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Sustainability and Environmental Behaviour in Family Firms: A Longitudinal Analysis of Environment-Related Activities, Innovation and Performance

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Introduction

AFTER THE INITIAL CALL FOR THE SOCIETAL NEED OF SUSTAINABLE DEVELOPMENT BY THE WORLD COMMISSION ON ENVIRONMENT AND Development (WCED, 1987), sustainability-related pressures for and benefits of engagement with environmental issues increased over time. This resulted in the intensified integration of non-financial goals related to environmental issues into the decision-making behaviour of firms. Prior research has demonstrated that firm- and country-level factors drive environmentally responsible behaviour (Panwar *et al.*, 2015) while influencing a firm's productivity (Bryson and Lombardi, 2009), image and performance (Hoffman, 2001). So far, however, we know little about the behaviour of family firms in this regard. This is an important gap in the literature, given that family firms constitute a significant part of many economies around the globe (IFERA, 2013), and theoretical arguments suggest that family firms differ from non-family firms regarding both general and environmental behaviour,

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which merits separate and comparative analysis. More, specifically theory suggests that members of family firms pursue the accumulation and conservation of wealth for future family generations (Zellweger *et al.*, 2012), and of the family name and thus its reputation, which has often been built up over several generations (Dyer and Whetten, 2006; Lumpkin *et al.*, 2010). Both goals are indicative of a more general long-term orientation of family firms (Gómez-Mejía *et al.*, 2007; Le Breton-Miller and Miller, 2006; Lumpkin *et al.*, 2010; Miller and Le Breton-Miller, 2005), which makes risky behaviour less likely in these firms. For example, prior studies about the innovation behaviour of family firms find that they pursue inherently uncertain activities less than non-family firms, and therefore invest fewer resources into R&D and innovation (Block, 2012; Duran *et al.*, 2015). Risky decisions, such as committing resources to R&D or adopting discontinuous technologies, are postponed due to concerns about family wealth (König *et al.*, 2013; Schulze *et al.*, 2002). Following this argument, family firms should be initially lagging behind non-family firms with regard to their environmental behaviour. On the other hand, because environment-related activities, best practices and innovations are posterior proven and thus hold low risk, they should ultimately be equally likely in family firms and thus increase firm (and family) image as well as performance. Moreover, prior research has investigated the relationship between family firms and environment and social responsibility, and confirmed that family firms care about their image also in terms of being environmentally friendly (Berrone *et al.*, 2010; Block and Wagner, 2014), which boosts the catching-up process of family firms compared with non-family firms with respect to their environmental behaviour. Their care for being good owners and their strong long-term orientation should result in less volatile behaviour, that is, more consistent pursuance of environment-related activities, innovations and performance. In analysing performance and its drivers, this paper also provides insights regarding firms' motivation to act pro-environmentally, a question of high relevance with a recent call to be further researched (Schaltegger and Wagner, 2011). By distinguishing between family and non-family firms, in this analysis we aim to study environment-related activities, innovations and performance dimensions in order to provide a more comprehensive overview of the differences regarding the development of firms' environmental behaviour.

Our empirical analysis uses four waves of the German Sustainability Barometer survey (2001, 2006, 2011 and 2016), which puts us in a unique position for exploring these longitudinal perspectives and also fits with shifts in research focus in the field more generally (Holt, 2011; Zollo *et al.*, 2013). We find that family firms are less likely than other firms to implement environment-related activities and innovations in early diffusion phases but catch up with non-family firms later. We also find that family firms' environmental behaviour is less volatile and more stable over time compared with non-family firms.

The remainder of our study is organized as follows. The next section summarizes related research about family firms, environmental behaviour and the interrelation between those. It also introduces our research questions. The following section introduces our sample, the data set and the variables. Then we present our results, followed by a discussion and conclusion.

Literature Review and Research Questions

As outlined in the introduction, the vital role of family members and their family-centered goals such as the strong focus on socioemotional wealth accumulation and conversion and related long-term orientation, on reputational aspects and on avoidance of risky undertakings results in a rather different firm behavior of family firms as compared with that of their non-family counterparts. The empirically verified long-term orientation of family firms (see, e.g., Miller and Le Breton-Miller, 2005) can explain why in principle they are better at addressing environmental and related social issues (Berrone *et al.*, 2010; Block and Wagner, 2014). In particular, Block and Wagner (2014) find that in the USA family ownership is positively associated with environmental management activities. Berrone *et al.* (2010) explain this by the fact that in family firms a preference exists to aim more for socioemotional wealth, such as a distinct family image in the community, and with it, reputation, or the perpetuation of the family's name. Calza *et al.* (2016) provide another explanation, by hypothesizing that ownership concentration, as is the case for family firms, positively determines proactive environmental firm behaviour. At the same time, higher risk aversion of family firms leads to lower levels of research expenditure (Block, 2010; Duran *et al.*, 2015), but in principle also

lower levels of environmentally harmful or socially detrimental activities (Dyer and Whetten, 2006). Yet, this could also concern inherently uncertain innovation with environmentally highly beneficial products, (technological) processes and organization-related changes, and thus further empirical tests of the net effect are considered necessary (Sharma *et al.*, 1997). More specifically, Gómez-Mejía *et al.* (2007) point out that distinguishing different types of risk could resolve the paradox of family firms being at the same time both long-term oriented (regarding the protection of socioeconomic wealth, such as firm reputation) and risk averse (regarding the pursuance of inherently risky or highly uncertain activities).

Independently of the existence of family members, the environmental behaviour of firms has been studied with respect to environment-related activities and best practices such as the certification of quality and environmental management systems, and the integration of core management process and functions with these management systems, cooperation with environmentally concerned stakeholders and the outcome of such activities, namely environmentally beneficial innovations and performance effects. As concerns environmental management activities in particular, literature on the adoption of process innovations suggests that many organization-related activities such as the introduction and certification of dedicated management systems or new management processes aimed at stakeholder integration or supporting an integrated pursuance of the firm's strategic goals can be framed as organizational innovations (Henriques and Sadorsky, 2007; Rueda-Manzanares *et al.*, 2008; Smith, 2005; Wagner, 2009). As a result of such innovations tangible performance effects have been shown, for example in terms of higher benefits from environmental management activities (Berman *et al.*, 1999; Darnall *et al.*, 2008; Hart and Sharma, 2004). More narrowly-defined technological environmental innovations (Hall and Vredenburg, 2003; Wagner, 2007) are also seen as important antecedents for achieving long-term sustainable development, and it has been argued that this at least partly requires system-level transitions based on a combination of product and process innovations (Hall and Vredenburg, 2003).

While prior research has shown that, due to significantly larger benefits, large firms are more likely to be engaged in environmentally beneficial activities such as involvement in environmental management practices (Brammer *et al.*, 2012), the motivation behind environmental activities (such as the adoption of environmental certifications) for SMEs and micro-enterprisers is found to be of external rather than internal nature (Mir, 2008; Masurel, 2007). These analyses do not consider the stronger environmental orientation of family firms as compared with their non-family counterparts. The association of environmental management activities with innovation is stronger in family firms (Craig and Dibrell, 2006), which Özsomer *et al.* (1997) explain in terms of the higher organizational flexibility of family firms. These findings again point to two logics, namely long-term orientation and risk aversion, competing at least to some degree in the context of family firms. For example, Dyer and Whetten (2006) based on KLD data find that family firms do not carry out more CSR-related activities, which is more consistent with the notion that family firms are risk averse. Opposed to this, Craig and Moores (2006) show that family firms in Australia are more innovative than non-family firms, which could be explained by a higher long-term orientation of family firms.

To the best of our knowledge no longitudinal study of German family versus non-family firms describing the temporal evolution of environmental behaviour exists to date. Therefore exploring this further seems a welcome complement to the current Anglo-Saxon focus of comparisons between family and non-family firms in terms of CSR (Craig and Moores, 2006). Furthermore, and in line with the increasing shift towards understanding change and learning processes in the field of corporate sustainability (see, e.g., Zollo *et al.*, 2013), we analyse the behaviour of family versus non-family firms over a longer period of time (2001–2016). This also echoes calls for more longitudinal research on family firms in organizations and the natural environment and broader sustainable development contexts (Craig and Dibrell, 2006).

In summary, our review of the literature leads us to the following two research questions to be addressed in the remainder of the paper.

Research question 1 (RQ1). How does the implementation of environmental behaviour develop over time in German family and non-family firms from a descriptive and comparative perspective?

Research question 2 (RQ2). In light of the competing logics of long-term orientation and risk aversion introduced earlier, what are the environment-related performance effects in German family and non-family firms?

Data and Method

Sample

The empirical data used for our analysis was collected in the context of a larger research project during four waves of the German Sustainability Barometer survey (2001, when this was integrated in the European Business Environment Barometer (EBEB) survey, 2006, 2011 and 2016). The survey waves aimed to assess the state of environmental management. The questionnaire asked firms to self-assess their main environmental activities in detailed categories as well as cooperation activities with several stakeholders. Furthermore, the level of integration between social, quality, health and safety (H&S) and corporate management and strategy was evaluated (Baumast and Dyllick, 2001), since this is considered crucial for linking the natural environment with business strategy. Finally, a number of questions elicited firm responses on various firm characteristics such as firm age and to what degree firms implemented environmental management systems.

