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Family Ownership and Carbon Emissions*

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Abstract

This study examines the relationship between family ownership and carbon emissions using a large cross-country dataset comprising 6,610 non-financial companies over the period 2010-2019. We document that family firms display lower carbon emissions, both direct and indirect, when compared to non-family firms, suggesting a higher commitment to environmental protection by family owners. We show that this differential effect started following the 2015 Paris Agreement. Differences in governance structure, familial values, and higher spendings in R&D partly explain our results. Paradoxically, we find that family-owned firms and family CEOs commit less publicly to a reduction in their carbon emissions and have lower ESG scores, although polluting less. This suggests a lower participation in the public display of such an outcome and a lower tendency to greenwashing.

Keywords: carbon emission, ESG, governance, family firms, greenwashing, climate change
JEL Codes: G3; G38; M14

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1. Introduction

Scientific evidence shows that among the various greenhouse gases (GHG) emitted by human activities, the emission of carbon dioxide (CO_2) is so far the largest contributor to climate change, and, if nothing changes, its relative role is expected to increase further (Reilly et al., 2003). Bolton and Kacperczyk (2021) document that institutional investors are already demanding compensation for investments with higher total CO_2 emissions. Polluting firms are paying higher financing costs, which may further increase in the future. At the same time, empirical evidence on the financial implication of firms' GHG emissions and motives remains inconclusive (Bush and Lewandowski, 2018).

In this study, we focus on the CO_2 emission of family firms. Family firms are the most prevalent form of business around the world (Morck and Yeung, 2004) and contribute to more than half of the GDP and two-thirds of employment worldwide (PwC, 2021). Understanding if this form of ownership is associated with a distinct behavior in terms of emission is important to help to reduce CO_2 emission globally. One might expect a distinct impact of family ownership on CO_2 emissions because family firms represent a unique type of shareholder (Anderson and Reeb, 2004; Bennedsen and Fan, 2014; Cheng, 2014; Chrisman et al., 2005). This is likely to affect both financial and non-financial environmental motives, as well as the type of agency conflicts within the firm.

First, family firms are likely to be more attracted by the financial gains associated with a reduction in pollution. The literature shows that most of the firms still seek financial gains when adopting environmental strategies (e.g., Hillman et al., 2009; Liedong et al., 2017; Mellahi et al., 2016). Pollution and climate change affect the long-term survival rate of firms. Zellweger et al. (2012) and Cheng (2014) document how family-owned firms are focused on more long-term goals, notably due to the desire of transmitting the firm to the next generation (Casson, 1999). This reduces the discount factor of long-term investment horizon and render more attractive a contemporaneous reduction in pollution emissions. Family owners are also more risk averse as they hold an undiversified portfolio (Anderson and Reeb, 2003; Cheng, 2014). In turn, they might be more concerned by the adverse impacts of climate change on their business and adopt more radical measures. Family firms also put a higher value on reputational costs (Sageder et al., 2015; Westhead et al., 2001). This means that family-firms might be more responsive to institutional pressures, such as government or regulatory body scrutiny, fear of media investigations or social norms (Berrone et al., 2010) and might be more likely to voluntarily adopt environment-protective measures beyond the regulator's requirements and/or their peers.

Second, family-firms might also adopt specific actions on pollution for non-financial reasons. Gomez-Mejia et al. (2007) suggest that family firms are more prone to strategic decisions deviating from economic benefits to satisfy emotional or social needs – what they call the socio-emotional wealth (SEW) theory. Family firms might seek non-economic benefits such as placing family members in strategic positions (Gomez-Mejia et al., 2010), engaging in altruistic activities (Schulze et al., 2003b) or avoiding equity dilution (Schulze et al., 2003a). Family owners are strongly tied with their company (Kepner, 1983), receive recognition from the community (Corbetta and Salvato, 2004) and seek to preserve a specific family identity (Deephouse and Jaskiewicz, 2013; Zellweger et al., 2010). Reducing GHG emissions are measures with a high socio-emotional value (Gomez-Mejia et al., 2007) and a way of showing to the public that the actions of the firm are appropriate and beneficial for the community, and not only focused on profitability. These non-financial motives might encourage family firms to pursue more stringent decarbonization policies than their non-family counterparts to demonstrate their commitment to environmental protection.

Third, these financial and non-financial motives are likely to be impacted by the specific agency context in which family firms evolve. Agency theory is a commonly used framework in the finance literature when it comes to ownership structure. On the one hand, family owners can serve as monitors in the firm (Villalonga et al., 2015) and ensure that the interests of the shareholders and managers are aligned, decreasing the type I agency cost (Jensen and Meckling, 1976). Based on this alignment hypothesis, we would expect family firms to pursue environmental investments not impacting shareholder wealth maximization (Abeysekera and Fernando, 2020). On the other hand, family owners can use their dominant position (Anderson et al., 2003) to extract private benefits of control (DeAngelo and DeAngelo, 2000) and pursue personal goals that might deviate from shareholder wealth maximization, increasing the type II agency cost between main shareholders and minority shareholders (Anderson et al., 2009). Based on this entrenchment hypothesis, we would expect family firms to pursue non-economic strategies such as investments in non-value enhancing environmental projects motivated by socio-emotional wealth maximization rather than shareholder wealth maximization (Abeysekera and Fernando, 2020).

In this study, we propose to explore the relationship between family ownership and environmental impact. We focus on CO_2 emissions, which are recognized as one of the most important factors responsible for climate catastrophes worldwide (Shahbaz et al., 2013). It is also one of the most understandable measures for sustainable development for politics and the public. Our dataset consists in a comprehensive sample of 6,610 non-financial firms from 44 countries over the period 2010-2019. Our sample includes unique information about the ownership structure that we combine with the CO_2 emissions and firm-level controls. We focus on both emission intensity, scaling CO_2 by firms' revenues, and on absolute emission levels. We employ three scopes of emissions that capture both direct and indirect emissions.

Our main results reveal that family firms have lower emissions, both direct and indirect, when compared to non-family firms, after controlling for firm characteristics, and country, industry and year fixed effects. It suggests higher real efforts to environmental protection by family owners. Cross-sectional analysis reveals that the positive effect of family ownership on CO_2 emissions is mainly clustered in three sectors, which are fundamentally different in terms of emission intensity (Consumption of Goods, Health Care, and Oil and Gas), and in North America. In additional analysis, we use the 2015 Paris Agreement as a quasi-exogeneous shock and study the evolution of emission intensity around this event for family and non-family firms.[3] We find that for each emission scope, the effect of family firms is negative and significant mainly after the Paris Agreement, suggesting a change in behavior more important for family shareholders following the agreement. This reaction is common in all three regions (Europe, North America, and Asia) and more pronounced in high emitting sectors (Utilities) and sectors with higher abatement costs (Consumption and Services).

Next, we explore some underlying factors that might explain the distinct effect of family ownership on CO_2 emissions. We first analyze whether the results might be attributed to differences in the governance structure of family and non-family firms. We find that family firms with boards of a longer tenure display an additional reduction in emissions, suggesting that the long-term vision of family firms plays an important role. However, the positive effect of family ownership in reducing emissions persists even after including several board characteristics, suggesting that governance is only part of the explanation. Second, we show that family-oriented family firms, that is firms that are strongly controlled, managed, and/or governed by family members pollute less than their counterparts. This suggests that family

[3] The Paris Agreement set out a global framework to reduce GHG emissions and limit global warming to well below 2°C. Since 2016, almost all countries in the world have ratified the Paris Agreement. The ratification of the Paris Agreement has increased the general awareness on climate change, which has been further strengthened by the growing climate change movements. The increasing environmental activism, which includes institutional investors (Azar et al., 2021), is forcing more and more companies to reduce and offset carbon emission.

values and involvement of the family in the company's business play a role in reducing CO_2 emissions. Third, we show that family firms also started investing more in R&D after the 2015 Paris Agreement, indicating that part of our results can be linked to innovations and technical changes in the production or service process.

