Sustainability practices of family and nonfamily firms: A worldwide study

Abstract

As sustainability is pivotal in combating the global warming and climate change crisis, we examine whether family firms differ from their nonfamily counterparts in the sustainability practices they adopt. Using a large sample of listed firms from 45 countries over an 8-year period, we show that family firms on average engage less in pollution prevention, green supply chain management, and green product development practices than nonfamily firms. Our results remain consistent after correcting for the endogeneity of family ownership, using alternative model specifications and variable definitions. Our findings hold important implications for both theory and practice.

Keywords: sustainability practices, environmental practices, family firms, family business

1. Introduction

Unlike nonfamily firms, the behavior of family firms is anchored in their loss-aversion to socioemotional wealth (SEW) (Cennamo et al., 2012; Gast et al., 2018; Gomez-Mejia et al., 2011; Kotlar et al., 2018) rather than financial wealth. This is explained by the fact that family firms are mainly concerned about their ability to maintain managerial discretion and control of the firm (Berrone et al., 2012). However, we know less than we should about whether family firms differ from their nonfamily counterparts in the sustainability practices adopted, which are increasingly important to mitigate climate change (Bansal and DesJardine, 2014; European Environmental Agency, 2011; Filser et al., 2019; UN-DESA, 2013). In particular, internal sustainability practices (pollution prevention and green supply chain management) help firms reduce costs and environmental risks, thus leading to wealth creation. Instead, external sustainability practices (green product development) allow firms to meet the expectations of external stakeholders, including customers, suppliers, NGOs, regulators and communities, hence improving the firm's legitimacy and reputation (Hart and Milstein, 2003).

With regard to the studies on the sustainability practices of family firms, very few are cross-sectional (Graafland, 2020; Memili et al., 2018; Richards et al., 2017), tending to focus on a single country (Berrone et al., 2010; Delmas and Gergaud, 2014). They typically assume that firms engage in a homogenous set of sustainability practices (Berrone et al., 2010; Endrikat et al., 2014), analyzing an aggregate construct of corporate social responsibility (CSR) (Campopiano and De Massis, 2015; Dyer and Whetten, 2006; García-Sánchez et al., 2020; Marques et al., 2014)[1], while neglecting the multidimensionality of sustainability practices (Endrikat et al., 2014; Hart and

[1] An aggregate construct of CSR has several issues. The different elements of CSR typically share very little variance, and aggregate constructs neglect relevant differences among them (McWilliams et al., 2019). As Griffin and Mahon (1997) highlight: "Collapsing (CSR's) multiple dimensions into a unidimensional index may mask the individual dimensions that are equally relevant and important".

Milstein, 2003). A common belief is that the presence of family influence affects the firm's strategic behavior (Chua et al., 1999; De Massis et al., 2021; Xi et al., 2015; Yu et al., 2020), and thus its sustainability practices. However, their nature and magnitude at the global level is unclear, and thus whether family firms excel in sustainability practices or not.

Family firms are the dominant ownership type worldwide (De Massis et al., 2018b, La Porta et al., 1999), and an international and longitudinal study accounting for both their internal and external sustainability practices may provide a holistic view of the non-financial objectives of family firms. This would not only enrich our knowledge of family business behavior, but might also improve environmental policymaking and regulations for firms with concentrated ownership. This is imperative given that investments in sustainability practices across the world are steadily increasing, reaching $600 billion this year (Paul, 2019).

We study the sustainability practices of family firms using a comprehensive sample of 10,508 firm-year observations for 2032 publicly traded firms from 45 countries and 19 industrial sectors over the period 2007–2014. Specifically, we examine the extent to which family firms vs non family firms engage in pollution prevention, green supply chain management, and green product development practices over time.

We first perform several univariate tests to understand whether family firms excel in sustainability practices or not, and whether this varies across different types of practices, industries, and countries. We find that compared to nonfamily firms, family firms are weaker in their pollution prevention, green supply chain management, and green product development practices, suggesting that they are less sensitive to sustainability than nonfamily firms. Moreover, the sustainability practices of family firms are particularly low in the industrial and utility sectors, and in developing countries.

We then examine the difference in sustainability practices between family and nonfamily firms using the pooled ordinary least squares (OLS) estimator with and without control variables. According to the multivariate analysis, compared to their nonfamily counterparts, family firms adopt fewer pollution prevention, green supply chain management, and green product development practices over time. These results remain unchanged when we re-estimate our explanatory model adopting alternative definitions of sustainability practices and family influence.

We then take advantage of the longitudinal nature of our dataset to mitigate several potential empirical pitfalls in our study. Given that the treatment (being a family firm) is not randomly assigned to ensure the equality of firms before treatment, self-selection-based endogeneity poses a challenge to a causal interpretation of our findings. Therefore, we first adopt the endogenous treatment (ET) regression-estimator using a set of instrumental variables (IVs) to mitigate the potential selection-based endogeneity problem of family influence. However, another possible source of endogeneity is the reverse causality issue that might arise between sustainability practices and the control variables. To mitigate this issue, we estimate our explanatory model using the ET regressions-estimator with lagged values of all the firm-level control variables following Amore et al. (2014). After accounting for different sources of the endogeneity problem, we again find that family influence is on average detrimental to sustainability practices over time.

Our study contributes to the literature in several ways. First, it substantially enriches knowledge on the drivers of firm environmental behavior by demonstrating the importance of ownership concentration and explicitly accounting for the multidimensionality of organizational sustainability. Second, it reveals important insights on the relationship between family influence and sustainability practices, responding to the calls of Sharma and Sharma (2011), and Villalonga (2018), amongst others. Third, our study contributes to the debate in the regulatory, business, and academic communities on the sustainable actions of publicly traded firms by comparing the pollution prevention, green supply chain management, and green product development practices of family vs. nonfamily firms.

The paper is structured as follows: the next section provides an overview of the literature on the sustainability practices of family firms, and postulates our hypotheses. Section 3 describes the data and methodology adopted. In section 4, we present the main findings and the results of the robustness tests. Thereafter, we provide the implications, limitations, and suggestions for future research. Section 6 concludes our work.