The first survey wave was carried out in 2001 on a random sample of 2000 firms drawn from the Amadeus database of Bureau van Dijk. Firms received a printed questionnaire by postal mail. For the second wave carried out in 2006 the sample was based on the 2001 firms plus additions to balance the sample structure for exits. This procedure was analogously applied in the third and fourth waves. Due to progress in internet technology, in 2006, 2011 and 2016 firms were invited by electronic mail to participate in a web-based version of the questionnaire. As a result, a dataset of repeated cross-sections of one defined firm population (i.e. the manufacturing sector¹) spanning 15 years and based on a survey instrument with identical questions over time forms the basis of our analysis.

Common method bias (whilst generally being below average in the field of management studies) might exist, even though self-assessment does not necessitate either its existence or its homogeneity, since method-related variance can deflate or inflate the true relationship (Cote and Buckley, 1987; Podsakoff *et al.*, 2003). Since common method bias may stem from different sources such as the use of the same source for dependent and independent variables, item characteristics and aspects of the measurement context, for the survey data used here a number of procedural steps were taken to ensure that common method bias is minimized or reduced. For example, the anonymity of respondents was guaranteed, different response formats were used, question order was counterbalanced, scale items were improved in the survey pre-test and respondents have been clearly instructed, in particular by telling them that we value and need their feedback. All these actions aimed to reduce item ambiguity as well as socially desirable responses. Since the survey ensured the anonymity of respondents, it could not directly implement separating measurements and obtaining assessments from different respondents as two other procedural steps. Still, the way the survey was implemented and its instructions in principle also enabled these two latter remedies.

In terms of statistical procedures, because we do not know if and how likely the explained specific sources are related to the bias, according to Podsakoff *et al.* (2012) we may use either the marker technique (Lindell and Whitney, 2001) or the common method factor technique (Bagozzi, 1984; Podsakoff *et al.*, 2003). According to the marker technique, common method bias exists if correlation between a theoretically uncorrelated marker variable and the variables of interest is found in the data. As not all sources of method bias can be determined a priori, there 'will always potentially be other sources of CMV [common method variance] beyond that associated with the marker variables used that remain unaccounted for' (Williams *et al.*, 2010, p. 477–514). Since the marker variable has to be chosen depending on the specific type of source of method bias (Williams *et al.*, 2010) and because we cannot determine the specific source of bias, we used the common method factor technique to control for the potential existence of systematic sources of bias. Thus, if no systematic error can be found in the latent method factor technique analysis, then all types of bias source are likely to be non-existent.

The self-reported data in this study is partly objective and verifiable (e.g. the adoption of environmental and quality management systems and the existence of product and process innovations) and thus considerably less problematic with respect to systematic measurement error (Podsakoff and Organ, 1986). Constructs that are subject to interpretation or evaluation (e.g. cooperation with different types of stakeholder, integration of environmental with

¹Focusing on a homogeneous sample with firms operating in the manufacturing sector helps to avoid distorted effects that may occur otherwise between EMS adoption and performance (Yin and Schmeidler, 2009).

social and H&S aspects, quality and strategy, and in particular perceived economic performance effects of environmental activities) may be prone to systematic measurement error.

We performed common method analysis for the different dimensions of environment-related economic performance effects, since this aspect seems most exposed to common method issues and concerns the largest number of individual variables. As suggested by Podsakoff *et al.* (2003, 2012) any large changes to the loading of each item on its corresponding construct after including the unmeasured common method variable are due to a systematic bias. A widely used threshold value identifying large changes is 0.2. We found that the differences between the loadings of items for the analysis with and without the common latent factor is always less than 0.2 for the market-, efficiency- and risk-related economic performance dimensions, meaning that the items did not show any substantial external loading on the common latent variable. Hence, regarding the three constructs our data does not suffer from common method bias. With respect to the image-related performance dimension, only one out of five items differs by 0.06 points above the threshold value. Since this change is very close to the threshold value of 0.2 and because only one out of five items may suffer from a systematic bias, the results of our analyses are not affected by this bias and we may neglect it in this analysis. Moreover, all item loadings remained significant and signs did not change after introducing the common latent variable, which additionally suggests that common method bias is not a significant problem in our study.

After collecting the survey data, in a subsequent step, information about family firms was added to the responses of all four waves. As the survey did not gather any information regarding family firms, we obtained the necessary information to determine if the firm is or is not a family firm. As the observations of the German Sustainability Barometer consist of listed as well as non-listed firms. In a first step information about family shareholders as well as information about family members being on the management board has been determined manually. A firm has been coded to be a family firm if more than five per cent of either the equity capital or the issued shares belongs to a family member, or if a family member is on the management board. Due to missing family data, 166 observations for 2001, 120 observations for 2006, 130 observations for 2011 and 217 observations for 2016 could be included in the final analysis. Thus, our final dataset consists of 633 observations.

Based on data from the Bundesanstalt für Arbeit (BfA, 2000), a size bias in the data needs to be acknowledged (relative to the population of manufacturing firms in Germany) in that larger firms with more than 500 employees are proportionally over-represented in the responses, whereas firms with up to 500 employees are under-represented in the second wave. This however is a persistent issue in empirical management studies in general, since smaller firms inherently have more limited resources to participate in surveys (Armstrong and Overton, 1977). Beyond this, however, response bias in the data is unlikely, since there is large variation across the responses in all survey waves, indicating that also firms less active in terms of environmental management did respond to the survey.

To assure this, we compared the dataset with respect to its representativeness for the manufacturing industry as well as regarding significant differences over the four different rounds of the survey. An assessment for the similarity of the observations across years is presented in Table A1 in the appendix. The three largest manufacturing segments (in terms of number of observations in our dataset), namely consumption, metal and machinery, are represented equally in each year, and we observe no significant differences across years based on χ^2 tests. Additionally, the distribution of the three largest subindustries is representative for the entire population (see Table A2). Our dataset is furthermore representative with respect to its distribution of family versus non-family firms. Over the four periods of the survey about 50 per cent of the firms in our dataset are family firms (see Table A3).

Variables and Analysis

To address the research questions formulated earlier, as concerns the determinants of environmental activities several variables were constructed from the questionnaire data, based on prior work.

Concerning innovation, all four waves of the German Sustainability Barometer survey asked one question about each of environmental product and process innovations. Furthermore, the level of environmental innovation activity in terms of whether a firm did not carry out any innovation at all (value 1), carried out exclusively product or process innovations (value 2) or pursued both types of innovation at the same time (value 3) was used as a variable.

Environmental management system certification is measured as whether a firm is certified or verified according to ISO 14001 or EMAS, the EU Eco-Management and Auditing Scheme, respectively. If a certification according to one of the schemes exists then the corresponding indicator assumes unit value; otherwise it is zero. The existence of a quality management system (QMS) is coded likewise. If a company reported that it had implemented a QMS system in accordance with ISO 9001 or an equivalent standard, then the corresponding indicator assumed unit value, otherwise zero.

The level of integration was calculated following Wagner (2009) based on four items concerning the integration of environmental, social, quality, H&S and strategy aspects to identify different levels of integration. The item questions asked respondents to rate the level in each case on a five-point Likert scale ranging from 'not at all' (value 1) to 'fully integrated' (value 5). An integration index was constructed by calculating the mean value across all for items for each firm, and is used in the analysis to follow.

The German Sustainability Barometer measures cooperation intensity for different stakeholder categories with respect to reducing environmental damage from the focal company's products (i.e. environment-oriented product development). Based on this a classification into three groups based on stakeholder theory (Donaldson and Preston, 1995; Freeman, 1984; Wagner, 2007) is done. These are predominantly environmentally concerned, partly environmentally concerned and environmentally neutral stakeholders (see, e.g., Hall and Vredenburg, 2003; Post *et al.*, 2002; Waddock *et al.*, 2002). For each group (detailed in Table 1 later) an index score of cooperation intensity as the average of the cooperation intensity (measured on a three-point scale coded as 1, not at all, 2, rarely, or 3, frequently) across all stakeholders in that group is calculated. By measuring cooperation intensity, we can at least

Variable	Items
Environmental product innovation	'green' design of a new product
Environmental process innovation	implementation of cleaner technology
Level of (environmental) innovation activity	implementation of cleaner technology, 'green' design of a new product, none or both of these
Environmental management system certification	company is certified according to ISO 14001 or EMAS
Quality management system certification	company is certified according to ISO 9001 or equivalent
Integration	level of integration of environmental with social aspects, level of integration of environmental with quality, level of integration of environmental with H&S aspects, level of integration of environmental with strategy
Predominantly environmentally concerned stakeholders	waste disposal firms, recycling firms, consumer (protection) associations, trade unions, government enforcement agencies, environmental non-governmental organizations
Partly environmentally concerned stakeholders	scientific institutions, competitors, owners, trade associations
Environmentally neutral stakeholders	users of the product, suppliers of raw materials, intermediate product suppliers, external consultants, commercial or industrial customers, retail customers
Market-related dimension of economic performance	competitive advantage benefits from environmental activities, product image benefits from environmental activities, sales increases from environmental activities, market share gains from environmental activities, new market opportunities from environmental activities
Image-related dimension of economic performance	corporate image benefits from environmental activities, owner/shareholder satisfaction increases from environmental activities, management satisfaction increases from environmental activities, worker satisfaction increases from environmental activities, recruitment and staff retention gains from environmental activities
Efficiency-based dimension of economic performance	short-term and long-term profits from environmental activities, cost savings from environmental activities, productivity benefits from environmental activities
Risk-related dimension of economic performance	improved insurance conditions from environmental activities, better access to bank loans from environmental activities

Table 1. Summary of variables and underlying items

indirectly conclude about underlying innovations enabling these, such as a stakeholder integration capability or stakeholder dialogue implementation.

