesses and firm performance. To construct our sample, we applied five complementary search strategies. In an initial step, two literature reviews on collaborative innovation in family firms (Bigliardi & Galati, 2018; Feranita et al., 2017) and two recent reviews on open innovation (Gjergji et al., 2019) and absorptive capacity (Pütz & Werner, 2023) in family firms were screened to identify quantitative studies that capture the relationship between collaborative innovation and firm performance in family firms. The process yielded 106 quantitative papers. Secondly, we searched the Web of Science Core Collection databases, EBSCOhost Business Source Premier by using the following search string: *(("collaborat* innovat*" OR "cooperat* innovat*" OR "co-innovat*" OR "open innovation" OR "synerg* innovat*" OR "inter-firm collaborat*" OR "alliance" OR "collaboration capacity" OR "extern*") AND ("family business" OR "family firm" OR "family management" OR "family enterprise" OR "family control" OR "family ownership" OR "family involvement" OR "family influence") AND ("innovat* performance" OR "firm performance" OR "value creation" OR "performance"))*. Additionally, we searched ABI/Inform Global (accessed via ProQuest) to include studies of dissertations, reports, and working papers. From

a total sample of 1005 papers, we then excluded duplicates and qualitative studies, and identified relevant papers by screening their titles and abstracts (*N=131 documents*). In a third step, we read the papers in their entirety, and included all studies that measure the bivariate relationship between the variables of interest as well as reported the Pearson's correlation *r* between the constructs (Hunter & Schmidt, 2004). We then excluded all studies that reported results from overlapping samples. This primary search was conducted in November 2023, and 49 studies were identified as meeting the inclusion criteria. In addition to the initial sampling process, 13 studies were identified through backward and forward searching in August 2024, yielding a total sample size of 62 studies. In order to update the sample in November 2024, the search query was re-run with the objective of identifying studies that had been published more recently. The final sample was then refined by identifying relevant articles of the recent meta-analytical contribution by Block et al. (2023). The application of these search strategies resulted in the identification of 14 additional studies, thereby augmenting the sample to 76 studies. However, 11 papers did not report correlation coefficients and/or descriptive data. Therefore, we contacted the authors to request the missing effect size information and their correlation matrix. The combination of all search strategies resulted in a final sample of 65 primary studies with 194 effect sizes, synthesizing information on 173.274 family firms[1] in over 21 countries and covering 20 years of studies (2004-2023). It is noteworthy that more than 77% of these studies have been published since 2015, indicating a notable increase in research interest over the past decade. The majority of the primary studies (58%) were cross-sectional in nature, with the oldest dataset dating back to 1997 and the most recent to 2021. Most studies were published in *Entrepreneurship Theory and Practice* (n=4) and *Small Business Economics* (n=4). The most popular outlets are shown in *Table 1*.

[1] Four primary studies did not report the number of family firms in their sample. We contacted the authors for the missing descriptive statistics and multiplied their total sample sizes by the average proportion of family firms in all studies (N=65, mean=0.66) in order not to lose the four primary studies in our sample.

After developing a coding protocol (Lipsey & Wilson, 2001), the first author proceeded to code the studies in accordance with the protocol, incorporating calculation-based information (e.g., statistical data, dependent, independent, moderation, and control variables). Coding work that included subjective judgement calls was independently coded by an additional senior researcher. For cases where there was significant disagreement, a third senior researcher was consulted. The first author was responsible for coding all effect sizes. In instances where a study failed to report essential statistical data, such as sample sizes or the time of data collection, the authors were contacted and requested to provide the missing information.

Insert Table 1 about here

Measures

Dependent variable – firm performance

Following previous studies, we measure firm performance by distinguishing four performance types: profitability-based performance (Ahuja & Novelli, 2017; Hult et al., 2008; Wagner et al., 2015), market-based performance (Hult et al., 2008), growth-based performance (Combs et al., 2005), and innovation-based performance (Ahuja & Novelli, 2017; Xie et al., 2023). Subsequently, we categorized the performance variables according to the main relationship between collaborative innovation input on *innovation* and *financial* performance. *Innovation performance* is defined as a firm's activities and outputs associated with new products, services, processes, or management (Block et al., 2023; Scaliza et al., 2022; Xie et al., 2023). In accordance with this definition, we included the following innovation performance measures: the development of new products, services, or processes; the sales revenue of new products or services; the number of filed patents; the number of patent citations; the number of management or business process innovations; and R&D expenditure as a proxy for innovation (e.g., Kim et al., 2023). Secondly, based on to the concept of multidimensionality

in organizational performance by Combs et al. (2005), we further categorize profitability (accounting returns), growth, and market items to measure the *financial performance* of family firms (Acquaah, 2012; Dyer, 2006; Lee, 2019; Sorenson et al., 2008; Spriggs et al., 2013; Wagner et al., 2015). Indeed, we coded the following measures as financial performance: return on assets (ROA), return on equity (ROE), return on sales (ROS), return on investment (ROI), gross margin ratio (GMR), the ratio of total debt to total assets as a proxy for firm leverage, and the growth of sales, revenue, operating cash flow and market share. *Table 2* provides an overview of the variables included in this study.