2. Theory and hypotheses

Family firms account for two thirds of all businesses worldwide (De Massis et al., 2018b). For instance, more than half of publicly traded firms in the US are controlled by families (Villalonga and Amit, 2010), and in Western Europe, over 40 percent (Faccio and Lang, 2002). In many countries, family firms constitute the backbone of the national economy (De Massis et al., 2018b). Moreover, they are viewed as a proactive force that can contribute to the mitigation of climate change (Sharma and Sharma, 2011, 2019), and deliver sustainable shareholder value (Hart and Milstein, 2003; Villalonga, 2018). For example, various characteristics of family firms, including lower agency costs (Chrisman et al., 2004; Le Breton-Miller and Miller, 2006), higher social capital (Arregle et al., 2007; Koropp et al., 2013; Salvato and Melin, 2008), family involvement and emotional attachment to the firm (Gómez-Mejía et al., 2007), firm-specific human capital (Kang and Kim, 2020; Miller et al., 2014), and image and reputational concerns (Bichler et al., 2021; Deephouse and Jaskiewicz, 2013; Sageder et al., 2018), can be strong incentives to invest more in sustainability practices compared to nonfamily firms. Taking into account these distinctive characteristics of family firms, we expect that investments in sustainability practices aimed at long-term survival and success are likely to play an important role in these firms. Indeed, compared to their nonfamily counterparts, family firms are known for their "… tendency to prioritize the long-range implications and impact of decisions and actions that come to fruition after an extended time period" (Lumpkin et al., 2010, p. 241). In fact, Villalonga et al. (2015) highlight that a long-term perspective is often adopted to understand family business behavior (Block and Henkel, 2010; Brigham et al., 2013; Lumpkin et al., 2010), and Miroshnychenko et al. (2021) found that that families in business invest generously in their firm and its growth due to the temporally extended benefits that will bring to their offspring, the firm, and its stakeholders. Our study also follows the long-term perspective in developing a set of arguments concerning the sustainability practices of family vs. nonfamily firms.

2.1 Pollution prevention practices

Pollution prevention practices include waste and emission reduction in current operations (Nishitani et al., 2011). These practices represent an ample opportunity for firms to lower the cost of raw materials and waste disposal in the long term, thereby increasing production efficiency (Ambec and Lanoie, 2008; Hart and Milstein, 2003). They also allow developing technological skills and capabilities that are particularly important for family firms that often have limited resources (De Massis et al., 2018a). The early study by Berrone et al. (2010) shows that in the US, family firms pollute less than their nonfamily counterparts.

A vast number of studies also show that pollution prevention practices lead to extraordinary financial performance (Ambec and Lanoie, 2008; Endrikat et al., 2014; Miroshnychenko et al., 2017), essential for family firms that often lag financially behind their nonfamily counterparts (Amit and Villalonga, 2020; Miller et al., 2007). In fact, some authors argue that family firms can achieve better financial returns from pollution prevention practices than nonfamily firms (Gomez-

Mejia et al., 2019).

Furthermore, risk can be substantially reduced through pollution prevention practices by minimizing the litigation costs associated with harming the environment (Ambec and Lanoie, 2008). This is particularly critical for family firms driven by a long-term orientation aimed at maintaining and sustaining the business across generations, and therefore eager to preserve their reputation and legacy in the long run (Kansikas, 2015).

Given the theoretical propositions and empirical evidence (Berrone et al., 2010; Gomez-Mejia et al., 2019), we expect that long-term oriented family firms are likely to excel in pollution prevention practices over time compared to nonfamily firms. Thus, we posit:

H1: Family firms engage more in pollution prevention practices over time than nonfamily firms.

2.2 Green supply chain management practices

Green supply chain management practices allow minimizing or even eliminating different types of waste along the supply chain (Sarkis, 2003; Srivastava, 2007). These include written environmental policies and communication material, questionnaires and audits, training and technical assistance, collaborative research and development with suppliers, lean operations, supplier purchasing, environmental purchasing policies, and complex restructuring relationships with suppliers (de Bakker et al., 2002; Golicic and Smith, 2013).

Even if green supply chain management practices allow firms to innovate their business model and thus contribute to their overall competitiveness (Cillo et al., 2019; Sarkis, 2003), these practices are found to be the least adopted green practices in publicly traded firms (Albino et al., 2009). Specifically, the reluctance to adopt green supply chain management practices can be particularly severe among family firms whose resistance to change and innovating their business models can be quite strong (Miller et al., 2003). Greening the firm’s entire supply chain is a very complex process and requires a substantial amount of financial and human resources (Sarkis, 2003), which are often limited in family firms compared to their nonfamily counterparts (Miller et al., 2014; Sirmon and Hitt, 2003). In addition, restructuring relationships with different players in the supply chain, often extending over very long periods of time (Huybrechts et al., 2011), can be an extremely challenging and risky process. Therefore, we expect that green supply chain management practices are likely to be more rarely adopted in family firms than nonfamily firms that have a higher degree of flexibility and openness to complex environmental approaches, such as green supply chain management practices. Hence:

H2: Family firms engage less in green supply chain management practices over time than nonfamily firms.

2.3 Green product development practices

Green product development practices focus on minimizing the negative environmental impact of a product (de Souza Moraes et al., 2019; Shahzad et al., 2020). Extended producer responsibility, eco-design, and green marketing programs are typical examples of green product development practices adopted by corporations worldwide (Albino et al., 2009). Family business giants such as Panasonic, Toyota, Porsche, and Samsung excel in delivering eco-friendly products to the market by introducing bio-based, recycled materials, and eco-packaging to minimize the environmental impact of their products (Galler, 2020; Todd, 2020). Integrating environmental aspects in the firm's product development processes creates long-term technological and investment opportunities (Albino et al., 2009; Ambec and Lanoie, 2008; Testa et al., 2015). This is particularly relevant for family firms, which are known to excel in and benefit from exploring these opportunities at a substantially greater pace and scale than any other organizational type (Andres, 2011; Eddleston et al., 2008).

Furthermore, green product development practices allow the firm to develop strong relationships with its customers and external stakeholders (Albino et al., 2009; Delmas and Gergaud, 2014). Family firms are often strongly embedded and attached to their local communities and customers (Basco, 2015; Baù et al., 2019), and therefore more likely than nonfamily firms to engage in green product development practices that allow them to maintain their 'local roots' and strong connections with stakeholders. In addition, these practices can allow family firms to reach out to new market segments and emerging green markets (Albino et al., 2009; Delmas and Gergaud, 2014), ensuring their long-term vitality, thus making green product development practices highly attractive to these firms. Some cross-sectional studies suggest that due to their transgenerational intensions, family firms are more likely to position their products as eco-friendly, for example, in the US wine industry (Delmas and Gergaud, 2014). Thus:

H3: Family firms engage more in green product development practices over time than nonfamily firms.

3. Data

3.1 Sample

The starting point of our data collection was Miroshnychenko et al.'s (2017) ASSET4 full universe list covering constituents of principal stock indices worldwide over the period 2002–2014, including publicly traded firms from 58 countries. We then matched this database against the NRG Metrics Family Firms database (hereafter NRG) created by a team of expert analysts who manually enter, review, and crosscheck data with senior analysts performing frequent random audits, covering publicly traded firms from 46 countries over the 2007–2017 period. Indeed, these two databases have been validated in both the management and finance literature (Aouadi and Marsat, 2016; Delis et al., 2019). Then, we collected financial and accounting data from Thomson

Reuters Datastream and deleted observations with missing financial and accounting data. Given that environmental data was only available up to 2014, our final sample is limited to this year. Therefore, our final dataset covers 2032 firms in 45 countries and 19 industrial sectors over the period 2007–2014. Tables 1 and 2 show the composition of our sample by geographic location and industry (two-digit industry codes).

