Overcoming the ability-willingness paradox in small family firms' collaborations

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Abstract Family firms' collaborative innovation is characterized by the so-called ability-willingness paradox i.e. they are less willing to engage in collaborations despite being more able to manage them for innovation purposes. In this paper, we introduce collaboration partner type and spatial proximity as two important boundary conditions of this paradox. We examine the differences in collaboration for innovation across different spatial proximities and partner types for small family and non-family firms. We use a large sample of 6272 small firms in the United Kingdom (UK) during 2002–2016 to show that this paradox is indeed not a universal phenomenon. Small family firms overcome their lower willingness when collaborating with customers within regional proximity and, based on their unique characteristics and superior ability to govern these collaborations, they are able to generate an innovation premium compared to small non-family firms.

Plain English Summary Open innovation constitutes a central strategy for small firms in general and for family firms. However, not all small firms are equally able to govern these collaborations. There are significant differences in the ways small family- and non-family firms innovate and collaborate with external partners, as well as the reasons why they do so. Our research demonstrated that the extent to which collaboration with external partners can be managed may relate to specific firm characteristics. We also showed that family firms' unique characteristics influence partner selection and the ability to govern collaborations with external partners, and thus make small family firms more likely to achieve an innovation output premium when collaborating with customers and within regional proximity.

Keywords Small family firm · Customers · Innovation · Ability-willingness paradox · Collaboration · Region

JEL Classification M14 · D8 · L14 · L21

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The use of this data does not imply the endorsement of the data owner or the UK Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

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1 Introduction

Innovation is a key priority of many companies, as it contributes to their longevity (Schumpeter, 1934). While family firms are no exception, and innovation directly contributes to their economic performance (Kellermanns et al., 2012), family-firm innovation has been characterized by the 'ability-willingness paradox' (Chrisman et al., 2015). This states that while family firms are more capable of managing innovation (Block, 2012; Czarnitzki & Kraft, 2009) than non-family firms (Huybrechts et al., 2013), they are less willing to do so (Chrisman et al., 2015; De Massis et al., 2015a; Feranita et al., 2017).

This 'family innovation dilemma' (Duran et al., 2016) also exists in the context of open innovation activities i.e. when family firms collaborate with external sources for innovative purposes. Prior studies have shown that while family firms are generally less willing to collaborate with external partners (Cassia et al., 2012; Nieto, Santamaria & Pittino & Visintin, 2011), at the same time they are better able to govern these collaborations than their non-family counterparts (e.g. Broekaert et al., 2016; Miller et al., 2009). The nature of the 'family innovation dilemma' remains puzzling in the family business and innovation literature (De Massis et al., 2015b), as family-firm innovation strategies may conflict with other family priorities such as long-term orientation and the need to preserve the past. This will lead to more risk-averse behaviour (De Massis et al., 2016), particularly for family CEOs (Huybrechts et al., 2013).

Overcoming this ability-willingness paradox in the context of open innovation is of even more importance for small family firms than large family firms, as they need to tackle internal resource constraints (De Massis et al., 2015a, b, 2018). Small family firms also need to expand their internal knowledge base and capabilities by combining in-house and external knowledge (Audretsch & Belitski, 2020a) in order to manage the increasingly complex business environment (Seidl & Werle, 2018). The theoretical explanation for open innovation with different partners is largely drawn from the resource-based view of the firm and organizational learning theory (Hitt et al., 2000). However, the nature of partner selection within family firm innovation strategies, as well as the combination of resources available for innovation, has remained understudied. Once the motivational gap for family firms to engage in open innovation with partners is overcome, family firms' unique characteristics and values (De Massis et al., 2016) will facilitate the joint efforts among the collaboration partners to act and implement, for example, international joint ventures (DeBellis et al., 2021; Van Gils et al., 2019). Researchers have therefore called for further study of ways family firms can use open innovation approaches to boost their innovation performance (Calabrò et al., 2019; Feranita et al., 2017; Kellermanns & Hoy, 2016), for small size family firms in particular (Cucculelli & Storai, 2015). Calls for further research include extending the debate about the benefits for family firms to engage in knowledge collaboration with partners by applying geographical and firm-size lenses (Stough et al., 2015), and across three types of effects: family effect (whether the firm is family owned); spatial effect (whether the firm is co-located in the proximity to other innovators and partners); and firm size effect.

Whilst the innovation process in family firms has been examined previously (Classen et al., 2012; Czarnitzki & Kraft, 2009), there is a need for more longitudinal and context-related studies that shed light on how small family firms can overcome the ability-willingness paradox to enhance their performance and identify the boundary conditions moderating this relationship. This study research gap deserves special attention for two main reasons. First, small family firms are particularly exposed to the paradox, because they are subject to the comparably higher involvement of their owner family (Chrisman et al., 2012; Miller et al., 2001). This higher involvement is associated with an unusual ability to behave idiosyncratically (Miller et al., 2001), which decreases their willingness to engage in external collaborations even though they have an ability to do so.

Secondly, small firms make up the vast majority of family businesses in the world and are a crucial engine of the economy (Chrisman et al., 2012). We therefore investigate the following research question: *Under which circumstances can small family firms use their unique characteristics to achieve an innovation output premium from open innovation compared to small non-family firms?*

Building on the open innovation literature for small firms (e.g. Audretsch et al., 2013; Spriggs et al., 2013; Street & Cameron, 2007), we advanced the

argument that knowledge collaboration is positively associated with both business success and innovation in small family firms.

We argue that small family firms, just like other small firms, will focus their collaboration activities on customers and within their regional communities in order to increase their innovation output (Freel, 2003; Freel & Harrison, 2006). However, the ability-willingness paradox present in small family firms (Chrisman et al., 2015) presents the opportunity to increase the propensity of small family firms to collaborate with partners on innovation as well as increase the returns from such collaboration (Stough et al., 2015). By choosing this type of collaboration partner, small family firms aim to overcome their lower willingness to engage in open innovation, since the main driver of this lower willingness in such firms is the fear of losing control (Pittino & Visintin, 2011).

Furthermore, we propose that characteristics and values that small family firms possess differ from those of small non-family firms in ways that enable them to govern the collaboration with customers in their regional proximity. This therefore allows them to facilitate the joint commitment, implementation and trustworthiness of collaboration, enhancing innovation outputs (DeBellis et al., 2021; Intihar & Pollack, 2012).

Based on these arguments, we propose that partner type and regional proximity constitute important contextual factors that set the boundary conditions (Busse et al., 2017) of the generalizability of the ability-willingness in previous research.

We investigate these hypotheses using a large sample of 6272 small firms in the UK during 2002–2016 based on the Business Structure Database (BSD) and the UK Innovation survey (UKIS).

Our paper makes three contributions. First, we enhance the literature on family firm innovation by developing two important boundary conditions for the ability-willingness paradox for small family firms (Chrisman et al., 2015; Ingram et al., 2016). More precisely, we argue that the ability-willingness paradox is not a universal phenomenon; instead, the differences in the willingness to collaborate and the ability to govern and generate value from collaboration depends on the partner type and spatial proximity. Second, we contribute to the literature on open innovation in family firms by shifting the focus from family firm characteristics and their influence on collaborative innovation to their collaboration partners' characteristics i.e. collaboration partner heterogeneity (Classen et al., 2012).

Third, we contribute to the literature on small businesses. Our research focuses on small firms rather than SMEs (Fang et al., 2016), allowing us to highlight the specific innovation behaviour of this globally dominant category of businesses. We were able to make empirical comparisons, employing a large database and comparable groups of family and non-family firms. This type of comparison is so far lacking (Miller et al., 2008; Miller & Le Breton-Miller, 2020)..