Independent variable – collaborative innovation

In our study, we define collaborative innovation as a form of inter-firm relationship involving the sharing and exchange of resources and knowledge with external parties with the objective of achieving innovation (Bigliardi & Galati, 2018; Feranita et al., 2017; Miles et al., 2005; Veider & Matzler, 2016). In accordance with this definition, we incorporate a wide range of external entities, including customers, suppliers, competitors, research institutes, universities, public organizations, as well as partners associated with business groups (Classen et al., 2012; Laursen & Salter, 2006). If one or more partnership types were used as measures in the primary studies, the effect size(s) of the collaborative innovation type(s) on firm performance were captured for the purpose of our operationalization.

Moderator variables

In order to ascertain the moderating effect on the collaborative innovation-family firm performance relationship, we included four different collaboration partner types. We considered partnerships with customers, competitors, and suppliers as *close network partners,* while partnerships with research institutions, universities, and public institutions were considered as *wide network partners* (Basco & Calabrò, 2016; Katila & Ahuja, 2002; Laursen & Salter, 2006). Furthermore, we considered partners that form formal or informal ties as part

of a network of legally independent businesses to coordinate activities and resources to create common value as bus*iness group affiliated partners* (Granovetter, 1995). Finally, we coded all partnerships that are characterized by the active involvement in joint R&D projects (Tether, 2002) as part of the fourth moderating variable *R&D partners*.

Control variables

As the extant literature has not yet converged on a common operationalization of family firms (Arregle et al., 2017; Hansen & Block, 2021), we adopt the conceptualization of Block et al. (2023), including the family firm definitions of (a) family ownership, (b) family management, (c) a combined measure of ownership and management, and (d) a combined measure of family ownership or management. To examine their influence on the primary relationship, we control for the family firm variables used in the primary studies (see *Table 2*) and used dummy coding (Hansen & Block, 2021). To circumvent the influence of exogenous factors on family firms' performance, we incorporated a series of additional firm-specific control variables. Indeed, to account for a sample bias between family firms and non-family firms, we include the *share of family firms* as a proxy for the number of family firms in our study sample. Secondly, according to previous meta-analyses (Block et al., 2023; Kosmidou & Philip, 2023; Xie et al., 2023) we controlled for *firm size* and *firm age*. Additionally, we included a dummy variable to distinguish between manufacturing firms (1), and service or other industries (0), as well as a control for *R&D intensity* to distinguish between high (1) and low (0) technology business sectors. The operationalization of this control measure was based on a combined variable, which comprised the median split of the ratio of R&D expenditure and sales, as well as a dummy variable for verbatim statements of high (1) and low (2) technology business sectors within the primary studies. Furthermore, we controlled for *GDP/capita* to account for the country context. Finally, we included methodological controls, such as *journal abs score* as a proxy for study quality, the *timeframe* to capture *longitudinal* versus *cross-*

sectional studies, the *mean year of data collection* to control for temporal effects, and the *data type* to identify whether the sample was based on data of *primary* or *secondary* sources.

Insert Table 2 about here

Analysis

In accordance with preceding meta-analyses, we employed the methodology proposed by Lipsey and Wilson (2001), utilizing subgroup analysis (SGA) and meta-analytical regression analysis (MARA) (e.g., Ilyas et al., 2024; Kluger et al., 2024; Wagner et al., 2015). MARA was utilized to account for the impact of multiple moderators and control variables. In doing so, we applied the effect size estimate on the collaborative innovation-firm performance (CI-FP) relationship as the dependent variable, with the controls and moderator variables functioning as independent variables (Lipsey & Wilson, 2001). Given that the majority of the included literature is correlational, we coded the correlation coefficient *r* as the effect size. Effect sizes were then weighted by the number of firms. For studies reporting observations rather than the number of firms, the number of total observations was divided by the number of years observed to approximate the sample size. In instances where multiple effect sizes were reported for a given relationship of interest, we treated all effect sizes independently and utilized a multiple-level meta-analysis to account for potential dependencies between the effects nested within and/or in-between studies (Kluger et al., 2024; Van den Noortgate, López-López, Marín-Martínez, & Sánchez-Meca, 2013).