(Insert Tables 1 and 2 here)

3.2 Measures of sustainability practices

To capture the multidimensionality of organizational sustainability, we constructed proxies for the pollution prevention, green supply chain management, and green product development practices following Miroshnychenko et al. (2017) and Testa et al. (2018).

To assess the *pollution prevention* practices, we considered the following: toxic chemicals reduction (Nishitani et al., 2011), emissions from transport (Comoglio and Botta, 2012), nitrogen and sulphur oxide emissions (Hoque and Clarke, 2013), waste and e-waste reduction (Franchetti, 2011), particulate matter and volatile organic compounds emission (Newbold, 2006), air emissions (Hart and Ahuja, 1996), water and energy efficiency (Gusmerotti et al., 2012).

With respect to *green supply chain management* practices, we considered: phasing out selection procedures (Handfield et al., 2005), environmental criteria to source or eliminate materials (Sarkis, 2003), including the supply chain in the firm’s efforts to lessen its overall environmental impact (Srivastava, 2007), adopting environmental criteria in supplier selection (Testa and Iraldo, 2010).

To measure *green product development* practices, we selected those aimed at reducing the environmental impact, such as eco-design practices (Zhu et al., 2005), promoting a cost-effective and environmentally preferable use (Nissinen et al., 2007), and complying with an environmental performance standard (Testa et al., 2015).

The detailed definitions of the pollution prevention, green supply chain management, and green product development practices are provided in Table 3.

(Insert Table 3 here)

3.3 Definition of family firm

Our *family firm* variable is defined as firms in which the founding family holds fractional equity ownership and/or family members serve on the board of directors, coded as a dummy variable equal to 1 if the founder, descendant, or a family member is director or large shareholder, 0 otherwise (source NRG Metrics) following Anderson and Reeb (2003).

3.4 Control variables

Given that firms in good financial health are in a better position to finance their sustainability practices than financially constrained firms (Delmas and Burbano, 2011), we include several proxies of financial constraints in out model. Specifically, the *cash* variable is estimated as the ratio of the sum of net income and all non-cash charges or credit to total assets (Vomberg et al., 2015), while *debt* is measured as the ratio of total debt to total assets (Barnea and Rubin, 2010). We also control for stock *volatility* in our explanatory model, estimated as the market beta based on between 25 and 35 consecutive month end price percent changes and their relativity to the local market index (Gómez-Mejía et al., 2010). In addition, we include the firm's *growth* rate estimated as the log-difference of net sales for firm *i* at time *t* and time *t-1* to control for firm growth.

Given that some studies show that having external investors can shape family business sustainability practices (Lamb and Butler, 2016; Xiang et al., 2020), we control for the influence of *institutional investors* (number of shares held by institutional investors) and *independent investors* (number of shares held by independent directors of the board). Larger and older companies are better able to resist pressure from the external environment than smaller and younger firms due to their experience, connections, and resources (Meznar and Nigh, 1995). We thus include in our model a proxy of firm *size* measured as the natural logarithm of total assets, and firm *age*, computed as the natural logarithm of the number of years since the firm's incorporation.

Furthermore, we consider the Herfindahl-Hirschman index (*HHI*) as a proxy of industry concentration. HHI is estimated as the sum of the squared market shares (measured using segment sales at the industry level) ranging from 0 to 1 (Nawrocki and Carter, 2010). In addition, we include 19 industry (two-digit industry codes) and 8 time dummy variables in our explanatory model to control for systematic differences in sustainability practices across different sectors and time periods, including economic shocks (Dess et al., 1990; Ducassy, 2012).

Finally, several studies show that environmental sensitivity can be determined by the institutional and legal characteristics of the country in which the firm operates (Kock and Min, 2015; Kock et al., 2012; Ortiz-de-Mandojana et al., 2016). Therefore, we include 45 country dummies to rule out any alternative explanations for institutional and legal country-level differences.

All control variables using financial and/or accounting data are winsorized at the 1% level in both tails to mitigate the effects of extremes values.

3.5 Descriptive statistics and correlations

Table 4 provides the summary characteristics of the whole sample and the correlations for all the variables used in the analysis. Family-controlled firms constitute around 24% of our sample.

(Insert Table 4 here)

The correlation coefficients between *family firm* and the sustainability practices variables (variable values of 2 to 4) are highly statistically significant, ranging in absolute values from -.09 to -0.13 ($p < 0.01$). The mean of the variance inflation factors of all the independent and control variables used in the analysis is below 3, indicating the absence of multicollinearity.

4. Empirical analysis

4.1 Univariate analysis

Table 5 presents the univariate tests of the pollution prevention, green supply chain management, and green product development practices for family and nonfamily firms over the 2007–2014 period (Panel A), the univariate tests of sustainability practices for family and nonfamily firms by industry (Panel B), and the univariate tests of sustainability practices for family and nonfamily firms by continent (Panel C).

(Insert Table 5 here)

Panel A shows that family firms engage less in sustainability practices than their nonfamily counterparts. This striking finding is confirmed for the three sustainability practices (pollution prevention, green supply chain management, and green product development). Thus, the lower environmental awareness of family firms compared to nonfamily firms translates into significantly fewer sustainability practices.

Panel B shows that nonfamily firms operating in the industrial, transportation, and utilities industries engage in more pollution prevention practices than family firms at the 1% level, suggesting that family firms are less likely to engage in pollution reduction practices. We obtain the same result for the green supply chain management and green product development practices, with the exception of the transportation industry where family firms seem to not significantly differ from nonfamily firms.

Panel C shows that family firms engage less in pollution prevention, green supply chain management, and green product development practices than nonfamily firms regardless of their geographic location (1% level). This difference is particularly striking for family firms in developing countries, usually characterized by weaker rule of law and environmental awareness (Itsubo et al., 2018; Zhu et al., 2005) compared to developing countries.

In summary, the results of the univariate analysis suggest that family firms around the world engage significantly less in pollution prevention, green supply chain management, and green product development practices than their nonfamily counterparts, particularly when they operate in the industrial or utilities sectors.

4.2 Multivariate analysis

Our goal is to estimate the effect of family influence on sustainability practices. To this end, we estimate the following preliminary explanatory model:

$$SP_{ic,t} = \beta_0 + \beta_1(family\ firm_{ic}) + d_t + i_i + c_i + e_{ic,t} \qquad (1)$$

where *i* refers to firms, *c* to countries, *t* to years, $SP_{ic,t}$ is one of the sustainability practices proxy (*pollution prevention*, *green supply chain management*, or *green product development*), $family\ firm_{ic}$ is the proxy of family influence, d_t represents time fixed effects, i_i industry fixed effects (two-digit industry codes), c_i captures country fixed effects, and $\varepsilon_{ic,t}$ is an error term.

