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Driving factors of innovation in family and non-family SMEs

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Abstract Prior findings are inconclusive concerning the innovation output of family and non-family SMEs. The study at hand takes one step back and examines the drivers of innovation output. Applying a contextualized approach, we use data of 1.870 SMEs located in Germany, arguing that the main characteristic of family SMEs is the unity of ownership and leadership. These specific elements affect both the drivers and the output of innovation leading to a more detailed understanding of family firm innovation. Our results indicate that a long-term perspective positively affects innovation output in small family firms. We also show that family firms are better able to preserve the knowledge of the workforce through lower fluctuation rates which leads to higher levels of innovation output. Finally, the succeeding generations of family firm leaders seem to be more risk averse than the founder generation. As a result, the innovation output continuously decreases from generation to generation.

Keywords SME · Family firm · Innovation output · Innovation driver · Context · Succeeding generation · Founder generation · Generation effect

JEL classification L26 · O31 · O32

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1 Introduction

Family business researchers rate innovations as highly important for the economic development and growth of a company (e.g., see Block 2012; De Massis et al. 2015; Nieto et al. 2015). Innovation does not only positively affect the long-term business performance (Alberti and Pizzurno 2013; Kellermanns et al. 2012; Partanen et al. 2014; Uhlander et al. 2013) but also ensures the survival of a firm against competitors (Carnes and Ireland 2013; De Massis et al. 2016). The "German Mittelstand" which builds the main driver of our economy is composed of small and medium-sized (SME) companies. Outside of Germany, the term "SME" is more frequently used (for details see De Massis et al. 2017; Welter et al. 2014). German SMEs consist of family as well as non-family businesses with the majority being family-owned (Bergfeld and Weber 2011; Klein 2000) and form a major source of innovation despite some resource-related weaknesses compared to larger companies (De Massis et al. 2017). Moreover, SMEs in Germany are in comparison to almost all other EU countries exceptionally innovative (Centre for European Economic Research 2016) and, hence, the appropriate unit of analysis when studying innovation activity of family and non-family SMEs in Germany. Thus, in this study, we apply a contextualized research approach by focusing on selected dimensions of the so-called where context, namely the business and spatial dimension of

context (Welter 2011). By conducting our research in a pre-defined contextual setting, we generate insights into the innovation output of German family and non-family SMEs along with their (family) firm-specific antecedents and drivers.

In recent years, a growing body of research on innovation can be observed (e.g., see the meta-analysis by Duran et al. 2016). However, only few studies compared innovation activities of family and non-family firms (Classen et al. 2014; De Massis et al. 2015) although research has shown that family firms differ for example in the perception of opportunities and barriers to innovation (e.g., see Zahra et al. 2007). Or as De Massis et al. (2015) put it: we need more detailed research on the "black box" of innovation in family firms, including the influences, which drive the innovation output. The ambiguity of existing results on innovation points to the need for more fine-grained research: obviously, the drivers of innovation depend on firm-specific criteria. Therefore, the present study aims at filling this important gap by examining family-firm (versus non-family firm) specific innovation drivers as a prerequisite of innovation output.

To our knowledge, this study is the first one taking several drivers in family business and innovation research simultaneously into account. Our study contributes to the family business and innovation research in several ways: First, our empirical survey is conducted with a huge and representative sample of 1870 German small and medium-sized enterprises consisting of family firms and non-family firms as comparison group. Our solid data basis offers the opportunity to reassess the rather ambiguous results in the field of innovation research. Second, by reviewing and systematizing the driving factors of innovation, our study responds to the call of De Massis et al. (2015) to open the black box of what influences innovation in family firms. Due to the complexity of effects on innovation, we apply a multi-theoretical approach. Based on three theoretical schools of thought, namely, agency theory, network and knowledge-based view as well as socio-emotional wealth, we offer a solid conceptual framework for future innovation research including direct, moderation, and mediation effects. Third, our study not only compares non-family and family firms but also illuminates the within-group heterogeneity of family firms (Chua et al. 2012; Penney and Combs 2013). This approach allows us to receive more in-depth research findings on family firm generations, for example by showing that the founder generation acts more innovatively (and produces more innovation output) than succeeding generations. On the one hand, this generation effect has important theoretical implications for researchers when it comes to the call of widening the definition of innovation. On the other hand, it offers practical implications, for example, to support the succeeding generations in family firms regarding their (long-term) innovation strategy, organizational flexibility, or risk assessment.

The rest of the paper proceeds as follows. In the next section, we briefly discuss the findings of previous empirical studies relating to our research question and outline a theoretical framework for our analyses. Then, we test our propositions using multivariate analyses. Finally, we discuss our main results, limitations, and present suggestions for future research.

2 Literature overview

Although the literature on family firms is comprehensive and growing fast, little is known about the drivers of innovation. A first overview of the literature on innovative family firms can be found in De Massis et al. (2013). However, the majority of comparative studies is based on samples with large and listed firms (e.g., Block 2012; Chin et al. 2009; Gómez-Mejía et al. 2014; Hsu and Chang 2011) pointing to a negative relationship between family involvement and innovation output.

Studies comparing family to non-family SMEs are, for example conducted by Craig and Dibrell (2006), De Massis et al. (2015), Gudmundson et al. (2003), as well as Pittino and Visintin (2013). Craig and Dibrell (2006) investigate the effect of firm-level natural-environment-related policies on innovation and financial performance. They argue that non-family firms are more likely to use formal monitoring and control mechanism that oppress innovation activities, whereas in small family firms, open channels of communication, informal decision making, and flexibility in processes are prevalent and lead to a more innovation-friendly atmosphere. De Massis et al. (2015) conducted a multiple case study to find out what differentiates family firms from non-family firms as regards to the organizational solutions and managerial principles used in the product innovation process. By drawing upon the resource-based view of the firms as well as agency, stewardship, and behavioral theories, they found differences regarding the innovation climate which is more risk averse and

informal in family firms. Gudmundson et al. (2003) focus on organizational differences, ownership structure, and type of customers in small family firms. In contrast to their own prediction, they found on the base of 4200 questionnaires completed by employees of 89 SMEs in the USA that the innovation output of small family businesses is significantly higher than the innovation output of small non-family businesses. However, they do not give an explanation what unique characteristics family firms have that are positively related to the implementation of innovations. Pittino and Visintin (2013) compare product innovation strategies carried out by family firms versus non-family firms rather than the innovation output. Their data encompasses a sample of 508 SMEs located in the north east of Italy. The regression results indicate that family firms prefer conservative innovation strategies, i.e., they are more likely to adopt exploitation than exploration strategies. Pittino and Visintin (2013) argue that owners in closely held family firms build fewer slack resources as financial risks are perceived as higher than it is for diversified corporate investors. However, when family firms still decide to undertake more high-risk projects, they more likely rely on external sources through strategic alliances.

