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A Dynamic View on Family Firms' Innovation Behavior

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Abstract

A growing literature has pointed towards differences in innovation behaviour between family and nonfamily firms. Yet, all studies have adopted a static view and it is unclear whether and how family firm innovation behavior to that of nonfamily firms over time. This paper adopts a dynamic view and aims at identifying the influence of family control on innovation persistence at the firm level. Based on a large panel of German firms for the period 2001 to 2012, it provides first evidence of family firms to innovate less persistently than nonfamily firms over time, whilst still having a higher propensity to invest into innovation in the first place

Jelcodes:L21,O32

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Abstract: A growing literature has pointed towards differences in innovation behaviour between family and nonfamily firms. Yet, all studies have adopted a static view and it is unclear whether and how family firm innovation behavior to that of nonfamily firms over time. This paper adopts a dynamic view and aims at identifying the influence of family control on innovation persistence at the firm level. Based on a large panel of German firms for the period 2001 to 2012, it provides first evidence of family firms to innovate less persistently than nonfamily firms over time, whilst still having a higher propensity to invest into innovation in the first place.

Keywords: innovation; family firms; prospect theory; multiple reference points; strategy
JEL: L21; L26; O32

1 Introduction

Understanding innovation in family controlled, that is majority family-owned and managed firms (henceforth family firms), has been subject to increasing interest to scholars. Commonly, this interest is motivated by the omnipresence of this organization type. In fact, and despite definitional variations, family firms are often found to be the dominant organizational structure globally (Astrachan *et al.*, 2002). Therefore it might come as no surprise that family business scholars have brought forward homegrown concepts – in the sense of concepts basically unique to the research field – to better understand the behavior of family firms. To name just a few, concepts such as familiness (Chrisman *et al.*, 2005), family capital (Dyer *et al.*, 2014), and socioemotional wealth (Gomez-Mejia *et al.*, 2007) have gained considerable attention in the recent past. Family firm literature on innovation, however, provides scholars with a paradox: Whilst family firms are associated to long-term or even dynastical success (Brigham *et al.*, 2014; Breton-Miller and Miller, 2006), evidence is strong that they are risk eschewing and invest less into innovation (for recent reviews compare De Massis *et al.*, 2013 and Hiebl, 2013) although innovation literature has corroborated that *continuous* innovation is conducive to long-term firm survival (Cefis and Marsili, 2005).

However, up to now the family business literature has adopted a pure static view on innovation discrepancies so that it remains unclear whether and how family firm innovation behavior differs over time in comparison to nonfamily firms and in particular whether family firms invest more or less continuously in innovation. In this study, we thus shed further light on the puzzle from yet another perspective. We adopt a dynamic view on firms' innovation behavior and aim at identifying the influence of family ownership on firms' decision to persistently invest in innovation. Analyzing innovation persistence aims at scrutinizing if being innovative once impacts the probability of being innovative in the subsequent period(s). Two in part opposing family specific themes are likely to influence the latter. One the one hand family firms are associated to transgenerational succession aspirations and innovation fostering resources and capabilities (Sirmon and Hitt, 2003; Brigham *et al.*, 2014). On the other hand, socioemotional goals – such as the longing to preserve control – may demote the willingness to continuously engage in projects with high output variability (Gomez-Mejia *et al.*, 2013). Better understanding innovation persistence at the firm level hence has severe practical implications.

From a theoretical point of view, analyzing persistence is of great relevance especially in Schumpetrian world of innovation based competition. However, from a managerial point of view, a better understanding about innovation persistence is of equal importance. Let's assume that innovation is indeed persistent at the firm level. In this scenario, a onetime investment positively influences long-term competitive advantages particularly in comparison to non-innovators. That is, given two otherwise identical firms, today's innovation increases the likelihood for forthcoming innovation and thus influences the repertoire of dynamic capabilities. That is, the trajectory decided upon today in part influences a firm's future ability to achieve competitive advantages (Teece *et al.*, 1998). If for example family firm decision makers attempt to reduce today's risk by refraining to continuously innovate, they effectively jeopardize the firm's long-term competitive position and thus the potential for transgenerational succession

Adopting a dynamic view, we hence particularly focus upon the following two research questions: First, is innovation persistent at the firm level? Second, if persistence is prevailing, does family control play a part in driving this phenomenon? The investigation is based on a long innovation panel data set for German firms covering the period 2001–2012. The study contributes to literature on innovation persistence and literature on family ownership and innovation by incorporating a dynamic view on firms' innovation behavior, whilst identifying the influence of family control.

The paper is organized as follows. Section 2 gives a brief overview of innovation persistence as posited by Heckman in 1981. It further relates the concept to theoretical arguments common in the field of family business research and develops the hypotheses to be tested in the empirical analysis. Section 3 describes the set-up of the empirical approach, including the employed model, its specification, and a few key descriptive statistics. Section 4 provides the empirical results, whereas Section 5 discusses the findings and draws some concluding remarks. Finally, section 6 presents limitations and possible routes for further research.

2 Theory and Hypotheses

2.1 Innovation Persistence

The concept of persistence was initially introduced by Heckman in 1981. He realized that across a wide field of academic research "*… it is often noted that individuals who have experienced an event in the past are more likely to experience the event in the future than are individuals who have not experienced the event*" (Heckman, 1981, p. 91). Heckman differentiated two types of persistence: true and spurious state dependence. One speaks of true state dependence if a past event impacts an individual in the sense that the individual behaves differently compared to a similar individual who has not experienced the event and as a result makes the individual more likely to experience the event in the future again. On the contrary, if individuals differ in certain unobserved permanent characteristics, which in turn influence the propensity to experience an event in the past and in the future, but the event as such does not influence future behavior, scholars speak of spurious state dependence.

Empirical findings on innovation persistence have been scarce and evidence seems sensitive to the indicator chosen (Duguet and Monjon, 2004). Investigations relying on patent data find little support for persistence, respectively only for top patentees. Studies targeted on R&D or more broadly on innovation inputs, however, find strong evidence for true state dependence (Peters, 2009; Le Bas and Scellato, 2014). Additionally, Le Bas and Poussing (2014) find firms engaging in both product and process innovation (complex innovators) to exhibit greater persistence than firms engaging only in one innovation type (single innovators).

Even if findings provide support for true state dependence, difficulties arise when attempting to identify and disentangle the underlying drivers of this phenomenon (for a recent review see Antonelli *et al.*, 2012 or Le Bas and Scellato, 2014). Reasons for true state dependence commonly brought forward are the concepts of (1) success breeds success, (2) dynamic increasing returns, and (3) sunk cost.