The results reported in Table 6 show that family influence has a negative impact on the pollution prevention (Model 1: $\beta = -0.498$; $p < 0.01$), green supply chain management (Model 2: $\beta = -0.242$; $p < 0.01$), and green product development practices (Model 3: $\beta = -0.222$; $p < 0.01$). These findings provide preliminary evidence that family firms underperform environmentally across the board.

(Insert Table 6 here)

Next, we estimate our main explanatory model including the vector of control variables ($volatility_{ic,t}$, $debt_{ic,t}$, $cash_{ic,t}$, $growth_{ic,t}$, $institutional\ investors_{ic,t}$, $independent\ investors_{ic,t}$, $size_{ic,t}$, $age_{ic,t}$ and $HHI_{ic,t}$) described in the previous section to rule out alternative explanations:

$$SP_{ic,t} = \beta_0 + \beta_1(family\ firm_{ic}) + \beta_2(controls_{ic,t}) + d_t + i_i + c_i + e_{ic,t} \quad (2)$$

After including control variables in Models 4–6 of Table 6, the regression coefficients of the *family firm* variable reduce in magnitude, but with the same negative signs, remaining statistically highly significant (1% level). Specifically, family influence has a negative impact on the pollution prevention, green supply chain management, and green product development practices at the 1% level, accounting for various firm-, time-, industry- and country-level differences in our sample. Thus, our preliminary results reject H1 and H3, but support H2.

The Wald tests of the joint significance of the time, industry, and country dummies are statistically significant at the 1% level in all the models, justifying controlling for unobserved heterogeneity across time, industries, and countries in the explanatory model. In other words, there is significant variability in the sustainability practices of family and nonfamily firms over time, across industries and countries, confirming the results of the univariate tests. Worth noting is that including the firm-level fixed effects in our explanatory model is not feasible due to the rarity of changes in the *family firm* variable (Dyer and Whetten, 2006; Villalonga and Amit, 2006).

4.3 Endogeneity concerns

The main econometric challenge in our study is estimating the effect of family influence on sustainability practices using non-experimental data where the treatment (being a $family\ firm_{ic}$) is not randomly assigned to ensure the equality of firms before treatment. Consequently, our regression estimates may be subject to a selection-based endogeneity problem associated with unobservables that might bias our estimates, even though we control for various firm-, time-, industry-, and country-level differences in our sample. The treatment effect may be heterogeneous across firms, and could exert an influence on both the decision to become a family firm and on our dependent variable, thus potentially leading to an endogeneity problem. To mitigate the possible family influence endogeneity concerns, we estimate the endogenous treatment regression-model, a specific type of treatment effect (TE) model that helps us come close to the randomized experiment by means of secondary data. Our endogenous treatment regression model includes two main equations: one for the endogenous treatment ($family\ firm_{ic}$), and one for the outcome variable ($SP_{ic,t}$) under the assumption of non-orthogonality between the error terms of both equations.

The endogenous treatment equation is a probit regression that predicts the treatment condition (probability of being a family firm (=1) or nonfamily firm (=0)) using the instrumental variables (IVs) and control variables. To meet the exclusion restriction for the model's identification, we adopt two IVs – *quotation* (logarithm of the number of years the firm has been listed) and *wedge* (the difference between voting share and cash-flow rights share) – excluded from the equation of the outcome model. *Quotation* is potentially a good IV – although (nearly) randomly determined and unlikely to be related to the firm's sustainability practices – and a good predictor of the probability of being a family firm or not, as De Massis et al. (2020) suggest. Indeed, the results from the probit regressions in all the columns of Table 7 indicate that the likelihood of being a *family firm* significantly reduces as the number of years the firm has been listed increases (1% level), accounting for various firm-, time-, industry-, and country-level characteristics. As a second instrument, we exploit a unique trait of family firms as the only blockholder whose voting rights typically exceed their cash flow rights (Barontini and Caprio, 2006; Villalonga and Amit, 2010), namely the *wedge*. However, it is very unlikely that the wedge affects a firm's propensity to engage in sustainability practices. In the outcome equation, our dependent variable is regressed against the treatment condition ($family\ firm_{ic}$), and the same endogenous-treatment equation controls. The self-selection coefficient (λ) is also included in the outcome equation.

(Insert Table 7 here)

The results are reported in Models 1–6 of Table 7. We again find that the effects of the *family firm* variable on the pollution prevention (Model 1), green supply chain management (Model 2), and green product development (Model 3) practices are negative and statistically highly significant (1% level), accounting for various firm-, time-, industry-, and country-level differences in our sample. As an additional check of potential simultaneity concerns between our dependent variable and firm-level control variables, we also re-estimate all the TE regressions by adopting all the firm-level controls lagged by one year (Models 4-6) following Amore et al. (2014). We find empirical support only for H2, but reject H1 and H3. In brief, family firms on average engage less in sustainability practices than nonfamily firms over time.

4.4 Robustness tests

To verify the sensitivity of our findings to the alternative definition of our dependent variable, we recalculate all three sustainability practice proxies using principal component analysis (Jackson, 1991) that allows obtaining linear combinations with the highest variance. In this context, the factors that we use in our analysis have an eigenvalue above one, a common indication that factors should be retained. The results of our analysis using the alternative definition of our dependent variable (reported in Panel A of Table 8), provide empirical support for our main findings. The negative effects of the *family firm* variable on all sustainability practices are of a similar magnitude and level of statistical significance as our estimates in Tables 6 and 7.

(Insert Table 8 here)

To check the sensitivity our main findings to an alternative family firm definition, we re-ran our main explanatory model (2) defining family firms using the 25% cutoff point for the existence of a control chain (family firm variable equal to 1 if the founder or a descendant holds at least 25% of voting rights, 0 otherwise), the same threshold that Kowalewski et al. (2009); Achleitner et al. (2014), and Andres (2008) use. As Panel B of Table 8 shows, adopting the alternative family firm definition does not alter our main findings. Specifically, the negative family firm effects on the sustainability practices remain strongly significant in all the specifications.

A final concern in our estimates is that they might be influenced by the global financial crisis of 2007–2010 as a confounding variable. Given that the financial crisis may be correlated with family firms' propensity to engage in sustainability practices and ownership stake, the omission of this variable from our explanatory model could bias our estimates. An advantage of our explanatory model is that the longitudinal nature of our data allows us to effectively control for time-variant heterogeneity by including the time dummies in all our estimates, thus explicitly accounting for the possible confounding effect of the global financial crisis in our estimations.