Last, our study explores if this different behavior relates to higher commitments to reduce CO_2 emissions by family firms—notably following the 2015 Paris Agreement. Our results are surprising in the sense that they point in the opposite direction. We found that family-owned firms commit less to a reduction in their GHG emissions than other firms. Moreover, they did not change this behavior following the Paris Agreement. This paradox suggests a lower engagement in public display of environmental performance. Despite polluting less, family firms do not commit more to do so. We complete this analysis by looking at their ESG environmental score. We confirm that family firms also have lower ESG scores – even if they do pollute less. These results reveal that family firms are less prone to communicating around their environmental performance—despite doing better—suggesting a lower propensity for greenwashing.

We dedicate an important part of our analysis to addressing potential endogeneity concerns. Because family ownership is mostly constant at the firm level, our model does not allow the inclusion of firms fixed-effects. This poses the risk of an omitted variable bias and limits the causal interpretation of our results. We propose several solutions. First, we strengthen our identification by incorporating country by time and country by industry fixed-effects. Results are maintained. Second, we match family and non-family firms based on observable characteristics and create two comparable samples along several dimensions. We run our main model on this matched sample and find consistent results. Third, we propose a two-stage least squares approach and instrument family ownership with the duration of the CEO tenure and the average number of children at the country level. Both instruments are positively correlated with family ownership, while at the same time unlikely to directly affect the level of CO_2 emissions. Relevance and exogeneity of these instruments are confirmed with standard statistical tests. This instrumental variable approach confirms our main finding. Fourth, we propose a dynamic difference-in-difference approach for the Paris Agreement. We report an absence of a different trend for family and non-family firms before the Paris Agreement and confirm the reduction in family firms' emissions several years afterwards. Last, we also ensure our results are not dependent on our measurements. We employ an alternative measurement of CO_2 emissions by using the absolute emissions levels. We also propose alternative measures of family ownership that have been employed in the literature. Our results are robust to these changes.

Our study adds to the burgeoning literature on climate change and environmental protection. First, by using the CO_2 emission intensity as a proxy for pollution, it shows that family firms are more prone to reduce CO_2 emissions when compared to non-family firms. Our results also show a different change in behavior and emissions levels following the Paris Agreement between both groups. So far, the literature presented results based on indirect proxies of pollution. Huang et al. (2009) survey 235 manufacturing firms in Taiwan and find that family firms are more prone to pursue green technical and administrative innovations in response to internal stakeholder pressures. Saeed et al. (2022) study the adoption of ISO 14001 certification—which defines the standards required for an effective environmental management system (EMS)—by Chinese companies. They find a positive relation between ISO 14001 adoption and family firms, and a stronger effect in family firms more affected by reputational concerns (proxied by the family name included in the firm's name) and in firms located closer to large cities. Focusing on polluting industries, Berrone et al. (2010) and Yang et al. (2022) find that family firms have less on-site emissions in the US and are more prone to apply for green patents in China, respectively.

Second, our study contributes more generally to the Corporate Social Responsibility (CSR) literature by showing the role of family ownership and CEOs on a non-financial outcome. The results demonstrate that family firms and family CEOs not only pollute less than non-family firms, but also communicate less about it, particularly in terms of ESG scores. Previous studies on family ownership and CSR notably include Dyer and Whetten (2006), Block and Wagner (2014), Cruz et al. (2014), and El Ghoul et al. (2016), with sometimes conflicting findings. Notably, Abeysekera and Fernando (2020) find that family owners refrain from undertaking environmental investments and seem to prioritize financial interests over non-economic benefits.. We qualify this view by looking at their effective environmental outcomes, which are better on average than those of non-family firms.

Third, our paper contributes to the rising literature on ESG and 'greenwashing' that finds a stark disconnect between firms' climate commitments and their observed behavior. For instance, Duchin et al. (2022) document how polluting firms divest some of their most polluting assets after scandals, without changing their practices and while still retaining access to these assets through their supply chain, gaining higher ESG ratings in the process. Berg et al. (2022) also reveal that ESG ratings from multiple providers are internally inconsistent and that nonenvironmental perception of the firm by the rater influences its environmental score. We add to this literature by stressing a paradox between the communication and effective pollution of family-owned firms. On the one hand, we document that family firms and family CEOs are disclosing less favorable environmental performance indicators than non-family firms and hired CEOs. On the other hand, we show that family firms and firms run by family CEOs display better environmental outputs. Pointing this discrepancy is an important topic as an increasing number of stakeholders rely on environmental disclosure and communication to properly evaluate firms' environmental impacts (Marquis et al., 2016).

The remainder of this paper is organized as follows. Section 2 describes the data and the research methods. Section 3 presents the main empirical results, including the effect of the Paris Agreement. Section 4 focuses on the different channels that underpin our findings, while Section 5 details the impact of family ownership on emission commitments. Section 6 reports robustness estimations with a focus on endogeneity concerns. Section 7 concludes the paper.

2. Data and empirical setting

To examine the relationship between family ownership and environmental pollution, we combine data from three different sources. As a starting point we use the Family Firms dataset from the NRG Metrics database to identify family firms. The NRG Metrics database sources publicly available documents to collect information on corporate governance and identify family ownership. It uses customized software programs to verify all levels of data entry for inconsistencies and errors using a combination of quality control measures.[4] The different datasets have been validated in both management and finance literatures (e.g., Cho et al., 2019; Delis et al., 2020; Eugster and Wang, 2023; Marano et al., 2022; Miroshnychenko et al., 2021). We combine the NRG Family Firm dataset with the CO_2 emissions data from Urgentem. We retrieve the accounting, market and Environmental, Social, and Governance (ESG) data from Refinitiv. We perform the matching using ISIN as a main identifier. In some instances, in which ISIN is not available to create a perfect match, we rely on matching based on company names. After merging the different datasets and excluding financial companies, we end up with a sample of 6,516 unique public firms, listed in 43 countries, from 2010 to 2019. The final sample consists in an unbalanced panel dataset covering 38,498 firm-year observations. In Appendix

[4] See additional information on the NRG Metrics' website: https://nrgmetrics.com/data-collection

Table A1 we provide information on the definition of all the variables used in the study and their source.

2.1. Firm carbon emissions data

The carbon footprint of firms is obtained from the Urgentem Database. Urgentem is an independent provider of climate risk data, which encompasses various aspects of corporate carbon emissions, including direct and indirect emissions and emission intensity. Urgentem has adopted the Greenhouse Gas Protocol (GGP) which sets the standard for measuring CO_2 emissions.[5] It provides annual CO_2 emissions data on listed firms in all major advanced and emerging economies. The dataset distinguishes between three sources, or scopes, of emissions. Scope 1 emissions refer to direct emissions from sources that are owned or controlled by the company and include emissions from fossil fuels employed in the production process. Scope 2 emissions stem from the consumption of purchased energy (heat, steam, and electricity) sourced upstream from the firm. Finally, Scope 3 emissions includes all other indirect emissions that occur in a company's value chain. This dataset has been used in other climate related studies (see for example, Alogoskoufis et al., 2021).

In our initial analysis, we employ the three different scopes to measure a firm's CO_2 emission intensity. We follow Ilhan et al. (2021) and Bolton and Kacperczyk (2021) and measure CO_2 emission intensity by scaling CO_2 emissions in units of tons by a firm's total revenues (in $millions). As argued in Garvey et al. (2018), this measure can be regarded as a proxy of firm efficiency in terms of GHG emissions and economic performance. We first focus on Scope 1 emissions, then aggregate Scope 2, and eventually Scope 3 emissions. The third variable aggregates all scopes, which might be more relevant for some sectors, like automobile and manufacturing (Bolton and Kacperczyk, 2021). As a robustness test, we also employ firms' absolute CO_2 emissions (see for example Azar et al., 2021).