The success breeds success hypothesis postulates that successful innovation positively moderates the conditions for subsequent innovation endeavors via the means of potentially increased market power (Phillips, 1971; Utterback and Suárez, 1993), the expansion of technological opportunities (Mansfield, 1968; Stoneman, 1983), and increased opportunity for internal/external financing (Nelson and Winter, 1982; Ganter and Hecker, 2013). The second line of argumentation is based on the idea that innovations stem from an accumulation of knowledge and competencies (Rosenberg, 1976; Antonelli *et al.*, 2012; Le Bas and Scellato, 2014). Experience in innovation is associated with learning effects which increase the firm's internal knowledge stock and thus technological and innovative capabilities which foster future innovations(Calantone *et al.*, 2002). The level of internal knowledge in turn positively moderates absorptive capacity (Cohen and Levinthal, 1990). Cohen and Levinthal argue that the ability to utilize external knowledge is a function of the internal knowledge accumulated beforehand. As such, absorptive capacity is a description for the ability to utilize prior acquired knowledge to identify innovation potential and to exploit it commercially. Hence, current innovation is associated with dynamic increasing returns as it improves innovative capability and absorptive capacity which in turn stimulates future innovation (Nelson and Winter, 1982). The third and last argument for true state dependence is associated to sunk costs. Investments enabling R&D such as set-up cost for an R&D-department and costs for hiring and training R&D staff – once made – are forgone and they are in general non-recoverable if R&D-endeavors are stopped. They create a barrier to exit for established R&D-performers but also a barrier to entry for current non-R&D performers leading to a persistent innovation behavior (Sutton, 1991; Antonelli *et al.*, 2012). We draw upon these three theoretical arguments to derive our first hypothesis:

H1: *The decision to invest into innovation is persistent at the firm level.*

2.2 Family Firms and Innovation Persistence

Literature brings forward several reasons why family firms may innovate more persistently. First, family firms strive for dynastical success and are consequently associated with a pronounced long-term orientation (McCann III *et al.*, 2001; Brigham *et al.*, 2014; Cennamo *et al.*, 2012; Tokarczyk *et al.*, 2007; Naldi *et al.*, 2007; Breton-Miller and Miller, 2006). In order to ensure survivability across generations, persistent innovation has, however, been found to be a prerequisite (Cefis and Marsili, 2005; Hoy, 2006; Cruz and Nordqvist, 2012; McCann III *et al.*, 2001). Interestingly, Chrisman and Patel (2012) find family-owned firms to invest more in R&D when transgenerational succession is intended. Second, family-owned firms are reasoned to be naturally equipped with resources and capabilities that increase the propensity to innovate. This is often loosely explained with a certain entrepreneurial spirit and capabilities that are commonly related to specific family firm capital developed in the overlap of the family with the business and ownership system. Carnes and Ireland (2013), for example, argue that the interaction of the family with the business system results in deeper tacit knowledge which in turn aids in identifying and exploiting innovation opportunities ahead of competitors. Zahra *et al.* (2004) similarly emphasize that family business-culture fosters recognizing entrepreneurial opportunities. Following the reasoning of dynamic increasing returns, family-owned firms may hence be expected to innovate more persistently.

However, one may doubt whether long-term orientation and greater innovative and technological capabilities in family firms actually result in persistent innovation behavior. The results provided by static analyses of innovation in family firms indicate that in fact innovation is likely to be less persistent in family firms. First, evidence is strong that family businesses invest less in R&D than comparable nonfamily firms (Block, 2012; González *et al.*, 2013; Lodh *et al.*, 2014; De Massis *et al.*, 2013; Nieto *et al.*, 2013). The commonly high overlap of a family's total wealth and the single firm equity promotes sensitivity towards investments with high output variability (Sciascia *et al.*, 2015). Family firms instead prefer investments with more certain cash flows (such as investments in fixed assets) (Bianco *et al.*, 2013). Although this relationship appears to depend on the position the family holds within the firm (e.g. management versus directorship) (González et al., 2013), findings hence suggest that all things equal the risk inherent in uncertain innovation endeavors reduces the family's inclination to invest in future innovation. Hence, family firms benefit less from experience in innovation and the associated learning effects, which in turn positively moderate innovation in subsequent periods. Second, investments in innovation need financing and innovation success in period t increases internal and external financing opportunities for innovation in the subsequent period. The focus on non-financial goals such as autarchy, however, reduces the owner family's willingness to take on external financing in an attempt to secure control over the company (Peters and Westerheide, 2011; Mishra and McConaughy, 1999; Gomez-Mejia *et al.*, 2007; Gomez-Mejia *et al.*, 2013). As a result, family firms will invest less in future innovation – and all things equal – will thus less persistently innovate. Subsuming, the family's high sensitivity to risk promotes little investments into innovation. The driver appears to be the potential clash between the goals of economic efficiency, and non-financial goals (Kotlar *et al.*, 2014; Gomez-Mejia *et al.*, 2011).

In addition, there are two are other empirically well-established findings in the literature that likewise point towards lower innovation persistence among family firms. First, incumbents might react loss averse and fear cannibalization effects after having introduced a product innovation and thus stop further innovating (Duguet and Monjon, 2004). Research making use of prospect theory finds family firms to behave particularly loss averse. The higher levels of loss aversion stem from additional non-financial endowments families derive from the firm (such as constant control) (Gomez-Mejia *et al.*, 2011). To put it in more layman terms, family firms have more to lose than mere financial performance when making decisions under risk. Since especially family owners and grow attached to the status quo over time and in later generations (Hauck and Prügl, 2015; Beck *et al.*, 2011; Kellermanns *et al.*, 2012), it is reasonable to assume that the willingness to accept potential cannibalization effects is lower.

Second, firms that live on prior successful innovation may have the tendency to overestimate the longevity of their products. They may not even perceive consumer demand for modernization to be valid and will cease to innovate (Peters, 2009). We expect this to be particularly true for family firms, which are often regarded as especially traditional and stagnant (Hall *et al.*, 2001).

Based on the theoretical outset, we argue that despite the fact family firms are associated with a transgenerational succession aspiration and might possess innovation fostering resources and capabilities, we expect nonfinancial goals and the associated risk aversion to thwart innovation persistence as they demote willingness to engage in projects with high output variability. Hypothesis 2 is thus established as follows:

H2: *Family control has a negative effect on innovation persistence at the firm level.*

3 Data and Method

3.1 Data Sources

We base our analysis on the German contribution to the European-wide Community Innovation Survey (CIS). The CIS data is provided by the Centre of European Economic Research (ZEW) and commissioned by the German Federal Ministry of Education and Research. In Germany, the CIS is an annual survey based on a stratified random sample and it is designed as a panel (for more information see Peters and Rammer, 2013). We make use of the surveys 2001 to 2012. The panel contains representative data for German companies with five or more employees. It features companies in mining, energy, manufacturing and a large number of service sectors.

CIS data do not contain information on the ownership structure. In order to identify family firms, we additionally make use of the Mannheim Enterprise Panel (Mannheimer Unternehmenspanel – MUP) of the Centre for European Economic Research (ZEW). The MUP is the most comprehensive micro database of companies in Germany outside the official business register (which is not accessible to the public). The MUP is based on the firm data pool of Creditreform e.V., which is the largest credit rating agency in Germany. Importantly, the MUP is the sampling frame for the Mannheim Innovation Panel (for some more detail see Bersch *et al.*, 2014). We thus base our investigation on a combination of CIS and MUP data.[1]

3.2 Model and Estimation Method

Econometrically, the differentiation between true and spurious state dependents brings a problem about. If some firm-specific permanent characteristics are unobserved, persistence may be considered truly structural merely because the lagged dependent variable might pick up the effect of the individual heterogeneity (Peters, 2009). Understanding differences between true and spurios state dependence is also important from a management point of view. If firms currently invest in innovation to gain competitive advantage and true state dependence exist, this management strategy will have a long lasting effect by stimulating future innovation and thus also future competitive advantage. If in contrast mere unobserved firm heterogeneity explains innovation the management strategy is unlikely to have a long-lasting effect on innovation and competitive advantage.