5. Discussion, implications and limitations

Motivated by the increasing sustainability pressures on businesses around the world in response to the climate change crisis (Bansal and DesJardine, 2014; European Environmental Agency, 2011; UN-DESA, 2013), this study has examined the largely neglected topic of family and nonfamily firms' sustainability practices using a large sample of publicly traded firms from 45 countries over an 8-year period.

Our study shows that family influence is detrimental to pollution prevention, green supply chain management, and green product development practices. Our study suggests that addressing the climate change crisis through engaging in sustainability practices seems to be much more important for nonfamily firms, which pay significantly more attention to sustainability practices. In particular, we show that family firms underperform across the board in their sustainability practices. In so doing, this study contributes to the literature in three important ways.

First, we considerably expand knowledge on the antecedents of environmental business behavior by showing the importance of ownership concentration and explicitly accounting for the multidimensionality of organizational sustainability. Specifically, we provide unambiguous insights regarding family influence on the pollution prevention, green supply chain management, and green product development practices, paving the way for future research on the interplay between family firms and the environment. Therefore, the conclusions of the seminal study of Berrone et al. (2010) limited to the US context, a single sustainability practice, and a relatively short period of time, are not confirmed when the analysis focuses on an international sample of firms, heterogeneous sustainability practices, and a larger time window. It might be that the pro-social behaviors of family firms take different forms (i.e., better employee-, diversity-, sustainable innovation, environmental certification-related practices (Ardito et al., 2019; Block and Wagner, 2014; Rehman et al., 2021; Singh et al., 2020), but this is beyond the scope of our study, and thus a fruitful area for future research mapping the pro-social practices of family firms with circular economy business models (Ferasso et al., 2020).

Second, we respond to the call of Sharma and Sharma (2011) to bridge the family business and sustainability research fields by providing important insights on the link between family influence and sustainability practices. Unlike prior research on family business behavior studying their sustainability, social and governance practices in an aggregate manner (Campopiano and De Massis, 2015; Dyer and Whetten, 2006; Marques et al., 2014), the present study focuses solely on sustainability practices, explicitly accounting for their multidimensionality. This provides a novel view in the environmental literature and addresses the recent call of Villalonga (2018) on understanding the nexus between different ownership types and sustainability performance, while accounting for multidimensionality. Therefore, this study serves as a point of departure for future research aiming to better understand the sustainability strategies and actions of publicly traded firms with concentrated ownership. We particularly encourage longitudinal studies considering a wide range of concentrated ownership types and various sustainability practices, allowing to further establish their causal relations across different industries, countries and business periods. Meta-analytical and bibliometric studies (Combs et al., 2018; Ferreira et al., 2019; Rovelli et al., 2021; Xi et al., 2015) investigating the effect of concentrated ownership on corporate sustainability would also help us better understand the environmental behavior of family firms and identify potential moderating conditions. Studies using mixed-methods approach are also welcome to uncover the environmental decision-making process of family business owners and key stakeholders, particularly non-family managers, employees or advisers.

Finally, another interesting aspect of our study is its contribution to the debate in the regulatory, business, and academic communities on the adoption of sustainability practices in publicly traded firms (Hollis, 2019; Roston, 2019), considered a top priority to ensure long-term survival and prosperity in different parts of the world (UNESCO, 2019). By identifying the impact of family influence on sustainability practices, our study provides novel empirical support for policymakers encouraging the enforcement of environmental policies and regulations for family firms around the globe. As the noted architect Richard Rogers emphasized: “The only way forward, if we are going to improve the quality of the environment, is to get everybody involved”. Given the ubiquity of family firms in the global economy (De Massis et al., 2018b; La Porta et al., 1999), the role of family business owners and managers can not be underestimated in facing environmental challenges.

5.1 Theoretical and practical implications

Our study also has several important theoretical implications. Our results challenge the stewardship perspective by showing that family firms dedicate fewer organizational resources not only to long-term investments, such as R&D (Choi et al., 2015; Kotlar et al., 2014; Orlando et al., 2020), but also to sustainability practices. Therefore, the long-term orientation predicted by stewardship theory proponents (Kappes and Schmid, 2013; Lumpkin and Brigham, 2011) does not necessarily hold. As such, this study adds to the growing criticism of the relevance of stewardship theorization in the family business context (Amit and Villalonga, 2020; Chrisman, 2019; Schulze et al., 2001).

Furthermore, while research on the nexus between family influence and sustainability practices has neglected the multidimensionality of organizational sustainability (Berrone et al., 2010; Block and Wagner, 2014; Campopiano and De Massis, 2015), we go a step further and show the family business effects on the pollution prevention, green supply chain management, and green product development practices. In so doing, we extend this research stream by providing a nuanced and empirically substantiated understanding of the role of family influence on different sustainability practices in longitudinal settings. With this insight, we shed definitive light on the average effect of family influence on sustainability practices over time in cross-industry and cross-country settings.

Third, our study enriches and extends the literature on the environmental behavior of listed firms with concentrated ownership (Dal Maso et al., 2020; Gomez-Mejia et al., 2019; Villalonga, 2018). To date, studies on sustainability practices have mainly investigated the effects of state ownership (Liu et al., 2019; Maung et al., 2016; Pan et al., 2020) and private ownership (Earnhart and Lizal, 2006), while our study provides novel empirical evidence on the effect of family ownership/management on sustainability practices, paving the way for future studies on the role of the controlling family in the firm's environmental decisions, thus addressing the call of Villalonga (2018).

Several important practical implications also derive from our study. Despite that listed firms are increasingly under pressure to improve their environmental outlook (de Souza Moraes et al., 2019; Kassinis and Vafeas, 2006; Venturelli et al., 2020), our findings demonstrate that family-controlled firms seem to be substantially less environmentally active compared to their nonfamily counterparts. Thus, business owners, managers, and advisors of family firms should consider improving the sustainability pillar of their corporate strategy so as not to be left behind by the competition, and thus start excelling environmentally. This can be achieved by critically reflecting on their business strengths, and building the sustainability pillar on these strengths. Potential investors and nonfamily shareholders should also pay attention to firm ownership and the ownership structure in evaluating the business prospects and risks related to the environmental challenges.

Furthermore, our findings have strong implications for policymakers as a suitable basis for policy actions fostering the adoption of sustainability practices in the corporate sector, particularly among firms with concentrated ownership structure. Sustainability is the focus of increasing attention in the design of public policies for organizations in general, and firms with concentrated ownership in particular, which given their ubiquity (De Massis et al., 2018b; La Porta et al., 1999) are crucial for the growth of economies across the world (Amit and Villalonga, 2020; La Porta et al., 2013). In this regard, our results are particularly useful, as they provide novel empirical evidence on the level and dissemination of sustainability practices among family and nonfamily firms around the world.