Dimensions of environment-related economic performance are measured based on a set of items asking about the effect of environmental management activities on individual aspects of corporate success and competitiveness. Since economic performance in general is determined by many factors, of which environmental performance is only one, this phrasing of the question was chosen to control for the effect of other factors, following similar approaches in the literature (e.g. Sharma, 2001). The individual items used in the survey were assigned to different dimensions of (environment- or sustainability-related) economic performance, following Wagner (2009). For each item the response was coded on a five-point Likert scale (1, very negative; 2, negative; 3, neutral; 4, positive; 5, very positive). For the analysis four indices were calculated by averaging the value across all relevant items for the corresponding dimension of (environment- or sustainability-related) economic performance as detailed in the following.

The first dimension refers to competitive advantage, product image, sales, market share and new market opportunities. Therefore, it was labelled 'market-related dimension of economic performance' since it predominantly relates to the market- and product-related economic benefits from a company's environment- and sustainability-related activities. The relevant survey items for the second dimension are corporate image, owner/shareholder satisfaction, management satisfaction, worker satisfaction, and recruitment and staff retention. Therefore, this was labelled the 'image-related dimension of economic performance', given that it mainly refers to internally oriented satisfaction and image benefits from a company's environmental activities. For the third dimension of (environment- or sustainability-related) economic performance, the items short-term and long-term profits, cost savings and productivity are central. These predominantly refer to the profitability and efficiency of a company, and the factor was therefore labelled 'efficiency-based dimension of economic performance'. The two remaining survey items, 'improved insurance conditions' and 'better access to bank loans', are both linked to the financial benefits of a firm from its environmental management activities. They are therefore assigned to the '(financial) risk-related dimension of economic performance'. All variables used and described above are summarized in Table 1.

Given the openness of our research questions, in the following we carry out an exploratory data analysis and multivariate regression analysis in order to clarify the effects of family or non-family status on environmental management activities (as one important subset of corporate sustainability), as well as its link with performance dimensions, in German manufacturing firms. In this we follow a value chain logic moving from innovation, structures and activities as antecedents to performance.

Results

In the following subsections we will elaborate on our research questions by analysing relevant variables concerning environmental management and innovation with respect to differences between family and non-family firms. These are (i) environment-related innovation, (ii) adoption of QMS and EMS certifications and integration of environmental issues with other managerial functions, (iii) stakeholder cooperation to reduce environmental burdens as key explanatory variables and (iv) different environment-related economic performance dimensions as outcome measures of (sustainability-related) firm performance. The analysis will cover a comparison of the mean values of family and non-family firms in same year as well as an analysis of the changes of mean values between different years for the same type of firm. Depending on the variable scale we performed either a *t*-test for equality of means or a chi-square test for the equality of proportions.

Environment-Related Innovation

For both family and non-family firms a significant increase of environmentally beneficial innovation activities from 2001 to 2006 is followed by a significant decrease from 2006 to 2011 (see Columns 13–16 in Table 2, and Figure 1). This trend is reversed from 2011 to 2016 (see Columns 17 and 18 in Table 2) such that over the entire

Mean values of family and non-family firms and their difference in respective year												
2001			2006			2011			2016			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	
Level of innov. Act.	2.00	1.86	0.14	2.60	2.33	0.27*	1.59	1.95	0.36***	2.26	2.25	0.01
Process innovation	0.59	0.51	0.08	0.89	0.69	0.20*	0.30	0.52	0.22*	0.71	0.71	0.00
Product innovation	0.42	0.36	0.06	0.73	0.69	0.04	0.29	0.44	0.15*	0.55	0.54	0.01
Difference of mean values between different years for same type of firm												
(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
01-06, non-family	01-06, family	06-11, non-family	06-11, family	11-16, non-family	11-16, family	01-16, non-family	01-16, family	01-11, non-family	01-11, family	06-16, non-family	06-16, family	
-0.60***	-0.47***	1.01***	0.38**	-0.67***	-0.30**	-0.26**	-0.39***	0.41***	-0.09	0.34**	0.08	
-0.30***	-0.18**	0.58***	0.17**	-0.41***	-0.19***	-0.12*	-0.2***	0.29***	-0.01	0.18**	-0.02	
-0.31***	-0.33***	0.44***	0.25***	-0.26***	-0.10*	-0.13*	-0.18***	0.13*	-0.08	0.18**	0.15*	

Table 2. Environment-related innovation

t-test for equality of means, with significance levels being indicated by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Diff., difference of mean values between non-family and family firms in same year; Level of innov. Act., level of innovation activity

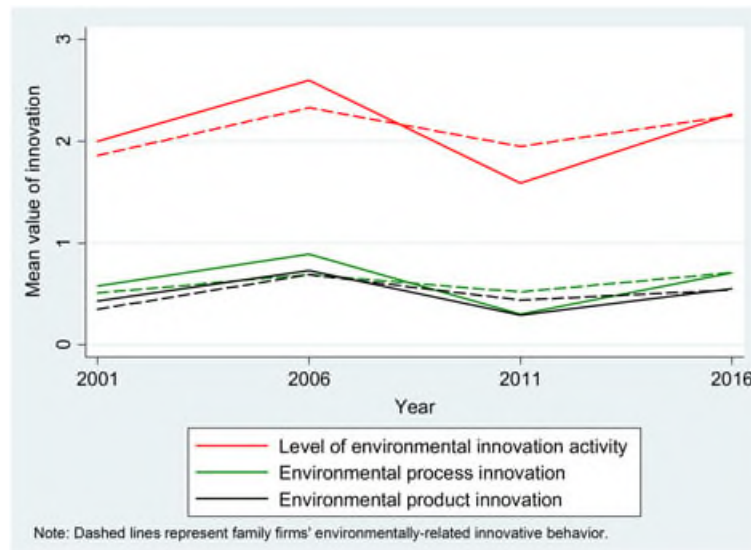


Figure 1. Environment-related innovation. [Colour figure can be viewed at wileyonlinelibrary.com]

period of analysis environment-related innovations increase for both family as well as non-family firms (see Columns 19 and 20 in Table 2). Although the firms' innovation activities vary across years for both family and non-family firms, the variation is much lower for family firms (compare values of Columns 14, 16 and 18 with those of 13, 15 and 17 in Table 2, respectively), indicating that the latter are more long-term oriented. Regarding non-family firms, an increase in the level of innovation activity of about 30 per cent (0.6, the value for level of innovation activity of Column 13, is divided by the maximum possible change of 2) is followed by a decrease of 50 and an increase of 34 per cent in the subsequent waves, with the differences being highly significant. The family firms' analogous changes are relatively moderate, at 24 and 19 and 15 per cent, being significant at one, five and five per cent levels, respectively. Innovation activities of both family and non-family firms differ significantly between the first and last waves. The 26 and 20 per cent increases of non-family and family firms' innovation activities respectively result in a significant difference between the innovation levels of the 2001 and 2016 waves.

In the early waves family firms lag behind (values in Columns 3 and 6 are positive), but in the later waves they catch up with non-family firms. Consequently, whilst in the first and second waves family firms' innovation activities are lower than those of non-family firms, in 2011 the environmentally beneficial innovation activities of family firms are higher than those of non-family firms, and they are equal in 2016. Moreover, when comparing the innovation intensities of the different innovation measures between the first and the last waves, they did increase more for family-firms than they did for non-family firms, such that in the last wave both types of firm become similarly active regarding product and process innovation, and thus the overall innovation activity.