In order to study differences in innovation persistence between family and nonfamily firms, we apply a dynamic random effects discrete choice model (RE probit model). We follow a variety of authors (e.g. Raymond *et al.*, 2010; Peters, 2009) in doing so. The starting point for the model is given by the following equation:

$$\boldsymbol{y_{it}^{*} = \gamma y_{it-1} + \beta x_{it} + u_i + \varepsilon_{it}} \qquad \textbf{(1)}$$

y_{it}^{*} is the unobserved expected present value of profits from investing in innovation. Assuming firms invest in innovation when y_{it}^{*} is positive, we get

[1] We however exclude industries belonging to WZ 2008 (Nace Rev. 2) codes 01-03, 41-43, 45, 47, 55-56, 68, 70.1, 75, 77, and 84-99.

$$\boldsymbol{y_{it}} \quad = \boldsymbol{I}[\boldsymbol{y_{it}^{*}} > \mathbf{0}] = \boldsymbol{I}[\boldsymbol{\gamma y_{it-1}} + \boldsymbol{\beta x_{it}} + \boldsymbol{u_i} + \boldsymbol{\varepsilon_{it}} > \mathbf{0}] \qquad \textbf{(2)}$$

y_{it} depicts the observed discrete innovation indicator of firm *i* in year *t*. Innovation in year t is explained by past (realized) innovation experience in year t-1 (y_{it-1}), other observed explanatory variables (x_{it}), u_i the unobserved individual heterogeneity and other unobserved variables, which vary across firms and time (ε_{it}) and that are assumed to be i.i.d. normally distributed as N(0,1). Thus the probability of being an innovator is given by

$$\boldsymbol{P}(\boldsymbol{y_{it}} = \mathbf{1} | \boldsymbol{y_{it-1}}, \boldsymbol{x_{it}}, \boldsymbol{u_i}) = \Phi(\boldsymbol{\gamma y_{it-1}} + \boldsymbol{\beta x_{it}} + \boldsymbol{u_i}) \qquad \textbf{(3)}$$

Key to the estimation of the model are the treatment of the individual effects u_i as well as the treatment of the initial observations y_{i0} and their relationship to u_i (Wooldridge, 2005). A fixed effect model would assume that the individual effect is random but without making any assumptions on its distribution. Unfortunately, there is no solution known in the literature to consistently estimate fixed effects in probit models set up according to the above. Hence, a random effects estimator will be applied. With respect to the initial observation, in fact, y_{i0} cannot be considered as truly exogenous, if the first observed period in the analysis does not coincide with the first period of the stochastic process. The resulting correlation between y_{i0} and the error term would result in biased estimates of γ (Antonelli *et al.*, 2012). Given that our focus is on measuring true state dependence γ, it is key to handle the initial condition with caution.
Wooldridge (2005) proposes to treat y_{i0} as a random variable and to specify the distribution of u_i conditional on y_{i0} and x_i. We follow this estimation approach and specify u_i based on the initial observations y_{i0} and the time-averaged covariates. The individual heterogeneity is thus given by the following relationship:

$$\boldsymbol{u_i} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1 y_{i0}} + \boldsymbol{\alpha_2 \overline{x}_i} + \boldsymbol{c_i}\textbf{, where } \boldsymbol{\overline{x}_i} = \boldsymbol{T^{-1}} \sum_{t=1}^{T} \boldsymbol{x_{it}} \qquad \textbf{(4)}$$

Wooldridge assumes the error term c_i to be normally distributed as $N(0, \sigma_c^2)$ and to be independent of the initial observations y_{i0} and the time-averaged covariates ($c_i \perp (y_{i0}, \bar{x}_i)$). This implies that the conditional distribution of u_i follows a normal distribution

$$\boldsymbol{u_i} | \boldsymbol{y_{i0}}, \boldsymbol{\overline{x}_i} \sim \boldsymbol{N}(\boldsymbol{\alpha_0} + \boldsymbol{\alpha_1 y_{i0}} + \boldsymbol{\alpha_2 \overline{x}_i}, \boldsymbol{\sigma_c^2}), \qquad \textbf{(5)}$$

and in turn permits rewriting of the model as follows:

$$\begin{aligned} &\boldsymbol{P}(\boldsymbol{y_{it}} = \mathbf{1} | \boldsymbol{y_{i0}}, \dots, \boldsymbol{y_{it-1}}, \boldsymbol{x_i}, \boldsymbol{\overline{x}_i}, \boldsymbol{c_i}) \\ &= \Phi(\boldsymbol{\gamma y_{it-1}} + \boldsymbol{\beta x_{it}} + \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1 y_{i0}} + \boldsymbol{\alpha_2 \overline{x}_i} + \boldsymbol{c_i}) \end{aligned} \qquad \textbf{(6)}$$

In addition to the original explanatory variables, the model contains a dummy depicting the initial realization of the endogenous variable, and the time average of the covariates – both being expected to be correlated to the individual effects (Antonelli *et al.*, 2012). The model can be estimated using the standard RE probit estimator.

3.3 Model Specification

3.3.2 Endogenous Variable

Prior studies have used different indicators to measure innovation and innovation persistence. A common indicator is the number of filed patents though it is well known that not all inventions are or can be patented and thus patents measure only some aspects of innovation activities (Griliches, 1990). In persistence studies they have an additional drawback since firms have to win the patent race continuously in order to be identified as persistent innovator and as a result patents are in a fact of a measure of persistence in innovation leadership (Duguet and Monjon, 2004). R&D expenditures have been used as an alternative indicator (see e.g. Antonelli *et al.*, 2012). R&D is an important input to the innovation process but it does not capture all expenditures related to innovation activities, e.g. design, testing, external knowledge, marketing and training activities related to innovation are not accounted for. Hence, R&D fails in particular to account for less formalized innovation activities of small and medium-sized and service sector companies. Therefore, we follow Peters and *"...define an innovator as a firm which exhibits positive innovation expenditure in a given year"* (Peters, 2009, p. 230). We consequently examine persistence in innovation input, rather than in output.

From a theoretical view point persistence might show up in input or output measures. The sunk costs hypothesis models the decision to invest in R&D and is thus related to input persistence whereas the success-breeds-success hypothesis is clearly output-oriented. Though the CIS includes a dummy variable whether the firm has introduced a new product or process as output indicator, we do not employ it since it is related to a three-year period which would lead to artificial high persistence in a yearly panel (Peters, 2009). Furthermore, Hagedoorn and Cloodt (2003) find the statistical overlap of a majority of innovation indicators to be substantial and suggest similar interpretations – regardless of the indicator put forward.

3.3.3 Explanatory Variables

Family: Research has not yet converged to one unifying definition (see e.g. Villalonga and Amit, 2006). Notwithstanding, we aim at ensuring possible family impact on firm level decisions – and innovation in particular – via the means of ownership and management. We thus define family businesses as firms with a maximum of six family shareholders (respectively three family shareholders for non-private companies) holding at least 50% of the shares, and where a family member is part of the top management team. These ownership and management criterions ensure the capability to impact firm level decisions (Chrisman *et al.*, 2015).