2 Theoretical background

2.1 Open Innovation in small family firms: the ability-willingness paradox

A lot of research has been done on innovation in companies of different sizes and governance structures (Rogers, 2004; De Massis et al., 2013; De Massis et al., 2015a, b, 2018; Audretsch et al., 2021). However, this research highlights the often-one-sided perspective of family firms, which behave cautiously and do not bring radical innovations to market (Rondi et al., 2019).

Small family firms maintain strong relationships in their open innovation models, especially with their customers (Cooper et al., 2005). One example in this regard is Grand Frame, a small frame shop in the Chicago area. By providing a standard service, they specialized in adapting to the changing needs of their customers by, for example, increasing the quality of their products. They also never turned down a job, irrespective of complexity (Intihar & Pollack, 2012). This likewise exemplifies the greater stewardship over these customer relationships that small family firms show compared to their non-family counterparts (Miller et al., 2008). Small family business owners typically play a more active role in the business than their non-family counterparts (Intihar & Pollack, 2012). While non-family firms are often primarily driven by a set of short-term financial motives, family firms are characterized by a long-term orientation and also follow non-economic goals (Chrisman et al., 2012).

As family firms attempt to manage their innovation process, family governance leads them to an apparent paradox—the ability (discretion to act) and the willingness (disposition to act) as drivers of family firms' innovation (Chrisman et al., 2015). 'Ability' here refers to 'the family owners' discretion to direct, allocate, add to, or dispose of a firm's resources' (Chrisman et al., 2015; p. 311). Meanwhile, 'willingness' is 'the disposition of the family owners to engage in idiosyncratic behaviour based on the goals, intentions and motivations that drive the owners to influence the firm's behaviour in directions diverging from those of non-family firms or the institutional norms among family firms' (Chrisman et al., 2015; p. 311).

Recent scholarly research has shown that the ability-willingness paradox of family firms also exists in the context of open innovation activities i.e. collaborations with external partners (DeBellis et al., 2021) In collaboration settings, this paradox translates into family firms being less willing to engage in collaborations than non-family firms, but possessing a higher ability to govern them. The lower willingness to collaborate is based on family firms' strong concerns about the potential for loss of control when collaborating, and highlights the importance of protecting their socioemotional wealth (SEW) (Gómez-Mejía et al., 2007). Open innovation thus brings significant challenges, and forces family firm managers to step out of their 'comfort zone' (Brinkerink & Bammens, 2018). Because external collaboration threatens the SEW of family firms (Cassia et al., 2012; Nieto et al., 2015; Pittino & Visintin, 2011), existing evidence indicates that family firms would avoid open innovation, thus resulting in the aforementioned lower willingness to engage in collaborative activities with external partners (Chrisman & Patel, 2012).

The ability of family firms to govern open innovation collaborations better than non-family businesses is rooted in their unique characteristics, such as their long-term orientation (Chua et al., 1999; Lumpkin et al., 2010) and their non-financial goals that lead them to invest in, build up and maintain social capital in terms of strong networks beyond the level of non-family firms (Matzler et al., 2015; Röd, 2016). Moreover, their generational outlook (Fang et al., 2016) results in additional reputational resources (Naldi et al., 2008) and customer loyalty (De Massis et al., 2018; Miller et al., 2008), and is accompanied by the provision of patient capital (Miller et al., 2016; Sirmon & Hitt, 2003). These features enable the emergence of long-term trust relationships with collaboration partners and a high level of trustworthiness (Intihar & Pollack, 2012). This facilitates a more intense and open knowledge exchange in turn (Mzid et al., 2019; Zahra, 2005).

This paradox is especially prevalent in small family firms, because small family firms are subject to the stronger and more direct involvement of the owner family (Chrisman et al., 2012; Intihar & Pollack, 2012; Werner et al., 2018) compared to their non-family counterparts. This leads to (i) a stronger desire to keep control within the family business and to protect their SEW (Becerra et al., 2020); and (ii) to a higher discretion to act and behave idiosyncratically (Miller et al., 2001, 2008).

2.1.1 The willingness of small family firms to engage in open innovation

The main reason for the ability-willingness paradox is that small family firms do take longer to decide whether a particular innovation will be relevant or not in a long-term perspective and whether the collaboration is needed (willingness). When judging the applicability of certain collaboration partners, small family firms consider the impact of innovation on their reputation, and the possible effects of departure from family firm traditions (De Massis et al., 2016; Miller et al., 2015).

There are a number of strategies which small family firms could use to overcome the ability-willingness paradox. First, the small size and the specificity of their management structure push family firms to build their competitive advantage by achieving good customer service, delivering a quality product and conveying a particular image for their firms (Cooper et al., 2005). Small family firms achieve and retain their competitive advantage by emphasizing long-term trust-based relationships with their customers and local community, which may also enable access to local human and financial resources (Freel, 2003).

Second, the danger of losing control and SEW is reduced when collaborations are pursued within regional proximity as this allows for face-to-face interactions with collaboration partners (Boschma & Frenken, 2009) and entails less market uncertainty (Zellweger et al., 2013). In line with prior empirical evidence, we therefore argue that their use of these

two strategies means small family firms have stronger incentives and are less afraid to overcome their size-induced resource constraints than their small non-family counterparts. Consequently, the willingness of small family firms to engage with external partners may increase. This indicates that the lower willingness of small family firms to engage in open innovation is not universal but is conditioned by the partner type and the firm's location.

2.2 Small (family) firms' innovation collaboration with customers

2.2.1 Small firms' customer collaboration and innovation output

Small firms face significant resource constraints and are thus limited in their innovative capabilities (Spithoven et al., 2013). Collaboration with external partners for innovative purposes has thus become an increasingly important way to tackle these internal resource constraints, especially for small firms (Colombo et al., 2012; Freel & Harrison, 2006; Street & Cameron, 2007). More specifically, Rogers (2004) argues that small firms rely more heavily on external knowledge networks than larger firms because they have less cash flows to fund innovation, their fixed costs of innovation are spread over a smaller sales base and their access to knowledge and human capital skills is more limited (Freel, 2003). Collaboration activities, however, are also associated with coordination and transaction costs (Classen et al., 2012; Cooper et al., 2005). Small firms are therefore limited in the number of network partners they can engage with, and have been shown to focus their collaboration activities on customers (Cooper et al., 2005; Freel & Harrison, 2003; Sorenson et al., 2008; Spriggs et al., 2013) for four major reasons.

Firstly, small firms usually cannot compete on the basis of scale economies, and thus predominantly pursue a niche market strategy from which they can obtain customer loyalty by emphasizing reliability and quality (Tagiuri & Davis, 1992). Collaborating with their customers within this niche enables them to complement their internal knowledge and R&D activities with their customers' external technical expertise and market knowledge to build up a remarkable level of expertise and efficiency in their niche (Freel, 2003). Secondly, involving their users in the innovation process shortens the time needed to experiment with and commercialize new products (Arias, 1995). This in turn will allow them to determine the optimal price-performance combination (Freel, 2003), to generate a competitive advantage in terms of customer service (Miller & Le Breton-Miller, 2005) and to provide cutting-edge technology (Muzyka et al., 1997). Thirdly, involving the user in the innovation process also reduces the need for learning (Freel, 2003), as interactions with customers improve the firms' understanding of their needs and help to avoid wasting time on making costly changes later in the product development process (Koufteros et al., 2005). Lastly, as a consequence of providing innovative services or joint innovation activities with customers, small firms can pursue a more focused marketing approach (Miller et al., 2008), generate an enhanced brand image as market specialists (Cooper et al., 2005; Intihar & Pollack, 2012) and enhance industry and public confidence in the value of their products and services. They will then be able to attract customers and other partners (Stuart, 2000) for further knowledge exchange and innovation activities.