In order to synthesize the effect sizes, a random effects model was selected, which considers both within-study and between-study variance. This approach allowed us to avoid bias, both in the underestimation of the significance of smaller sample sizes and the overestimation of the significance of larger sample sizes (Lipsey & Wilson, 2001; Xie et al., 2023). In accordance with preceding meta-analyses (Kluger et al., 2024; Wagner et al., 2015),

we employed the *rma.mv* function of the R package *metafor* (Viechtbauer, 2010) to encompass all multivariate/ multilevel meta-analysis models with random effects (Kluger et al., 2024). To confirm the random effects model, we tested for heterogeneity and additionally calculated a separate sub-group analysis in order to gain a first indication of the moderating effects. However, owing to a potential power problem caused by missing values and a potential under- or overestimation of small sub-group sizes, we do preferably utilize MARA over sub-group analysis to test the hypotheses.

In order to ensure that there is no multicollinearity between variables, we calculated the variance inflation factor (VIF) in each model, which demonstrated factors with a maximum of 3.31. The values are well below the critical threshold of 10 (Kleinbaum, Lawrence, Muller, & Nizam, 1998), indicating that multicollinearity is not a thread to the analysis.

RESULTS

The results of the meta-analysis are shown in *Table 3* (subgroup analysis) and *Table 4* (multi-level meta-analytic regression analysis). Our analysis confirms H1 and demonstrates that the relationship between collaborative innovation and firm performance is significantly positive ($p<.001$), with a mean correlation-based effect size of $r=.176$ (95% confidence interval: .139 to .213). Furthermore, the findings indicate significant heterogeneity in the effects ($Q=5268.40$, $p<.0001$), suggesting the likely presence of moderating effects on the CI-FP relationship. Consequently, we analyze the main relationship between CI and FP in light of the moderating variables.

Insert Table 3 about here

We employed a sub-group analysis to gain initial indications of the moderating and controlling effects. First, the subgroup-analysis results do not indicate significant differences in the strength of effect sizes between high- or low-quality outlets ($Qbtw=1.190$, $p=.275$).

Conversely, studies, whose sample was cross-sectional rather than longitudinal (*Qbtw*=40.904, *p*<.001*)*, used primary data rather than secondary data (*Qbtw*=38.116, *p*<.001), and collected data before the year 2011 (*Qbtw*=26.702, *p*<.001*)* indicate significantly *larger* effect sizes for the CI-firm performance relationship. Furthermore, the SGA results demonstrate that the measurement of innovation and financial performance has the capacity to impact the strength of the CI-FP relationship. Studies that measure innovation performance (*r*=.220, *Qbtw*=58.611, *p*<.001) report significantly *larger* effect sizes than financial performance measures (*r*=.073, *Qbtw*=33.341, *p*<.001). Consequently, both study-level and measurement variables were controlled for in the subsequent moderating analysis (*Model 1).*

The MARA results provide further insights into different family firm- and study-specific contingencies. First, we control for potential effects on the CI-FP relationship of different family firm operationalizations, such as family firm ownership, and the combined measure of family firm ownership and management. While the investigation encompassed all four family firm variables, the regression analysis was constrained to these two, owing to potential multicollinearity threats. The regression results show that family ownership positively influences the CI-FP relationship (*Model 1: β*=.120, *p*<.001). Conversely, the family firm ownership and management measure does not imply a significant effect (*p*=.208). Second, we controlled for the effect of innovation performance outcomes. The results demonstrate a highly significant positive effect of the variable (*Model 1: β*=.096, *p*<.0001). This finding is consistent with the subgroup analysis, which identified a *stronger* innovation performance effect (*r*=.220) compared to the effect of financial performance (*r*=.073).

Furthermore, the findings demonstrate that the CI-firm performance relationship is contingent on the nature of the collaboration partner. Indeed, the subgroup analysis results indicate that collaborating with R&D partners (*Qbtw*=5.350, *p*=.021) and partners in affiliated business groups (*Qbtw*=9.074, *p*=.003) have a significant moderating effect on the CI-firm

performance relationship. Conversely, partnering with collaboration partners from a close network (*Qbtw*=2.245, *p*=.134) or wide network (*Qbtw*=1.529, *p*=.216) do not show significant moderating effects. However, the results of the regression analysis only partially support these findings. Indeed, the regression results (*Model 2*), presented in *Table 4*, show that engaging with collaboration partners from a close network significantly (*p*=.028) moderates the CI-firm performance relationship. However, this finding contradicts H2a, as the moderating variable demonstrates a negative significant effect (*Model 2:* β=-.051), thereby leading to the rejection of H2a. In line with the subgroup-analysis results, collaborating with a wide network partner shows an insignificant negative effect (*Model 2: β*=-.005, *p*=.830), thus H2b is not supported. Furthermore, we analyze effects of the close- and wide network partnership variables. The results of the subgroup- and regression analysis indicate that partnership within close networks (*r*=.145; *Model 2: β*=-.051) exhibit a slightly *weaker* effect than those within wide networks (*r*=.192; *Model 2: β*=-.005). Consequently, we are unable to support H2c. Despite the indicated significant effect (*p*=.003) in the subgroup analysis, MARA results show an insignificant effect (*p*=.837) of business group affiliated partnerships, H2d is thereby not supported. However, the regression results confirm H2e, showing that a collaboration with a R&D partner positively impacts the relationship between collaborative innovation and firm performance (*Model 2: β=.0*65, *p*=.037).