Size & Asset intensity: We follow the seminal work of Acs and Audretsch (1987) and account for the commonly found innovative advantage of large firms in capital intensive industries. Moreover, we try to pick up on some variance related to easier access to finance larger firms commonly have (Beck and Demirguc-Kunt, 2006). This advantage is even larger in turbulent times – such as the 2008/2009 financial crisis (Khwaja and Mian, 2008). The natural logarithm of number of employees in a given year proxies firm size, whereas, the asset intensity is measured by the natural logarithm of the stock of fixed assets scaled by turnover. For all firms with no fixed assets we set the variable to zero and additionally include a dummy variable being 1 for these firms (Peters, 2009; Hall *et al.*, 2012).

Export intensity: The literature has argued that internationalization fosters innovation through increased international competition, greater knowledge pools from which firms can draw upon for innovation and larger profit potentials due to larger market size (Criscuolo *et al.*, 2010; Salomon and Shaver, 2005; Evenson and Westphal, 1995). Empirical studies support this view by finding a strong link between innovation and export performance (see e.g. Roper and Love, 2002 or Pla-Barber and Alegre Martín, 2007). We thus control for export activities by including the export intensity measured as the ratio of revenue generated with exports to total turnover.

Training intensity: Since Griliches (1979) seminal work on the relationship between R&D and innovation, innovation output is commonly modeled by a production function. Key elements in such functions are internal knowledge and the ability to process external knowledge, and thus human capital (Cohen and Levinthal, 1990). Employee training is seen as an important input factor for developing knowledge necessary to innovate (see for example Freel, 2005). To account for this relationship, we include the natural logarithm of the amount of training expenses in relation to the firm's average number of employees in a given year. Similar to Peters (2009) and Hall *et al.* (2012), we set the variable to zero and additionally include a dummy variable being 1 for all firms with no training expenditures.

Age: Evidence is strong that young and start-up firms tend to show the highest probability of innovating, whilst older firms are commonly found to innovate less or at least less radical (see e.g. Huergo and Jaumandreu, 2004). In our study, controlling for age is important for an additional reason, which is the attempt to at least partly control for the family firm generation, information that we do not directly observe in the data. Chrisman *et al.* (2010) find evidence that founders tend to focus more on innovation than subsequent owners and managers. Subsequent generations are more likely to be risk averse and conservative. Again, it is argued that the ambition to secure control over the company increases over the generations (Hülsbeck *et al.*, 2011). While old age in itself does not necessarily mean multi-generational family involvement or even any generational impact, we argue that it is at least partly correlated with dynastical succession in family firms and thus picks up some of the possible variance associated to generational impact.

Group: Firms in multi-group corporations may benefit from knowledge spillovers (see e.g. van den Hooff and Ridder, 2004). Furthermore, managers and firms in multi-group corporations might depend in their innovation decisions on the mother company. In order to control for both effects, we incorporate a dummy indicating whether the firm is part of an enterprise group.

Creditworthiness: Investments into innovation depend on the availability of both internal and external financial resources. We account for the availability of financial means by incorporating the credit rating, a measure for the firm's creditworthiness. Creditreform e.V. assesses firms' creditworthiness based on criteria such as revenue, profits, payment behavior, industry risk, management skill, order situation, and others. As such, we already singularly control for parts of the variable's basis. Nonetheless, by adding this bespoke variable, we supplement the analysis with an element, which further has an important signaling effect to external parties (financiers and supplier firms) and as such affects external capital costs. We expect the credit rating to negatively affect innovation since the index ranges from 1 (best) to 6 (worst).

Legal Form: The legal form of firms is of great importance for innovation for several reasons. First, and given the varying liability limitations of different legal forms in Germany, the chosen legal status may reflect an attitude towards risk (Almus and Czarnitzki, 2003). Second, singlemember (or lone founder) companies may be confounded with family firms. Block *et al.* (2013) show the difference between founder-managed and family-managed firms in terms of innovation especially. Similar to younger firms, founder-managed firms tend to be particularly innovative. We thus control for the legal status and distinguish between single proprietorships, business partnerships (unlimited liability) and listed companies.

East: Given Germany's history, it is still important to control for firms' geographical location (Czarnitzki, 2005). The differences brought about by different (technological) regimes in the former German Democratic Republic and Federal Republic of Germany, albeit slowly diminishing, are thus controlled for with a dummy variable indicating the geographical belonging to East (=1) or West Germany (=0).

Industry: We follow Rammer et al. (2015) and cluster 22 industries available in the German CIS by research-intensity and further separate them into services and industries.

We thereby control for industry effects with four dummies. (1) *Research intensive manufacturing industries* comprise chemicals and pharmaceuticals (Nace Rev. 2 codes 20-21), electronics (26-27), machinery (28) and vehicles (29-30). (2) *Other manufacturing industries* consist of mining (05), food (10-11), tobacco (12), textiles (13-15), paper and printing (16-18), cookery (19), plastic (22), minerals (23), metals (24-25), other manufacturing (31-33), energy (35) and water supply (36-39). (3) *Research intensive services* comprise information and telecommunication (58-63), financial services (64), professional, scientific and technical services (69-73 without 70.1). (4) *Other services* include wholesale (46), transport (49-53), and other business related services (74, 78-82).

3.4 Descriptive Statistics

For our analysis, we keep firms with a minimum of two consecutive observations over the entire investigation period. We exclude companies with missing values in the endogenous and exogenous variables. We further treat outliers in regards to age by censoring age at a value of 200. The summary statistics are based on *N* = 13416 observations, and *n* = 5030 companies. The average number of observations amounts to $\bar{T} = 2.67$ years. Table I shows the overall summary statistics and the mean values for family and nonfamily firms, respectively. To increase readability and ease of use, we decided to report non-log-transformed values in the descriptive section.

Table I

Summary Statistics

Variable	Overall Mean	Overall Std. Dev.	Overall Min.	Overall Max.	Mean Family	Mean Nonfamily	Mean Δ	Median Family	Median Nonfamily
Family	0.56	0.5	0	1	-	-	-	-	-
Innovation	0.53	0.5	0	1	0.49	0.59	***	0.00	1.00
Size	223.05	1851.66	1	96,230.00	70.86	415.64	***	20.00	89.00
Export intensity	0.15	0.24	0	1	0.12	0.20	***	0.00	0.03
Asset intensity	167.04	928.05	0	68593.10	100.55	251.19	***	25.29	59.81
Training intensity	0.88	2.02	0	67.94	0.78	0.99	***	0.32	0.50
Age	22.07	2.53	1	200	21.37	22.98	***	18.00	18.00
East	0.38	0.48	0	1	0.40	0.35	***	0.00	0.00
Group	0.3	0.46	0	1	0.11	0.55	***	0.00	1.00
Creditworthiness	2.26	0.55	1	6	2.35	2.14	***	2.27	2.10
Single proprietorship	0.09	0.29	0	1	0.14	0.03	***	0.00	0.00
Business partnership	0.18	0.39	0	1	0.19	0.17	**	0.00	0.00
Limited companies	0.73	0.45	0	1	0.67	0.80	***	1.00	1.00
Research intensive manufacturing ind.	0.20	0.40	0	1	0.18	0.23	***	0.00	0.00
Other manufacturing ind.	0.42	0.49	0	1	0.41	0.43	**	0.00	0.00
Research intensive serv.	0.22	0.41	0	1	0.23	0.21	***	0.00	0.00
Other services	0.16	0.37	0	1	0.18	0.14	***	0.00	0.00