We therefore hypothesize:

H1: Collaboration with customers is positively associated with innovation output in small firms.

2.2.2 Small family firms' superior ability to govern customer collaborations

According to the ability-willingness paradox, small family firms differ from small non-family firms in their ability to govern and deal with the complexities of these collaborations and their relationships (Chrisman et al., 2015). More precisely, a recent body of research (e.g. DeBellis et al., 2021) emphasizes that family firms have unique characteristics that may make them better than non-family firms in overcoming the major challenge in collaborations to access their partners' knowledge, especially tacit knowledge, by engaging in intense and trustful interactions with the collaboration partners (Miller et al., 2008). According to this research stream, small family firms use their higher discretion to act in order to build up superior social capital, a strong reputation and a strong community embeddedness (Baù et al., 2019; Miller et al., 2008). As a consequence, small family

firms are perceived as more trustworthy by their customers than non-family firms (Beck & Prügl, 2018; Carrigan & Buckley, 2008; Intihar & Pollack, 2012). This higher level of trust increases the ability of small family firms to govern the complexities of the knowledge collaboration, which will thus ease the necessary knowledge transfer and will increase innovation premium.

Family firms' long-term orientation (Chua et al., 1999; Lumpkin et al., 2010) will lead small family firms to invest heavily in building and maintaining social capital with network partners such as their customers, and to show a stronger commitment towards them than small non-family firms (Miller et al., 2008). This materializes in the form of, for example, paying more attention to frequent interactions with customers. It can also include being 'on the floor' with customers to gain firsthand experience and 'on-the-spot' feedback about the customers' needs and the business environment (Intihar & Pollack, 2012) while building informal personal relationships, reciprocity and solidarity (Miller et al., 2001). As a consequence of this stewardship and high-quality customized products, small family firms will build up superior customer loyalty (Le Breton & Miller, 2006) as well as social capital. This will grant them access to a more intense reciprocal exchange of knowledge within innovation collaborations (Miller et al., 2008).

Reputation constitutes the second unique characteristic of small family firms that enables them to better govern innovation collaborations. Miller et al. (2009) argue that family firms see the business not simply as a way of making money, but as an extension of the family. This materializes in the way they offer products and services bearing the family name (Cooper et al., 2005). Maintaining strong long-term relationships with their customers and introducing new customized and client-oriented services (Le Breton & Miller, 2006) serve as additional means to preserve respect for the family name and reputation (Cooper et al., 2005; Miller et al., 2001) and protect their identity (Zellweger et al., 2013). This reputation increases customers' perception of the small family firms' trustworthiness, and will likewise increase the collaborating customer's willingness to share knowledge (Intihar & Pollack, 2012).

Accordingly, recent studies show that identity and reputation concerns in small family firms lead them to pursue non-financial goals that satisfy the needs of non-family stakeholders (Zellweger et al., 2013) and are considered to be major drivers of collaboration for small family firms that leverage collaborative innovation (Magistretti et al., 2019, 2020).

Lastly, small family firms are highly embedded in their local communities (De Massis et al., 2018). Given their local roots, existing linkages within the community were often formed over several generations (Bird & Wennberg, 2014). The set of local network partners is rather diverse, as family firms develop strong relationships with customers and suppliers, as well as schools, local government, banks, research centers and other institutions (De Massis et al., 2018). Examples of this community embeddedness and engagement at the local level include sponsoring events and various organizations, a high appreciation of family time and the provision of jobs for local disabled residents. We therefore hypothesize:

H2: The association between collaboration with customers and innovation output is stronger for small family firms than for small non-family firms.

2.2.3 Limits to small family firms' higher ability to govern customer collaborations

As argued above, the unique characteristics of small family firms make them better able to govern innovation collaborations with customers than small non-family firms. However, these unique characteristics and their associated advantages prevail first and foremost when small family firms collaborate with customers within their region (Freel, 2003). As highlighted, the higher trustworthiness and the associated knowledge advantage of small family firms are primarily based on the higher stewardship over the customer relationship, supported by a higher reputation and community embeddedness (Beck & Prügl, 2018). Frequent interactions and gaining firsthand experience 'on the floor', as well as personal and informal relationships (Intihar & Pollack, 2012; Miller et al., 2001), are the key ingredients to fostering strong customer relationships. However, these relationship with customers are geographically bound for three reasons:

First, spatial proximity of collaboration partners is a prerequisite for regular face-to-face interactions, especially in the context of severe resource constraints (De Massis et al., 2018). Mutual trust

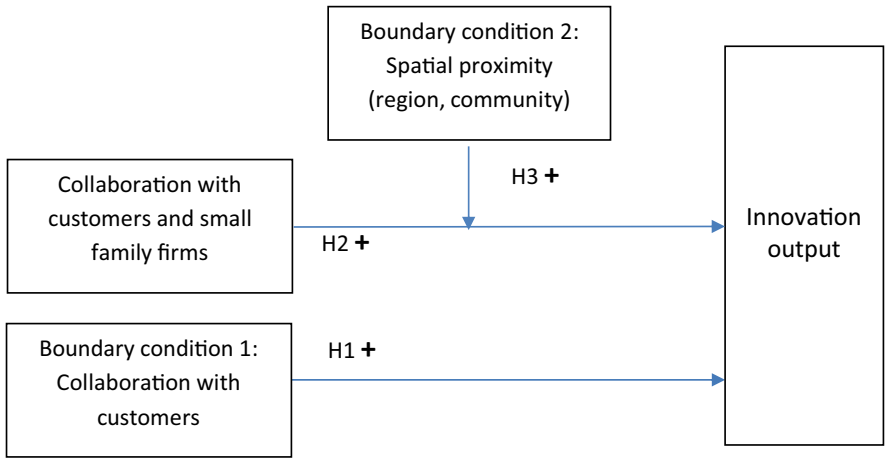

Fig. 1 The conceptual model

relationships, intense knowledge exchange and spillover effects between the collaboration partners will take place first and foremost within spatial proximity (Baù et al., 2019; Boschma & Frenken, 2009; De Massis et al., 2016, 2018; Vestal & Danneels, 2018). Second, long-term, generation-spanning community embeddedness (De Massis et al., 2018) and the associated greater trustworthiness are by definition localized, except for a general reputation effect of these activities. Lastly, small family firms are expected to invest their resources in partnerships if the goal of the partnership is consistent with their non-economic goals and long-term orientation (Pittino & Visintin, 2011). This situation is more likely to occur in partnerships with members of the close community.

The quality and intensity of social capital and spatial proximity are therefore interdependent, and the higher discretion to govern collaborations based on small family firms' unique characteristics is thus regionally bound to a certain extent. Consequently, the associated trust and knowledge advantages of small family firms that result from small family firms' higher discretion to act will only prevail when the collaborating customer resides in the same region. We hypothesize:

> H3: The positive association between customer collaboration and innovation output in small family firms compared to small non-family firms is limited to the case of geographically close collaborations.

The conceptual model for our hypothesis is illustrated in Fig. 1.

3 Data and sample description

3.1 Data matching

To test our hypotheses, we used the Business Structure Database (BSD) and matched it with the UK Innovation survey (UKIS) and Small Business Survey (SBS).