Further comparative SME studies we found are mostly limited to certain industry sectors. For example, Classen et al. (2012), Llach and Nordqvist (2010), as well as Nieto et al. (2015) compare unquoted SMEs from the manufacturing sector. Again, the results seem to be rather ambiguous. Classen et al. (2012) apply a multiple regression approach of 167 SMEs located in Belgium and the Netherlands to show that family firms have fewer external partners to acquire resources for their innovation activities. Due to the focus on socioemotional wealth preservation and partly because of their limited cognitive diversity and absorptive capacity, family businesses prefer a less diversified set of external innovation partners. Llach and Nordqvist (2010) use a matched sample methodology and show with a sample of 151 Spanish SMEs the strategic advantages of family firms in comparison to non-family SMEs with regard to the role of human, social, and marketing capital for innovation. Nieto et al. (2015) examined innovation behavior of Spanish family and non-family SMEs. Their panel analysis of 15,173 observations over a period of 10 years reveals that family SMEs invest less in R&D due to higher risk aversion and resource constraints. Concerning the type of innovation output, family firms are more likely to achieve incremental than radical innovations and are less inclined to assimilate external knowledge than their non-family counterparts. Last but not least, studies by Classen et al. (2014) which include not only the manufacturing but also the service sector come to the result that family firms produce significantly more process innovations than non-family firms, however, without analyzing the specific innovation drivers. Moreover, the definition of family firms Classen et al. (2014) apply does not consider a family member in management, but only a family capital share of at least 50% in the firm.

Recapitulating our literature review, it can be stated that empirical studies investigating drivers of innovation output of family SMEs based on numerous observations with a representative character and a comparison group (of non-family SMEs) can rarely be found. Our paper closes this gap by establishing a sound research framework, testing major innovation drivers, and analyzing the innovation output of family versus non-family SMEs with a representative sample of 1870 German SMEs. Our empirical study measures the innovation output directly and does not use investments in research and development (R&D) or patent data. We refrain from using R&D investments (with the exception of R&D cooperation) as the output of R&D is often uncertain and numerous SMEs do not explicitly invest in R&D though being innovative due to stimulation by their customers, suppliers, or employees. Especially for SMEs, patent data does not seem to be the appropriate measurement as a lot of innovations are never patented. Patent applications are often too expensive for SMEs and many innovations do not justify such high investments.

Finally, Duran et al. (2016) highlight the innovation input-output relationships of family and non-family firms to be dependent on country-specific factors. As mentioned above, the German Mittelstand is widely recognized for its innovation capacity, and since the local context shape the organizational behavior (see, e.g., De Massis et al. 2017), our comparative study of family and non-family SMEs located in Germany will offer additional insights.

3 Hypothesis development

Innovative firms have strategic skills like long-term goals as well as the willingness and ability to collect, process, and assimilate new knowledge. They also possess

organizational skills like the mastery of risks, flexible organizational structures, and willingness to cooperate as well as maintain their qualified human resources (OECD 2005). These skills are at least partly affected by the ownership and management structure of the firm. We use the accepted and widely used definition of family firms considering the unity of ownership and management as a central criterion (e.g., Chua et al. 1999; Kotey 2005; Posch and Wiedenegger 2014) for clarifying why the driving factors of innovation differ in family and non-family SME. We examine a combination of product and process innovation as the introduction of a completely new or significantly improved product or service also requires new production processes in the firm.

In the following, we elaborate the principal agent (Jensen and Meckling 1976), the principal problem (Le Breton-Miller et al. 2011; Miller et al. 2013) as well as approaches which highlight the local embeddedness of family firms (e.g., Basco 2013; Block and Spiegel 2013; Davis 1983; Lee 2006). Our research hypotheses are derived from a critical discourse regarding the drivers and constraints of innovation output which emerge through the unity of ownership and management in family SMEs.

3.1 Firm size, agency costs, and decision-making processes

The unity of ownership and management avoids the well-known corporate governance problem that may result if a firm's owner employs external managers (Le Breton-Miller and Miller 2006). This governance problem is known as the principal-agent problem (Chrisman et al. 2004; Fama and Jensen 1983; Jensen and Meckling 1976) assuming that the interests between the firm owner (principal) and the external manager (agent) diverge. To prevent this, the owner may implement an incentive system at his own expenses, to increase the willingness of the manager to decide according to the owner's strategies and interests.

Usually smaller family firms do not have to deal with these so-called agency costs (Corbetta and Salvato 2004) since management positions can be filled with family members (Ang et al. 2000; Carnes and Ireland 2013; Cruz et al. 2012). Consequently, these firms can invest their savings in innovations. This positive effect decreases with growing firm size: while internal processes increase in complexity and higher formalization, the pool of potential family members who can be entrusted with management functions remains limited. In other words, larger family firms with more management positions to fill do not automatically possess the necessary amount of appropriate and skilled family members. Thus, agency costs might occur as is the case in non-family firms. From this follows that smaller family firms have innovation benefits since additional resources for innovations are still available due to the omission of agency costs.

Another aspect that is advantageous for smaller family firms regarding innovation is the organization of decision making processes. The firm's size as well as the ownership structure often determine the organization of the firm's innovation management. Non-family SMEs and larger firms usually coordinate innovation activities with the help of formal management systems to mitigate the principal-agent problem. The flexibility and less formalized processes in small family firms foster innovation (Posch and Wiedenegger 2014) as the owner-manager usually "pulls the strings." Long-time experience allows for a fast coordination and efficient management.