Certifications and Integration of Environmental Issues

The above-discussed convergent behaviour of non-family and family firms with respect to environment-related innovation is also found in EMS and QMS certification, both of which can conceptually be understood as organizational innovation. The analyses of the adoption of QMS and EMS certifications show once more differences between family and non-family firms (see Table 3 and Figure 2). Regarding QMS certification, we observe initially no significant differences between family and non-family firms within the same wave (see Columns 3, 6 and 9 of Table 3). Nevertheless, the overall diffusion level of family and non-family firms increases from about 75 and 76 per cent in 2001 to 95 and 83 per cent in 2016, respectively. The high diffusion level in the first wave is due to

Mean values of family and non-family firms and their difference in respective year												
2001			2006				2011				2016	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	
QMS certification	0.76	0.75	0.88	0.82	0.06	0.86	0.87	-0.01	0.83	0.95	-0.12 ^{**}	
EMS certification	0.45	0.33	0.53	0.53	0	0.80	0.89	-0.09 [*]	0.78	0.68	0.10 [*]	
Integration	3.35	3.22	3.36	3.56	-0.20	3.67	3.63	0.04	3.48	3.45	0.03	
Difference of mean values between different years for same type of firm												
(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
01-06, non-family	01-06, family	06-11, non-family	06-11, family	11-16, non-family	11-16, family	01-16, non-family	01-16, family	01-11, non-family	01-11, family	06-16, non-family	06-16, family	
-0.12 ^{**}	-0.07	0.02	-0.05	0.03	-0.08 [*]	-0.07	-0.20 ^{**}	-0.10 [*]	-0.12 ^{**}	0.06	-0.13 ^{**}	
certification												
EMS	-0.20 ^{***}	-0.27 ^{***}	-0.36 ^{***}	0.02	0.21 ^{***}	-0.33 ^{***}	-0.35 ^{***}	-0.35 ^{***}	-0.56 ^{***}	-0.25 ^{***}	-0.15 ^{**}	
certification												
Integration	-0.01	-0.34 ^{**}	0.19 [*]	0.18 [*]	0.11	-0.13	-0.23 ^{**}	-0.32 ^{***}	-0.41 ^{***}	-0.07	-0.12	

Table 3. Certification and integration
 Depending on variable scale either t-test for equality of means or chi-square test for the equality of proportions, with significance levels being indicated by ^{***} $p < 0.01$, ^{**} $p < 0.05$, ^{*} $p < 0.1$; Diff., difference of mean values between non-family and family firms in same year

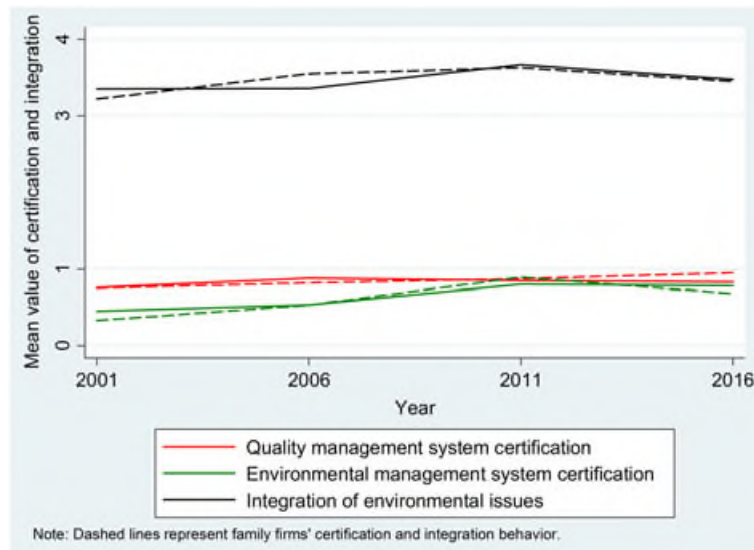


Figure 2. Certification and integration of environmental issues. [Colour figure can be viewed at wileyonlinelibrary.com]

the introduction of QMS certification schemes well before 2001.² Hence, the data on QMS certification shows the maturity phase of the corresponding diffusion curve, thus explaining why there exists only one statistically significant difference regarding the adoption behaviour of QMS certifications between family and non-family firms. Although not being continuously statistically significant, we observe the tendency of family firms towards a more risk-averse behaviour (in 2001 and 2006 family firms' QMS certification adoption is lower than that of non-family firms, see Columns 3 and 6 of Table 3) but at the same time a more conservative, and thus long-term oriented, adoption behaviour (the diffusion level of family firms increases in a less volatile way, and is thus more stable compared with that of non-family firms), resulting in a significantly higher diffusion level of family firms in the last wave (see Column 12 of Table 3).

The diffusion levels of EMS certification cannot be compared year by year with those for QMS certification, because the EMS certificates EMAS and ISO 14001 were introduced later than QMS certification (see Footnote 2). If anything, we could compare the diffusion level of QMS certification with the corresponding EMS certification levels in the subsequent waves. When comparing diffusion levels on this basis, we observe that in 2011 they are as high for EMS as for QMS certification (see Columns 7 and 8 of Table 3), indicating that the former diffused faster than the latter. Ultimately therefore, despite having been launched after QMS certification, in 2011 EMS certification has been adopted by 9 out of 10 family firms in our data set and also by nearly 80 per cent of non-family firms. In 2016 we observe a decrease of EMS certification for family firms.

Furthermore, regarding EMS certification, we observe a slightly different development than for QMS certification. This is because, other than for QMS certification, due to the later launch time of EMS certification, next to the maturity phase we also have information about the growth phase of the diffusion curve. In 2001, EMS certification has been adopted more by non-family firms compared with family firms. Hence, analogous to QMS certification, we observe that family firms are more cautious in adopting an EMS certification. The steadily increasing adoption behaviour of family firms regarding QMS certification is also found in the diffusion of EMS certifications. The EMS diffusion level of family firms increases from initially 33 per cent in 2001 to ultimately 89 per cent in the third wave. The EMS diffusion level of non-family firms saturates at a level of about 80 per cent (80 and 78 per cent in the years 2011 and 2016, respectively). Thus, we find evidence for both the above stated characteristics of family firms, namely (initial) risk aversion but also long-term orientation. One reason why QMS certification does not

²QMS certification is based on the most commonly used ISO 9001 standard and was first launched in 1987, before the first EMS standards, which have been implemented internationally only since 1993.

diffuse as fast as EMS certification is probably that QMS adoption is mainly market driven, while EMS adoption is mostly driven societally.

According to Wagner (2009), the lack of integrating environmental management activities with other managerial functions results in economic as well as ecologic inefficiencies. Since the integration of environmental management systems with core functions thus improves performance, we determined the differences of family and non-family firms regarding such integration. We find that family firms lag behind (in the first wave the difference of integration level between family firms and non-family firms is not significant, but four per cent higher for non-family firms; see Column 3 of Table 3), but a growth over the waves results in family firms catching up. We thus observe a significant, eight per cent increase in the integration level of family firms (see Column 20 of Table 3), but only a four per cent non-significant increase of non-family firms between the last and first waves. Thus, in the last wave the difference in the integration level between non-family and family firms shrinks to one per cent (see Column 12 of Table 3).

Stakeholder Cooperation

The higher degree of innovation complexity due to additional environmental requirements suggests that firms cooperate more intensively with stakeholders when it comes to environmentally beneficial innovations (Hall and Martin, 2005). Since environmental patents were found to associate positively with environmentally concerned, but negatively with environmentally neutral, stakeholders (Wagner, 2007), we analyse if the stakeholder cooperation differs for family and non-family firms.

Similar to the findings above, we find that family firms initially lag behind non-family firms with regard to stakeholder cooperation activities. Although the differences are not statistically significant, independent of the type of stakeholder, in 2001 non-family firms cooperate more with stakeholders than family firms (see Column 3 of Table 4, and Figure 3). We face a rather differentiated development between family and non-family firms regarding the different types of cooperation. While in 2016 non-family firms are less likely cooperate with predominantly environmentally concerned stakeholders as compared with 2001, family firms do not change their behaviour (see Column 19 of Table 5). Regarding partly environmentally concerned and environmentally neutral stakeholders, we observe an opposing development between family and non-family firms. While family firms increasingly cooperated with environmentally neutral stakeholders to catch up with the level of non-family firms, the latter did not change their cooperation intensity. Non-family firms significantly increased the cooperation behaviour with partly environmental stakeholders, while family firms did not change their cooperation behaviour at all (see Columns 19 and 20 of Table 5). This resulted in similar cooperative behaviours of family and non-family firms in 2016, except for the cooperation with partly environmentally concerned stakeholders. Hence, an equalizing process

	Mean values of family and non-family firms and their difference in respective year											
	2001			2006			2011			2016		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.
Predominantly environmentally concerned stakeholders	2.09	1.99	0.10	1.96	1.89	0.07	2.11	2.09	0.02	2.01	2.00	0.01
Partly environmentally concerned stakeholders	1.77	1.74	0.03	1.76	1.67	0.09	1.84	1.80	0.04	1.87	1.74	0.13*
Environmentally neutral stakeholders	2.08	1.98	0.10	2.04	1.98	0.06	2.19	2.18	0.01	2.09	2.07	0.02

Table 4. Stakeholder cooperation

t-test for equality of means, with significance levels being indicated by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Diff., difference of mean values between non-family and family firms in same year