2.2. Definition of Family Firm

The literature has shown that there is no unique definition of a family firm (e.g., Chrisman et al., 2005; Harms, 2014; Kraus et al., 2011). We follow Anderson and Reeb (2003) and Villalonga and Amit (2006, 2009) and create the variable *Family*, which is a dummy variable equal to 1 if the founder or a member of the founding family is officer, director or owns more than 5% of the firm's equity, individually or as a group, and 0 otherwise. This definition is commonly used in U.S. studies where ownership is generally more diffused but might differ

[5] See for more information: https://ghgprotocol.org/corporate-standard

from non-US studies which tend to use higher control thresholds (e.g., Faccio and Lang, 2002; La Porta et al., 1999). In robustness tests, we employ alternative definitions of family firm used in the literature (Miller et al., 2007).

Table 1 reports the distribution of the sample between family and non-family firms, across regions and industries. Based on our definition, 32% of our sample is composed of family firms globally and the distribution is similar across Northern America, Europe, and Asia. This proportion is consistent with the 37% of family ownership found in the study of Amit and Villalonga (2014). Comparing the frequency of family firms across industries, we find that the highest share of family firms is within technology firms (41%) and the lowest in the utilities sector (12%) with the other sectors in the sample within the 20-40% range.

[Insert Table 1 here]

2.3. Firm-level controls

We include a number of firm-level variables to control for confounding factors that may affect firms' emissions in our sample (Azar et al., 2021; Bolton and Kacperczyk, 2021). We control for firms' *Size*, the natural logarithm of total assets; *MBV*, the market-to-book ratio; *PPP*, the ratio of property, plant, and equipment over the firm's total assets; *CAPEX*, measured as Capital expenditure to total assets; *ROA*, return on assets, measured as the ratio of net income before extraordinary items to total assets; *Leverage*, the ratio of total debt to total assets; *Liquidity* measured as total current assets divided by total current liabilities; and *Age*, measured by the year of incorporation.

To mitigate the impact of outliers, we winsorize all firm-level variables at the 1% and 99% levels. In addition to these firm-level variables, we control for industry, country, and year fixed effects in all our regressions.

2.4. Descriptive statistics

Panel A of Table 2 presents the summary statistics for the main variables used in the study.[6] On average, the emissions intensity of Scope 1 CO_2 emissions is 124 metric tons per million USD of firms' revenues. This means that, on average, each million dollar of revenue generates 1.24 tons of CO_2. Scope 2 adds the emissions associated with energy consumption to the initial Scope 1. CO_2 emissions intensity increases, with each million dollars of revenue generating 1.66 tons

[6] Appendix Table A2 presents the summary statistics for the additional variables, in their chronological order of use.

of CO2 on average. When further including indirect emissions (Scope 3), CO_2 emissions intensity escalates—in this case, each million dollars of revenue generates on average 15 tons of CO_2. As documented in the literature, Scope 3 emissions tend to represent a much larger share of firms' revenues. They also capture distinct sources of pollution that adds up to the firm's internal sources: Scope 1 and 2 exhibit a correlation of 98%, whereas Scope 1 and 3 have a correlation of only 59% (correlations are reported in Panel C of Table 2).

[Insert Table 2 here]

Figures 1 and 2 report the average emission intensity (Scope 1) across the two types of firms across region and industries, respectively. In a general manner, European firms tend to pollute the least on average. In the three regions, family firms tend on average to pollute less than non-family firms. This gap is the most important for firms located in North America. Utilities, Oil & Gas, and Basic Materials are the most polluting sectors in intensity. In all sectors, family firms pollute less as a proportion of their revenues. The most polluting sectors tend to report the highest absolute difference in emission intensity across the two types of firms (Utilities and Oil and Gas). At the same time, family firms in less polluting sectors exhibit a larger relative gap. As a proportion of non-family firm emission intensity, family firms in Technology, Consumer Services, and in Consumer Goods pollute less. Figure 3 reports the evolution of Scope 1 emission intensities over time for both family and non-family firms. The visualization reveals that family firms consistently pollute less than non-family firms.

[Insert Figure 1 here]

[Insert Figure 2 here]

[Insert Figure 3 here]

Panel B of Table 2 reports meaningful differences between family firms and non-family firms across the different pollution scopes (see Panel B). For example, family firms have a Scope 1 emission intensity of 83 metric tons per million USD of revenue, compared with 144 metric tons per million USD of revenue for non-family firms. This situation is similar for Scope 2 and Scope 3 emissions. The difference is highly significant for the three Scope variables suggesting a distinct impact of the two groups of firms in terms of pollution. In terms of the differences in characteristics between the two types of firms, family firms generally tend to be smaller and to exhibit a lower leverage. They also have fewer tangible assets (*PPP*) and are slightly less profitable (*ROA*). On the other hand, they have more capital expenditure and more liquidity reserves. They also tend to be older.

Panel C of Table 2 reports the correlation across the different variables. Bigger firms, with higher Market-to-Book, more tangible assets, more capital expenditures, and higher leverage exhibit higher pollution intensity. Less performing firms and less liquid firms tend to pollute less.

2.5. *Empirical Setup*

We employ the following standard regression to test the effect of family ownership on CO_2 emission:

$$y_{i,c,t} = \beta_0 + \beta_1 Family_{i,c,t} + \gamma X_{i,c,t-1} + \alpha_{i,t} + \mu_{c,t} + \epsilon_{i,c,t} \tag{1}$$

where $y_{i,c,t}$ denotes the CO_2 emission intensity by firm i located in country c in year t; $Family_{i,c,t}$ is the dummy variable that captures family ownership, while $X_{i,c,t-1}$ is a vector of one period lagged firm-level control variables. The control variables are lagged by one period to mitigate potential simultaneity issues. We control for unobserved time-invariant industry effects ($\alpha_{i,t}$) and common time- and country-specific shocks (country-year fixed effects $\mu_{i,t}$). The standard errors of the error term $\epsilon_{i,c,t}$ are clustered at the firm level because clustering at the industry level may result in biased standard errors since the number of clusters is small (Cameron and Miller, 2015).

Since there is minimal within-group variation in family ownership, our model does not allow the inclusion of firm fixed-effects that could be used to remove unobserved (time-invariant) heterogeneity at the firm level. Consequently, a key concern regarding our identification strategy is that the time-invariant component in the error term might be correlated with right-hand side regressors, including family ownership.

To alleviate some of the causality concerns, we take advantage of the 2015 Paris Agreement and run a difference-in-difference analysis. Falkner (2016) argues that the change in regulatory stance following the Agreement was sudden and unexpected and the date of the Agreement has been used in previous studies as a quasi-exogeneous shock, that changed the incentives of firms to reduce their pollution levels (e.g., Ginglinger and Moreau, 2019; Reghezza et al., 2022). We reproduce this approach and study the evolution of emission intensities around the Paris

Agreement for family and non-family firms. This corresponds to the following factorial model, adapted from Equation 1:

$$y_{i,c,t} = \beta_0 + \beta_1 Family_{i,c,t} + \beta_2 Paris + \beta_3 Family_{i,c,t} \times Paris + \gamma X_{i,c,t-1} + \alpha_{i,t} + \mu_{c,t} + \epsilon_{i,c,t} \quad (2)$$

Paris is a dummy variable taking on between 2015 and 2019 and zero for the years before. We set the treatment date in 2015, rather than the year following its approval. Various studies show that firms affected by the new policy reacted as soon as the new rules were publicly disclosed (Carboni et al., 2017; Schäfer et al., 2016). The coefficient of interest is β_3, which captures the different effect of the Paris Agreement on family firms.