With increasing size of the company, these benefits can turn into disadvantages since an organizational structure directed by one person (the owner-manager) has its limitations. This might lead to a slowdown in decision-making processes. Moreover, passing control on to succeeding generations (with a limited pool of qualified family managers) often results in a more dispersed ownership structure. A principal-principal problem may arise due to family conflicts with the family in charge making rather "selfish decisions" on the cost of other family equity owners (Le Breton-Miller et al. 2011; Miller et al. 2013). Thus, an increasing size of the family firm therefore should result into comparatively lower innovation activities, an effect we do not expect for larger non-family firms. Therefore, for firm size, we hypothesize the following moderation effect:

> *Hypothesis 1: Small family firms are more innovative than small non-family firms. In contrast, large family firms are less innovative than large non-family firms.*

3.2 Firm age, network activities, and R&D cooperation

R&D cooperation is considered as a source of innovation without capital-bound investments (Lipparini and

Sobrero 1994) and the resourcing of the entire know-how. External know-how can be obtained through networks which provide valuable information for the development of new products and processes (Carnes and Ireland 2013; Classen et al. 2014; Duran et al. 2016; Partanen et al. 2014; Posch and Wiedenegger 2014).

Over the years, family firms are often well embedded in the regional environment (Aldrich and Cliff 2003; Bird and Wennberg 2014). The long-lasting incumbency of the family owner leads to trusting networks with customers and suppliers as potential partners in R&D cooperation (Habbershon and Williams 1999). It is the ability of the family owner-manager to "extract benefits from their social structures, networks and memberships" (Davidsson and Honig 2003, p.307). A trusting cooperation along the value chain illustrates the strong networks of SMEs, specifically of traditional and older family firms (Llach and Nordqvist 2010). Consequently, those networks with regional partners established over time can be seen as an important source for innovation activities and should correspond to a higher number of joint R&D projects (Alberti and Pizzurno 2013; Pittino and Visintin 2013).

Thus, especially older family firms with more networks will have a higher potential to invest in R&D cooperation compared to younger firms that are less experienced and embedded in the region. For firm age, we hypothesize the following moderation effect:

> *Hypothesis 2: Older innovative family firms invest more often in R&D cooperation than their non-family counterparts. In contrast, younger non-family firms invest more often in R&D cooperation than young family firms.*

3.3 Fluctuation rates, long-term perspective, and innovation

For family firms, (long-term) goals referring to the family are ranked at least equally important (Chrisman et al. 2012; Zellweger 2007) and sometimes even more important compared to corporate goals (Berrone et al. 2012; Gómez-Mejía et al. 2007, 2014). Important family and non-financial objectives which imply a long-term temporal approach (Brigham et al. 2014) are low fluctuation rates of the workforce even in times of crisis and the successful handing-over to the next generation, that is, the intra-family succession (Berrone et al. 2012; Zellweger 2007).

3.3.1 Fluctuation rates of the workforce

One of the most important factors for generating innovations is the knowledge basis of the workforce. It can represent a competitive advantage when the company is able to develop, keep, and exchange the knowledge as it is based at least partially on experience (Cabrera-Suárez et al. 2001) and build on trust. From a knowledge-based view, this includes know-how gained through education, training, and experience as well as the ability and motivation to share and exchange one's knowledge within the firm and to absorb new knowledge from colleagues (Cohen and Levinthal 1990). The knowledge of the workforce needs time to grow requiring a supportive and trusting company climate. The long-term perspective in family firms facilitates the emergence of an atmosphere of trust, commitment, and an overall motivation (Broekaert et al. 2016). Family firms often live a family-culture where employees cultivate closer and more personal relationships among each other and with the corporate management creating a warmer and less anonymous atmosphere in the company (Davis et al. 1997; Vallejo 2008). This intensifies the circulation of knowledge and hence the innovation capacity (Posch and Wiedenegger 2014). In addition, employees in family firms show higher job satisfaction levels and lower fluctuation rates compared to non-family firms (Carmon et al. 2010; Clark et al. 1998; Sieger et al. 2011).

A company has to trade the potential gains and losses accompanying high versus low fluctuation rates. In the time of the financial crisis, Bassanini et al. (2013) were able to illustrate that family firms reduced their new hires instead of increasing the number of layoffs in comparison to non-family firms. Thus, family firms were able to keep the valuable knowledge of their staff in the company. For family firms, it seems that the long-term loss of the knowledge basis of their workforce outweighs the short-term advantage of lower labor costs. Hence, we expect the following mediation effect:

> *Hypothesis 3: Family firms have lower fluctuation rates than their non-family counterparts. Lower fluctuation rates in turn have a positive effect on innovation output.*

3.3.2 Intra-family succession

We now shift our focus from the comparison between family and non-family SMEs to the within-group heterogeneity of family firms and their variance of behaviors (Chrisman and Patel 2012). Schumpeter (1987) emphasizes the role of the (founding) entrepreneur for the creation of innovations as well as for the entire innovation process. According to Schumpeter, a successful entrepreneur is highly assertive and willing to take risks. In this context, one of the most important objectives of the entrepreneur is to successfully hand over the firm to the next generation (Berrone et al. 2012; Gómez-Mejía et al. 2007; Zellweger 2007). However, after the founder departs, family firms usually show lower entrepreneurial activities (Jaskiewicz et al. 2015). This may be due to a change of risk aversion regarding investments in innovative projects (Beck et al. 2011). Usually the founder generation is less risk averse and less sensitive to uncertainty than succeeding generations (Duran et al. 2016).

A change of generation often comes with additional owners. This leads to a growing complexity and variety of interests within the family firm and principal-principal problems become more likely (Kellermanns et al. 2012; Miller et al. 2013). The alignment of interests due to a larger number of shareholders also influences the risk and innovation tendency of family firms (Block 2012). Drawing on the socio-emotional wealth approach (Gómez-Mejía et al. 2007), the potential gains and losses associated with the innovation decision differ from generation to generation. In terms of financial (and emotional) gains and losses, the first (founder) generation has little to lose, as the company is quite young but a lot to gain when expanding the company. This effect changes for each additional generation. The company grows, so does the amount of family owner-managers. Succeeding owner-managers might be more risk averse when making innovation decisions as they feel the pressure (from the family) to preserve the company. They need to cautiously weigh whether it is worth to invest in (risky) innovations.

In addition, we assume that the first (founder) generation had a pull motivation and independently decided to found the company. For the following generations, this cannot be assumed automatically. Thus, we expect that the innovation output is the highest within the founder generation and decreases with each additional generation.