All three datasets are collected by the Office of National Statistics in the United Kingdom. UKIS data are gathered through an EU-wide, harmonized survey created in accordance with the guidelines of the third revision of the OECD Oslo Manual (OECD, 2018) and widely used in the open innovation literature (Audretsch & Belitski, 2020a; van Beers & Zand, 2014). Small Business Survey (SBS) was used to identify family business firms amongst the population of SMEs (Tsai et al., 2008). As we aimed at investigating the willingness and ability of small family firms to collaborate with external partners and their innovation performance at the firm level, we had to limit our analysis to small firms, and we had the number of employees variable matched from the BSD data. Data regarding the geography and types of collaboration partners, risks of innovation and knowledge investments were collected from the UKIS.

First, we used seven consecutive UKIS waves (UKIS 4 2002–04, UKIS 5 2004–06, UKIS 6

Table 1 Industrial/regional and distribution in a sample

Industry distribution	Firms	Share %	*Regional distribution*	Firms	Share %
1 Mining & quarrying	0	0	North East	746	5.15
2 Manufacturing basic	934	6.45	North West	1253	8.65
3 High-tech manufacturing	2419	16.70	Yorkshire and The Humber	1407	9.71
4 Electricity, gas and water supply	499	3.44	East Midlands	1126	7.77
5 Construction	1517	10.47	West Midlands	1335	9.21
6 Wholesale, retail trade	2076	14.33	Eastern	1032	7.12
7 Transport, storage	830	5.73	London	1486	10.26
8 Hotels & restaurants	930	6.42	South East	1570	10.84
9 ICT	889	6.14	South West	1357	9.37
10 Financial intermediation	278	1.92	Wales	829	5.72
11 Real estate and other business activity	1664	11.49	Scotland	1019	7.03
12 Public admin, defence	1353	9.34	Northern Ireland	928	6.41
13 Education	244	1.68	Total	14,088	100.00
14 Other community, social activity	455	3.14			
Total	14,088	100.00			

Source: *UKIS* UK Innovation survey, *BSD* Business Structure Database; *SBS* Small Business Survey. Number of observations 14,088 after controlling for missing values in all variables

2006–08, UKIS 7 2008–10, UKIS 8 2010–12, UKIS 9 2012–14; UKIS 10 2014–16) each conducted every second year by the Office of National Statistics (ONS), United Kingdom (UK). Second, we used BSD surveys conducted annually by the ONS for the years 2002, 2004, 2006, 2008, 2010, 2012 and 2014. We matched each correspondent UKIS survey wave with the data from BSD (2002, 2004, 2006, 2008, 2010, 2012 and 2014) taken for the initial year of each UKIS period. Finally, we matched SBS survey with information on family ownership to UKIS-BSD survey.

The result of the match are illustrated in Table A1 in Appendix A.

Table 1 illustrates the sample of small firms' distribution by industry and region in the UK during 2002–-2016 (seven waves of UKIS).

The two groups of firms (small family and non-family firms) differ along several innovation relevant dimensions. For example, the average age of a small family firms is 24.2 years while a non-family firm is 8.94 years, the share of training expenditure in family firms is 0.35 and 0.11 in non-family firms demonstrating that family firms invest more in human capital (De Massis et al., 2018). Family firms are less likely than non-family firms (0.48 as compared to 0.89) to use new methods of organizing work responsibilities and decision making (measured by the use of a new system of employee responsibilities, teamwork, decentralisation, integration, or de-integration). Family firms have a lower share of employees that hold a degree or higher qualification in science and engineering (4.2%), while this share is 7.5 for non-family small firms. Small family firms also invest less in R&D. There are differences in the geographical distribution of family firms, with more of them located in Scotland, Wales, East of England and the South West of England. Fewer family firms are in the South East, London and the North-West, which are more populated areas of the UK.

3.2 Variables

Dependent variable The first step of our empirical analysis includes examining the likelihood of collaboration with suppliers, enterprise groups, competitors, consultants, universities and customers. We used a binary variable equal to one if the firm collaborates with the respective partner types, zero otherwise. In addition, we would like to examine the likelihood of collaboration across four spatial proximities, regionally, nationally, Europe and internationally. We use four binary variables of collaboration for innovation for regions, UK, Europe and other world equals to

one, zero otherwise (Audretsch & Belitski, 2020b; van Beers & Zand, 2014).

Even though we do not explicitly hypothesize about the willingness to collaborate with different partners, we want to confirm prior findings that small firms (independent of being a family firm or not) indeed focus their innovation activities on regional customers within our sample (Freel, 2003; Freel & Harrison, 2006; Intihar & Pollack, 2012). This confirmation is necessary to show that partner type and spatial proximity constitute important boundary conditions for the willingness part of the paradox, before we investigate in more detail how these two aspects condition the ability of small family firms to govern these collaborations and to achieve an innovation output premium.

In the second step, we measure the association between collaborating with customers and firm innovation. The survey methodology and the definition of innovation follow the Oslo Manual (OECD, 2018) and covers firms with ten or more employees from across sectors. In the UKIS, firms are asked whether they introduced new to the market products or services during the three years prior to the survey. Our dependent variable, the share of new to market products, is commonly used to measure innovative performance (Audretsch & Belitski, 2020b; Berchicci, 2013; Santamaría et al., 2009). At each stage of our analysis, we used different dependent variables related to the propensity to collaborate (step 1) and innovation outcome (step 2).

Explanatory variables Our central explanatory variable is whether the firm is a family firm or not. We defined a company to be a small family firm if the majority of votes are owned by the person or persons who established the firm or are members of the founding family (Miller et al., 2011; Wolter & Hauser, 2001) and the number of full-time employees is less than 50. Should this be the case, we treat a firm as a small family firm, zero otherwise. In identifying family firms, we used SBS (Office of National Statistics, 2014, 2015; Tsai et al., 2008) and we followed Wolter and Hauser (2001) who identify a company to be part of the family business if up to two natural persons (and/or their close families) hold at least 50% of the voting shares of the company.

A full list of variables included in the model is in Table 2, while the descriptive statistics for collaboration variables only across four geographical proximities are provided in Table A2 in Appendix A. Moreover, focussing on collaborations with customer, we include four binary explanatory variables equal to one if the firm collaborates with customers regionally, nationally, in Europe and internationally, zero otherwise from the UK Innovation survey (Balland et al., 2015).

Control variables We include a number of control variables related to the firm's characteristics, which were found to influence innovation outcome. First, we control for the level of absorptive capacity such as *in-house R&D expenditure* (Kleinknecht et al., 2002; Santamaría et al., 2009) as well as *design intensity* and *training intensity*. Design intensity is calculated as design expenditure (£) to the total sales (£) ratio. Training intensity is calculated as an investment in training for innovation (£) to total sales (£) ratio. We also include a share of employees with BSc degree and above in total employment (*Scientist*) as a proxy for human capital (Audretsch & Belitski, 2020a).

Additional controls include a binary variable *Risks* which indicates firm's attitude and perception of risks (Miller & Friesen, 1978) such as high direct cost of innovation and risks related to access to finance (*finance*), lack of qualified personnel, information on markets risks (*knowledge*) and risks related to market dominance by established firms (*Incumbents*). We use a binary variable *Process innovation* which indicates whether a firm introduced process innovation. Process innovations are all new or significantly improved methods, although new to the business, they do not need to be new to the industry. We include *Firm age* to measure potential decreasing marginal returns of innovation to firm age (Coad et al., 2016). We also control for the fact if the firm is foreign-owned with a binary variable *Foreign as well as firm ownership by including a binary* variable 'Group ownership' equals one if a firm is owned by an enterprise group, zero otherwise.

Finally, to control for unobserved heterogeneity across industries, regions and survey waves, we include 70 industry dummies (SIC code 2 digit) (mining and quarrying is a reference category), 128 region fixed effects where firms are located (Aberdeen is a reference category) and seven waves fixed effects (2002–2004 period as a reference category).