We further address endogeneity concerns in the robustness section. Notably, we add another layer of fixed-effects, conduct a propensity-score matching approach to create comparable samples, perform a dynamic difference-in-difference, and propose relevant and exogeneous variables to instruments family ownership.

3. Family Ownership and Carbon Emissions

This section initially presents our ordinary OLS regression results. Next, we apply the DiD approach and concentrate on the effect of the Paris Agreement.

3.1. Ordinary OLS regression results – main results

Our main model incorporates the full sample of firms and relates family ownership to emissions intensity. We control for firms' characteristics as well as industry and country by time fixed-effects. We progressively consider the three scopes of emissions. Results are reported in Table 3.

[Insert Table 3 here]

For any scope of emissions, family firms display significantly lower levels of emissions intensity. The effect is economically meaningful. When considering direct emissions only (Scope 1), family firms emit 12.8 tons/USD million of revenue less than non-family firms. Given an average Scope 1 emission of 124 tons/USD million, this represents an average reduction of emission-to-revenue of 10.32%. The effect is stronger when indirect emissions are taken into account. Considering Scope 2 emissions as well, family firms have a lower emission intensity of 15.6 tons/USD million. When the full direct and indirect emission costs are accounted for, family firms end up polluting 71.5 tons/USD million less than non-family firms.

The model controls for size, capital structure, profitability, age, and tangibility of assets, as well as country-years and industry fixed-effects. Looking at the control variables, larger firms and firms with more tangible assets tend to pollute more (even in terms of emission intensity and not only absolute levels). Profitability is negatively related to emissions. Firms that favor a higher level of debt pollute also less. Age does not exert a significant impact.[7] The results suggest that family ownership results in a better environmental output, even after controlling for potential differences across firms.

In a second step, we look at the effect of family ownership across industries and geographic regions. GHG emissions are clustered by industries, with some sectors being structurally more polluting. This in turns impact abatement costs and capacity and incentives to reduce emissions (Huang et al., 2016). We explore the role of sectorial differences by splitting our sample across nine sectors: Basic Materials, Consumption of Goods, Consumption of Services, Health Care, Industrial, Oil and Gas, Technology, Telecommunications, and Utilities. We run our main model separately for each sector employing the GHG Scope 1 emissions intensity metric. Results are reported in Table 4. Family ownership is associated with lower Scope 1 CO_2 emission intensity in three sectors: Consumption of Goods, Health Care, and Oil and Gas. It plays a non-significant impact in the other sectors. As robustness check we employ the other proxies (scopes) for GHG emissions and find similar results – hence, we do not show them out of brevity.[8]

[Insert Table 4 here]

Table 5 splits the sample into three regions: Asia-Pacific, Europe, and North-America. The literature has emphasized different patterns in terms of family ownership (Aminadav and Papaioannou, 2020) and emission intensities (Raupach et al., 2007) across these regions. We do observe that the effect of family firms on emission intensity is only significant in the case of North America.

[Insert Table 5 here]

So far, our results suggest that family ownership is associated with a lower level of emission intensity, even after controlling for potential other systematic differences between firms. The effect is however different across industries, and across regions. In the next sections we further explore these results and their potential origin.

[7] In all the specifications, the coefficients for the firm-level control variables are consistent and qualitatively similar. Henceforth, we will not discuss them further in this paper.
[8] The results of the robustness test are available upon request.

3.2. Difference-in-differences – the Effect of Paris Agreement

We use the Paris Agreement as a shock to firms' perception of climate-related risks. Along with previous studies (e.g., Ginglinger and Moreau, 2019; Reghezza et al., 2022) we argue that the Paris Agreement struck in 2015 provides a strong and clear exogeneous signal of tightening of future carbon emission regulations. We adopt the Paris Agreement in a Difference-in-Difference setting and study the evolution of emission intensities around the event for family and non-family firms.

[Insert Table 6 here]

We create a dummy variable *Paris* that equals to one for 2015 and the years following the agreement and zero otherwise. We interact this variable with the family ownership variable and document the effect on the three variables of emissions intensity (see Equation 2). Table 6 reports the results. For each of our emission proxies, the effect of family ownership on emissions is negative and significant after the Paris Agreement. The effect is the strongest for the measure that aggregates scope 1, 2 and 3 emissions. Importantly, the variable *Family* alone is not significant. This suggests that, prior to 2015, there was no statistically significant difference between the two types of ownership. The Paris Agreement seems to have triggered a change in behavior and emissions levels, that was more important for family firms.

[Insert Table 7 here]

We further explore this result, looking at the impact of the Paris Agreement across industries and regions. Table 7 reports the results for different sectors. Family ownership further reduces emissions intensities after the Agreement in the Consumption of Goods, Consumption of Services, and Utilities sectors. There is no different effect due to the Paris Agreement in the Health Care and Oil and Gas industries. This pattern brings two conclusions. First, there was a reaction of family ownership to the Paris Agreement that was more pronounced in certain sectors, and notably sectors with higher abatement costs, such as Consumption of Services. Second, the reduction in emissions intensities associated with family ownership in certain sectors is irrespective of the Agreement date. This is notably the case for Oil and Gas companies, which is a sector with lower abatement costs.

[Insert Table 8 here]

Table 8 reports the effect of the Paris Agreement across world regions— Mani et al. (2018) document potential uneven effects of the Agreement across the globe. In all three regions, the Paris Agreement was followed by a significant impact of family ownership on emissions intensity. Firms controlled by families polluted less following the agreement compared with non-family firms. The size of the effect is similar for Europe and North America, but double for firms located in Asia-Pacific. On the contrary, there is no significant effect of family ownership preceding the 2015 Paris Agreement in all three regions.

The results hint to a substantial impact of the Paris Agreement on the relative behavior of family firms. Before the Agreement, there is, in most cases, not a significant difference in emissions across the two types of ownership—apart from two sectors, and notably the Oil and Gas sector. After the Agreement, a common pattern emerges for the full sample, across different sectors and around the globe: family ownership leads to a further reduction in emission intensity. Family-owned businesses seem to have reacted more to the new environment implied by the Paris Agreement.

4. Channels

We propose to investigate the role of three channels that might explain our results: governance structure, family values, and higher investment in research and development (R&D). We review each explanation in turn. Appendix Table A1 presents the definitions of all the variables used in this section and their sources.

4.1. Governance Structure

To explain our main result, we first document the effect of the governance structure and potential differences in governance across family-owned and non-family-owned firms. On the one hand, the literature on family firms have pointed out differences in governance as one of the key explanations of a differential effect of family ownership on economic outcomes (e.g., Villalonga and Amit, 2006). Family firms are notably characterized by longer tenures and family members as part of the board, with effects on their financial performance (Wilson et al., 2013). On the other hand, the literature has underlined the role of board characteristics on emissions levels (de Villiers et al., 2011). Haque (2017) documents that board independence and board gender diversity have positive associations with CO_2 reduction initiatives. However, they do not find any relationship between other corporate governance variables and firms' CO_2 emissions. Consequently, the empirical results on the impact of corporate governance on CO_2 emissions remains ambiguous.

We focus on four board's characteristics: the existence of a woman in the board (*Board Gender*), the number of board members (*Board Size*), the expertise of the board (*Board Skills*), and the average tenure of board members (*Board Tenure*). We first control if our results are maintained when board characteristics are taken into account; we then interact our measure of family ownership with each board characteristics to document their role in explaining our results. Table 9 reports the estimations.