*Note: Asset intensity and training intensity displayed in 1000 € spend per employee; ***, ** and * indicate significance on a 1%, 5% and 10% level in a two-tailed t-test on equal means in both groups (the variances are allowed to be unequal between both*

The sample features 56% family firms. This amount is in line with other studies, finding family firms to be the dominant organizational type in Germany. Similarly congruent to the literature finding family firms to shy away from R&D-investments (compare De Massis *et al.*, 2013 for a recent review), we find family firms to invest less often into innovation. On average, 53% of all firm-observations are innovators defined as having positive innovation expenditure. Family firms do so less often (49%) than their nonfamily counterparts (59%). Whilst scholars commonly explain the latter with risk aversion, other factors might explain this difference too. Among others, firm size, age, export intensity, asset intensity, and enterprise group belonging may add to the underlying reasons to why family firms are found to invest in innovation less often. Here, family firms are on average quite a bit smaller. The rather large difference between average firm sizes of the two groups (70.86 vs. 415.64 employees) is in part explained with few very large firms found among the nonfamily firms. The difference is less pronounced when medians are compared, but still apparent (20 vs. 89 employees). Family firms are on average also younger (though not when medians are compared), less export and asset intensive, and are less often part of an enterprise group. Given the crucial influence these factors exercise on e.g. gaining knowledge and access to finance, the observed difference in innovation between family and nonfamily firms is likely to be in part explained by these underlying factors. In addition, we find family firms to be single proprietorships more often and to be listed comparatively seldom. We, however, find little differences when it comes to industry allocation and creditworthiness. On average, around every fifth firms belongs to either research intensive manufacturing industries (20%) or research intensive services (22%), whilst the remaining part split into other manufacturing industries (42%) and other services (16%). Family and nonfamily firms are distributed similarly among the industries. Likewise, we find no apparent large difference in term of creditworthiness.

Table II

Correlation Matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Innovation	1.00																
(2) Family	-0.10	1.00															
(3) Size	0.23	-0.41	1.00														
(4) Export intensity	0.39	-0.13	0.36	1.00													
(5) Asset intensity	0.07	-0.25	0.25	0.13	1.00												
(6) Training intensity	0.27	-0.17	0.12	0.08	0.16	1.00											
(7) Creditworthiness	-0.14	0.26	-0.44	-0.20	-0.28	-0.16	1.00										
(8) Age	-0.06	-0.02	0.18	0.11	0.12	-0.03	-0.27	1.00									
(9) Group	0.16	-0.48	0.47	0.24	0.20	0.15	-0.24	0.04	1.00								
(10) East	-0.02	0.05	-0.16	-0.20	0.00	-0.05	0.14	-0.36	-0.12	1.00							
(11) Single proprietorship	-0.14	0.17	-0.22	-0.20	-0.01	-0.08	0.01	0.12	-0.17	-0.01	1.00						
(12) Business partnership	0.02	0.03	0.14	0.11	0.07	-0.03	-0.07	0.18	0.04	-0.19	-0.15	1.00					
(13) Limited companies	0.07	-0.14	0.01	0.03	-0.05	0.08	0.05	-0.23	0.07	0.17	-0.51	-0.77	1.00				
(14) Research intensive manufa	0.30	-0.05	0.17	0.43	0.06	0.09	-0.09	-0.03	0.12	-0.02	-0.11	-0.01	0.08	1.00			
(15) Other manufacturing ind.	-0.10	-0.01	0.07	0.03	0.22	-0.13	-0.09	0.15	0.01	-0.05	0.01	0.10	-0.09	-0.43	1.00		
(16) Research intensive serv.	0.03	0.02	-0.25	-0.24	-0.24	0.22	0.12	-0.16	-0.09	0.07	0.01	-0.11	0.09	-0.26	-0.45	1.00	
(17) Other services	-0.23	0.06	-0.01	-0.24	-0.10	-0.17	0.08	0.02	-0.04	0.01	0.10	0.01	-0.07	-0.22	-0.37	-0.23	1.00

Table II shows the correlation matrix. Consistent with a lower share of innovators among family firms we find the corresponding correlation to be negative.. Importantly, the overall relatively low correlations among the explanatory variables indicate that multicollinearity should be less of a problem in estimations.

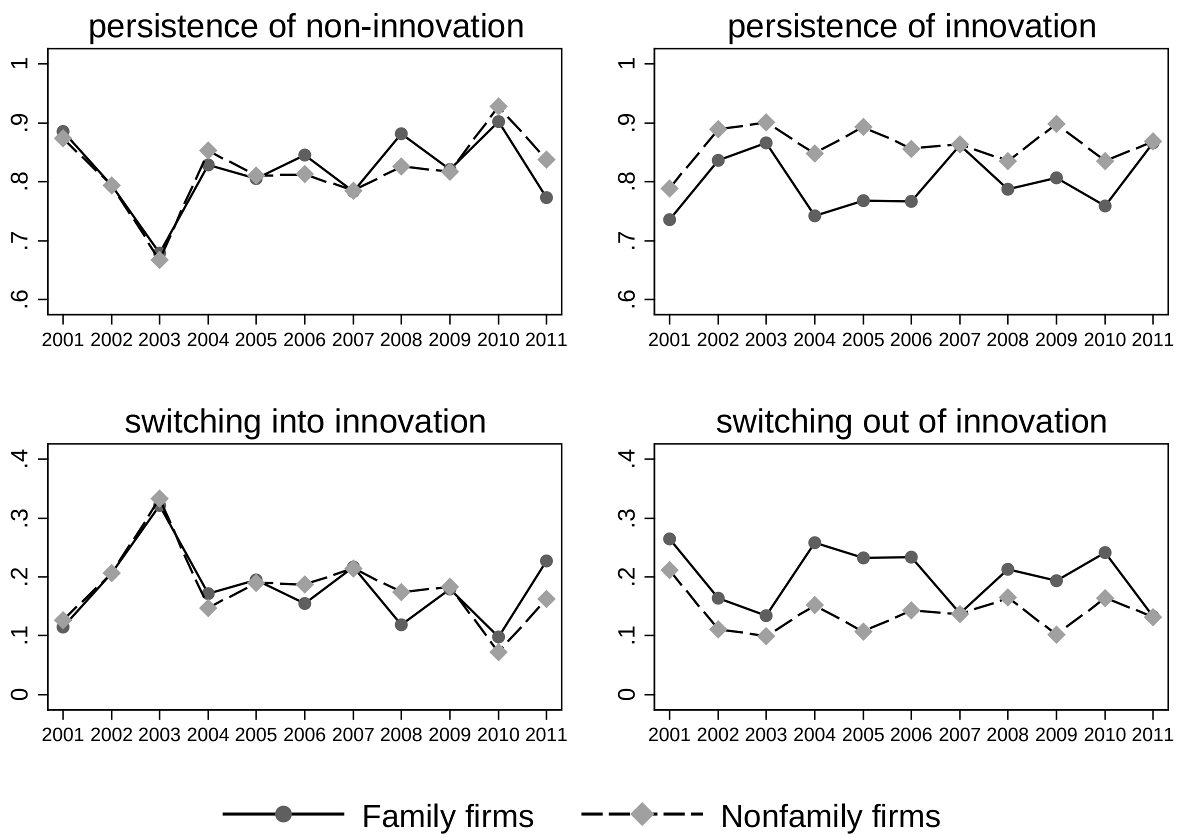
Table III

Transition Matrix

Innovation		t+1								
		All Firms			Family Firms			Nonfamily Firms		
		No	Yes	Total	No	Yes	Total	No	Yes	Total
t	No	81.79	18.21	100	81.66	18.34	100	82.00	18.00	100
	Yes	16.78	83.22	100	19.78	80.22	100	13.67	86.33	100
Total		47.63	52.37	100	51.47	48.53	100	41.30	58.70	100

As a first indication for persistence, Table III shows the overall one-year transition rates for innovation to no innovation and vice versa (from year *t* to *t*+1) for all firms and for family and nonfamily firms separately. Overall, the transitions rates indicate innovation to be highly persistent at the firm level. A large majority of roughly 83% of innovating firms in one period stay with their decision to innovate in the subsequent period. A somewhat smaller proportion of non-innovating firms remain non-innovative in the following period (ca. 82%). Most interestingly, both persistence in innovation and non-innovation is slightly lower for family firms than for nonfamily firms. Correspondingly, the amount of switchers rises among family firms. This is in line with our hypothesis that family firms less persistently innovate.