Table 2 Descriptive statistics of variables related to research hypotheses

Label	Description of variables	Survey used	Mean	Std. dev
Regional collaboration	DV for stage 1: Firm collaborates with external partners on innovation regionally = 1, 0 otherwise	UKIS	0.13	0.34
National collaboration	DV for stage 1: Firm collaborates with external partners on innovation nationally (country) = 1, 0 otherwise	UKIS	0.15	0.35
Europe collaboration	DV for stage 1: Firm collaborates with external partners on innovation in European countries = 1, 0 otherwise	UKIS	0.06	0.24
World collaboration	DV for stage 1: Firm collaborates with external partners on innovation in other world countries = 1, 0 otherwise	UKIS	0.05	0.23
Group	DV for stage 1: Firm collaborates innovation with other businesses within enterprise group = 1, 0 otherwise	UKIS	0.02	0.04
Suppliers	DV for stage 1: Firm collaborates innovation with suppliers of equipment, materials, services = 1, 0 otherwise	UKIS	0.05	0.07
Clients	DV for stage 1: Firm collaborates innovation with clients or customers = 1, 0 otherwise	UKIS	0.10	0.11
Competitors	DV for stage 1: Firm collaborates innovation with competitors = 1, 0 otherwise	UKIS	0.01	0.04
Consultants	DV for stage 1: Firm collaborates innovation with consultants, commercial labs or private R&D institutes = 1, 0 otherwise	UKIS	0.01	0.03
Universities	DV for stage 1: Firm collaborates innovation with universities = 1, 0 otherwise	UKIS	0.01	0.04
Innovation sales	DV for stage 2: Percentage of sales of products and services that are new to the market in total sales (0–100)	UKIS	0.041	0.13
Group ownership	Binary variable = 1 if a firm is owned by an enterprise group, 0 otherwise	BSD	0.06	0.16
Employment	Number of Full-time employees (FTEs)	BSD	19.09	11.65
Family firm	Binary variable equal one if small firm is a family owned, zero otherwise	BSD	0.21	0.41
Design	Binary variable all forms of design expenditure	UKIS	0.38	0.48
Training	Binary variable on training for innovative activities	UKIS	0.21	0.41
Entrepreneurial climate	Binary variable = 1 if new methods of organizing work responsibilities and decision making (use of a new system of employee responsibilities, teamwork, decentralisation, integration or de-integration education/ training etc.), zero otherwise	UKIS	0.76	0.42
Process innovation	Binary variable = 1 if firm introduced any new or significantly improved processes for producing or supplying goods or services, zero otherwise	UKIS	0.21	0.40
Finance	Binary variable = 1 if excessive perceived economic risks, direct innovation costs too high, cost and availability of finance, zero otherwise	UKIS	0.396	0.524
Knowledge	Binary variable = 1 if firm experiences a lack of qualified personnel, lack of information on markets, lack of information on technology and markets = 1, zero otherwise	UKIS	0.366	0.265
Incumbents	Binary variable = 1 if market dominated by established businesses, uncertain demand for innovative goods or services, zero otherwise	UKIS	0.010	0.309
In-house R&D expenditure	Internal Research and Development expenditure (£) in logs	UKIS	0.88	1.64
Entrepreneurial behaviour	How important were increasing range of goods or services and Increasing market share in your decision to innovate in goods or services, processes?	UKIS	1.525	0.474
Scientists (UKIS)	The proportion of employees that hold a degree or higher qualification in science and engineering at BA / BSc, MA / PhD, PGCE levels	UKIS	6.97	17.45
Foreign (UKIS)	Binary variable = 1 if a firm is foreign-owned, 0 otherwise	UKIS	0.30	0.46
Firm age (BSD)	Age of a firm (years since the establishment), in logarithms	BSD	2.54	0.78

Table 2 (continued)

Label	Description of variables	Survey used	Mean	Std. dev
Variables used for Heckman selection model				
Goods range	How important was an increase of a range of goods and services to innovate? (0 – not important, 3 – high importance)	UKIS	1.95	1.01
Market share	How important was an increase in a market share to innovate? (0 – not important, 3 – high importance)	UKIS	1.87	1.04

Source: *UKIS* UK Innovation survey, *BSD* Business Structure Database, *SBS* Small Business Survey. Number of observations 14,088

Correlation matrix for variables included in step to is in Table A3 in Appendix A.

4 Methodology

We first estimate the panel data logistic regression model with collaboration across four geographical dimensions and six collaboration partners as dependent variables.

In the reduced form function of collaboration, φ_i (binary variable = 1 if firm engages in collaboration in each region i at time t or with a specific external partner, zero otherwise) is estimated as:

$$\varphi_{it} = \pi_0 + \beta_i x_{it} + \pi_i \varrho_{it} + \nu_{it} \quad (1)$$

where x_{it} is a vector that represents family firms i at time t and ϱ_{it} are other exogeneous control variables for firm i at time t which predict the propensity of a firm i at time t to collaborate across different geographies and partner types (Wooldridge, 2009).

We then use a multilevel mixed-effects logistic model by using a generalized estimation equation (Papke & Wooldridge, 2008) the bounded dependent variable y_{ijk} between [0,1] and a truncated distribution and the independent variable x_{ijk} such that:

$$y_{ijt} = \beta_0 + \beta_1 x_{ijt} + \beta_2 \tau_{ijt} + \varepsilon_{ijt} \quad (2)$$

where i is the firm level-1 j is the region level-2, and t serves to index the period survey level-3. The dependent variable y_{ijt} – innovation output of firm i in region j at time t. The explanatory variables and interactions are in x_{ijt}. Other control variables, which represent firm-specific characteristics, as well as region fixed effects, industry and survey period fixed effects described in Table 1, are presented in τ_{ijt}. Finally, ε_{ijt} is an error term that consists of three components in the hierarchical model:

$$\varepsilon_{ijt} = \gamma_i + \mu_j + t_k + \nu_{ijt} \quad (3)$$

where γ_i represents the omitted variables that vary across firms but not over regions and waves, μ_j denotes the omitted variables that vary over regions but are constant across firms and time, t_k represents omitted variables which vary across survey period, but not across firms and regions, while finally ν_{ijt} is the error term.

Furthermore, when estimating Eq. (2), it was necessary to control for a sample selection bias which could have originated from the fact that we moved from 64,192 observations in the originally matched UKIS-BSD to 14,088 observations in the matched sample.[1]

5 Results

We started by performing multivariate logistic regressions (Table 3) to examine the differences in the likelihood of collaboration for innovation between small family firms and small non-family firms across six types of external partners, including customers and four geographical regions. We use the same set of variables as we specified in Eq. (1), while the collaboration for innovation variables are now placed as dependent variables. Regional dummy variables were not used because our dependent variables in the model (1) have regional and national collaboration aspects with suppliers, customers, competitors, universities, consultants and enterprise groups, a linear

[1] Heckman (1979) type procedure is used to test and correct for the selection bias in our sample is described in Appendix B.