[Insert Table 9 here]

The first column includes board characteristics, with no interaction. The coefficient of *Family* is still negative and significant, and the size of the effect is similar to the main results presented in Table 3. This supports the view that the positive effect of family ownership in reducing emissions persists even after controlling for boards characteristics. Among all the boards characteristics, only the presence of a woman on the board contributes to a reduction in emission levels. This is in line with Altunbas et al. (2022), who have documented the negative effect that diverse management can have on emission intensity. The four next models interact boards characteristics with the type of ownership. Women on the board, larger boards, or more skilled boards do not exert a distinct impact for family firms. However, family firms with boards of a longer tenure display a further reduction in their emission intensities. This suggests that the long-term vision of boards of family firms plays an important role in cutting emissions. Plotting the numbers of years and adding the coefficient of *Family, Board Tenure* and their interaction suggests that board tenure in family firms should be longer than 8 years for a reduction in emissions to materialize.

4.2. Family Values

Part of our results might be explained by family-oriented values. Because pollution and climate change affect the long-term survival rate of firms, family-oriented firms that wish to transmit the company to the next generation might put a premium on their long-term survival (e.g., Zellweger et al., 2012). This renders contemporaneous reduction in pollution emissions financially more attractive. Family-firm with strong family values are also likely to base some of their decisions on emotional and altruistic motives (Schulze et al., 2003b). Because reducing CO_2 emissions are measures with a high socio-emotional value toward the community (Gomez-Mejia et al., 2007), it might encourage family firms to pursue more stringent decarbonization policies. Existing research indicates that the characteristics of CEOs also affect corporate climate-related practices (Altunbas et al., 2022; Lewis et al., 2014). For example, Homroy (2023) finds that CEOs who raise a daughter reduce by 10% the GHG emission of a company, while leaving the profitability unaffected. It suggests that CEOs familial values may also play an important role in the reduction of firms' GHG emissions.

We expand this approach by investigating the relationship between family values and CO_2 emissions. To capture family values, we follow Lozano-Reina et al. (2022) and focus on family control, family involvement in governance, and family involvement in management. We measure family control based on the percentage of family ownership (*Family Share)* (e.g., Gomez-Mejia et al., 2018).[9] We then explore the impact of family involvement in governance using the family representation on the board (Barontini and Bozzi, 2018), proxied by the percentage of family members in the board (*Family Board*). Finally, we investigate the impact of family involvement in management by focusing on the appointed CEO and whether he/she is a family member (*Family CEO*) (Naldi et al., 2013) as well as the chairman of the board (*Family Dual*). These two later variables are further decomposed into *Founder CEO/Dual* and *Descendant CEO/Dual*, as family generation might play a role (Aguilera and Crespi-Cladera, 2012). We expect family firms with a large ownership stake, a strong representation in the board, a CEO being a family member as well as the chairman of the board to prioritize family values.

[Insert Table 10 here]

Table 10 presents the results employing the GHG Scope 1 emissions intensity variable. In the three models, *Family share* is negative and significant. The higher the family's control, the lower the emission intensity. In Model 1, *Family Board* is also negative and highly significant, showing that a strong representation of the family into the board is associated with less GHG emissions. This suggests that representation of family interests at the board contributes to the reduction in CO_2 emissions. The model also includes the interaction between family ownership and the percentage of family members on the board. The coefficient of the interaction is positive and significant, suggesting that the positive effect of family control is tempered when the family representation on the board increases (or vice-versa). This moderating effect is small, and the total effect remains positive. It, however, points to a limit of the benefits of family ownership when the firm is both owned and controlled by family members. This might be related to a lack of opposing power from minority shareholders due to family entrenchment.

[9] We replace the dummy variable *Family* with the percentage of family ownership in order to disentangle the effect of ownership from involvement in the board. A similar approach is adopted by Lozano-Reina et al. (2022).

The second column of Table 10 adopts a similar approach, this time looking at the involvement of the family in top management *(Family CEO*). A similar pattern emerges. Both family control and family involvement at the CEO level contribute to a reduction in GHG emissions. Compared with firms with an outside CEO, firms with a family CEO tend to pollute less—suggesting that family values play a role in explaining our results. Again, the coefficient of the interaction term is positive and significant: family control both at the ownership and management level limits the reduction in CO2 emissions, even if the total effect remains positive. When the family CEO is also the chairman of the company (*Family Dual*), the reduction is even higher (Column 3). Finally, the fourth and fifth columns show that the generation matters, and that the emission reduction is more pronounced when the firm is at the descendant stage. This suggests that family transmission plays a role in explaining why family firms tend to pollute less. Overall, the results highlight that family values play an important role in the decrease of CO_2 emissions for family firms.

4.3. R&D Investments

Technological change plays a central role in addressing pressing societal issues such as climate change (Jaffe et al., 2005; Steffen et al., 2022). One possible reasons family firms pollute less than non-family owned firms might be due to a higher investment in R&D to find climate-friendly solutions. Investment in green R&D often requires a long-term vision by management (Faleye et al., 2014). Our previous results have already highlighted that family firms with longer board duration emit less, suggesting that this long-term environment vision might be more frequent with family ownership. This might translate into higher R&D expenses in order to reduce emissions. We explore this possibility in this section. To do so, we document to which extent firms' R&D expenses (scaled by total assets) differ for family firms in general, as well as before and after the Paris Agreement. We also investigate if higher polluting firms owned by families invest more in R&D.

[Insert Table 11 here]

Results are reported in Table 11. The first column relates R&D expenses to a string of independent variables, including family ownership and the amount of CO_2 emitted. We control for firm's size, book value relative to market value, fixed-assets, profitability, leverage, and liquidity. We exclude CAPEX as this variable is highly correlated with R&D. Family firms do not display a higher tendency to spend on R&D in general. This is also not the case for highly polluting firms (*iai_1*). We do observe that bigger, more tangible, and more profitable firms spend less on R&D (scaled by total assets), while more liquid and glamour firms tend to spend more. In the second column, we interact family ownership with the level of pollution. We do not find a significant coefficient for the interaction term. Over the full sample period, firms that pollute more do not invest more in R&D, whether they are owned by a family or not.

The next two columns focus on the effect of the Paris Agreement. Our previous results have reported a change in behavior following the Agreement, with family firms emitting less than other types of firms. We explore whether R&D expenses follow this pattern. The third column looks at the distinct effect of the Agreement for family firms with an interaction. The coefficient is positive and significant: following the Agreement, family firms did invest more into R&D compared with non-family firms. This aligns with our main result and suggest that the reduction in pollution levels for family firms is accompanied by an increase in R&D, that is not observed for firms that are not owned by a family. The last column analyses whether this effect is more pronounced for highly polluting family firms after the Paris Agreement. The triple interaction term is not significant. Even if family firms did invest more into R&D in general after the Agreement, this effect was not up to the point of incentivizing highly polluting family firms in investing more than their peers.

In short, our results show that the reduction in CO_2 emissions by family firms after the Paris Agreement was accompanied by an increase in R&D spendings. This goes along our main results and support the view that family firms adopt a more long-term vision that leads them to being more environmentally friendly.

5. Greenwashing: Emission Commitments, and ESG Scores

Our main results reveal a lower CO_2 emission intensity for family firms compared with non-family firms. This situation does not necessarily correspond to the perception the firm has of its own environmental performance nor with the way it is communicated externally. We propose two measures that look at the environmental communication of the firm: its emission commitments and its Environmental ESG score. We obtain data for both variables from Refinitiv.

Firms can adopt GHG targets and commit to environmental objectives. These commitments are usually public and have been found to be an effective way to communicate an environmental stance to stakeholders (Bolton and Kacperczyk, 2022). We first look if family firms tend to commit more to a reduction in GHG emissions. We construct the variable *Commitment* that equals to one if a firm has adopted such commitment and zero otherwise. We run a panel logit regression with random-effects at the firm-level.

[Insert Table 12 here]

Column 1 of Table 12 reports the results. The coefficient of *Family* is negative and significant. Family-owned firms commit less to a reduction in their GHG emissions. The effect is sizable. Being a family-owned firm reduces the odds of committing to a reduction in GHG by 42.07%. While polluting less, family-firms adopt fewer public commitments to reduce their emissions. This suggests that family-owned companies integrate in their normal business model the need to reduce emissions and do not specifically advertise on a given target. Family firms might also be less exposed to external pressure in publishing such commitments.