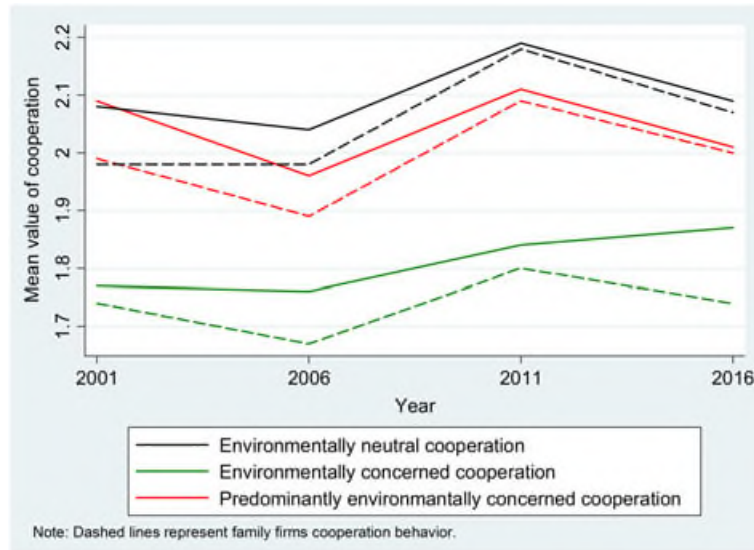


Figure 3. Stakeholder cooperation. [Colour figure can be viewed at wileyonlinelibrary.com]

of family firms’ cooperative behaviour with that of non-family firms cannot be observed regarding partly environmentally concerned stakeholders only. Again, we observe a rather stable and less volatile behaviour of family firms as compared with non-family firms. Overall, environmentally neutral stakeholders are the most important cooperation partners to family and non-family firms.

Environment-Related Economic Performance Dimensions

Implementation of certifications and environmental innovation activities as well as integration of environmental aspects and stakeholder cooperation are core antecedents to performance outcomes, which can be distinguished in market-, image-, efficiency- and risk-related dimensions (Dangelico, 2015; Wagner, 2009). With respect to these

	Difference of mean values between different years for same type of firm											
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	01–06, non-family	01–06, family	06–11, non-family	06–11, family	11–16, non-family	11–16, family	01–16, non-family	01–16, family	01–11, non-family	01–11, family	06–16, non-family	06–16, family
Predominantly environmentally concerned stakeholders	0.13	0.10	-0.15*	-0.20***	0.10	0.09	0.08	-0.01	-0.02	-0.10	-0.05	-0.11*
Partly environmentally concerned stakeholders	0.01	0.07	-0.08	-0.13*	-0.03	0.06	-0.10	0.00	-0.07	-0.06	-0.11*	-0.07
Environmentally neutral stakeholders	0.04	0.00	-0.15*	-0.20**	0.10	0.11*	-0.01	-0.09	-0.11	-0.20**	-0.05	-0.09

Table 5. Stakeholder cooperation (difference) t-test for equality of means, with significance levels being indicated by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

performance dimensions, in Columns 14, 16 and 20 of Table 7 we only observe negative values, indicating that the effect of above antecedents in each dimension is rising steadily for family firms over first two waves. A different picture emerges when analysing non-family firms. For these, we observe analogous effects for the market- and the efficiency-, and partly for the image-, but not for the risk-related economic performance dimension (see Columns 13, 15 and 19 of Table 7). Regarding the risk-related dimension the performance effect is largely decreasing, while it only increases in the last wave (see Figure 4, and Tables 6 & 7).

The consistently positive and largely significant values for the changes in all economic performance dimensions between non-family and family firms in the first wave (0.12, 0.06, 0.16 and 0.14) are evidence for a lagging effect of family firms. This finding is consistent with the above-discussed lagging effect of antecedent variables. Over time, on the efficiency-related dimension, family firms catch up with the performance effect of non-family firms. In 2011 the effects for the image- and risk-related dimensions, and in 2016 the effect for the market-related dimension, even become larger for family firms than for non-family firms. As explained in the introduction and the literature review, the risk- and image-related dimensions in particular are of very high importance for family firms. Thus, not only do

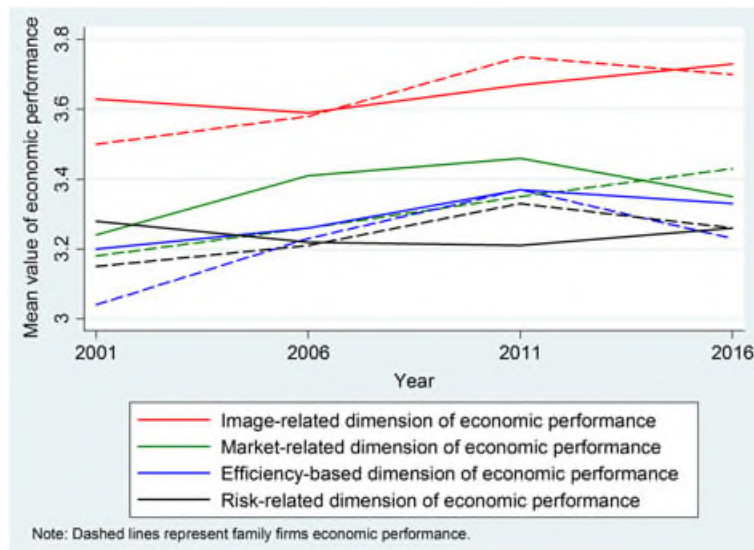


Figure 4. Environment-related economic performance dimensions. [Colour figure can be viewed at wileyonlinelibrary.com]

	Mean values of family and non-family firms and their difference in respective year											
	2001			2006			2011			2016		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.	Non-family	Family	Diff.
Image related	3.63	3.50	0.12*	3.59	3.58	0.01	3.67	3.75	-0.08	3.73	3.70	0.03
Market related	3.24	3.18	0.06	3.41	3.26	0.15*	3.46	3.35	0.11*	3.35	3.43	-0.08
Efficiency related	3.20	3.04	0.16**	3.26	3.23	0.03	3.37	3.37	0.01	3.33	3.23	0.10
Risk related	3.28	3.15	0.14**	3.22	3.21	0.00	3.21	3.33	-0.12*	3.26	3.26	0.00

Table 6. Environment-related economic performance dimensions
t-test for equality of means, with significance levels being indicated by *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Diff., difference of mean values between non-family and family firms in same year

	Difference of mean values between different years for same type of firm											
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	01–06, non-family	01–06, family	06–11, non-family	06–11, family	11–16, non-family	11–16, family	01–16, non-family	01–16, family	01–11, non-family	01–11, family	06–16, non-family	06–16, family
Image related	0.04	-0.07	-0.08	-0.17**	-0.06	0.05	-0.10*	-0.20**	-0.04	-0.25***	-0.14*	-0.12*
Market related	-0.17***	-0.08	-0.05	-0.09	0.11*	-0.08	-0.11*	-0.25***	-0.22***	-0.17**	0.06	-0.17***
Efficiency related	-0.06	-0.19**	-0.12*	-0.14**	0.04	0.14**	-0.13**	-0.19***	-0.18***	-0.33***	-0.07	0.00
Risk related	0.06	-0.06	0.01	-0.12*	-0.05	0.07	0.02	-0.11*	0.07	-0.18*	-0.04	-0.05

Table 7. Environment-related economic performance dimensions (difference) *t*-test for equality of means, with significance levels being indicated by ****p* < 0.01, ***p* < 0.05, **p* < 0.1

we find evidence for the long-term behaviour of family firms, but more importantly we are able to show that differences in performance effects between family and non-family firms vanish, or even reverse in 2011 and partly in 2016, which is consistent with a stronger long-term orientation of family firms.

To ensure that the development of differences discussed above does indeed relate to family or non-family status, we additionally performed a multivariate analysis. Table 8 provides the descriptive analysis including the bivariate correlation coefficients, while Table 9 shows for the different drivers of performance that the estimated models of a multivariate multiple regression analysis are significant overall after controlling for a number of important influences. Most of the performance drivers are found to be significantly lower in the first two waves (see Columns 1, 3 and 5 of Table 9). For the market-related performance driver the above-stated constantly increasing performance of family firms at later waves to catch up with and even overtake the performance effect of non-family firms is also found to be true in the multivariate analysis. All else being equal, the market-related performance of family firms is significantly higher in 2016 than in the previous years (see Column 2 of Table 9).

A further important finding from the multivariate analysis is that integration of sustainability aspects with business strategy is a significant predictor for positive environment-related economic performance effects in all four dimensions, with the impact being strongest for the market- and image-related dimensions.