Table 3 Panel logistic regression estimation. Dependent variables: collaboration with regional, country, Europe and world partners, as well as collaboration within enterprise group, suppliers, customers, competitors, consultants and universities. Results are reported in odd ratios

Dependent variable	Geography of collaboration				Collaboration partners					
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Geography of collaboration	regional	country	Europe	World	Group	Supplier	Custom	Competitor	Consultants	Univer-sity
Family firm	1.066	0.693**	0.775**	0.543**	0.787	0.202*	0.167	0.644	0.215**	0.167**
	(.14)	(.07)	(.11)	(.08)	(0.56)	(.11)	(.16)	(.11)	(.04)	(0.07)
Group ownership	1.022	1.014	0.919	0.918	1.205	1.295	1.191	1.185	1.156	1.089
	(.02)	(.02)	(.02)	(.02)	(.03)	(.03)	(.03)	(.04)	(.04)	(.04)
Firm age	1.032	1.034	0.940	0.971	0.941	0.985	1.217	1.101	0.971	1.104
	(.03)	(.04)	(.04)	(.03)	(.13)	(.11)	(.11)	(.15)	(.44)	(.32)
Process innovation	2.129***	2.398***	1.915***	1.852**	2.814**	2.185**	1.758**	1.510**	2.251**	3.010**
	(0.07)	(0.07)	(0.08)	(0.07)	(0.90)	(0.80)	(0.71)	(0.36)	(0.51)	(0.84)
Training	1.580**	1.666**	1.532**	0.968	0.610	1.173	1.212	1.136	1.676	2.111
	(.15)	(.12)	(.12)	(.30)	(.19)	(.50)	(.36)	(.40)	(.44)	(.25)
Design	1.498**	1.345*	1.398*	1.499**	1.079	1.362	1.405	2.311**	1.817	1.316
	(.09)	(.09)	(.07)	(.09)	(.52)	(.1)	(.14)	(.20)	(0.46)	(.15)
Risks – Finance	1.624**	1.208**	1.202**	1.256**	1.106	1.389	1.320	0.565	0.958	1.110
	(.12)	(.15)	(.17)	(.15)	(.25)	(.34)	(.21)	(.25)	(.36)	(.27)
Risks – Knowledge and Finance	1.015**	1.079	0.996	1.094**	2.105**	1.520	1.630	0.596	0.851	0.652
	(.32)	(.47)	(.25)	(.24)	(0.20)	(0.17)	(0.17)	(.42)	(.59)	(.41)
Risks – Incumbents	1.102	0.868	0.902	1.250	0.257**	0.706**	0.854	1.365	0.868	1.650
	(.39)	(.01)	(.09)	(.51)	(0.02)	(0.15)	(0.12)	(.40)	(.33)	(.70)
Scientist	1.002*	1.006**	1.012**	1.016**	1.003**	1.002**	1.012**	1.008**	1.024**	1.032**
	(.07)	(.05)	(.09)	(.09)	(.13)	(.12)	(.08)	(.26)	(.10)	(.12)
In-house R&D expenditure	1.084**	1.223**	1.213**	1.207**	1.134**	1.135**	1.085**	1.098**	1.072**	1.075**
	(.01)	(.02)	(.01)	(.05)	(.02)	(.05)	(.09)	(.09)	(.08)	(.07)
Foreign	1.106	1.211**	1.106**	1.160**	1.520	0.852	1.155**	1.425**	0.865	0.527
	(0.21)	(.05)	(.08)	(.15)	(.54)	(.20)	(0.12)	(0.20)	(0.30)	(0.21)
Industry controls (2 digit SIC)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regions controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.09***	0.10***	0.12***	0.10***	0.09***	0.10***	0.08***	0.07***	0.06***	0.08***
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Chi2	1544.2	2650.2	1541.2	1420.3	197.3	178.2	389.6	147.5	189.1	175.1
Log-likelihood	−3422.8	−3391.1	−2388.1	−2265.3	−253.3	−339.1	−221.3	−113.71	−142.20	−199.0

Standard errors are robust for heteroscedasticity in parenthesis. Industry (1 digit SIC) and year fixed effects are suppressed to save space. Estimation method: logistic regression. Note: reference category for legal status is Company (limited liability company). industry (mining), region (North East of England). Robust standard errors are in parenthesis. Significance level: *$p < 0.10$; **$p < 0.05$, ***$p < 0.01$. Number of observations 14,088. Source: *UKIS* UK Innovation survey, *BSD* Business Structure Database

combination of region dummies. The estimation of Eq. (1) is reported in odds ratios, which means that the value below unity indicates a reduction in the likelihood of collaboration, while the result above unity indicates an increase in the likelihood of collaboration. The results which demonstrate the likelihood of collaboration for innovation across four geographical dimensions are reported in Table 3 (specifications 1–4). Table 3 (specifications 5–10) illustrates the likelihood of collaboration across six collaboration partners. The results demonstrate that there is no difference between small family and non-family firms in their willingness to engage in collaboration with regional partners and customers for innovation. We find that small family firms have a lower willingness to collaborate with suppliers ($\beta = 0.202$, $p < 0.10$), consultants ($\beta = 0.215$, $p < 0.05$) and universities ($\beta = 0.167$, $p < 0.05$), ceteris paribus. Meanwhile, they also have a lower willingness to collaborate for innovation with partners in national markets ($\beta = 0.693$, $p < 0.05$), in European markets ($\beta = 0.775$, $p < 0.05$) and other world markets ($\beta = 0.543$, $p < 0.05$).

Our findings thus demonstrate that small family firms are (i) less willing to collaborate with partners in national, European and global markets (spec. 2–4, Table 3); (ii) less willing to collaborate with universities, suppliers and consultants (spec. 6, 9 and 10, Table 3); (iii) as likely as small non-family firms to collaborate regionally with enterprise groups, customers and competitors (spec. 5, 7 and 8, Table 3). Drawing on prior research on willingness of collaboration with customers (Freel, 2003; Freel & Harrison, 2006), our results demonstrated that small family firms are as willing to collaborate with customers, enterprise groups and competitors as non-family firms. Partner type and spatial proximity thus place important boundary conditions on the willingness of small family firms to engage in knowledge collaborations, and this is what distinguishes their style of collaboration from non-family firms.

To test the ability of small family firms to govern collaborations and to gain an innovation premium from them, we estimate (2) using the multilevel mixed-effects logistic model (see Table 4). First, we investigate H1 proposing that collaboration with customers for innovation is positively associated with innovation output in small firms ($\beta = 0.60$, $p < 0.01$) (specification 1, Table 4). This result is statistically significant and consistent across small firms that collaborate with customers across different geographical proximities (Table 4, specifications 2–5). The coefficients of interest range between 0.35 and 0.75 ($\beta = 0.35$–0.75, $p < 0.05$) (Table 4, spec. 2–5).

Our H2, which states that the association between collaboration with customers and innovation output is stronger for small family firms than for small non-family firms, is not supported. Our interaction coefficient of small family firms and collaboration with customers across all four geographical dimensions is positive but not statistically significant ($\beta = 0.29$, $p > 0.05$) (Table 4, specification 6). Our H3, which focused on the geographical location of collaboration with customers, is supported. The interaction coefficients in Table 4 (specifications 7–10) demonstrate that collaboration with customers within close geographical proximity is positively associated with innovation in small family firms ($\beta = 0.22$, $p < 0.05$) (Table 4, specification 7). The interaction coefficients for collaboration with customers outside the region are positive with global customers and national customers and negative with European customers, while none of the interaction coefficients are statistically significant (Table 4, specifications 8–10). In economic terms, collaboration with regional customers is associated with an additional 22% of innovative sales for small family firms compared to small non-family firms.

5.1 Robustness check

We estimated Eq. (2) with the Tobit data model instead of mixed effect generalized least square (GLS) estimation to test whether the major results still held and our hypotheses were supported. Our dependent variable is new to market product share, which is left-censored (some firms have zero innovation sales). The Tobit estimation results fully support the results obtained using the multilevel mixed-effects logistic model.

As part of our robustness check, we added interactions between small family firms with other types of external collaboration partners (enterprise groups, suppliers, universities, consultants, competitors, local and national government). These coefficients were not statistically significant, which means that returns from collaboration with other types of external partners do not differ between small family and non-family firms.