> *Hypothesis 4: In family firms, the first generation is more innovative than non-family firms. With a growing number of generations, the positive effect of the family firm on innovation output decreases.*

Figure 1 summarizes our conceptual framework.

4 Methods

4.1 Sample and data

Overall, 4175 companies responded in a survey conducted by Creditreform e.V., Germany's largest credit rating agency. The survey includes SMEs with annual sales up to 50 million Euros, which are not a subsidiary of a larger company. Our final data set consists of 1870 SMEs as we excluded incomplete questionnaires. The survey was addressed to the CEOs of small and medium-sized companies. The questionnaire comprised wide-ranging questions about the company's current situation, innovation output, and potential drivers of innovation.

4.1.1 Dependent variables

As our first dependent variable, we measured innovation output in terms of technological innovation output (self-reported). One set of questions aimed at the innovation output between autumn 2008 and autumn 2011 (that is, in the last 3 years preceding the survey). In particular, we asked if the interviewed companies have introduced within the last 3 years a completely new or significantly improved product or service in the market. In a similar manner, we asked for process innovation, defined as the implementation of a new or significantly improved production process. We explicitly excluded purely organizational innovations. For our regression analysis, we merged this information in a single 0/1 (dummy) variable (coded as "1" if the companies have realized at least one product or process innovation in the past 3 years, and "0" if this was not the case). If the companies answered one of the aforementioned questions with yes (i.e., product and/or process innovation), we further asked if this innovation has been developed by the company itself or in cooperation with another firm or institution. This forms

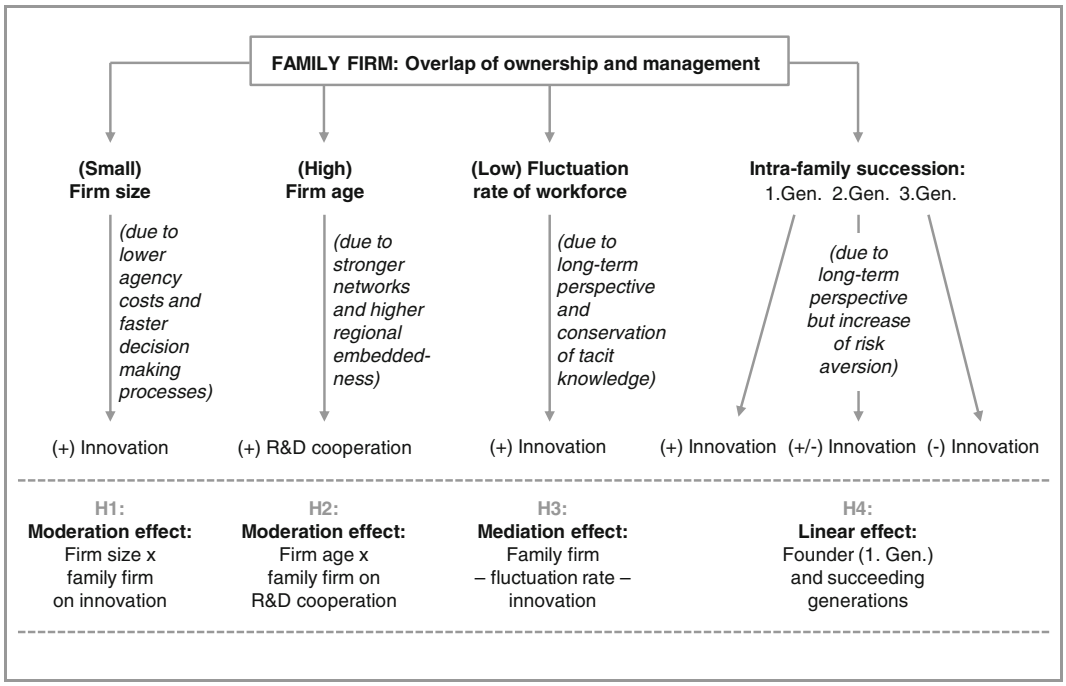

Fig. 1 Conceptual framework of the drivers of innovation. Source: own illustration

our second (0/1 dummy) dependent variable: R&D cooperation. Our third dependent variable (and mediator variable)—a three-level categorical variable—constitutes the fluctuation rate of the work force. We asked the companies if the labor stock has changed in the past 2 years. The variable takes on the value "1" if the firm downsized their workforce in the period covered, "2" if the workforce was unchanged, and "3" if the workforce increased. Based on this information, we constructed a 0/1 (dummy) variable with two categories for our regression analysis coded "1" if the workforce remained unchanged or increased, and "0" if the firm downsized their workforce (reference group).

4.1.2 Independent variables

In general, a variety of indicators are used in research literature to measure family involvement in firms (Astrachan et al. 2002; Zahra et al. 2007; Villalonga and Amit 2006). To identify a company as a family firm in our sample, we apply the definition of the EU commission which considers a firm a family firm if the family owns at least 50% of shares and at least one family member is part of the management team (European Commission 2009; see also Classen et al. 2014; Chua et al. 1999; Eddleston and Kellermanns 2007; Peng and Jiang 2010; Posch and Wiedenegger 2014; Westhead and Cowling 1998; Zellweger et al. 2012a, b). On the other side, non-family firms are operationalized as companies that have no family members in management and/or where one or more families own less than 50% of shares. In other words, and in line with the family business literature, we generated a binary variable containing information on management participation of family and non-family members as well as family capital shares to define the firms as family firms if a family member manages the firm alone or together with other family members and if the family capital share is at least 50%. On average, 70.9% of the companies in our data can be defined as family firms using these two criteria, which is consistent with family business literature (e.g., Klein 2000; Westhead and Cowling 1998).