The next two columns look at the effect of the Paris Agreement on the issuance of GHG reduction commitments. In general, commitments have strongly increased since the Paris Agreement. The coefficient in the second column of Table 12 corresponds to an odd-ratio of 4.19—or a more than four time increase in commitments following the Agreement. However, this change in trend is not specifically observed for family firms and the interaction in the third column shows no significative difference based on ownership.

In short, family firms commit less to emissions reductions; however, they do exhibit lower emissions when employing their effective pollution levels. This suggests that family ownership might have a lesser concern on displaying a positive green stance, but at the same time actually do have a better environmental profile. In a sense, they are less prone to greenwashing. To give this interpretation further credit we look at the impact of family ownership on ESG scores, and especially Environmental ESG score.

Over the past decade, the role of ESG criteria in the investment industry has exploded and empirical research shows that it can significantly improve corporate performance and affect long-term outcomes (Eccles et al., 2014; Krueger et al., 2020). On the other hand, ESG scores are often assigned based on the firm's own declarations and recent studies revealed that they might be subject to a greenwashing bias (Bartram et al., 2022; Edmans, 2023). Table 13 relates ESG scores to family ownership. We report a negative effect of family ownership on ESG scores, both in general and on the Environmental ESG score specifically. This situation is not impacted by the Paris Agreement. Such a result is at odds with the effective reduction in emissions intensity we observe for these firms. It suggests a discrepancy between the displayed and effective environmental performance of family firms that goes along the line of a lower greenwashing. The specific business model, governance, values, and time horizon of family firms are likely to explain this paradox. Family-owned companies are likely to embed in their daily business activity a higher concern for environmental harm that translates into lower global emissions. They, however, do not engage in the public display of such an outcome.

[Insert Table 13 here]

These results help to understand previous findings in the literature. Notably, Dyer and Whetten (2006) find lower social concerns in family firms. Cruz et al. (2014) report a lower responsibility towards external stakeholders. El Ghoul et al. (2016) show that CSR performance is lower in family-controlled firms and explain their findings by family owners using their power to invest in non-CSR activities. Finally, Abeysekera and Fernando (2020) find that family firms in the US do not exhibit environmental concerns. Our results explain these findings by illuminating an apparent paradox: while family-owned firms communicate less on their environmental commitment, they do structurally pollute less and consequently are more environmentally friendly than non-family firms.

In additional estimations that we present in Appendix Table A3, we confirm the role of family values in explaining this result by focusing on the type of CEO. Previously, we found that family members acting as CEOs (both founders and descendants) contribute to a reduction in emissions intensity, meaning that hired CEOs tend to increase CO_2 emissions. We found opposite effects regarding emission commitments and ESG scores. Hired CEOs are associated with more emission commitments and higher ESG scores. On the contrary, family CEO are associated with lower commitments and lower ESG scores. These results confirm the view that family-driven firms are less likely to be involved in 'green washing'. It also suggests that it is the type of value and incentives embodied by management that explains this situation.

6. Robustness Checks

We conduct a variety of additional tests to check the robustness of our results. First, we propose alternative measurements of family ownership and emission levels. Second, we modify the set of fixed-effects and the clustering of standard-errors. Third, we conduct a Propensity Score Matching (PSM) approach. Fourth, we propose a dynamic treatment of the Paris Agreement DiD. Last, we perform an instrumental variable approach to address potential endogeneity problems.

6.1. *Alternative Measurements*

Our main measure of emission is based on emission intensity, that is, tons of CO_2 emissions scaled by the revenues of the firm. We offer an alternative measurement in the form of absolute emissions levels. This serves two purposes. First, it ensures that the results are robust to an alternative definition of pollution. Second, it assesses if our results hold not only in terms of efficiency—which corresponds to emission intensity—but also in terms of efficacy (absolute levels). The literature has pointed to different mechanisms in term of pollution efficiency and efficacy (e.g., Jenkins, 2014). We employ the natural logarithm of the absolute level of emissions for the different scopes and run our main model with these new dependent variables. Results are reported in Panel A of Table 14. In all three models, the impact of family ownership is consistent with our main results. Family firms report lower absolute levels of emissions, after controlling for firms' characteristics, industry fixed-effects, and country by time fixed-effects. Difference in ownership type also affects emission efficacy.

[Insert Table 14 here]

The literature has also shown that there is no unique way of defining a family firm (e.g., Harms, 2014) and that empirical results can be sensitive to the definition employed (Miller et al., 2007). Therefore, we use alternative measures to define a family firm and re-run our main model with the Scope 1 emission intensity as dependent variable.[10] Results are reported in Panel B of Table 14. In Column 1, we use a broader definition as employed by Anderson and Reeb (2003), in which no 5% minimum threshold for a large shareholder is required. In Columns 2 and 3, we focus only on the family ownership stake and define a family firm as a firm in which the family is the largest voteholder or the largest shareholder, respectively. In Column 4, we use a similar definition as in our initial setting but require the presence of at least two family members as director, officer or large shareholder. Finally, in Column 5, a firm is defined as a family firm if the family is the largest voteholder and at least one family member is part of the board. In all our specifications, the coefficient for *Family* remains negative and significant, which alleviates concerns about the choice of the definition of family firm adopted in our study.

6.2. *Fixed-Effects and Clustering*

We now address the question of fixed-effects and clustering. Our main model clusters by firms and employ industries and country by time fixed-effects. We propose alternative specifications.

[10] The results for the two other measures of emissions intensity are also consistent with the main result and are available upon request.

Columns 1 to 5 of Table 15 report the results; the dependent variable is the Scope 1 emissions intensity. We begin by estimating more parsimonious versions of Equation (1), gradually building towards the most saturated specification. The first column proposes the simplest model, with no fixed-effects nor control variable. The effect of family ownership is negative and significant and explain 1.2% of the variance across the population (R^2). The next column adds firms' controls but no fixed-effects; then industry fixed-effects, country by time (baseline), and country by time by industries fixed-effects are added. In all models but one, the effect of family ownership on emissions intensity is negative and significant. It supports the view that while country and industry heterogeneity matters, results are stable for the full sample.

[Insert Table 15 here]

Columns 6 to 9 of Table 15 modify the level of clustering while the set of fixed-effects corresponds to our main model. We alternatively propose clustering of standard errors at the industry, the industry-country, and the industry-country-year levels. In all cases, the coefficient of *Family* remains significant. The evidence suggests that the main result of the paper is not sensitive to how standard errors are clustered.

6.3. Propensity Score Matching

Our results so far suggest that family ownership is associated with lower CO2 emissions, both in intensity and absolute levels. To adjust for systematic differences in the characteristics of family and non-family firms that might influence our previous findings, we propose employing a propensity score matching (PSM) approach. PSM helps address endogeneity by creating matched pairs of treatment and control units that share similar observable characteristics (Rosenbaum and Rubin, 1983).

We estimate propensity scores with a logit regression of the binary variable of family ownership on the vector of covariates specified in Eq. 1. Both the treatment and the control firms are from the same industry. To choose a subsample of comparable units, we match companies based on their observable traits prior reaching the final Paris Agreement in December 2015 and using one-to-one nearest neighbor technique. To be precise, for each family firm, we identify one unique non-family firm, and we require that the absolute difference in predicted propensity scores is not larger than 0.01. The matching process is done without replacement, so that there is a unique match between a firm in the treatment group and a company in the control group.