Figure 1



This suspicion is further supported when plotting the innovation investment behavior over time. Figure 1 indicates that the persistence of non-innovation and switching into innovation (left column) is similar when comparing family and nonfamily firms over time. Family firms, however, more or less constantly innovate less persistently over time. This is mirrored in family firms switching out of innovation with a higher likelihood (bottom right).

Having a higher persistence in innovation should give firms a competitive advantage in the long-run. In the following section we will analyze the sources of the observed differences in persistence. In particular, we are interested in whether innovation experience matters for future innovation (true state dependence) and whether innovation experience is less of a driver for future innovation in family firms.

4 Results and Analysis

In the following, we show and interpret results for seven models in total. We start with a static approach to investigate the influence of family ownership and management on the decision to invest in innovation in German firms as has been done in the literature so far. In Model I to Model III we always control for the in essence time invariant covariates East, Group, legal status and industry belonging. We add the remaining time varying covariates in a stepwise manner in Model II through Model III. Since our main interest concerns the dynamic perspective of family ownership and innovation and whether family firms invest more or less continuously in innovation, we extend the analysis with the dynamic Model IV and Model V. We control for the initial condition problem as proposed by Wooldridge (2005). This allows us to identify true state dependence, whilst controlling for potential spurious state dependence. In Model IV we primarily focus on scrutinizing the effect of the one-year lagged endogenous variable in order to test hypothesis H1. In Model V, we add an interaction term between the lagged endogenous variable and family ownership and management which allows us to test hypothesis H2.

Throughout all models, we control for year specific heterogeneity by adding time dummies. To further investigate potential regime shifts caused by the European financial crisis 2008/9, we additionally split the sample in a pre- and post-crisis set. Consequently, Model VI shows the results of a dynamic approach for a sample from 2001 to 2007, and Model VII displays the results of a dynamic approach for a subsample of the year 2008 to 2012. Since we can only interpret the signs but not the magnitudes of the coefficients in the probit model, we further provide marginal effects (ME), which indicate the change in the predicted probability of innovation due to a one-unit change in the explanatory variable.

4.1 Static Analysis

Table IV shows the probit regression results and ME for the static models Model I to Model III. Based on Model I, we find family ownership and management to have a negative effect on the innovation decision at the 10% significance level (ME -0.035). The relationship between family ownership and management, and innovation, however, reverses in direction once we control for firm size in Model II (ME 0.040 significant at the 5% level). The effect of family control on the innovation decision becomes even stronger and larger in Model III, where we additionally control for the remaining covariates (ME 0.059 significant at the 5% level). As the descriptive statistics indicate that family firms are on average smaller and slightly younger, it seems that failing to control for size and age confounds family effects on innovation with underlying reasons. The results from Model I to Model III thus provide further evidence supporting Classen *et al.* (2014), who used the 2007 wave of the CIS and find German family firms to have a higher propensity to invest in innovation in the first place but given the decision to invest they spend a lower amount. This finding in turn supports the positive association of family firms to opportunity recognition capability and the commonly found positive relationship between new product introduction and family firms (e.g. Ayyagari *et al.*, 2011; Gudmundson *et al.*, 2003; Craig and Dibrell, 2006) .

Table IV
Static models

	Regression results			Marginal effects		
	I	II	III	I	II	III
Family	-0.125*	0.158**	0.245***	-0.035*	0.040**	0.059***
	(0.075)	(0.076)	(0.072)	(0.021)	(0.019)	(0.017)
Size		0.396***	0.308***		0.102***	0.075***
		(0.027)	(0.028)		(0.006)	(0.006)
Export intensity			1.846***			0.448***
			(0.160)			(0.037)
Asset intensity			-0.037**			-0.009**
			(0.018)			(0.004)
Training intensity			0.254***			0.062***
			(0.026)			(0.006)
Age			-0.165***			-0.040***
			(0.037)			(0.009)
Creditworthiness			-0.642***			-0.028
			(0.213)			(0.020)
Creditworthiness²			0.116***			
			(0.032)			
East	-0.057	0.071	0.118*	-0.016	0.018	0.029*
	(0.075)	(0.075)	(0.072)	(0.021)	(0.019)	(0.017)
Group	0.563***	0.289***	0.161**	0.157***	0.076***	0.040**
	(0.077)	(0.077)	(0.073)	(0.021)	(0.020)	(0.018)
Business partnerships	0.775***	0.443***	0.271**	0.215***	0.116***	0.066**
	(0.136)	(0.135)	(0.125)	(0.037)	(0.035)	(0.031)
Limited companies	0.713***	0.472***	0.238**	0.197***	0.123***	0.058**
	(0.118)	(0.117)	(0.109)	(0.032)	(0.031)	(0.027)
Research intensive manufacturing ind.	2.880***	2.793***	2.118***	0.571***	0.544***	0.452***
	(0.143)	(0.140)	(0.126)	(0.014)	(0.014)	(0.017)
Other manufacturing ind.	1.000***	1.005***	0.800***	0.242***	0.229***	0.181***
	(0.103)	(0.103)	(0.094)	(0.020)	(0.019)	(0.018)
Research intensive serv.	1.544***	1.793***	1.331***	0.376***	0.389***	0.305***
	(0.119)	(0.122)	(0.111)	(0.020)	(0.017)	(0.020)
Constant	-1.905***	-3.281***	0.556			
	(0.162)	(0.197)	(0.438)			
Observations	13,416	13,416	13,416	13,416	13,416	13,416
Number of firms	5,030	5,030	5,030	5,030	5,030	5,030
LL	-6434.889	-6319.439	-6110.026	.	.	.
chi2	1022.083	1252.983	1671.809	.	.	.
rho	0.788	0.779	0.737	.	.	.
McFadden R²	0.07	0.09	0.12			

Time dummies included
Dummies indicating zero for asset and training intensity included
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The static models further show the importance of controlling for the remaining explanatory variables. Congruent to the reasoning brought forward in Section 3.2.3, we find positive and significant effects for firm size, export intensity, training intensity, and group belonging. Similarly, we find support for the suspected negative effect of firm age, and credit worthiness. Interestingly, a quadratic fitting of creditworthiness indicates a u-shaped relationship. That is, for decreasing credit worthiness (i.e. higher values) we find a negative effect on the decision to invest in innovation. This supports findings indicating that firms reduce risk taking when in fear of financial distress (see e.g. March and Zur Shapira, 1992; Chen and Miller, 2007). Intriguing, this relationship, however, reverses at higher values and thus less credit worthiness. Specifically, the inflection point lays around 2.8 which corresponds to the 95%-percentile in the data. From here on, we find positive effects. This supports recent findings indicating that decision makers may behave loss averse and accept higher levels of risk when in despair (see e.g. Chrisman and Patel, 2012).