Insert Table 4 about here

Robustness tests and additional analyses

To verify our results, we ran separate models (*Models 3-8*) with additional control variables. We did not include these control variables in the overall model, as their inclusion resulted in a substantial reduction in the number of effect sizes in the analysis, reduce the power of the model and lead to multicollinearity issues. The separate models yielded no significant

differences in the results of our main model. None of the controls were significant: the share of family firms (*Model 3: k*=165, *β*=-.225, *p*=.652), firm size (*Model 4: k=1*84, *β*=-.005, *p*=.885), firm age (*Model 5: k=134, β*=.029, *p*=.436), R&D intensity (*Model 6: k=132, β*=-.012 *p*=.755), industry (*Model 7: k= 167, β*=-.043, *p*=.260), or GDP/capita (*Model 8: k=180, β*=-0.00, *p*=.835). Thus, all regression results remain robust when the impact of these control variables is examined.

To assess potential publication bias, we first illustrated a funnel plot (*Figure 1*), which is commonly used to check whether effect sizes are symmetrically distributed around the overall average effect size across studies. Symmetry in the funnel plot indicates an absence of systematic biases, such as publication bias or small-study effects, whereas asymmetry may suggest their presence. While the funnel plot provides an initial indication, asymmetry is often challenging to detect visually. Therefore, we performed Egger's test on a simplified (one-level) regression model to statistically evaluate funnel plot asymmetry. The test yielded a z-value of 1.4124 (*p*=.158), indicating no statistically significant evidence of funnel plot asymmetry. This suggests that there is no strong evidence of small-study effects or publication bias in our data.

DISCUSSION

Building on 65 primary studies and synthesizing information from 173.274 family firms across 20 years of research, our meta-analysis provides a comprehensive understanding of collaborative innovation and its relation to family firm performance. The analysis is built on the extensive literature of innovative behavior in family firms (Block et al., 2023), and adds the specific focus of collaborative innovation (Bigliardi & Galati, 2018; Feranita et al., 2017) on innovation and financial performance. In the present analysis, we thus consider how differing partnership types and family contexts impact the relationship between CI and firm performance.

The results from our meta-analysis demonstrate that collaborating with different external partners is an essential determinant of family firm performance. In line with extant research,

we thus support the view that family firms foster external knowledge and resource integration to not only improve innovative capabilities, but also strengthen financial outcomes such as the growth of profitability or market share (Muñoz-Bullón et al., 2020; Rauter et al., 2018; Sorenson et al., 2008). Addressing the call for innovation-based measurements for the innovation input-output relationship (Feranita et al., 2017), we contribute to the family firm literature, by confirming a positive performance relationship for both, innovative and financial outcomes. This underscores the importance of integrating economic measurement types into future studies. Specifically, our results also demonstrate that innovation-based performance has significantly larger effect sizes, thus a stronger effect compared to financial performance outcomes, which calls for further empirical investigation. In this regard, future studies may concentrate on the economic performance of family firms, particularly incorporating growth- and market-based measurements.

In light of the findings that different types of partners exert varying effects on the CI-FP relationship (Najafi-Tavani et al., 2018), we contribute to the family firm and innovation literature by investigating the impact of close and wide network partners, business group affiliated partners, and R&D partners on the positive CI-FP relationship. The results demonstrate that collaborating with a close network partner (e.g., supplier, customer, or competitor) negatively moderates the positive relationship. This finding is surprising as it contradicts extant literature and demonstrates that family firms may not fully leverage the potential of shared risks and innovation costs, as the collaborative benefits eventually outweigh synergy effects (Classen et al., 2012). We are thus partly confirming the body of research indicating that such partnerships may exert an adverse effect on investment and growth opportunities by firm-specific exploitation of positions within the network (Ashwin et al., 2015; Choi et al., 2015), as well as a potential lack of familiarity and incentives among wide collaboration partners (Brettel & Cleven, 2011; Xie et al., 2023). Yet, the present study

contributes to the ongoing discourse on social ties and informal/formal relationships with varying partner types.