[Insert Table 16 here]

[Insert Figure 4 here]

Panel A of Table 16 stresses that the characteristics of family and non-family firms are statistically different before implementing the propensity score matching. Panel B shows that the sample is well balanced and not statistically different across groups after the propensity score matching. This ensures the comparability of the two groups in terms of ex ante observable characteristics. Figure 4 reports propensity scores across the two groups, before and after the matching. The left-hand-side density plot underlines that propensity scores differ widely between family firms and non-family firms in the unmatched sample. On the contrary, the right-hand-side density plot reveals that the distribution of propensity scores across the two groups is similar after the matching. This similarity underpins favorable balancing properties of the matching procedure employed.

[Insert Table 17 here]

We reassess the link between family ownership and CO_2 emissions using the matched balance sample. The procedure reduces by approximately six thousand the number of available observations. Columns (1) – (3) of Table 17 report the results for emissions intensities along the three different scopes and column (4) – (6) repeat this exercise for absolute emissions. We include the same set of covariates as in our main analysis, as well as industry and country-time fixed effects. In line with our baseline estimates, family ownership consistently reduces CO_2 emissions. The magnitude of the coefficients tends to be even higher when employing matched samples. Column (7) and (8) focus on the differential treatment following the implementation of the Paris Agreement. In line with our main results, most of the effect occurs after the Agreement. Employing a PSM approach confirms our main findings.

6.4. Dynamic Treatment – Paris Agreement

The validity of the difference-in-differences estimators relies on certain assumptions. Primarily, treatment assignment must be independent of the level of CO_2 emissions. This can be assumed to be true in our case, as the Paris Agreement is not focused on firms' ownership but rather on the potential negative impacts of global warming on economies and societies. Second, the difference-in-differences approach is only valid if trends of the outcome variable are parallel across groups before the event (e.g., Imbens and Wooldridge, 2009).

We employ a specification test to examine the dynamic impact of the Paris Accords on family and non-family firms' emissions and capture any pre-trend effect. We replace the variable *Paris* in Eq. (2) with a series of dummy variables corresponding to pre-treatment lags (up to 4 years) and post-treatment leads (up to 4 years) to track the year-by-year effects of the Paris Accords on firms' emissions. The parallel trend assumption for the treatment and control firms before the regulation is fulfilled if the coefficients on the interactions involving the years before the event are all insignificant. Figure 5 plots the estimated time-varying coefficients on the treatment for all the years and the 95% confidence intervals, adjusted for firm-level clustering.

[Insert Figure 5 here]

The coefficients of the interaction term (*Family* × *Year$_t$*) are insignificant for all years before 2015, suggesting no pre-treatment trends difference in CO_2 emissions across the two groups. The impact of the Paris Agreement on family firms' emissions is evidenced by the declining pattern of the coefficients of the post-treaty interaction variables. This result confirms that the emissions of family firms decline after the Paris Agreement and remain structurally lower thereafter.

6.5. *Endogeneity – 2SLS approach*

The matching approach assures that we are comparing similar firms when we analyze the dissimilarities in CO_2 emissions between family and non-family firms. However, there is also the possibility that the choice of maintaining a concentrated family ownership is influenced by the emissions themselves, leading to a reverse causality issue. This possibility cannot be dismissed since some families may reduce ownership because of the reluctance to operate in high emitting sectors, which are often dominated by large international fossil fuel conglomerates or state-owned enterprises.

The second identification challenge that makes causal statements difficult is that it is still possible that our results are driven by omitted variables related to both family ownership and firms' CO_2 emissions. The choice of being a family firm may be affected by time-invariant characteristics that might be correlated with firms' CO_2 emissions. Because family-ownership is also mostly time-invariant, we cannot fully control for it in our regression framework.[11] In order to mitigate these endogeneity problems, we employ an instrumental variable (IV) approach.

We specify the average tenure of the CEO at the entity level (*CEO Tenure*) as our first instrument for family firms. This choice is motivated by the fact that family firms are often governed by family-members or family-related executives, which should have a positive impact

[11] See Zhang et al. (2022) for a discussion on endogeneity issues in family business research.

on the length of their tenure. Therefore, we expect the length of CEO tenure to be a relevant instrument for family ownership. By contrast, because there is no clear rational and evidence that the CEO tenure might be related to shock in CO_2 emissions, this variable plausibly satisfies the exclusion restriction (this is notably supported by the absence of significant effect of *Board Tenure* in model 5 of Table 9).

Our second instrument for family ownership is a survey-based measure. We employ the by country average answer to the World Value Survey question on the number of children in the family. [12] The World Value Survey is carried out on a representative sample of minimum 1,000 individuals in each country and is conducted in waves with intervals of 5 to 10 years. Respondents assign a score of 0 to 7 (0 = no children, 7 = at least 7 children or more) to the question. We compute the average response at the country level (*Children*). Countries valuing large families are more likely to have family firms and to see successful family successions when founders retire, making this instrument relevant. At the same time, it is highly unlikely that the respondents' answers to the World Value Survey are affected by the ownership choices made by the owners in our sample since participants are randomly chosen from the entire population. Consequently, most if not all of the survey respondents have no links with the firms in our sample, making this instrument exogeneous.[13]

[Insert Table 18 here]

Panel A of Table 18 documents the first-stage estimation. In Column 1, we use the CEO tenure to instrument family firms, while in Column 2, we add the number of children in the family as a second instrumental variable. We include the complete set of control variables and cluster standard errors at firm level. As predicted, CEOs in family firms hold their positions longer than in non-family firms and family enterprises are more important in children-oriented countries. The statistical significance of the coefficients of both variables is demonstrated at the 1% level.

Columns 3 and 4 report the second-stage results for Scope 1 emissions. Instrumented ownership confirms that family firms exhibit a lower level of CO_2 emissions relative to non-family-firms. The end of the table reports diagnostic tests. The p-value of the Wald Test under the null

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[12] Inglehart, R., C. Haerpfer, A. Moreno, C. Welzel, K. Kizilova, J. Diez-Medrano, M. Lagos, P. Norris, E. Ponarin & B. Puranen et al. (eds.). 2014. World Values Survey: All Rounds - Country-Pooled Datafile Version: https://www.worldvaluessurvey.org/WVSDocumentationWVL.jsp. Madrid: JD Systems Institute.

[13] This dataset was also used in different family firm studies to instrument family control. For example, Bennedsen et al. (2019) instrument the presence of family firms across countries using survey-based questions from the World Value Survey about the strength of family values and trust levels across countries.

hypothesis of no endogeneity of *Family* is lower than 10%, suggesting that the null hypothesis of no endogeneity can be rejected. The instruments employed are strong, as shown by the Kleibergen-Paap F test statistics. In Column 4, second-stage Hansen's J-tests are not rejected, suggesting that exogeneity assumptions of our instruments are valid.[14]

7. Conclusion

Using a large cross-country dataset, we examine the relationship between family ownership and CO_2 emissions, employing different proxies for its intensity. Our results reveal a link between the type of ownership and the environmental footprint of a company. Family firms exhibit lower carbon emissions both direct and indirect when compared to non-family firms, suggesting a higher commitment to environmental protection by family owners. When using the 2015 Paris Agreement as a quasi-exogeneous shock, results show that family firms reacted more to the Agreement and recorded a further decline in their emissions.

We explore potential channels that might explain our results. Looking into the governance characteristics of family firms reveals that the capacity of the board to adopt a long-term vision matters. Family values also play a positive role. Firms directly managed by the family experience a further reduction in their emissions. On the contrary, family firms with hired CEOs see an increase in emissions. We show that family firms record a higher level of R&D expenses, suggesting that they invest more in new technologies, which might contribute to reducing their environmental footprint.

In final results, we uncover a paradox between the actual emissions of family firms and their environmental communication. Compared with non-family firms, family firms commit less to a reduction in their carbon emissions and display lower ESG scores. This is especially the case for firms chaired by family members. While polluting less, family firms also communicate less about it. This apparent paradox suggests a lower extent of greenwashing in these companies.