Another central variable in our model is the variable representing small firm size. In our survey, the responding CEOs were asked to estimate how many people approximately work in their firm. Specifically, the CEO were asked to indicate how many employees work in their company by choosing one of four categories (coded "1" = 1–10 employees; category "2" = 11–20 employees; "3" = 21–50 employees; "4" = 50–500 employees). As we are interested in the effect of small family and non-family firms on innovation, we

regrouped the answers for our regression analysis based on a two categories coded "1" (those firms with up to 20 employees) and "0" (those firms with more than 20 employees). Likewise, following the hypotheses derived in the last section, we also include in our empirical models the independent variable firm age ("1" = older than 10 years, "0" = up to 10 years old as reference group). To determine the generational stage of the family firm, we included a variable reflecting the number of successfully accomplished successions in the past within the family (the first generation being the founder generation). Specifically, this unordered categorical variable has four different coded values: "1" for first-generation and founder, "2" for second generation, "3" for third and later generation, and "4" if the company is a non-family firm. In our multivariate analysis, we regroup this variable by generating a set of dummy variables for each value of the original four-level categorical generational stage variable. We select the dummy variable "1" = first-generation and founder firms, "0" = otherwise as our reference category.

4.1.3 Control variables

Finally, we include a number of control variables that might simultaneously affect innovation drivers and output. That is, in addition to these predictors and in line with prior research on family firm innovation (e.g., Choi et al. 2011; Duran et al. 2016; Kammerlander et al. 2015; Zahra 1996), we included five control variables. Regional influences (North, West, South, and East Germany) and different industry sectors (construction, trade, service industry, and manufacturing) influence innovation output as clusters of more innovative industries such as IT services or biochemistry can be found in specific regions, e.g., in North-Rhine-Westphalia or Bavaria rather than in Mecklenbourg (Duran et al. 2016). Moreover, we control for various dimensions of the surrounding market conditions with a set a 0/1 (dummy) variables: (1) market entry of rival firms is a threat ("1" = yes, "0" = no), (2) high degree of technological change in the industry ("1" = yes, "0" = no), and (3) easy substitutability of own products with competitor's products in the industry ("1" = yes, "0" = no). It can be argued that substitutes, lower entry costs, and the rapid change of technologies create greater competition and competitive pressure, which drives firms to innovate their products and processes (e.g., Jianming 2006; Vives 2008; Hecker and Ganter 2013).

A description of all categorical variables with their distribution as well as of the regrouped variables that we used for our regression analysis can be found in Table 1.

4.2 Analytic strategy

In the empirical models discussed in detail in the next section, we regress innovation output on the potential innovation drivers as discussed above. Our hypotheses are tested using hierarchical logit regression models. Because all dependent variables are two-item scale variables, the appropriate econometric model to use is a regression model for binary outcome variables (Wooldridge (2003). Specifically, we estimate seven logit regression models.

In the first model, we analyze the ceteribus paribus effect played by our independent 0/1 variables: family firm, firm's age, small firm's size, and the control variables discussed above. Second, we test Hypothesis 1 by including an interaction term reflecting the impact of the different firm size in family firms on innovation output (model 2). Because the coefficients of interactions in logit models are unintuitive to interpret, we follow Hoetker (2007), Hilbe (2009), and Mitchell (2012) and convey these results in a more meaningful way by providing graphical interpretations. Please note that, in the cases where we illustrate our results, we display predictive probabilities, i.e., the firms' likelihood of realizing product or process innovation output compared to the situation where the firms have no innovation output in the covered period—setting all other covariates to their mean values. We do so for our variables of interest because the predicted probabilities in non-linear logit provide a more informative interpretation of the coefficient's effects. For simplicity, we display the log-odds coefficients for all other cases.

Third, to test Hypothesis 2, we regress R&D cooperation on the potential innovation drivers with focus on firm's age, that is, we include an interaction term describing the effect of different firm age in family firms on innovation (model 3 and 4). Forth, to test Hypothesis 3, we calculate two models (model 5 and 6) which test the mediating effect of staff fluctuation on innovation output with focus on family firms (Baron and Kenny 1986). Please note that, in these two models, we additionally add a control variable reflecting the business situation of the firm, which will most certainly affect staff fluctuation. Here, the indirect effect (mediator effect) explaining the relationship between family firm and innovation covers

Table 1 Description of variables

Variable name	Variable description	Mean
	Dependent variables	
Innovation output	Did your company realize at least one product innovation or at least one process innovation in the past 3 years? [No = 0; Yes = 1]	0.5144
R&D cooperation	Has this innovation been developed by the company itself or in cooperation with another firm or institution? [No = 0; Yes = 1]	0.2813
Fluctuation rate	The labor stock has not been reduced in the past 2 years [No = 0; Yes = 1]	0.8963
	Independent variables	
Family firm	Does a family member manage the firm alone or together with other family members and is the family capital share is at least 50% [No = 0; Yes = 1]	0.7086
Firm's age	Age of the company? [10 years and less = 0; older than 10 years = 1]	0.7594
Firm's size	Size of the company?	
	[Else = 0; 20 employees and less = 1]	0.5920
	[Else = 0; 21–50 employees = 1]	0.1978
	[Else = 0; 51–100 employees = 1]	0.1337
	[Else = 0; more than 100 employees = 1]	0.0765
Generation of family firm	In what generation is your business in family ownership?	
	[Else = 0; non-family business = 1]	0.2620
	[Else = 0; first generation (founding generation) = 1]	0.3594
	[Else = 0; second generation = 1]	0.2075
	[Else = 0; third generation and more = 1]	0.1711
	Control variables	
Industrial sector	Which of the following sectors does your company operate in?	
	[Else = 0; 1 = manufacturing]	0.3262
	[Else = 0; 1 = construction]	0.1422
	[Else = 0; 1 = trade]	0.2005
	[Else = 0; 1 = service]	0.3311
Region	The location of your company is in the following regions of Germany:	
	[Else = 0; 1 = South Germany]	0.2802
	[Else = 0; 1 = North Germany]	0.2802
	[Else = 0; 1 = West Germany]	0.3203
	[Else = 0; 1 = East Germany]	0.1193
Market conditions	Please indicate if the following characteristics describe the competitive environment in your main market:	
	Market entry of rival firms is a threat [No = 0; 1 = Yes]	0.1717
	The environment is characterized by a high degree of technological change in the industry [No = 0; 1 = Yes]	0.1898
	Our products are easily substitutable with the products of the competition in the industry [No = 0; 1 = Yes]	0.3321
Business situation	The current business situation of your company is (very) good [No = 0; Yes = 1]	0.5091

both the effect of family firm on staff fluctuation (model 5) and staff fluctuation on innovation output (model 6) while simultaneously taking the control variables into account.