Furthermore, we are arguing that the positive moderating effect of collaboration partners in a close collaboration network is stronger than the effect of collaborating with partners in a wide collaboration network. Contrary to the findings of previous studies (Basco & Calabrò, 2016; Wang & Hu, 2020) as well as a subsequent meta-analysis (Xie et al., 2023), our results show that partnerships within close networks exert a comparatively weaker influence on the CI-FP partnership. Consequently, the findings of Xie et al. (2023), who demonstrated a more positive effect of related- rather than unrelated partnerships on collaborative innovation, could not be corroborated in a family firm setting. Nevertheless, collaboration with a close network generally enriches family firms with analogous external knowledge and resources, resulting in incremental idea generation (Basco & Calabrò, 2016). Conversely, when engaging with universities or research institutions, family firms seek new knowledge, which is often related to radical innovative approaches (Katila & Ahuja, 2002). The results of our meta-analysis indicate that there are no significant differences in family firms' tendency towards incremental or radical innovation practices, which merits further empirical investigation.

Moreover, the findings of our meta-analysis further confirm the positive impact of collaborating with external partners in joint R&D projects. In line with previous findings, it is therefore argued that alliances with R&D partners may provide access to modern technologies and external competencies, which are crucial during all stages of the innovation process (Dinh et al., 2021; Gjergji et al., 2022; Hagedoorn & Cloodt, 2003). The objective of family firms is to establish trust-based, long-term relationships with R&D partners, thereby benefiting from their ability to build strong personal and social ties with their R&D networks (Aiello et al., 2021; Choi et al., 2015; Gomez-Mejia et al., 2014). Subsequently, our results serve to further expand the extant body of knowledge in this field by demonstrating that family firms are able

to reduce coordination costs, internal resource-constraints and financial hurdles through improved communication and ties along their entire supply chain and developmental processes (Martínez-Alonso et al., 2023; Muñoz-Bullón et al., 2020).

Finally, the regression results demonstrate that the CI-FP relationship is robust across primary studies employing different firm-specific measures and samples. However, the analysis reveals that the positive effect is stronger when a family firm is defined based on family ownership and weaker when family management is involved. This finding corroborates conclusions of studies demonstrating the significant impact of governance structures and generational involvement on the performance of family firms (Nieto et al., 2015; Werner et al., 2018). Consequently, we support the proposition that family management may impede effective collaborative innovation due to the threat of control loss, misalignment of values and misappropriation of trust (Feranita et al., 2017). The present study contributes to the understanding of family firm characteristics and their distinctive effects in the context of collaborative innovation, and calls for further research on the impact of family management, ownership and control on the CI-FP relationship. Future studies should therefore investigate family firm-specific factors, such as family governance, or generational involvement in collaborative innovation activities.

Managerial implications

Overall, our findings show that family firms are recommended to consider opening up their innovation processes to complement and leverage their internal capabilities with external knowledge and resources. Indeed, family firm managers need to consider the type of network partners, since not all collaborators exert equally positive effects on the innovative and financial performance of their firms. In this regard, family businesses should predominantly focus on partnerships that enhance their internal R&D processes across the entire supply chain and internal developmental processes. This approach has the potential to reduce development costs,

enhance the sharing of innovation risks, and optimize innovation processes, ensuring that new products or services are perfectly aligned with market demand. This is particularly salient for family firms, which are characterized by a robust family ownership structure. Indeed, firms with a higher stake in family ownership tend to demonstrate higher performance over time. Hence, the long-term orientation of family firms is conducive to the establishment of enduring partnerships based on trust and social ties.

Limitations

In addition to presenting our study's findings, it is important to acknowledge its limitations. The conclusions of a meta-analysis are inherently constrained by the number and quality of the studies it synthesizes, as well as the extent to which these studies report relevant information under the specific conditions in which the effect sizes are observed. Despite our best efforts to assemble a substantial sample, we were unable to test the combined effects of all potentially relevant variables influencing the CI-FP relationship. To mitigate potential issues related to statistical power due to missing data, we employed stepwise modeling to incorporate various control variables of relevance. However, the limitations inherent to the primary studies reviewed precluded us from examining the potential moderating effects of additional partnership types, such as those involving family-controlled firms (Arregle et al., 2017; Xie et al., 2023). We therefore encourage future research to explore the impact of other collaboration types on the CI-FP relationship.

Additionally, the multi-level structure of our data imposed certain constraints on robustness testing. In some instances, we were compelled to simplify the analyses, foregoing the independence criterion of effect sizes and conducting analyses without accounting for the nesting structure.