5.2 Limitations and future research avenues

We also acknowledge the limitations of our work, which provide fruitful avenues for future research. As in many other studies examining the long-term orientation of family firms (Le Breton-Miller and Miller, 2006; Miller and Le Breton-Miller, 2005), we do not directly measure long-term orientation associated with a firm's adoption of environmental practices. Nevertheless, we perform a wide range of sensitivity tests to rule out alternative explanations of our main results, highlighting that the sustainability practices are indeed a function of family firms' long-term orientation. Therefore, we encourage future research on the sustainability practices of family businesses to examine the validity of our findings by measuring different types of long-term investments.

Given that our sample covers only publicly traded firms, we hope that others will extend our work to private family firms insulated from financial markets and adopting different investment strategies (Carney et al., 2015). Some good examples in this domain already exist (e.g., Uhlaner et al., 2012). It may also be useful to study the sustainability and communication practices of family firms to understand whether there are any divergences due to the conflicting institutional logics they often face (Lyon and Montgomery, 2015; Venturelli et al., 2020). This is particularly important today in the face of the greenwashing scandals (Testa et al., 2018; Thompson, 2019) and irresponsible corporate behavior in different parts of the world (UNEP, 2019).

In addition, our study is based on secondary data sources with all their inherent limitations. Therefore, we encourage future studies on the non-financial performance of family firms using primary data or a combination of different data sources to further test our conclusions. We also encourage scholars to study the sustainability practices of family firms using qualitative research methods (De Massis and Kammerlander, 2020) to understand how the organizational processes and routines that family firms vs. nonfamily firms adopt affect their sustainability actions.

Finally, our work disentangles the average effect of family business on sustainability practices. Understanding extreme environmental family business outcomes is beyond the scope of this study. However, we agree with the recent research call of Miller and Le Breton-Miller (2020) on the importance of studying the tendency toward extremes in family business behavior. Therefore, we encourage future research to go further and examine the entire distribution of sustainability practices of family firms, as compared to their nonfamily counterparts. Specifically, understanding of family business among the sustainability champions and among the most polluting businesses can help us unpack the potential heterogeneity in family business behavior towards the environment.

6. Conclusion

Climate change, biodiversity loss, depletion of natural resources, ocean acidification, pollution represent some of the most important sustainability challenges that our society is facing nowadays. Consequently, many businesses around the globe have started to integrate the sustainability dimension into their daily operations (de Souza Moraes et al., 2019; Shahzad et al., 2020; Venturelli et al., 2020).

This study has examined the role of family influence on the sustainability practices of firms worldwide. We find that family firms engage less in pollution prevention, green supply chain management, and green product development practices than nonfamily firms over time. Our results remain constant after correcting for endogeneity of family ownership, using alternative model specifications and variable definitions. Taken together, our findings suggest that family-controlled firms globally lag behind their counterparts in mitigating their environmental impact.

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Table 1
Distribution of the sample by geographic location.

Country	Nonfamily firms %	Family firms %	Total %
Australia	5.37	5.38	5.37
Austria	0.91	0.44	0.80
Belgium	0.82	0.72	0.80
Bermuda	0.04	0.56	0.16
Brazil	1.46	1.44	1.46
Virgin Islands	0.01	0.00	0.01
Canada	5.81	8.02	6.33
Chile	0.14	0.20	0.15
China	0.24	0.76	0.36
Czech Republic	0.14	0.00	0.10
Denmark	1.08	0.80	1.02
Finland	1.60	0.76	1.40
France	4.04	6.98	4.74
Germany	4.26	2.77	3.91
Greece	0.45	1.44	0.68
Hong Kong	0.96	4.89	1.89
Hungary	0.06	0.24	0.10
India	0.52	5.17	1.63
Indonesia	0.42	0.44	0.43
Ireland	0.71	1.16	0.82
Israel	0.22	0.24	0.23
Italy	1.43	2.17	1.61
Japan	11.59	3.85	9.76
South Korea	0.74	0.72	0.73
Luxembourg	0.35	0.56	0.40
Malaysia	0.5	0.6	0.52
Mexico	0.29	0.88	0.43
Netherlands	1.75	1.04	1.58
New Zealand	0.27	0.08	0.23
Norway	1.33	0.00	1.02
Philippines	0.20	0.88	0.36
Poland	0.46	0.32	0.43
Portugal	0.57	0.00	0.44
Qatar	0.07	0.00	0.06
Russia	1.47	0.60	1.26
Singapore	1.41	0.88	1.28
South Africa	1.15	0.56	1.01
Spain	1.58	1.97	1.67
Sweden	2.19	0.88	1.88
Switzerland	2.42	2.37	2.41
Taiwan	0.25	1.08	0.45
Thailand	0.40	0.36	0.39

Turkey	0.25	1.81	0.62
United Kingdom	11.59	9.95	11.20
United States	28.46	25.99	27.87
Total	100	100	100

Notes: Family firms are those in which the founding family holds fractional equity ownership and/or family members serve on the board of directors.

Table 2
Distribution of the sample by industry group (two-digit industry codes).

Industry group	**Nonfamily firms %**	**Family firms %**	**Total %**
Apparel (16)	0.49	1.40	0.70
Automotive (19)	1.92	3.73	2.35
Beverages (22)	2.13	1.76	2.05
Chemicals (25)	6.30	3.25	5.58
Construction (28)	6.21	10.23	7.17
Diversified (31)	4.48	3.53	4.25
Electrical (37)	1.70	1.04	1.54
Electronics (40)	11.39	15.08	12.27
Food (46)	3.89	4.05	3.93
Machinery & Equipment (49)	6.18	1.28	5.02
Metal producers (52)	6.56	8.95	7.13
Metal product manufacturers (55)	2.08	1.48	1.94
Oil, gas, coal and related services (58)	9.79	11.63	10.23
Paper (61)	1.88	1.36	1.76
Printing & Publishing (64)	1.58	2.57	1.82
Textiles (73)	0.42	0.36	0.41
Transportation (79)	4.90	4.33	4.77
Utilities (82)	14.52	5.86	12.47
Miscellaneous (85)	13.55	18.09	14.63
Total	100	100	100

Notes: Family firms are those in which the founding family holds fractional equity ownership and/or family members serve on the board of directors. In the miscellaneous industry group are all firms not falling into one of the major industry group classifications.

Table 3
Definition of sustainability practices.