Fifth, we present a model (model 7) to test the effect of successfully accomplished successions within the family firm on innovation output (Hypothesis 4). We test the non-linear (concave) effect by including our generational stage variable dummies with exception of non-family firms being the reference group. Using dummy specification in this way shows how different generational stages of family firms affect innovation output

of these firms. Last but not least, please note that all the empirical models presented here have robust standard errors with correction for heteroscedasticity.

5 Results

All correlations can be found in Table 2. Please note that the correlation between the explanatory variables is only of moderate size. Thus, multicollinearity should not be an issue in this study. Moreover, the highest variance inflation factors (VIF) value is 1.30 based on the estimation results of model 1 (Table 3). To check whether common method bias according to Podsakoff and Organ (1986) is of concern, Harman's one-factor test was performed. Common method bias is assumed to exist if a single factor emerges from unrotated factor solutions or if a first factor explains the majority of the variance in the variables (Podsakoff and Organ 1986). The results of the unrotated factor analysis show nine factors with eigenvalues more than one, where the maximum variance explained by one single factor is 11.09%. Thus, the results of Harman's single-factor test gives evidence that this type of bias is not of concern in our study.

The estimation results of seven models are presented in Table 3. It is noticeable that, ceteris paribus, family firms are not more (or less) innovative than non-family firms (model 1). Our results also show that young and large firms in the manufacturing industry and in competitive environments, which are characterized by a high degree of technological change, as well as firms that are located in South Germany are more innovative. However, a competitive environment that is characterized by market entries of many rival firms leads to a smaller number of innovation output.

Our results in model 2 also illustrate a significant and positive coefficient estimate of the interaction term reflecting the effect of small firm size in family firms on innovation output ($\beta = 0.864$; $p < 0.001$). Put differently, smaller family firms are more innovative than their smaller non-family counterparts are. This result supports Hypothesis 1. Estimation results in model 3 show that family firms also are not more often engaged in R&D cooperation than non-family firms are. However, this effect changes for older family SMEs, which are more likely to be engaged in R&D cooperation to foster innovation output than their non-family counterparts are. We find a significant positive coefficient estimate for the interaction term family firm (yes) × firm's age (older than 10 years) in model 4 ($\beta = 1.337$; $p < 0.001$). This result is in accordance with Hypothesis 2. In model 5, we test whether the fluctuation rate of the workforce is a mediator between family firms and innovation output. As the results show, the probability that there was no staff reduction in the last 2 years and will be no staff reduction in the near future is higher in family firms compared to non-family firms ($\beta = 0.561$; $p < 0.001$). Furthermore, as shown in model 6, firms without (planned) staff reduction are more likely to be engaged in innovation output ($\beta = 0.414$; $p < 0.05$). These results confirm our mediation Hypothesis 3. Please note, Baron and Kenny (1986) argue that if the original contribution of an independent variable is reduced or displaced by another independent variable, then the second independent variable would have a mediating effect on the dependent variable. Moreover,

Table 2 Descriptive results and pair-wise correlations among key variables

		1	2	3	4	5	6	7	8	9
1	Innovation output	1								
3	R&D cooperation	0.608	1							
3	Fluctuation rate	0.087	0.041	1						
4	Family firm	−0.025	0.003	0.094	1					
5	Firm's age (1 > 10 years)	0.004	0.035	−0.027	−0.009	1				
6	Small firm's size (1 up to 20 employees)	−0.153	−0.023	0.064	0.107	−0.210	1			
7	Market entry rival firms (1 = yes)	−0.137	−0.067	−0.054	−0.001	0.007	0.055	1		
8	Technological change (1 = yes)	0.056	0.031	0.048	−0.038	−0.037	−0.009	0.109	1	
9	Substitutability (1 = yes)	0.033	0.029	−0.047	0.067	0.089	−0.110	0.158	0.096	
10	Business situation (1 = good)	0.020	0.050	0.238	0.018	−0.042	−0.053	−0.078	0.031	−0.064

Industry dummies, regional dummies, and generational dummies are designed to be exclusive so correlations between them are not reported

Table 3 Logit estimation results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Innovation Output		*R&D Cooperation*		*Fluc. Rate*	*Innovation Output*	
Family firm (yes)	-0.077	-0.567**	-0.036	-1.051***	0.561**	-0.090	
	(0.113)	(0.179)	(0.119)	(0.243)	(0.169)	(0.113)	
Firm's age (older than 10 years)	-0.233†	0.238*	0.080	-0.818***	-0.005	-0.237*	-0.137
	(0.121)	(0.121)	(0.132)	(0.227)	(0.207)	(0.121)	(0.129)
Small firm's size (up to 20 employees)	-1.645***	-1.249***	-0.054	-0.045	0.352*	-0.664***	-0.731***
	(0.111)	(0.200)	(0.114)	(0.113)	(0.175)	(0.112)	(0.113)
Family firm * Small firm's size		**0.864*** **					
		(0.234)					
Family firm * Firm's age				**1.337*** **			
				(0.281)			
Family firm (1. generation)							**0.312***
							(0.130)
Family firm (2. generation)							**0.085**
							(0.155)
Family firm (3. generation and more)							**-0.409***
							(0.172)
Region (North)	-0.293*	-0.304*	0.140	0.124	-0.256	-0.295*	-0.250†
	(0.136)	(0.137)	(0.140)	(0.140)	(0.229)	(0.137)	(0.137)
Region (West)	-0.459***	-0.478***	-0.182	-0.153	0.252	-0.477***	-0.419**
	(0.131)	(0.131)	(0.139)	(0.140)	(0.245)	(0.132)	(0.132)
Region (East)	-1.015***	-1.027***	-0.649**	-0.632**	-0.738**	-0.979****	-0.944***
	(0.177)	(0.179)	(0.209)	(0.214)	(0.254)	(0.179)	(0.181)
Industry (construction)	-2.277***	-2.269***	-1.646***	-1.626***	-0.906***	-2.254***	-2.283***
	(0.189)	(0.192)	(0.229)	(0.230)	(0.252)	(0.192)	(0.188)
Industry (trade)	-0.670***	-0.696***	-0.040	-0.038	0.516†	-0.692***	-0.732***
	(0.144)	(0.144)	(0.140)	(0.142)	(0.299)	(0.144)	(0.145)
Industry (service)	-0.879***	-0.923***	-0.583***	-0.526***	-0.307	-0.875***	-0.923***
	(0.125)	(0.126)	(0.132)	(0.135)	(0.210)	(0.124)	(0.128)
Market entry rival firms (yes)	-0.713***	-0.703***	-0.398*	-0.387*	-0.226	-0.709***	-0.705***
	(0.137)	(0.138)	(0.155)	(0.155)	(0.198)	(0.139)	(0.139)
High degree of technological change (yes)	0.270*	0.271*	0.119	0.177	0.328	0.262†	0.241†
	(0.135)	(0.137)	(0.136)	(0.138)	(0.243)	(0.135)	(0.136)
Easy substitutability of products (yes)	0.048	0.0034	0.073	0.137	-0.306†	0.059	0.080
	(0.113)	(0.113)	(0.114)	(0.116)	(0.184)	(0.113)	(0.114)
Business Situation (good)					1.860***	-0.136	
					(0.206)	(0.104)	
Fluctuation rate (no staff reduction)						**0.414*** **	
						(0.192)	
Number of observations				1,870			
-2-Log-Likelihood	1131.373	1124.361	1050.722	1039.178	525.015	1128.434	1121.317
McFadden R^2	0.1266	0.1320	0.0543	0.0647	0.1575	0.1289	0.1344