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Figure 1: Funnel plot to illustrate potential publication bias

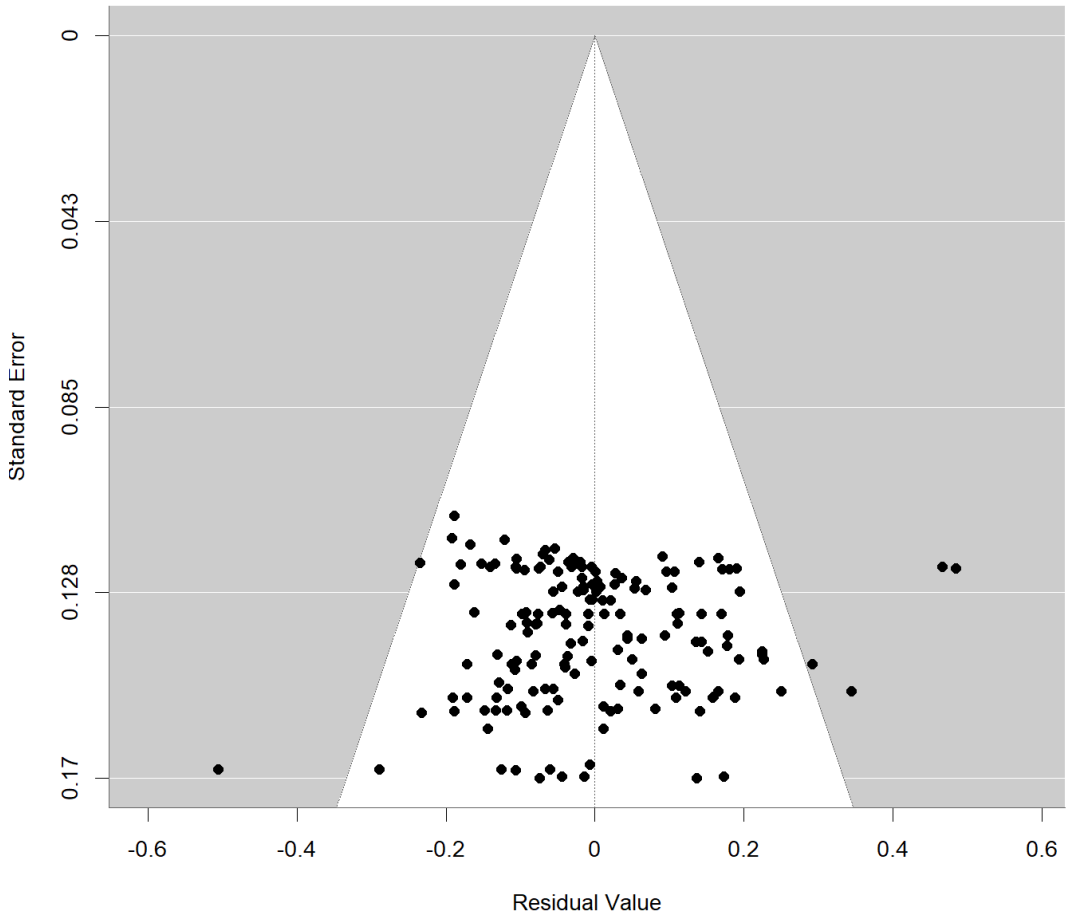

Table 1: List of journals

Publication Journal	*Number of Publications*
Entrepreneurship Theory and Practice	4
Small Business Economics	4
Working Paper	3
Journal of Business Research	3
Journal of Product Innovation Management	3
Family Business Review	2
Journal of Small Business and Enterprise Development	2
Sustainability	2
Strategic Management Journal	2
International Business Review	2
Journal of International Business Studies	2
Innovation-Organization & Management	2
Asia Pacific Journal of Management	2
Journal of Knowledge Management	2
Journal of Family Business Strategy	2
Other outlets	28

Table 2: Definitions of constructs and measures

Construct	*Operationalization*
Overall relation	Effect size reported in the primary study concerning the relationship between collaborative innovation and performance
Performance measures	
Innovation performance	Dummy is 1 if an innovation performance measure is used in the primary study
Financial performance	Dummy is 1 if a financial performance measure is used in the primary study
Conceptual moderators	
Collaboration types	
Close network partner	Dummy is 1 if a close network partner measure is used in the primary study
Wide network partner	Dummy is 1 if a wide network partner measure is used in the primary study
Business group affiliated partner	Dummy is 1 if a business group affiliated partner measure is used in the primary study
R&D partner	Dummy is 1 if a R&D partner measure is used in the primary study
Controls	
Family firm measures	
Family ownership	Dummy is 1 if a family ownership measure is used as a family firm measure
Family management	Dummy is 1 if a family management measure is used as a family firm measure
Combined family ownership and management	Dummy is 1 if a family management and family ownership measure is used as a family firm measure
Combined family ownership or management	Dummy is 1 if a family management or family ownership measure is used as a family firm measure
Firm Size	
SMEs	Dummy is 0 if the primary study uses a sample of only small- and medium-sized firms (SMEs)
Large firms	Dummy is 1 if the primary study uses a sample of only large firms
Firm age	
Young firms	Dummy is 0 if the primary study uses a sample of only young firms