4.2 Dynamic Analysis

Table V shows the regression results and ME for the dynamic models , in which we use the Wooldridge approach (2005).[2] The dynamic models achieve a far better fit with a McFadden's pseudo R^2 of about 0.23 than the static model (McFadden's pseudo R^2=0.12), which already indicates the importance of path dependence for innovation. This suspicion is substantiated by the highly significant findings for the lagged innovation variable and the relatively large magnitude of the ME. In fact, we find past innovation experience increases the probability of innovating in the next period by 20 percentage points. We thus find strong support for H1 at the 1% significance level. The introduction of the lagged dependent variable further leads to a substantial reduction in the importance of unobserved firm heterogeneity. But still unobserved firm heterogeneity explains about 44% of the variance in innovation (compared to 79% in the static model).

Model V shows that the interaction term between lagged innovation and family ownership and management is significantly negative at the 1% level. We hence find strong support for hypothesis H2, too. The results show innovation to be persistent at the firm level, and family ownership and management to negatively moderate path dependence. Notwithstanding, the dynamic models again support Classen *et al.* (2014) as family firms are found to have a higher propensity to invest into innovation (ME around 0.02 at significant at the 1% level).

[2] Note that we do not incorporate the means of all time varying explanatory variables. Similar to Raymond *et al.* (2010), we exclude the time mean when the correlation between the time varying variable and its mean is too high so that severe multicollinearity problems arise. We include the means of export intensity, training intensity, and asset intensity. Since the latter two variables are measured in logs we additionally include the means of the dummies indicating zero values for these two variables.

Table V

Dynamic Models

	Regression results		Marginal effects	
	IV	V	IV	V
Lagged innovation	0.793***	0.988***	0.195***	0.199***
	(0.058)	(0.075)	(0.019)	(0.019)
Family	0.126**	0.296***	0.024**	0.026***
	(0.051)	(0.066)	(0.010)	(0.010)
Lagged innovation X Family		-0.322***		
		(0.079)		
Size	0.138***	0.136***	0.027***	0.026***
	(0.021)	(0.021)	(0.004)	(0.004)
Export intensity	0.555**	0.573**	0.108**	0.111**
	(0.244)	(0.248)	(0.047)	(0.048)
Asset intensity	0.013	0.016	0.003	0.003
	(0.028)	(0.028)	(0.005)	(0.005)
Training intensity	0.060**	0.058*	0.012**	0.011*
	(0.030)	(0.030)	(0.006)	(0.006)
Age	-0.086***	-0.087***	-0.017***	-0.017***
	(0.026)	(0.026)	(0.005)	(0.005)
Creditworthiness	-0.445***	-0.448***	-0.018	-0.019
	(0.153)	(0.153)	(0.012)	(0.011)
Creditworthiness²	0.077***	0.078***		
	(0.023)	(0.023)		
East	0.097**	0.098**	0.019**	0.019**
	(0.049)	(0.049)	(0.010)	(0.010)
Group	0.026	0.020	0.005	0.004
	(0.056)	(0.056)	(0.011)	(0.011)
Business partnerships	0.108	0.126	0.021	0.024
	(0.089)	(0.088)	(0.017)	(0.017)
Limited companies	0.050	0.070	0.010	0.014
	(0.079)	(0.078)	(0.015)	(0.015)
Research intensive manufacturin	0.938***	0.935***	0.193***	0.193***
	(0.086)	(0.086)	(0.018)	(0.018)
Other manufacturing ind.	0.403***	0.402***	0.077***	0.077***
	(0.066)	(0.066)	(0.012)	(0.012)
Research intensive serv.	0.503***	0.498***	0.099***	0.098***
	(0.077)	(0.077)	(0.015)	(0.015)
Initial innovation	1.230***	1.218***	0.336***	0.332***
	(0.079)	(0.078)	(0.023)	(0.023)
Mean export intensity	0.499*	0.468*	0.097*	0.091*
	(0.271)	(0.275)	(0.053)	(0.053)
Mean asset intensity	-0.077**	-0.079**	-0.015**	-0.015**
	(0.033)	(0.033)	(0.006)	(0.006)
Mean training intensity	0.157***	0.161***	0.031***	0.031***
	(0.040)	(0.040)	(0.008)	(0.008)
Constant	0.215	0.140		
	(0.337)	(0.337)		
Observations	13,416	13,416	13,416	13,416
Number of firms	5,030	5,030	5,030	5,030
LL	-5355.319	-5345.565	.	.
chi2	3181.223	3200.730	.	.
rho	0.447	0.443	.	.
McFadden R²	0.23	0.23	.	.

Time dummies included
Dummies indicating zero for asset and training intensity included
Mean for dummies indicating zero for asset and training intensity included
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The remaining findings of Model IV and Model V support the results already described for the static models. That is, we find positive and significant effects of firm size, export intensity, training intensity, and geographical location. Similarly, we find age and creditworthiness to have negative effects. Again, the negative effect of creditworthiness is found to be nonlinear with a u-shape relationship indicating higher willingness to invest into innovation when in strong despair (inflection point at 2.9; 95% percentile). Whilst group belonging and the legal forms are still congruent to the static models in regard to their sign, we do not find significant effects in Model IV and Model V. Given the ambition to treat the initial condition problem in accordance to Wooldridge (2005), we find the mean effects of the time varying explanatory variables and the initial condition (Initial innovation) to have significant effects. This in turn substantiates the importance of controlling for unobserved individual heterogeneity over time.

4.3 Dynamic Analysis Pre and Post crisis

Table VI shows the results for the dynamic model before (2001-2007) and after/within the European financial crisis (2008-2012). We find support for H1 and H2 at the 1% significance level again. The effect sizes are similar to the findings displayed in Table V indicating a robust pattern in the effect of family ownership and management on innovation over time. There are, however, signs indicating a possible regime shift. Whilst we find no significant results for the export intensity prior to the crisis in Model VI, we find a positive and significant effect for export intensity after the crisis. This could indicate that export intensive firms benefit from demand diversification during and after the crisis. On the contrary, we find positive and significant effects for training intensity before the crisis (ME 0.019) whilst from 2008 onwards, training intensity is found to be insignificant with effects close to zero (ME 0.006). Surprisingly, the same pattern holds true for creditworthiness. The latter possibly indicates that suppliers and banks trust ratings less in times of crisis and high turbulence.