Variables	Mean	Std dev.	Min.	Max.	(1)	(2)	(3)	(4)
(1) Integration of environmental aspects	3.465	0.848	1	5				
(2) Firm age ¹	4.004	0.872	0	5.971	-0.001			
(3) Quality management system	0.847	0.360	0	1	0.138	0.006		
(4) Number of employees ¹	6.266	2.110	1.946	13.321	0.033	0.152	0.135	
(5) Family firm	0.513	0.500	0	1	-0.005	0.204	0.048	-0.176

Table 8. Descriptive statistics and correlations *N* = 530; correlations with an absolute value greater than 0.072 are significant at *p* < 0.1; Std dev., standard deviation; Min., minimum in-sample value; Max., maximum in-sample value; ¹logarithmized

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Market	Market	Efficiency	Efficiency	Image	Image	Risk	Risk
Integration of environmental aspects	0.125 ^{***} (0.021)	0.128 ^{***} (0.021)	0.104 ^{***} (0.022)	0.103 ^{***} (0.023)	0.253 ^{***} (0.022)	0.252 ^{***} (0.022)	0.097 ^{***} (0.021)	0.096 ^{***} (0.021)
Firm age ¹	0.020 (0.021)	0.027 (0.021)	0.040 [*] (0.023)	0.036 (0.023)	0.037 [*] (0.022)	0.034 (0.023)	0.035 (0.022)	0.031 (0.022)
Quality management system	-0.015 (0.052)	-0.031 (0.052)	0.023 (0.056)	0.019 (0.056)	0.020 (0.055)	0.011 (0.055)	0.078 (0.053)	0.072 (0.053)
Number of employees ¹	0.015 (0.009)	0.018 [*] (0.010)	0.023 ^{**} (0.010)	0.024 ^{**} (0.010)	0.026 ^{***} (0.010)	0.029 ^{***} (0.010)	0.004 (0.010)	0.007 (0.010)
Year 2001	-0.182 ^{***} (0.047)	-0.090 (0.066)	-0.132 ^{***} (0.051)	-0.074 (0.071)	-0.091 [*] (0.050)	-0.023 (0.070)	-0.036 (0.048)	0.039 (0.067)
Year 2006	-0.106 ^{**} (0.050)	0.053 (0.073)	-0.049 (0.054)	-0.058 (0.079)	-0.112 ^{**} (0.053)	-0.072 (0.077)	-0.034 (0.051)	-0.022 (0.074)
Year 2011	-0.039 (0.048)	0.057 (0.068)	0.078 (0.051)	0.049 (0.073)	-0.056 (0.050)	-0.118 (0.072)	0.016 (0.049)	-0.018 (0.069)
Family firm	-0.022 (0.037)	0.119 ^{**} (0.060)	-0.082 ^{**} (0.0397)	-0.064 (0.065)	-0.012 (0.039)	0.015 (0.064)	-0.008 (0.038)	0.024 (0.061)
Year 2001 × family firm		-0.183 ^{**} (0.089)		-0.115 (0.097)		-0.132 (0.095)		-0.146 (0.091)
Year 2006 × family firm		-0.299 ^{***} (0.099)		0.013 (0.107)		-0.080 (0.105)		-0.027 (0.101)
Year 2011 × family firm		-0.181 [*] (0.093)		0.057 (0.100)		0.121 (0.098)		0.067 (0.095)
Constant	2.937 ^{***} (0.200)	2.773 ^{***} (0.205)	2.509 ^{***} (0.215)	2.507 ^{***} (0.222)	2.277 ^{***} (0.211)	2.26 ^{***} (0.217)		2.398 ^{***} (0.209)
R-squared	0.156	0.174	0.149	0.154	0.283	0.292		0.132
F-statistic	3.083 ^{***}	3.156 ^{***}	2.914 ^{***}	2.735 ^{***}	6.556 ^{***}	6.200 ^{***}		2.280 ^{***}

Table 9. Estimation results for market-, image-, efficiency- and risk-related drivers of economic performance

Significance levels are indicated by ^{***} $p < 0.01$, ^{**} $p < 0.05$, ^{*} $p < 0.1$; $N = 530$; 22 industry dummies variables at two-digit NACE level included in the estimation; standard errors are indicated in parentheses; ¹logarithmized

Discussion and Conclusions

Family firms constitute a significant part of the economy in terms of creating new technologies, jobs and wealth (Berleemann and Jahn, 2015; IFFERA, 2013). This depends on firms' ability to survive, in particular by adopting and implementing innovations, and thus by taking risks to achieve and maintain a competitive advantage. While environmentally beneficial product, process and organizational innovations contribute to building the positive reputation of a family firm (Berrone *et al.*, 2010; Deephouse and Jaskiewicz, 2013), the risk aversion of family firms induced by the family as owners could have an important negative influence on their environmental innovation activities. Yet, at the same time, the long-term orientation of family firms and their owners may be conducive for sustainable development. Our study addresses this particular trade-off situation by analysing how family and non-family firms differ with respect to their environmental behaviour in a longitudinal perspective using data from Germany in order to also derive broader insights from system-wide strategic perspective.

Regarding our research question RQ1 about the development of the environmental behaviour, we find that over time the environmental behaviour between German family and non-family firms converges. While in the first wave in 2001 non-family firms were superior regarding environment-related activities and beneficial product, process and organizational innovations as well as the economic performance dimension, the gap with family firms is reduced over time, and for some aspects such as environmentally beneficial product innovations we can even observe that in 2011 family firms become more active than non-family firms, while achieving equal levels in 2016. This catching-up process is found for almost all the different environment-related aspects. As concerns research question RQ2 about the environment-related performance outcomes of environmental product, process and organizational innovation, our findings indicate that the balance between the theoretically derived competing logics of long-term orientation and risk aversion changes over time. In early waves, the higher uncertainty of environmental innovation activities makes family firms' risk aversion dominant over their long-term orientation. In later waves, the uncertainty associated with environmental innovations is reduced such that the long-term orientation of family firms becomes more important, resulting in increased adoption of such innovations by family firms.

This paper is related to the literature on innovation systems as it provides insights into technological change, especially as related to environmental issues. More specifically, from a system perspective, these findings indicate that, at the aggregate level of a national economy, family firms may substantially help to balance innovation risks whilst not jeopardizing the ultimate level of innovatory activity. Furthermore, the strong effect of integration suggests furthermore that linking of issues relating to the natural environment in a comprehensive manner with business strategizing is a very powerful way to realize win-win situations and avoid paradoxes of sustainability challenges.

Given the heightened importance of image and reputation aspects for family firms (Deephouse and Jaskiewicz, 2013), in the 2011 wave this leads even to higher performance effects of these activities (as compared with non-family firms), whilst in the 2016 wave on nearly all the different performance dimensions family firms at least catch up with non-family firms. This finding is in line with a recent meta-analysis by Duran *et al.* (2015), who find that family firms invest less in innovation but achieve higher benefits from it. Whilst our findings regarding performance effects are certainly co-determined by the corresponding evolution of the key explanatory variables (i.e., since performance is determined by firm behaviour, it should evolve (possibly with some time lag) analogously with the latter), we also as a result note a convergence between structurally different firms. This convergence is in line with recent findings that, whilst family firms have lower levels of innovation activity, they appear to be better able to transfer these into performance outputs (Duran *et al.*, 2015), which can further explain the catching-up dynamics we observe. Our findings thus lead to the conclusion that initially different environmental behaviours between family and non-family firms do not ultimately disadvantage family firms, yet in the short run the risk aversion of family firms could result in a disadvantage compared with non-family firms. Family firms should thus be aware of the issue of allowing non-family competitors to achieve first-mover advantages, while being focused on the risks associated with environmentally beneficial investments.

As discussed above, environmental behaviour plays an important role as concerns the public image and performance of firms as well as for the achievement of sustainable development, and our findings hold some important practical insights and recommendations for businesses. Regarding the aspects where family firms are still lagging behind their non-family counterparts, the former may have to undertake strategic actions to catch up and even overtake non-family firms. Analysing the results of the catching-up process in detail, we observe that in the last wave

except for the level of QMS certification adoption no other environment-related behaviour of family firms is superior to those of non-family firms, while non-family firms' level of EMS certification adoption, cooperation intensity with environmentally concerned stakeholders and efficiency-related performance are significantly higher. As the results stem from actual data in 2016, family firms still have potential relative to non-family firm behaviour for environment-related improvement and could accordingly align their strategies. Furthermore, given that family firms are, as is also true in our dataset, smaller than their non-family counterparts (Block and Wagner, 2014; Zahra *et al.*, 2004), they have a lack of the human and financial resources that are potentially needed to adopt certifications, which may make them less likely to adopt EMS certification. While reputational and image-related reasons promote family firms' behaviour towards the adoption of EMS certification, it is the lack of resources and thus the risk associated with it that hinders its adoption. Thus, the above-stated differences may also be due to recent times of economic crisis, and therefore policy makers are advised to support family firms and particularly family-owned SMEs in acting pro-environmentally.

As outlined in the introductory section and the literature review, family firms face a trade-off between risk aversion and long-term orientation, and naturally this particularly concerns innovation, but less so the different environment-related variables, which may not imply risk. Thus, while product and process innovations are strongly affected by potentially high sunk cost and thus the risk of failure, this is much less likely for certification adoption.