Old firms	Dummy is 1 if the primary study uses a sample of only old firms
Type of industry	
Manufacturing	Dummy is 1 if the primary study uses a sample of only manufacturing firms
Service or other	Dummy is 0 if the primary study uses a sample of service or other firms
R&D Intensity	
High-technology business sector	Dummy is 1 if the primary study uses a sample of only high R&D-intensity firms
Low-technology business sector	Dummy is 0 if the primary study uses a sample of only low R&D-intensity firms
GDP/Capita	GDP/capita of a country in a given mean year of data collection (continuous)
Share of Family Firms (%)	
High (above median)	Dummy is 1 if the primary study uses a sample with a high share of family firms
Low (below median)	Dummy is 0 if the primary study uses a sample with a low share of family firms
Data year	Mean year of collected data (continuous)
Journal abs score	Numerical variable (0-5)

Table 3: Sub-group analysis

Variable	*Subgroup*	*k*	*n*	*r*	*95% CI*		I^2	*z-value*	*p*	*Q-between*	*p(Q)*
Overall	-	194	302280	.176	.139	.213	-	9.3215	.000	5.268	**.000**
Innovation performance	Yes	128	164426	.220	.189	.251	96.924	14.047	.000	58.611	**.000**
	No	66	137854	.064	.039	.090	90.973	4.954	.000		
Financial performance	Yes	53	110854	.073	.042	.105	89.055	4.566	.000	33.341	**.000**
	No	141	191426	.200	.171	.229	97.172	13.435	.000		
Close network partner	Yes	71	97602	.145	.107	.183	96.714	7.504	.000	2.245	.134
	No	123	204678	.182	.151	.214	97.257	11.349	.000		
Wide network partner	Yes	57	68715	.192	.148	.237	96.368	8.451	.000	1.529	.216
	No	137	233565	.158	.129	.188	97.383	10.623	.000		
Business group affiliated partner	Yes	17	9973	.053	-.025	.131	91.721	1.324	.186	9.074	**.003**
	No	177	292307	.179	.154	.204	97.392	13.861	.000		
R&D partner	Yes	144	239328	.182	.153	.211	97.492	12.449	.000	5.350	**.021**
	No	49	62164	.120	.076	.164	92.515	5.341	.000		
Family ownership	Yes	35	85353	.225	.165	.285	98.130	7.360	.000	6.011	**.014**
	No	154	214382	.144	.119	.169	95.959	11.347	.000		
Family management	Yes	127	91581	.164	.136	.192	93.231	11.484	.000	.225	.635
	No	62	208154	.151	.108	.194	98.640	6.904	.000		
Family firm ownership and management	Yes	80	33720	.174	.135	.213	91.721	8.744	.000	.983	.321
	No	109	266015	.149	.120	.179	97.760	10.012	.000		
Family firm ownership or management	Yes	36	58511	.204	.150	.258	96.921	7.465	.000	3.380	**.066**
	No	153	241224	.148	.122	.174	96.725	11.234	.000		
Firm size	Large	91	58736	.123	.094	.152	90.960	8.281	.000	10.505	**.001**
	Small	98	237866	.201	.164	.238	98.413	10.662	.000		
Firm age	Old	65	81482	.133	.099	.168	95.103	7.551	.000	7.366	**.007**
	Young	73	109136	.214	.167	.260	97.860	8.977	.000		
Industry	Manufacturing	100	170950	.119	.095	.142	94.961	9.910	.000	20.740	**.000**
	Mixed	72	36470	.242	.194	.289	94.254	9.970	.000		
R&D intensity	High technology	108	115199	.179	.143	.215	96.629	9.754	.000	2.943	**.086**
	Low technology	29	70814	.115	.050	.179	98.389	3.497	.000		
GDP/Capita	High	93	194471	.159	.122	.195	97.932	8.541	.000	.286	.593
	Low	93	105829	.173	.137	.208	95.983	9.614	.000		
Share of family firms	High	80	130571	.207	.166	.248	96.666	9.870	.000	2.443	.118
	Low	91	140983	.165	.131	.199	96.874	9.557	.000		
Time frame	Longitudinal	90	199416	.094	.066	.122	96.584	6.587	.000	40.904	**.000**
	Cross-sectional	104	102864	.239	.205	.273	95.487	13.663	.000		
Data type	Primary	81	26452	.262	.221	.304	90.247	12.372	.000	38.116	**.000**
	Secondary	113	275828	.110	.085	.135	97.061	8.718	.000		
Data year	Before 2011	75	135614	.249	.206	.293	97.392	11.216	.000	26.702	**.000**
	After 2011	119	166666	.117	.092	.142	95.067	9.123	.000		
Journal abs score	High	84	176330	.154	.117	.190	98.095	8.209	.000	1.190	.275
	Low	110	125950	.181	.148	.214	94.124	10.858	.000		

k = number of effect sizes; *n* = sample size; *r* = sample-weighted mean effect size; *95% CI* = 95% Confidence interval; *z* = z value for significance tests; *p* = corresponding p-value of z; *Q-btw* = test for significance of variation between subgroups; *p(Q-btw)* = corresponding p-value of Q-btw (significant p-values bold).