Standard errors in parentheses; White robust variance estimators; † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Reference categories: generation of family firm (non-family firms). Region (South). Reference category: industry (manufacturing)

according to Baron and Kenny (1986), this direct effect should be statistically significant which is not the case in our analysis ($\beta = -0.077$; ns). However, newer mediation analysis literature emphasizes that a statistically significant total effect is not obligatory to observe mediation effects because suppressor effects may be at work (Kenny et al. 1998; MacKinnon et al. 2000). In model 7, the results are presented containing the family business generation variable. Estimated results show that first-generation family firms (the founder generation) are more innovative than non-family firms ($\beta = 0.312$; $p < 0.05$). But, while family firms in the second generation do not differ with respect to innovation output compared to non-family firms, family firms in the third generation are less likely to produce innovation output ($\beta = -0.404$; $p < 0.05$). Thus, Hypothesis 4 is supported.

As mentioned in Section 4.2, in Fig. 2, we display the predictive probabilities of the two moderation hypotheses and the business succession hypothesis (Hypotheses 1, 2, and 4, respectively) for a better illustration of our results.

To test the robustness of our results, we also reran our estimations by using "product- and process innovation output" as our dependent variable (model 1, 2, 6, and 7). We find no noteworthy differences in the results with the exception of later generational family firms. Here, we find that later generations seem to develop fewer product innovations while they do not differ in process innovations compared to non-family firms. Put simply, we believe that as these firms develop over generations, they become more risk averse and bring fewer new products to the markets than in the founder generations they still focus on implementing new processes to reduce costs or enhance product quality. Because categorizing quantitative variables may be criticized for several reasons (Maxwell and Delaney 1993; McCallum et al. 2002), we also tested the robustness of our results by using two different cutoff points for our firm size variable (up to 50 and up to 100 employees). In short, we find that the results of our central variables remain robust and in line with our first hypothesis. That is, the effect (interaction term) is still significant, but weaker, when using the cutoff point "up to 50 employees" and becomes insignificant when using "up to 100 employees." In addition, further tests for robustness applying different family firm definitions—self-perception (e.g., Westhead and Cowling 1998) and family ownership (Zellweger et al. 2012a, b)—were executed and did not alter our main results.

6 Discussion and conclusion

Based on a representative sample, we provide evidence that overall family businesses are as innovative as non-family businesses. Beyond recent studies, we applied a contextualized research approach (here, the business and spatial dimension of context; Welter 2011) in order to take an important step to open the black box of innovation output. We therefore focused on family and non-family SMEs in Germany (the German Mittelstand) and examined (family) firm-specific drivers leading to

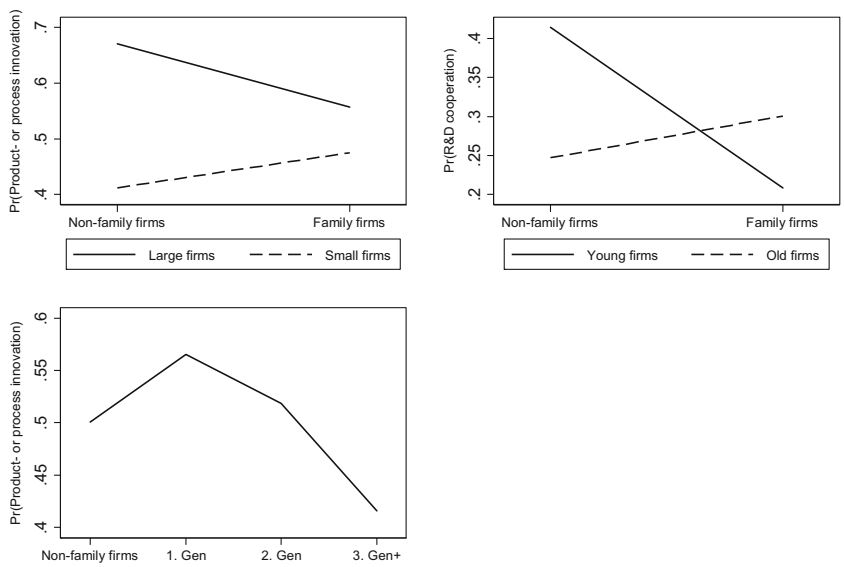

Fig. 2 Firm size, firm age, generation succession, and the probability of innovation output. Source: Own Illustration

innovation output (product versus process innovation) by contrasting family and non-family SMEs in Germany.