Variable	Description
Pollution prevention (source: TR ASSET 4)	Sum of the 10 emission and resource reduction KPIs: 1. Emissions: Does the company describe, claim to have, or mention processes in place to improve emission reduction? (Yes=1/No=0) 2. Nitrogen Oxide (NOx) and Sulfur Oxide (SOx) Emissions Reduction: Does the company report on initiatives to reduce, reuse, recycle, substitute, or phase out SOx or NOx emissions? (Yes=1/No=0) 3. Volatile Organic Compounds (VOC) Emissions Reductions: Does the company report on initiatives to reduce, substitute, or phase out VOC? (Yes=1/No=0) 4. Particular Matter Emissions Reductions: Does the company report on initiatives to reduce, substitute, or phase out particulate matter less than ten microns in diameter (PM10)? (Yes=1/No=0) 5. Waste Reduction Total: Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out total waste? (Yes=1/No=0) 6. e-Waste Reduction: Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out e-waste? (Yes=1/No=0) 7. Staff Transportation Impact Reduction: Does the company report on initiatives to reduce the environmental impact of transportation used for its staff? (Yes=1/No=0) 8. Water Efficiency: Does the company describe, claim to have, or mention processes in place to improve its water efficiency? (Yes=1/No=0) 9. Energy Efficiency: Does the company describe, claim to have, or mention processes in place to improve its energy efficiency? (Yes=1/No=0) 10. Toxic Chemicals or Substances Reduction: Does the company report on initiatives to reduce, reuse, substitute or phase out toxic chemicals or substances? (Yes=1/No=0)
Green supply chain management (source: TR ASSET4)	Sum of the 4 resource reduction KPIs: 1. Environmental Supply Chain: Does the company describe, claim to have, or mention processes in place to include the supply chain in its efforts to lessen its overall environmental impact? (Yes=1/No=0) 2. Materials Sourcing Environmental Criteria: Does the company claim to use environmental criteria (e.g., life cycle assessment) to source or eliminate materials? (Yes=1/No=0) 3. Environmental Supply Chain Management: Does the company use environmental criteria (ISO 14001, energy consumption, etc.) in selecting its suppliers or sourcing partners? (Yes=1/No=0) 4. Environment Supply Chain Partnership Termination: Does the company report or show to be ready to end a partnership with a sourcing partner if environmental criteria are not met? (Yes=1/No=0)
Green product development (source: TR ASSET4)	Sum of the 3 product innovation KPIs: 1. Environmental Products: Does the company report on at least one product line or service designed to have positive effects on the environment or is environmentally labelled and marketed? (Yes=1/No=0) 2. Product Environmental Responsible Use: Does the company report on product features and applications or services that will promote responsible, efficient, cost-effective and environmentally preferable use? (Yes=1/No=0) 3. Eco-design Products: Does the company report on specific products designed for reuse, recycling, or the reduction of environmental impacts? (Yes=1/No=0)

Table 4
Descriptive statistics and correlations.

	Mean	S.D.	1	2	3	4	5	6	7
1 Family firm	0.237	0.425	1.000						
2 Pollution prevention	3.645	2.411	-0.104***	1.000					
3 Green supply chain management	1.509	1.452	-0.095***	0.589***	1.000				
4 Green product development	1.174	1.162	-0.129***	0.485***	0.490***	1.000			
5 Volatility	1.027	0.571	0.047***	-0.050***	-0.048***	-0.003	1.000		
6 Debt	0.255	0.159	-0.120***	0.076***	0.082***	0.012	-0.054***	1.000	
7 Cash	0.105	0.067	0.078***	-0.106***	-0.116***	-0.124***	0.002	-0.240***	1.000
8 Growth	0.061	0.193	0.087***	-0.146***	-0.140***	-0.153***	0.053***	-0.055***	0.208***
9 Institutional investors	12.889	16.163	0.004	-0.006	-0.003	-0.013	0.009	-0.006	-0.005
10 Independent investors	0.645	4.251	0.101***	-0.046***	0.002	-0.026**	0.014	0.004	0.021**
11 Size	16.525	2.448	-0.109***	0.391***	0.292***	0.315***	-0.041***	0.174***	-0.185***
12 Age	3.847	0.946	-0.175***	0.216***	0.223***	0.258***	-0.087***	0.071***	-0.146***
13 HHI	0.090	0.120	-0.002	0.046***	0.098***	-0.004	-0.081***	0.034***	-0.003

	8	9	10	11	12	13
8 Growth	1.000					
9 Institutional investors	0.003	1.000				
10 Independent investors	0.011	-0.016	1.000			
11 Size	-0.067***	-0.012	-0.066***	1.000		
12 Age	-0.143***	0.025**	0.016	0.168***	1.000	
13 HHI	-0.013	0.018*	-0.012	-0.050***	-0.006	1.000

Notes: Time, country, and industry dummies are not shown. All the definitions of variables are provided in the Data section. *p<.10, **p<.05, ***p<.01.

Table 5
Univariate tests
Panel A. Mean difference of sustainability practices by firm type.

	Family firms (1) Mean	**Nonfamily firms (2)** Mean	**Difference in means** (1) - (2)
Pollution prevention	3.245	3.769	-0.524**
Green supply chain management	1.279	1.580	-0.301***
Green product development	0.918	1.253	-0.335***

Notes: This panel presents the independent sample t-tests with unequal variances on equality of means of sustainability practices by firm type. *p<.10, **p<.05, ***p<.01.

Panel B. Mean difference of the sustainability practices by industry and firm type.

	Family firms (1) Mean	**Nonfamily firms (2)** Mean	**Difference in means** (1) - (2)
Pollution prevention			
Industrial	3.268	3.655	-0.387***
Utility	2.826	4.315	-1.488***
Transportation	3.324	4.046	-0.722**
Green supply chain management			
Industrial	1.317	1.579	-0.262***
Utility	0.815	1.702	-0.887***
Transportation	1.130	1.252	-0.122
Green product development			
Industrial	0.949	1.313	-0.363***
Utility	0.493	1.083	-0.590***
Transportation	0.843	0.774	0.069

Notes: This panel presents the independent sample t-tests with unequal variances on equality of means of the sustainability practices by industry and firm type. Industrial firms include apparel, automotive, beverages, chemicals, construction, diversified, electrical, electronics, food, machinery, metal producers, metal product manufacturers, oil and gas, paper, printing, publishing, and textiles. *p<.10, **p<.05, ***p<.01.

Panel C. Mean difference of the sustainability practices by continent and firm type.

	Family firms (1) Mean	**Nonfamily firms (2)** Mean	**Difference in means** (1) - (2)
Pollution prevention			
North America	2.802	3.358	-0.557***
Europe	3.679	3.987	-0.308***
Asia	3.932	4.400	-0.467***
Others	1.769	3.276	-1.507***
Green supply chain management			
North America	1.066	1.174	-0.108*
Europe	1.631	1.993	-0.362***

Asia	1.424	1.767	-0.342***
Others	0.476	1.113	-0.637***
Green product development			
North America	0.864	1.113	-0.248***
Europe	1.114	1.336	-0.222***
Asia	0.989	1.656	-0.667***
Others	0.266	0.742	-0.476***

Notes: This panel presents the independent sample t-tests with unequal variances on equality of means of sustainability practices by continent and firm type. North America includes USA and Canada. Europe includes Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Asia includes China, Hong-Kong, India, Indonesia, South Korea, Kazakhstan, Malaysia, Philippines, Singapore, Taiwan, Thailand and Turkey. Others are Australia, Bermuda, Brazil, Virgin Islands, Chile, Israel, Mexico, New Zealand, Qatar, Russia, South Africa. *$p<.10$, **$p<.05$, ***$p<.01$.