From our analyses we can further conclude that family firms compared with non-family firms show more conservative behaviour in early phases of environmental innovation diffusion. Yet, at the same time we find evidence of a stronger long-term orientation, which makes family firm behaviour less volatile. In particular, our data reveals that family firms have caught up with or even overtaken non-family firms with respect to important aspects of environmental management since 2000. Our findings therefore also contribute to the literature on family firms and innovation (Block, 2012; Craig and Moores, 2006; Duran *et al.*, 2015; König *et al.*, 2013). So far, the empirical literature about family firms and innovation has mainly analysed R&D input and innovation output in general, whilst more narrow aspects such as the implementation of environmentally beneficial product, process and organizational innovations have been neglected. These narrower aspects of innovation are, however, very relevant from a practical perspective, as they influence the reputation of family firms with the public (Berrone *et al.*, 2010) and possibly also the competitiveness of family firms. Furthermore, we contribute to the literatures on environmental management and corporate sustainability more generally in showing how family and non-family firms compare in terms of one important aspect of their sustainability strategies and whether the two types of firm differ in their stakeholder management and engagement (Cruz *et al.*, 2014). Even though family firms care about their image of being a good and responsible company, they are risk averse in their approach towards the adoption of environmentally beneficial product, process and organizational innovations. They are more likely to adopt them when their effects are proven to be successful. However, once adopted, they are more likely than other firms to stick with them. Our findings illustrate the importance of taking a longitudinal perspective when investigating innovation and CSR in family firms. Finally, with our analysis we address calls to link organizational and field-level analyses and contribute an assessment of the degree to which family and non-family firms differ in their choice of sustainability strategies in the face of institutional pressures. Whilst we find initial differences in this respect, we show that, as predicted by institutional theory, the two types of firm converge (DiMaggio and Powell, 1983; Hoffman, 2001). Yet, whilst in terms of antecedent activities this suggests considerable isomorphism, with regard to performance outcomes we find that aspects idiosyncratic to family firms remain, most importantly in terms of their heightened concern for family image and reputation (Deephouse and Jaskiewicz, 2013).

As a limitation, it has to be acknowledged that culture and traditions may influence risk taking behaviour, which cautions to some degree against inference from our German sample to other countries. Still, Germany is a prime example of an economy highly influenced by family and small- and medium-sized firms, and these traditionally play a more important role regarding their economic impact in Germany than SMEs in other industrialized nations (Audretsch and Elston, 1997). The share of small- and medium-sized manufacturing firms is higher in Germany than in other countries such as France (Blanca and Baptiste, 2015). Furthermore, since family firms constitute a large share of small- and medium-sized firms, we may have to consider intercountry differences when transferring our findings to other countries. Although the behaviour of family firms will not necessarily change due these intercountry differences, the lagging behaviour of family members may be more important in Germany than in other industrialized countries, simply because of the higher share of family firms. Furthermore, higher levels of risk awareness ascribed to Germany, for example in the context of entrepreneurship, mainly concern societal reactions

to start-up failure or entrepreneurial intent, and typically not the behaviour of firms already active in the market. Thus again, any distorting effect of this on comparisons of family and non-family firms should be small. Even if this difference matters, at most in countries where risk awareness is higher than in Germany catching up of family firms should take longer, whilst in the opposite case family firms in the extreme might not lag behind at all. The comparative patterns between family and non-family firms would thus also ultimately be very similar and not affected by this difference in risk awareness across countries.

As a further limitation, it needs to be acknowledged that some of our data is only based on perceptions. This mainly concerns the self-reported data on economic performance, as well as the assessment of the levels of cooperation with different types of stakeholder and of integration of environmental issues with social and H&S aspects, quality and strategy.

Appendix

	2001			2006			2011			2016		
	Machine	Metal	Consum.	Machine	Metal	Consum.	Machine	Metal	Consum.	Machine	Metal	Consum.
Focal year mean	0.09	0.09	0.08	0.13	0.12	0.09	0.12	0.11	0.11	0.06	0.10	0.05
Remaining years (average) mean	0.14	0.13	0.11	0.09	0.08	0.11	0.11	0.10	0.06	0.11	0.11	0.10
Difference	-0.05	-0.04	-0.03	0.04	0.04	-0.02	0.01	0.01	0.05	-0.05	-0.01	-0.05

Table A1. Distribution of largest segments in the sample
Machine, machinery; Consum., consumption.

	Machinery (WZ 28)	Metal (WZ 25)	Consumption (WZ 10, 11)
Number of firms	5997	7205	5917
%	0.14	0.16	0.14

Table A2. Distribution of largest segments versus population: 2011 (total 43 738)
Based on German Federal Statistical Office (2012).

	2001	2006	2011	2016	Overall
Non-family	46.99%	48.33%	50.77%	47.5%	48.18%
Family	53.01%	51.67%	49.23%	52.5%	51.82%
Total (absolute)	166	120	130	217	633

Table A3. Distribution of family firms

References

- Armstrong JS, Overton TS. 1977. Estimating nonresponse bias in mail surveys. *Journal of Marketing Research* 14: 396–402. <https://doi.org/10.2307/3150783>
- Audretsch DB, Elston JA. 1997. Financing the German Mittelstand. *Small Business Economics* 9: 97–110. <https://doi.org/10.1023/A:1007963621438>
- Bagozzi RP. 1984. A prospectus for theory construction in marketing. *Journal of Marketing* 48: 11–29. <https://doi.org/10.2307/1251307>

- Baumast A, Dyllick T. 2001. Umweltmanagement-Barometer 2001. Institute for Economy and the Environment, University of St. Gallen, St. Gallen.
- Berlemann M, Jahn V. 2015. Regional importance of Mittelstand firms and innovation performance. *Regional Studies*. <https://doi.org/10.1080/00343404.2015.1058923>
- Berman SL, Wicks AC, Kotla S, Jones TM. 1999. Does stakeholder orientation matter? The relationship between stakeholder management models and firm financial performance. *Academy of Management Journal* 42: 488–506. <https://doi.org/10.2307/256972>
- Berrone P, Cruz C, Gomez-Mejia LR, Larraza-Kintana M. 2010. Socioemotional wealth and corporate responses to institutional pressures: do family-controlled firms pollute less? *Administrative Science Quarterly* 55: 82–113. <https://doi.org/10.1080/0969160X.2011.593832>
- Blanca N, Baptiste T. 2015. SME Investment and Innovation: France, Germany, Italy and Spain. KfW Bankengruppe: Frankfurt am Main, Germany; 1–128.
- Block JH. 2010. Family management, family ownership, and downsizing: evidence from S&P 500 firms. *Family Business Review* 23: 1–22. <https://doi.org/10.1177/0894486509360520>
- Block JH. 2012. R&D investments in family and founder firms: an agency perspective. *Journal of Business Venturing* 27: 248–265. <https://doi.org/10.1016/j.jbusvent.2010.09.003>
- Block JH, Wagner M. 2014. The effect of family ownership on different dimensions of corporate social responsibility: evidence from large US firms. *Business Strategy and the Environment* 23: 475–492. <https://doi.org/10.1002/bse.1798>
- Brammer S, Hojmosse S, Marchant K. 2012. Environmental management in SMEs in the UK: practices, pressures and perceived benefits. *Business Strategy and the Environment* 21: 423–434. <https://doi.org/10.1002/bse.717>
- Bryson JR, Lombardi R. 2009. Balancing product and process sustainability against business profitability: sustainability as a competitive strategy in the property development process. *Business Strategy and the Environment* 18: 97–107. <https://doi.org/10.1002/bse.640>
- Bundesanstalt für Arbeit (BfA). 2000. Written communication of the Bundesanstalt für Arbeit on the number of firms in the German manufacturing sector as of 31 December 1999. Data provided on 8 August 2000.
- Calza F, Profumo G, Tutore I. 2016. Corporate ownership and environmental proactivity. *Business Strategy and the Environment* 25: 369–389. <https://doi.org/10.1002/bse.1873>
- Cote JA, Buckley MR. 1987. Estimating trait, method, and error variance: generalizing across 70 construct validation studies. *Journal of Marketing Research* 24: 315–318. <https://doi.org/10.2307/3151642>
- Craig J, Dibrell C. 2006. The natural environment, innovation, and firm performance: a comparative study. *Family Business Review* 19: 275–288. <https://doi.org/10.1111/j.1741-6248.2006.00075.x>
- Craig JB, Moores K. 2006. A 10-year longitudinal investigation of strategy, systems, and environment on innovation in family firms. *Family Business Review* 19: 1–10. <https://doi.org/10.1111/j.1741-6248.2006.00056.x>
- Cruz C, Larraza-Kintana M, Garcés-Galdeano L, Berrone P. 2014. Are family firms really more socially responsible? *Entrepreneurship Theory and Practice* 38: 1295–1316. <https://doi.org/10.1111/etap.12125>
- Dangelico RM. 2015. Green product innovation: where we are and where we are going. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.1886>
- Darnall N, Jolley GJ, Handfield R. 2008. Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment* 17: 30–45. <https://doi.org/10.1002/bse.557>
- Deephouse DL, Jaskiewicz P. 2013. Do family firms have better reputations than non-family firms? An integration of socioemotional wealth and social identity theories. *Journal of Management Studies* 50: 337–360. <https://doi.org/10.1111/joms.12015>
- DiMaggio PJ, Powell WW. 1983. The iron cage revisited: institutional isomorphism and collective rationality in organization fields. *American Sociological Review* 48: 147–160.
- Donaldson T, Preston LE. 1995. The stakeholder theory of the corporation: concepts, evidence, and implications. *Academy of Management Review* 20: 65–91. <https://doi.org/10.5465/AMR.1995.9503271992>
- Duran P, Kammerlander N, van Essen M, Zellweger T. 2015. Doing more with less: innovation input and output in family firms. *Academy of Management Journal*. <https://doi.org/10.5465/amj.2014.0424>
- Dyer WG, Whetten DA. 2006. Family firms and social responsibility: preliminary evidence from the S&P 500. *Entrepreneurship Theory and Practice* 30: 785–802. <https://doi.org/10.1111/j.1540-6520.2006.00151.x>
- Freeman RE. 1984. Strategic Management: a Stakeholder Approach. Pitman: Boston, MA.
- German Federal Statistical Office. 2012. Produzierendes Gewerbe - Beschäftigung und Umsatz der Betriebe des Verarbeitenden Gewerbes sowie des Bergbaus und der Gewinnung von Steinen und Erden nach Bundesländer 2011. https://www.destatis.de/GPStatistik/servlets/MCRFileNodeServlet/DEHeft_derivate_00009568/2040414117004.pdf [29 September 2017].
- Gómez-Mejía LR, Haynes KT, Núñez-Nickel M, Jacobson KJ, Moyano-Fuentes J. 2007. Socioemotional wealth and business risks in family-controlled firms: evidence from Spanish olive oil mills. *Administrative Science Quarterly* 52: 106–137. <https://doi.org/10.2189/asqu.52.1.106>
- Hall JK, Martin MJC. 2005. Disruptive technologies, stakeholders and the innovation value-added chain: a framework for evaluating radical technology development. *R&D Management* 35: 273–284. <https://doi.org/10.1111/j.1467-9310.2005.00389.x>
- Hall JK, Vredenburg H. 2003. The challenges of sustainable development innovation. *Sloan Management Review* 45: 61–68. [https://doi.org/10.1016/S0959-6526\(01\)00048-8](https://doi.org/10.1016/S0959-6526(01)00048-8)
- Hart SL, Sharma S. 2004. Engaging fringe stakeholders for competitive imagination. *Academy of Management Executive* 18: 7–18. <https://doi.org/10.5465/AME.2004.12691227>
- Henriques I, Sadosky P. 2007. Environmental technical and administrative innovations in the Canadian manufacturing industry. *Business Strategy and the Environment* 16: 119–132. <https://doi.org/10.1002/bse.475>
- Hoffman AJ. 2001. Linking organizational and field-level analyses: the diffusion of corporate environmental practice. *Organization and Environment* 14: 133–156. <https://doi.org/10.1177/1086026601142001>