Table VI

Dynamic Models & Regime Split

	Regression results		Marginal effects	
	VI	VII	VI	VII
Lagged innovation	0.816***	1.436***	0.112***	0.259***
	(0.117)	(0.094)	(0.020)	(0.016)
Family	0.324***	0.251***	0.025*	0.022*
	(0.100)	(0.078)	(0.014)	(0.012)
Lagged innovation X Family	-0.362***	-0.300***		
	(0.118)	(0.101)		
Size	0.153***	0.097***	0.029***	0.020***
	(0.031)	(0.023)	(0.006)	(0.005)
Export intensity	0.371	0.713**	0.070	0.147**
	(0.383)	(0.340)	(0.072)	(0.070)
Asset intensity	-0.039	0.059	-0.007	0.012
	(0.043)	(0.037)	(0.008)	(0.008)
Training intensity	0.103**	0.031	0.019**	0.006
	(0.049)	(0.042)	(0.009)	(0.009)
Age	-0.087**	-0.089***	-0.016**	-0.018***
	(0.038)	(0.029)	(0.007)	(0.006)
Creditworthiness	-0.701***	-0.292*	-0.035**	-0.008
	(0.223)	(0.171)	(0.016)	(0.014)
$Creditworthiness^2$	0.112***	0.056**		
	(0.033)	(0.026)		
East	0.117	0.101*	0.022	0.021*
	(0.072)	(0.052)	(0.013)	(0.011)
Group	0.055	-0.039	0.010	-0.008
	(0.083)	(0.064)	(0.016)	(0.013)
Business partnerships	0.089	0.114	0.017	0.024
	(0.139)	(0.093)	(0.026)	(0.019)
Limited companies	0.071	0.055	0.013	0.011
	(0.123)	(0.081)	(0.023)	(0.017)
Research intensive manufacturin	0.814***	0.801***	0.153***	0.165***
	(0.123)	(0.099)	(0.022)	(0.019)
Other manufacturing ind.	0.410***	0.314***	0.077***	0.065***
	(0.099)	(0.073)	(0.018)	(0.015)
Research intensive serv.	0.386***	0.431***	0.073***	0.089***
	(0.114)	(0.086)	(0.021)	(0.017)
Initial innovation	1.384***	0.788***	0.260***	0.162***
	(0.138)	(0.083)	(0.017)	(0.015)
Mean export intensity	0.696*	0.163	0.131*	0.034
	(0.411)	(0.367)	(0.077)	(0.075)
Mean asset intensity	-0.023	-0.113***	-0.004	-0.023***
	(0.049)	(0.041)	(0.009)	(0.008)
Mean training intensity	0.159**	0.137***	0.030***	0.028***
	(0.062)	(0.051)	(0.012)	(0.010)
Constant	0.702	-0.173		
	(0.492)	(0.373)		
Observations	6,084	7,332	6,084	7,332
Number of firms	2,896	3,621		
LL	-2487.349	-2915.577	.	.
chi2	1725.680	2141.025	.	.
rho	0.479	0.254	.	.
McFadden R^2	0.26	0.27	.	.

Time dummies included
Dummies indicating zero for asset and training intensity included
Mean for dummies indicating zero for asset and training intensity included
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4 Marginal Contrasts

Since our main dynamic specification includes an interaction between lagged innovation and family ownership, we additionally provide marginal contrasts for Model V (and Model VI & VII) in Table VII. A marginal contrast calculates the marginal effect of lagged innovation for each family status, separately.

Table VII

Marginal contrast for lagged innovation

	V	VI	VII
Nonfamily	0.240***	0.178***	0.416***
	(0.023)	(0.033)	(0.329)
Family	0.166***	0.107***	0.333***
	(0.020)	(0.030)	(0.030)
Δ	-0.079***	-0.083***	-0.082***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table VII again supports our hypothesis. We find innovation to be persistent on the firm level for both family and nonfamily firms which means that innovation experience triggers future innovation. However, family firms exhibit lower innovation persistence (e.g. 0.240 vs. 0.166 in Model V). Delta denotes the difference between the marginal effects of both groups and it is displayed in the last row in Table VII. It shows that the marginal effect of lagged innovation for family firms is significantly smaller.

Subsuming, the results support our hypotheses. We find innovation to be truly state dependent at the firm level, whilst family ownership and management negatively moderate the relationship between lagged and current innovation. The results nevertheless indicate that family firms have a higher propensity to invest into innovation. One possible explanation for this seemingly contradicting finding may be that family capital and long term investment horizons fosters opportunity recognition and thus the propensity to invest into innovation, whilst risk aversion and agency issues suppress continuous innovation over time.

5 Discussion & Conclusion

This paper contributes to the literature by employing a dynamic view on the relationship between innovation investment decision and family ownership and management. We hypothesize innovation to be truly persistent, and base out reasoning on the arguments of success breeds success, barriers to exit for established innovators, and accumulation of knowledge. Drawing upon literature in the cross section of innovation and family firms, we however argue that family firms exhibit less true state dependence. We claim that – and although family firms are associated with a transgenerational succession aspiration and innovation fostering resources and capabilities – nonfinancial goals and the associated risk aversion thwart innovation persistence as they demote innovation investments.

We investigate innovation persistence based on the CIS panel for Germany for the period of 2001 to 2012. We use a random effects discrete choice model and regress innovation against its past realization.

To treat the initial condition problem, we make use of a rather recent econometric approach as proposed by Wooldridge in 2005. With the analysis we confirm our first conjecture and find support for true state dependence for innovation at the firm level (H1). Moreover, we find the interaction between lagged innovation and family ownership to be significantly negative (H2).

Although the results corroborate less true state dependence for family firms, we find family firms to have a higher propensity to invest into innovation in the first place. We conjecture that family capital and long term investment horizons foster opportunity recognition and thus the propensity to invest into innovation, whilst risk aversion and agency issues suppress continuous innovation over time.

This conjecture remains to be put under scrutiny in more detail. Nonetheless, our findings strongly suggest family firms' innovation behavior to be less impacted by former decisions regarding investment into innovation. Evidence is growing that family centered goals might strongly impact innovation investment behavior over time. This is likely to be the case here, too. Our results thus have at least one important implication for the target of innovation strategies – and from a more economic perspective – for innovation policies too: Albeit the higher propensity to invest into innovation, promoting innovation in family firms is less likely to display persistent effects. This in turn influences the long-term competitive position of family firms especially in comparison to continuously innovating nonfamily firms negatively.

6 Limitations & Future Research

The study is naturally subject to some limitations. First, our study fails to disentangle the determinants of the family firm idiosyncratic behavior detected. Though we conjecture long term orientation and nonfinancial goals to at least partly drive the phenomenon, we find it advisable to further investigate what family firm specific elements cause family firms to have a higher propensity to invest into innovation but to show less true state dependence. Family goal diversity, management and governance heterogeneity, and differing generational impact spring to mind as possible driving factors. Such an approach would further allow better understanding heterogeneity within the group of family firms.

Second, we use a binary measure on the input side to measure innovation persistence. Future research should aim at using continuous measurements on both, the in- and output side. Given that it is likely that the innovation intensity further determines state dependence to at least some degree, revisiting the topic with continuous data seems particularly promising.

Third, the study does not touch upon the rather delicate question of endogeneity of family ownership and management. Continuous (successful) innovation may for example affect merger and acquisitions activities, or the willingness of subsequent generations to enter the company. Innovation may thus cause changes in ownership status. Despite these concerns, we are convinced that endogeneity doesn't bias our results. First, we find the transition rates of family to nonfamily ownership and vice versa to be practically zero. Furthermore, we additionally perform a test on exogeneity by including the one-year lead of family ownership (see Wooldridge, 2000). Under the null hypothesis of exogeneity the coefficient should be insignificant which we find to hold in our data set. Lastly, and from a more practical point of view, the study would benefit from a larger balanced panel.

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