Table 4: Multi-level meta-analytic regression analysis of collaboration effects on firm performance

	Model 1			**Model 2**			**Model 3**			**Model 4**			**Model 5**			**Model 6**			**Model 7**			**Model 8**		
	β	SE	p	*β*	SE	p	*β*	SE	p	*β*	SE	p	*β*	SE	p	*β*	SE	p	*β*	SE	p	*β*	SE	p
Intercept	-14.729	6.513	**.024**	-13.889	6.523	**.033**	-14.243	7.100	**.045**	-11.347	6.687	**.090**	-11.72	9.030	.194	-15.241	7.748	**.049**	-15.012	7.635	**.049**	-13.453	7.541	**.074**
Journal ABS score	.014	.009	.103	.014	.009	**.096**	.014	.009	.137	.012	.009	.177	.007	.012	.568	.009	.011	.414	.017	.011	.102	.014	.009	.130
Time frame	-.054	.037	.139	-.0598	.036	**.096**	-.059	.039	.135	-.068	.044	.121	-.057	.046	.216	-.076	.049	.120	-.047	.042	.258	-.063	.040	.120
Mean year of data collection	.007	.003	**.023**	.0069	.003	**.032**	.007	.004	**.044**	.006	.003	**.088**	.006	.005	.193	.008	.004	**.048**	.008	.004	**.048**	.007	.004	**.074**
Family ownership (dummy)	.120	.033	**.000**	.1121	.034	**.001**	.108	.036	**.003**	.093	.035	**.008**	.127	.045	**.005**	.094	.043	**.029**	.111	.040	**.005**	.111	.036	**.002**
Family firm ownership and management	.034	.027	.208	.0263	.026	.310	.030	.029	.301	.032	.026	.224	.035	.032	.280	.043	.034	.209	.040	.030	.176	.029	.028	.311
Survey-based measure of FP	.073	.037	**.046**	.0681	.036	**.061**	.070	.040	**.080**	.063	.037	**.090**	.092	.048	**.057**	.052	.052	.319	.053	.045	.238	.067	.040	**.093**
Innovation performance	.097	.023	**.000**	.0912	.023	**.000**	.090	.027	**.001**	.089	.023	**.000**	.077	.029	**.007**	.120	.028	**.000**	.074	.023	**.001**	.088	.024	**.000**
Close network partner				-.0514	.023	**.028**	-.054	.027	**.042**	-.047	.024	**.049**	-.053	.030	**.077**	-.073	.029	**.012**	-.042	.024	**.082**	-.052	.025	**.038**
Wide network partner				-.0052	.024	.830	-.005	.028	.860	-.003	.025	.919	-.014	.030	.650	-.023	.031	.463	-.007	.024	.791	-.006	.026	.828
Business group partner				-.010	.049	.837	-.015	.056	.790	-.013	.050	.793	-.009	.068	.892	-.003	.057	.954	-.068	.060	.262	-.012	.051	.813
R&D partner				.065	.031	**.037**	.067	.034	**.048**	.062	.032	**.049**	.070	.039	**.070**	.091	.046	**.048**	.061	.033	**.061**	.066	.033	**.042**
Share of FF							-.023	.050	.652															
Firm size										-.005	.033	.885												
Firm age													.029	.038	.436									
R&D intensity																-.012	.037	.755						
Industry																			-.043	.038	.260			
GDP/Capita																						.000	.000	.975
R^2 (pseudo)	.46			.49			.43			.50			.40			.45			.51			.46		
K	64			64			60			61			43			46			51			61		
k	189			188			165			184			134			132			167			180		
Q_{model} (p)	73.48 (<.0001)			86.39 (<.0001)			67.25 (<.0001)			81.62 (<.0001)			54.26 (<.0001)			84.08 (<.0001)			66.78 (<.0001)			76.80 (<.0001)		
$Q_{residual}$ (p)	2822.51 (<.0001)			2237.27 (<.0001)			2029.18 (<.0001)			1987.06 (<.0001)			1851.39 (<.0001)			1484.76 (<.0001)			1798.35 (<.0001)			2179.92 (<.0001)		
VIF (mean)	1.50			1.50			1.47			1.65			1.57			1.737			1.546			1.556		
VIF (max)	2.19			2.28			2.19			3.31			2.39			2.846			2.533			2.480		
v	.0151			.0143			.0172			.0141			.0170			.0163			.0137			.0153		

Significant values in bold; K=number of independent samples; k=number of effect sizes; v=random effects variance component