Our empirical results clarified that systematic differences between non-/family firms regarding innovation output in different types of SMEs. Company size and age have a moderating effect on innovation which differs for family and non-family businesses. For the German Mittelstand, we could show that small size as well as high age of the firm both increases the likelihood to be innovative (in terms of innovation output as well as R&D cooperation) only in family businesses. Regarding the higher R&D cooperation, we argued that a higher regional embeddedness of owner-managers is responsible for this effect. This positively influences joint research projects especially when the family firm is settled in the region for multiple generations. While older family businesses show a higher likelihood to be engaged in R&D alliances, we find a negative effect for non-family businesses. This might derive from the fact that the majority of the younger non-family businesses are spin-offs of established companies and therefore tend to cooperate with the parent company in the early stages. Another salient trait which gives family SMEs a competitive advantage in innovation output is the knowledge basis of the workforce. Due to their long-term goals, family SMEs have lower fluctuation rates than non-family SMEs leading to the maintenance of valuable knowledge, expert insights, and experiences (Davenport and Prusak 1998) which forms an important basis for innovation output (De Massis et al. 2017).

Finally, our generation analyses offer important results for the family firm heterogeneity debate. While the aforementioned results demonstrate differences between types of SMEs, we herewith highlight that it is worth differentiating family SMEs according to the generation currently managing the company (Broekaert et al. 2016). For the three generations under consideration, we found a negative linear relationship between innovation output and the subsequent generations of family SMEs in comparison to the group of non-family SMEs: the third generation of family SMEs being the least likely to produce innovation output. Therefore, the succeeding generation might only be interested to preserve the company and to ensure the survival and management of the company.

Our findings offer important theoretical and practical implications for family business, regional science studies, and innovation research. First, we apply a representative data set for German SMEs including family SMEs and a non-family comparison group. Thus, we were able to identify drivers of innovation activities that differ for family and non-family SMEs. Here, CEOs of non-family SMEs might be interested to learn from family firms with regard to the company climate and strong social capital resources in family-owned and managed firms. Especially low turnover rates going hand in hand with a sense of commitment and mutual trust help family firms to increase their innovation activity by keeping the knowledge basis of the workforce as a source for innovation output.

Second, we theoretically derive determinants of innovation output and relate them to each other. As a result, we present a solid conceptual framework (see Fig. 1) for future research which differentiates direct, mediated, and moderated relationships. Our multi-theory framework demonstrates the complex nature of (family-) firm innovation and emphasizes that single-theory research falls short to explain such a challenging and intertwined field of studies. We would like to go even further by answering a recent call by Stough et al. (2015) to combine the fields of family firms and regional science studies as a necessary precondition to empirically and theoretically move forward. In our study, we found regional influences on innovation output: family SMEs in Eastern Germany showed lower innovation output compared to family SMEs located in Western Germany. Due to the division into two different economic systems until 1990, family SMEs in Eastern Germany are on average younger and thus less regionally embedded compared to their Western counterparts. However, with a gradual alignment of the regional conditions, hopefully the innovation output of Eastern and Western German family SMEs will assimilate over time. A combination of both research fields can offer new and more holistic (contextualized) perspectives for the development of a theoretical framework to improve the understanding of innovation output.

Third, with the help of our empirical data set, we were able to further subdivide family SMEs and not only identify fostering but also hindering factors of innovation output. We, for example, could show that the founder generation tends to be the most innovative compared to succeeding generations. From the second (successor) generation, the innovation output decreases, however, only for product innovations. For process innovation, no generation differences were found. This finding theoretically and practically contributes to the ongoing debate about succession research and transgenerational entrepreneurship (Jaskiewicz et al.

2015), i.e., how to support and motivate next-generation owners to engage in strategic and innovative activities. But it also demonstrates a necessity to widen our present definition of innovation because the succeeding generations might not be less innovative but innovate differently than the founder generations. We as researchers and the succeeding generations will profit from a broader definition of innovation, as already perpetuated in the contemporary academic discussion. We would like to encourage other researchers to shed additional light on the generation effect. Here, important questions for future studies open up: What happens within the second generation? What are the causes for the decreasing innovation output? Is it possible to counteract this tendency and how can we support the succeeding family business generations? According to Zahra (2005), for example, family firms where multiple generations are involved in the management tend to be more innovative. This distinction would be interesting to investigate in future innovation research.

While we were able to show that family firms are generally not less innovative than non-family firms, our findings reveal the necessity to include the heterogeneity of family firms, e.g., that structural effects like company size have a significant influence on innovation output. Lean management structures which positively influence innovation output in small family firms might get too formalized with growing size of the company so that family firms lose their competitive advantage. Therefore, it represents a challenge for family SMEs to grow the company and at the same time keep an innovation-friendly climate. Future researchers might want to look into these structural and contextual effects which develop and change over time.

As any empirical study, our research comes with some limitations, the first being our use of a cross-sectional design with a retrospective approach. The participating companies had to specify whether they invented new products or services within the last 3 years. Using a longitudinal design with different inquiry periods would be more suggestive of causal relationships. Second, while we examined and highlighted the effects of several drivers on innovation output, it remains open and would be interesting to know how these drivers influence the innovation input and thus the conversion rate or efficiency of the firm's innovation process (e.g., see the meta-analysis by Duran et al. 2016 who found opposite effects for input and output, i.e., that family firms invested less in innovation than non-family firms but had higher innovation output). Third, as some of our study variables are measured as two-item scale variables, this implies a loss of information. When differentiating between family and non-family SMEs, our measure ignored that ownership is rather a matter of degree than a binary variable. Future research could not only probe the question which degree of ownership is important for innovation output but also who—the owner or the manager—makes the difference. Fourth, we are not able to randomize our respondents to groups, and we most certainly do not have all the information in our data which may influence innovation in family and non-family firms. For example, we have no information on risk inclination and, therefore, we cannot directly test if risk aversion has a mediating negative effect on innovation with regard to family firms as suggested by research literature (see, e.g., Nieto et al. 2015; De Massis et al. 2015). Moreover, we believe, for example, that this may be the reason for the suppressor effect discussed earlier. Thus, we encourage future research to look into these possible mediation effects in more detail. Finally, due to our decision to conduct a contextualized research study, this approach limits the generalizability of our results. However, it offers the opportunity for future studies to test our results in another country (cross-country research) or extend our quantitative results by a qualitative study design which would be an appropriate approach to advance our understanding of such a complex field of study (Broekaert et al. 2016).

In conclusion, while we noticed a growing but ambiguous body of research on innovation output, little is known about potential drivers of innovation. Our contextualized approach has proven successful differentiating between non-/family SMEs when trying to detect driving factors of innovation. Based on a representative sample, our study provides a solid multi-theory framework for future family business, regional science studies, and innovation research.

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