Table 6
Pooled OLS regressions.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	Pollution prevention	Green supply chain management	Green product development	Pollution prevention	Green supply chain management	Green product development
Family firm	-0.498***	-0.242***	-0.222***	-0.146***	-0.117***	-0.131***
	(0.056)	(0.032)	(0.023)	(0.054)	(0.032)	(0.024)
Volatility				-0.077*	0.094***	0.052***
				(0.040)	(0.023)	(0.018)
Debt				-0.584***	-0.059	-0.349***
				(0.155)	(0.090)	(0.067)
Cash				2.086***	1.352***	0.498***
				(0.342)	(0.202)	(0.161)
Growth				-1.097***	-0.444***	-0.326***
				(0.111)	(0.068)	(0.051)
Institutional investors				0.000	0.001	-0.000
				(0.001)	(0.001)	(0.001)
Independent investors				-0.006	0.005	-0.002
				(0.004)	(0.003)	(0.002)
Size				0.909***	0.464***	0.260***
				(0.017)	(0.010)	(0.008)
Age				0.244***	0.062***	0.100***
				(0.025)	(0.016)	(0.012)
HHI				-1.070*	0.563*	0.443**
				(0.587)	(0.333)	(0.216)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.546***	1.708***	0.184	-10.920***	-5.175***	-3.781***
	(0.320)	(0.169)	(0.145)	(0.384)	(0.216)	(0.188)
Observations	10491	10508	10507	9198	9213	9212
Adjusted R^2	0.165	0.235	0.337	0.371	0.373	0.412

Notes: This table presents estimates of the pooled OLS regressions with robust standard errors (in parentheses). All definitions of variables are provided in the Data section. **p*<.10; ***p*<.05; ****p*<.01

Table 7
Endogenous treatment regressions.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Outcome variable:	Pollution prevention	Green supply chain management	Green product development	Pollution prevention	Green supply chain management	Green product development
Family firm	-1.042**	-0.410**	-0.635**	-0.766**	-0.268*	-0.727**
	(0.178)	(0.112)	(0.094)	(0.225)	(0.138)	(0.118)
Controls (as in Table 6)	Yes	Yes	Yes	No	No	No
Lagged controls	No	No	No	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-10.556**	-5.097**	-3.602**	-8.552**	-4.155**	-2.715**
	(0.389)	(0.219)	(0.192)	(0.461)	(0.252)	(0.243)
Endogenous treatment:	Family firm	Family firm	Family firm	Family firm	Family firm	Family firm
Quotation	-0.264**	-0.249**	-0.257**	-0.243**	-0.231**	-0.248**
	(0.026)	(0.025)	(0.025)	(0.033)	(0.032)	(0.032)
Wedge	1.771**	1.781**	1.832**	1.723**	1.752**	1.818**
	(0.239)	(0.237)	(0.228)	(0.292)	(0.291)	(0.276)
Controls (as in Table 6)	Yes	Yes	Yes	No	No	No
Lagged controls	No	No	No	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.086	0.039	0.062	-0.017	-0.058	-0.003
	(0.084)	(0.083)	(0.082)	(0.109)	(0.107)	(0.106)
Athrho	0.278**	0.151**	0.339**	0.209**	0.084	0.394**
	(0.052)	(0.054)	(0.059)	(0.067)	(0.064)	(0.074)
Lnsigma	0.660**	0.145**	-0.090**	0.642**	0.159**	-0.077**
	(0.010)	(0.008)	(0.011)	(0.011)	(0.008)	(0.015)
Mill's λ	0.525	0.173	0.298	0.391	0.099	0.347
Observations	9047	9062	9061	6213	6228	6227
Wald test of indep. eqns. (p-value)	0.000	0.005	0.000	0.018	0.189	0.000

Notes: This table presents estimates of the endogenous treatment regressions with robust standard errors (in parentheses). All definitions of control variables are provided in the Data section. *p<.10, **p<.05, * p<.01.

Table 8
Robustness tests.
Panel A. Alternative definition of sustainability practices.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	Pollution prevention $_{PCA}$	Green supply chain management $_{PCA}$	Green product development $_{PCA}$	Pollution prevention $_{PCA}$	Green supply chain management $_{PCA}$	Green product development $_{PCA}$
Family firm	-0.009**	-0.081***	-0.112***	-0.275***	-0.288***	-0.0539***
	(0.025)	(0.022)	(0.021)	(0.057)	(0.078)	(0.079)
Controls (as in Table 6)	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-4.686***	-4.608***	-4.241***	-4.594***	-4.553***	-4.090***
	(0.161)	(0.148)	(0.162)	(0.161)	(0.150)	(0.165)
Observations	9198	9213	9212	9047	9062	9061
Adjusted R^2	0.261	0.373	0.412			
Log pseudolikelihood				-16230.216	-15527.612	-15222.939

Notes: This panel presents estimates of the pooled OLS regressions (Models 1-3) with robust standard errors (in parentheses) and the estimates of the outcome equation of the endogenous treatment regressions (Models 4-6) with robust standard errors (in parentheses). Pollution prevention $_{PCA}$, green supply chain management $_{PCA}$ and green product development $_{PCA}$ are the firm's pollution prevention practices, the green supply chain management and green product development practices variables are constructed using principal component analysis. All definitions of control variables are provided in the Data section. **p*<.10; ***p*<.05; ****p*<.01.

Panel B. Alternative definition of family firm.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	Pollution prevention	Green supply chain management	Green product development	Pollution prevention	Green supply chain management	Green product development
Family firm $_{ALT}$	-0.573***	-0.475***	-0.149***	-1.643***	-0.694***	-0.338**
	(0.120)	(0.067)	(0.053)	(0.272)	(0.186)	(0.144)
Controls (as in Table 6)	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-10.825***	-5.094***	-3.831***	-10.703***	-5.101***	-3.818***
	(0.383)	(0.212)	(0.188)	(0.384)	(0.213)	(0.188)
Observations	9198	9213	9212	9047	9062	9061
Adjusted R^2	0.372	0.375	0.411			
Log pseudolikelihood				-20038.689	-15515.491	-13215.929

Notes: This panel presents estimates of the pooled OLS regressions (Models 1-3) with robust standard errors (in parentheses) and the estimates of the outcome equation of the endogenous treatment regressions (Models 4-6) with robust standard errors (in parentheses). Family firm $_{ALT}$ is the dummy variable equal to 1 if the founder or a descendant holds at least 25% of voting rights, 0 otherwise. All the definitions of control variables are provided in the Data section. **p*<.10; ***p*<.05; ****p*<.01.