- Holt D. 2011. Where are they now? Tracking the longitudinal evolution of environmental businesses from the 1990s. *Business Strategy and the Environment* 20: 238–250. <https://doi.org/10.1002/bse.697>
- International Family Enterprise Research Academy (IFERA). 2013. Family businesses dominate. *Family Business Review* 16: 235–240. <https://doi.org/10.1111/j.1741-6248.2003.tb00019.x>
- König A, Kammerlander N, Enders A. 2013. The family innovator's dilemma: how family influence affects the adoption of discontinuous technologies by incumbent firms. *Academy of Management Review* 38: 418–441. <https://doi.org/10.5465/amr.2011.0162>
- Le Breton-Miller L, Miller D. 2006. Why do some family businesses out-compete? Governance, long-term orientations, and sustainable capability. *Entrepreneurship Theory and Practice* 30: 731–746. <https://doi.org/10.1111/j.1540-6520.2006.00147.x>
- Lindell MK, Whitney DJ. 2001. Accounting for common method variance in cross-sectional research designs. *Journal of Applied Psychology* 86: 114–121. <https://doi.org/10.1037/0021-9010.86.1.114>
- Lumpkin GT, Brigham KH, Moss TW. 2010. Long-term orientation: implications for the entrepreneurial orientation and performance of family businesses. *Entrepreneurship and Regional Development* 22: 241–264. <https://doi.org/10.1080/08985621003726218>
- Masurel E. 2007. Why SMEs invest in environmental measures: sustainability evidence from small and medium-sized printing firms. *Business Strategy and the Environment* 16: 190–201. <https://doi.org/10.1002/bse.478>
- Miller D, Le Breton-Miller I. 2005. *Managing for the Long Run: Lessons in Competitive Advantage from Great Family Businesses*. Harvard Business Press: Boston, MA.
- Mir DF. 2008. Environmental behaviour in Chicago automotive repair micro-enterprises (MEPs). *Business Strategy and the Environment* 17: 194–207. <https://doi.org/10.1002/bse.517>
- Özsoy A, Calantone RJ, Di Bonetto A. 1997. What makes firms more innovative? A look at organizational and environmental factors. *Journal of Business and Industrial Marketing* 12: 400–416. <https://doi.org/10.1108/08858629710190259>
- Panwar R, Nybakk E, Pinkse J, Hansen E. 2015. Being good when not doing well examining the effect of the economic downturn on small manufacturing firms' ongoing sustainability-oriented initiatives. *Organization and Environment* 28: 204–222. <https://doi.org/10.1177/1086026615573842>
- Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology* 88: 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Podsakoff PM, MacKenzie SB, Podsakoff NP. 2012. Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology* 63: 539–569. <https://doi.org/10.1146/annurev-psych-120710-100452>
- Podsakoff PM, Organ DW. 1986. Self-reports in organizational research: problems and prospects. *Journal of Management* 12: 69–82. <https://doi.org/10.1177/014920638601200408>
- Post JE, Preston LE, Sachs S. 2002. Managing the extended enterprise: the new stakeholder view. *California Management Review* 45: 6–28. <https://doi.org/10.2307/41166151>
- Rueda-Manzanares A, Aragón-Correa JA, Sharma S. 2008. The influence of stakeholders on the environmental strategy of service firms: the moderating effects of complexity, uncertainty and munificence. *British Journal of Management* 19: 185–203. <https://doi.org/10.1111/j.1467-8551.2007.00538.x>
- Schaltegger S, Wagner M. 2011. Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business Strategy and the Environment* 20: 222–237. <https://doi.org/10.1002/bse.682>
- Schulze WS, Lubatkin MH, Dino RN. 2002. Altruism, agency, and the competitiveness of family firms. *Managerial and Decision Economics* 23: 247–259. <https://doi.org/10.1002/mde.1064>
- Sharma P, Chrisman JJ, Chua JH. 1997. Strategic management of the family business: past research and future challenges. *Family Business Review* 10: 1–35. <https://doi.org/10.1111/j.1741-6248.1997.00001.x>
- Sharma S. 2001. Different strokes: regulatory styles and environmental strategy in the North-American oil and gas industry. *Business Strategy and the Environment* 10: 344–364. <https://doi.org/10.1002/bse.303>
- Smith K. 2005. Measuring innovation. In *The Oxford Handbook of Innovation*, Mowery DC, Nelson RR, Fagerberg J (eds). Oxford University Press: Oxford; 148–177.
- Waddock SA, Bodwell C, Graves SB. 2002. Responsibility: the new business imperative. *Academy of Management Executive* 16: 132–148. <https://doi.org/10.5465/AME.2002.7173581>
- Wagner M. 2007. On the relationship between environmental management, environmental innovation and patenting: evidence from German manufacturing firms. *Research Policy* 36: 1587–1602. <https://doi.org/10.1016/j.respol.2007.08.004>
- Wagner M. 2009. Innovation and competitive advantages from the integration of strategic aspects with social and environmental management in European firms. *Business Strategy and the Environment* 18: 291–306. <https://doi.org/10.1002/bse.585>
- Williams LJ, Hartman N, Cavazotte F. 2010. Method variance and marker variables: a review and comprehensive CFA marker technique. *Organizational Research Methods* 13: 477–514. <https://doi.org/10.1177/1094428110366036>
- World Commission on Environment and Development (WCED). 1987. *Our Common Future*. Oxford University Press: Oxford.
- Yin H, Schmeidler PJ. 2009. Why do standardized ISO 14001 environmental management systems lead to heterogeneous environmental outcomes? *Business Strategy and the Environment* 18: 469–486. <https://doi.org/10.1002/bse.629>
- Zahra SA, Hayton JC, Salvato C. 2004. Entrepreneurship in family vs. non-family firms: a resource-based analysis of the effect of organizational culture. *Entrepreneurship Theory and Practice* 28: 363–381. <https://doi.org/10.1111/j.1540-6520.2004.00051.x>
- Zellweger TM, Kellermanns FW, Chrisman JJ, Chua JH. 2012. Family control and family firm valuation by family CEOs: the importance of intentions for transgenerational control. *Organization Science* 23: 851–868. <https://doi.org/10.1287/orsc.1110.0665>
- Zollo M, Cennamo C, Neumann K. 2013. Beyond what and why – understanding organizational evolution towards sustainable enterprise models. *Organization and Environment* 26: 241–259. <https://doi.org/10.1177/1086026613496433>