Table 4 Tobit estimation. DV – share of new to market products

Model	Model 1 (basic)					Model 2 (interactions)				
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Region of collaboration	All regions	Regional	National	Europe	World	All regions	Regional	National	Europe	World
Group	0.14	0.02	0.01	0.01	0.01	0.24	0.01	0.01	0.01	0.01
	(.15)	(.01)	(.01)	(.01)	(.03)	(.15)	(.02)	(.01)	(.03)	(.03)
Suppliers	0.22*	0.18	0.26***	0.07	0.46**	0.34**	0.17	0.26**	0.08	0.45**
	(.12)	(.00)	(.10)	(.04)	(.20)	(.15)	(.02)	(.10)	(.06)	(.12)
Customers	0.60***	0.35***	0.75**	0.48***	0.51***	0.47***	0.31***	0.73**	0.51***	0.49***
	(.13)	(.09)	(.05)	(.10)	(.03)	(.15)	(.00)	(.02)	(.03)	(.04)
Competitors	0.10	0.11	-0.01	0.30	0.07	0.05	0.10	0.02	0.30	0.07
	(.15)	(.15)	(.01)	(.20)	(.05)	(.17)	(.07)	(.02)	(.21)	(.04)
Consultant	−0.11	0.23	−0.37**	−0.22	−0.11	−0.24	−0.23	−0.38**	−0.23	−0.22
	(.17)	(.13)	(.14)	(.14)	(.40)	(.18)	(.21)	(.17)	(.29)	(.27)
Universities	0.06	0.35	0.02	−1.22***	−1.48***	−0.05	0.36	−0.01	1.28**	−1.49**
	(.16)	(.22)	(.02)	(.42)	(.36)	(.18)	(.50)	(.05)	(.45)	(.42)
In-house R&D expenditure	0.29***	0.29***	0.28***	0.28***	0.29***	0.32***	0.29***	0.28***	0.28***	0.29***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.02)	(.00)	(.00)	(.00)	(.00)
Training	0.44***	0.27***	0.27***	0. 28***	0.29***	0.34***	0.27***	0. 26***	0. 29***	0.29***
	(.10)	(.00)	(.00)	(.01)	(.01)	(.09)	(.00)	(.00)	(.00)	(.01)
Design	0.77***	0.76**	0.75**	0.76***	0.77**	0.64***	0.76**	0.75**	0.76***	0.77**
	(.09)	(.00)	(.00)	(.00)	(.00)	(.09)	(.00)	(.00)	(.00)	(.00)
Entrepreneurial climate	0.02	0.07	0.05	0.09	0.11	0.15	0.07	0.05	0.09	0.11
	(.10)	(.05)	(.05)	(.08)	(.08)	(.11)	(.05)	(.05)	(.08)	(.08)
Process innovation	0.54***	0.58***	0.58***	0.63***	0.61***	0.50***	0.59***	0.58***	0.61***	0.62***
	(.09)	(.00)	(.00)	(.00)	(.03)	(.09)	(.01)	(.01)	(.02)	(.02)
Entrepreneurial behaviour	0.18*	0.07***	0.05***	0.03***	0.01***	0.24***	0.07***	0.05***	0.03***	0.01***
	(.10)	(.01)	(.01)	(.01)	(.01)	(.10)	(.01)	(.01)	(.01)	(.01)
Risks – Finance	0.30**	0.23***	0.26***	0.25***	0.26***	0.08**	0.23***	0.26***	0.25***	0.28***
	(.10)	(.05)	(.05)	(.04)	(.04)	(.04)	(.05)	(.05)	(.04)	(.04)
Risks – Knowledge and Finance	0.04	−0.09	−0.11	−0.08	−0.07	−0.01	-0.09	−0.11	−0.08	−0.07
	(.12)	(.08)	(.08)	(.08)	(.06)	(.11)	(.08)	(.08)	(.09)	(.05)
Risks – Incumbents	−0.04	−0.04	−0.02	−0.03	−0.04	−0.04	−0.04	−0.02	−0.03	−0.04
	(.11)	(.03)	(.03)	(.03)	(.04)	(.06)	(.03)	(.03)	(.03)	(.04)
Group ownership	0.13	0.14	0.15	0.13	0.14	0.22	0.24	0.25	0.22	0.19
	(.09)	(.08)	(.09)	(.09)	(.09)	(.15)	(.15)	(.15)	(.15)	(.12)
Employment	−0.16**	−0.44***	−0.23***	−0.26***	−0.30***	−0.26***	−0.30***	−0.23***	−0.26***	−0.30***
	(.07)	(.00)	(.00)	(.00)	(.05)	(.07)	(.00)	(.00)	(.00)	(.05)

Table 4 (continued)

Model	Model 1 (basic)					Model 2 (interactions)				
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm age	−0.12	−0.07	−0.07	−0.07	−0.07	−0.09**	−0.07	−0.07	−0.07	−0.06
	(.09)	(.05)	(.04)	(.04)	(.06)	(.05)	(.05)	(.06)	(.06)	(.06)
Scientists	0.009***	0.004***	0.003***	0.002***	0.002***	0.003**	0.003***	0.003***	0.002***	0.002***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Foreign	−0.11	−0.14	−0.16	−0.16	−0.14	−0.18	−0.14	−0.15	−0.14	−0.11
	(.10)	(.10)	(.12)	(.16)	(.10)	(.12)	(.10)	(.12)	(.16)	(.10)
Family firm	0.04	0.01	0.05	0.04	0.03	0.01	0.01	0.02	0.04	0.02
	(0.10)	(0.06)	(0.05)	(0.05)	(0.02)	(.01)	(.01)	(.02)	(.05)	(.02)
Family firm × Customers						0.29	0.22**	0.33	−0.44	0.64
						(.19)	(.07)	(.20)	(.24)	(.36)
Mills ratio: Innovation active selection bias	0.25***	0.22***	0.24***	0.21***	0.19***	0.26***	0.23***	0.20***	0.19***	0.17***
	(.05)	(.02)	(.02)	(.02)	(.02)	(.02)	(.01)	(.01)	(.00)	(.00)
Constant	−4.43***	−3.93***	−3.94***	−3.99***	−3.95***	−3.99***	−3.93***	−3.90***	−3.98***	−3.80***
	(.81)	(.71)	(.73)	(.71)	(.71)	(.73)	(.71)	(.71)	(.71)	(.70)
variance (year)	0.36	1.37	1.30	1.36	1.45	1.38	1.36	1.31	1.35	1.40
	(.24)	(1.1)	(.50)	(.91)	(.98)	(1.26)	(1.0)	(.69)	(1.0)	(.85)
variance (year/region)	0.13***	0.09***	0.09***	0.09***	0.09***	0.11***	0.08***	0.08***	0.08***	0.08***
	(.04)	(.01)	(.01)	(.01)	(.01)	(.05)	(.01)	(.01)	(.01)	(.01)
LR test vs. logistic model: chi2	247.52	498.82	298.96	278.02	254.09	212.35	492.04	285.45	249.42	290.01
Overall model chi2	777.18	1097.85	1145.31	1092.07	1090.10	836.10	1090.01	1124.31	1095.01	1090.85
Left censored observations	10,100	10,100	10,100	10,100	10,100	10,100	10,100	10,100	10,100	10,100
log likelihood	−2106.01	−2730.20	−2709.20	−2737.20	−2740.10	−2137.05	−2730.01	−2709.60	−2740.37	−2730.21

Standard errors are robust for heteroscedasticity in parenthesis. Industry (1 digit SIC) and year fixed effects are suppressed to save space. Estimation method: Mixed-effects GLM: Product innovation regression/LR test vs. logistic model supports use of Multi-level mixed-effects generalized linear model. Out of 14,088 obs. in a sample we have 10,100 obs. where left censored, which means zero share of new to market products. Significance level: Significance level: *$p < 0.10$; **$p < 0.05$, ***$p < 0.01$. Source: *UKIS*-UK Innovation survey, *BSD* Business Structure Database, *SBS* Small Business Survey. Number of observations 14,088

We estimated Eq. (2) with logistic regression, which measures the likelihood of product innovation instead of innovation sales as a dependent variable. Our dependent variable was converted into a binary variable, being equal to one in case of positive innovation sales, zero otherwise. The results of logistic regression support mixed effect GLS estimation, as we found that collaboration with customers in a close geographical proximity provides an innovation premium for small family firms compared to small non-family firms.

6 Discussion

The paper investigated two important boundary conditions of the well-known ability-willingness paradox (Chrisman et al., 2015) i.e. partner type and spatial proximity. Building on prior research (Miller & Miller, 2008), we found that the willingness of small family firms to collaborate with customers in the region does not differ from the willingness of small non-family firms.

In addition, we found two relationships that are worth commenting on. First, we found that small family firms show a significantly lower likelihood to collaborate with suppliers compared to non-family firms. While this is not in direct contrast to prior research indicating that customers and suppliers are the main collaboration partners of small family firms (Colombo et al., 2012; De Massis et al., 2018), this finding might be used as a first indicator of how small family firms prioritize these two partner types differently. More precisely, small non-family firms are significantly more likely to collaborate with suppliers.

Second, we also observed that small family and non-family firms do not differ in their likelihood to collaborate with competitors. Although we did not hypothesize about this relationship, the finding is in line with prior research highlighting various reasons for engaging in this type of coopetition partnership in innovation-intensive contexts (Gast et al., 2019).

We make three contributions to the literature by introducing partner type and regional proximity as two important boundary conditions of the ability-willingness paradox of small family firms. First, we contribute to the debate on how small family firms turn their idiosyncrasies into strengths and successfully engage in open innovation activities (De Massis et al., 2018; Spriggs et al., 2013). While prior research has highlighted that small (family) firms frequently engage in collaborations with customers in their region (Intihar & Pollack, 2012; Spriggs et al., 2013), these arguments have yet to be explicitly integrated in the ability-willingness-paradox. Moreover, by introducing these two boundary conditions, we answer a call by DeBellis et al. (2021) to investigate how the ability-willingness paradox can be overcome. Putting small family firms at centre stage, this study also answers the call of recent research to understand alternative innovation models adopted by smaller family firms, allowing them to innovate (De Massis et al., 2018).

Second, while prior literature has focussed on analyzing how family firms differ from non-family firms in their ability to govern collaborations (Debellis et al., 2021), we shift attention to collaboration partner type heterogeneity as an important contextual factor for partner type selection and subsequent innovation performance in the family business literature (Alberti et al., 2014; Classen et al., 2012; De Massis et al., 2015b; Magistretti et al., 2019). Previous research highlighted the impact of family ownership, along with their motivation and outcomes of their involvement (e.g. Alberti et al., 2014; Classen et al., 2012), and on the different ways family firms collaborate (Magistretti et al., 2019). Yet, little is known regarding how engagement in such collaborations affects the innovation outcomes for small family firms.

Third, we contribute to the literature on open innovation in small businesses. Our results go beyond the previous literature by assessing the likely impact of customer collaboration on product innovation (Kobarg et al., 2019; Laursen & Salter, 2006).

7 Conclusion

7.1 Contributions

This paper investigated the well-known ability-willingness paradox (Chrisman et al., 2015) in the context of small family firms. Small family firms are subject to a comparably higher involvement of their owner family which is associated with an unusual ability to behave idiosyncratically (Miller et al., 2001). Our research argues and provides empirical support for

the view that the ability-willingness paradox is not a universal phenomenon for small family firms. Instead, partner type and spatial proximity between the collaboration partners constitute important boundary conditions.

We build on prior research arguing that small family firms focus their collaboration activities on customers in their immediate surroundings (Intihar & Pollack, 2012), and reason that this attenuates the lower willingness of small family firms to collaborate with these partners. We discuss and hypothesize why small family firms' unique characteristics lead to a higher ability to govern these collaborations than small non-family firms. As a consequence of this higher ability to govern collaborations, a more intense knowledge transfer might take place explaining the higher innovation output of small family firms.

7.2 Implications for policy and practice

Based on these results, two cautious conclusions can be drawn to offer implications for policy and practice. We have shown that small family firms could overcome their reservation towards open innovation when engaging in collaborations for innovation within their region and with customers, with strong implications for the UK's small business and innovation policy. In particular, policy-makers are called to incentivize family firms to collaborate with customers in their local and regional markets, as those small family firms who do so will achieve higher innovation performance.

Moreover, we have shown that collaborating with customers within a region is positively associated with innovation for small family firms compared to small non-family firms. Support programmes designed to bestow innovation activities via open innovation for small firms may therefore need to differentiate between support tools and networks for family and non-family firms, as their needs for support to engage in collaborations differ. While small non-family firms may need assistance in accessing the relevant networks and facilitating long-term relationship management, small family firms might need assistance in overcoming the perceived threats associated with such collaborations. This suggestion can also be extended to other institutional settings where the ability-willingness paradox for family firms in the context of collaborations can be observed. While our empirical analysis is based on UK data, the conclusions may thus be cautiously applied in other institutional settings to enhance innovative collaboration performance.

Finally, two managerial implications can be advanced. First, small family firms are well advised to stick to collaborating with regional customers. This does not preclude small family firms from engaging in external knowledge collaboration with customers outside their region. One possible solution could be to pursue a 'temporary proximity collaboration strategy' (Lavoratori et al., 2020), which also constitutes our second managerial recommendation. Periodic project team meetings on innovation may suffice to develop other forms of proximity for small family firms, who may face financial constraints related to sustaining permanent spatial proximity with international partners.

7.3 Limitations & future research

Our study has two major limitations, providing a potential starting point for future research.

After matching and cleaning our sample for missing values, only 21% of observations in our sample are categorized as family firms. While this percentage is lower than the percentages of family firms usually reported in European studies (see European Parliament, 2015; Pongelli et al., 2019 for review), this is the first study in the UK when family firms were identified within the UK innovation survey. Prior family business studies in the UK have mainly used qualitative methods such as conducting interviews with family businesses, employing between 10 and 250 staff or case studies (Gupta & Levenburg, 2010). Yet, a noteworthy quantitative study performed in the UK remains. Levie and Lerner (2009) who drew on two large surveys of adults in 2005 and 2006 as part of the Global Entrepreneurship Monitor (GEM) research and were able to identify that 55% of individuals in their final sample were family business owners. Trying to explain the lower percentage of family businesses in our study, we postulate that family businesses in the UK are more likely than non-family businesses to be micro with 85% of family firms are micro firms, while fewer were small businesses (13%), and just 2% of family businesses were classified as medium-sized businesses (BIS, 2015). As the UKIS surveys are focussed on innovation topics

micro and small family firms were (i) less likely to be randomly selected; and (ii) if selected, they were less inclined to fill questionnaires due to the lack of innovation activity. Future research on innovation in small family firms might benefit from more representative samples.

Second, we restricted ourselves to analyzing collaboration activities with customers across four geographic dimensions in line with our derived hypotheses. Future studies may expand this analysis to other types of collaboration partners with a regional, national, European and worldwide scope. Finally, insights from network theories could be used in future studies to further explore the role of network size, breadth and depth in the context of small family business and their innovation performance.

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