Our results reveal that the type of ownership has an impact on environmental performance, even if the company itself might be unaware of it—as revealed by the lower public commitments and ESG Environmental scores. The governance mechanisms and values that are induced by

[14] The size of the coefficients of the IV regressions are not readily interpretable. First, the number of children in the family is not observable for all countries in our sample; second, the predicted value of *Family* from the first-stage is not a dummy variable.

different types of ownership are likely to explain this effect. Due to the perilous impact of global warming and climate change over the next decades, it seems imperative to further document the role of ownership structure in affecting firms' non-financial incentives and potentially reducing their environmental footprints. Public policies could be put in place to take into consideration these effects. Critically, our study reveals that such policies should be based on actual pollution instead of firms' commitments and communication as there might be a notable gap between the two.

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Figure 1 Average CO_2 Emissions Over Time

The figure below reports the evolution of average Scope 1 carbon emission intensities (tons of CO_2 by millions of $US Revenues) over time for family and non-family firms.

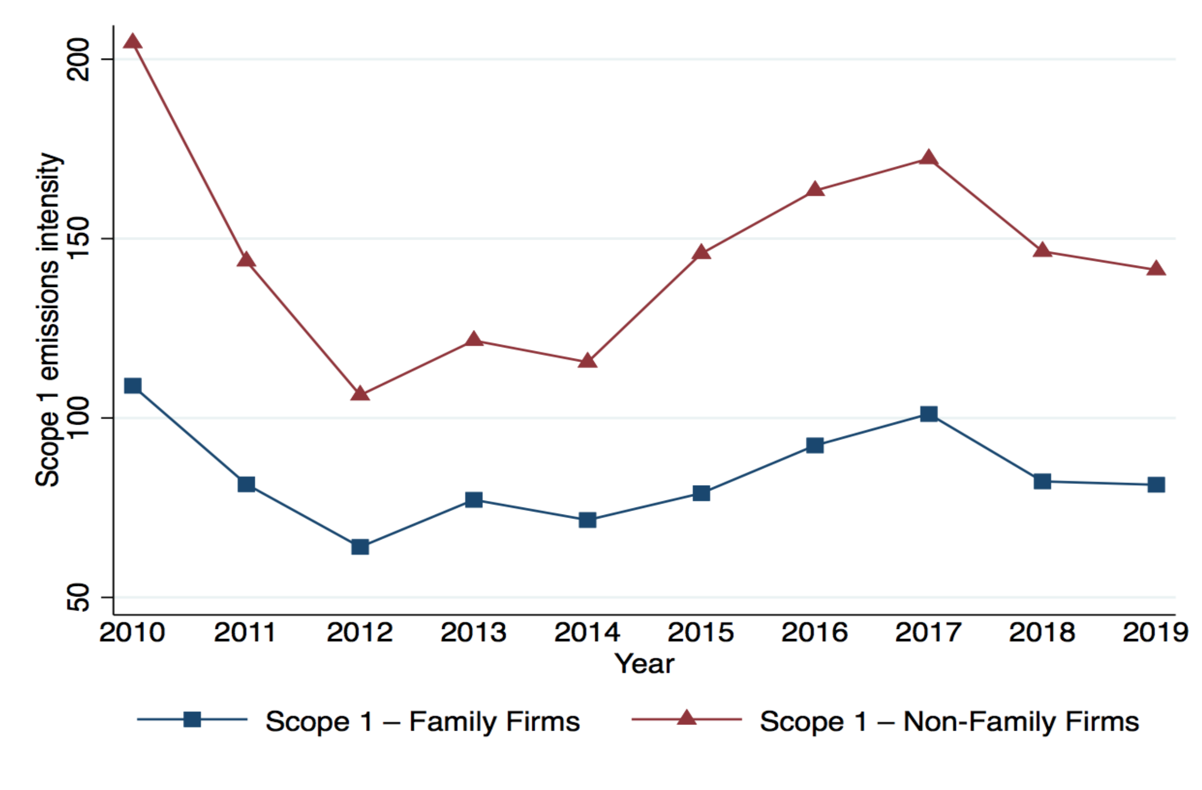

Figure 2 Average CO_2 Emissions Across Regions

The figure below reports the average Scope 1 carbon emission intensities (tons of CO_2 by millions of $US Revenues) from the year 2010 to 2019, across three different regions, for family and non-family firms.

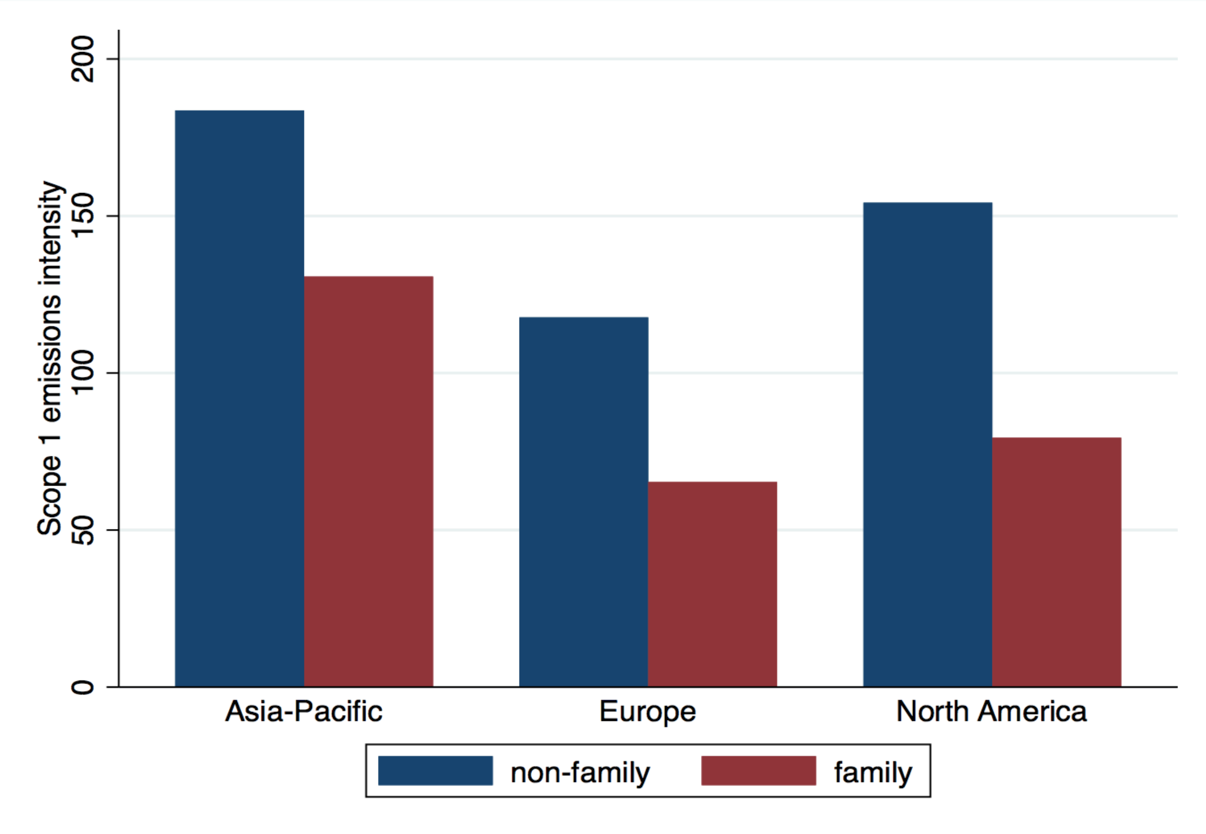

Figure 3 Average CO_2 Emissions Across Sectors

The figure below reports the average Scope 1 carbon emission intensities (tons of CO_2 by millions of $US Revenues) from the year 2010 to 2019, across the different industries, for family and non-family firms.

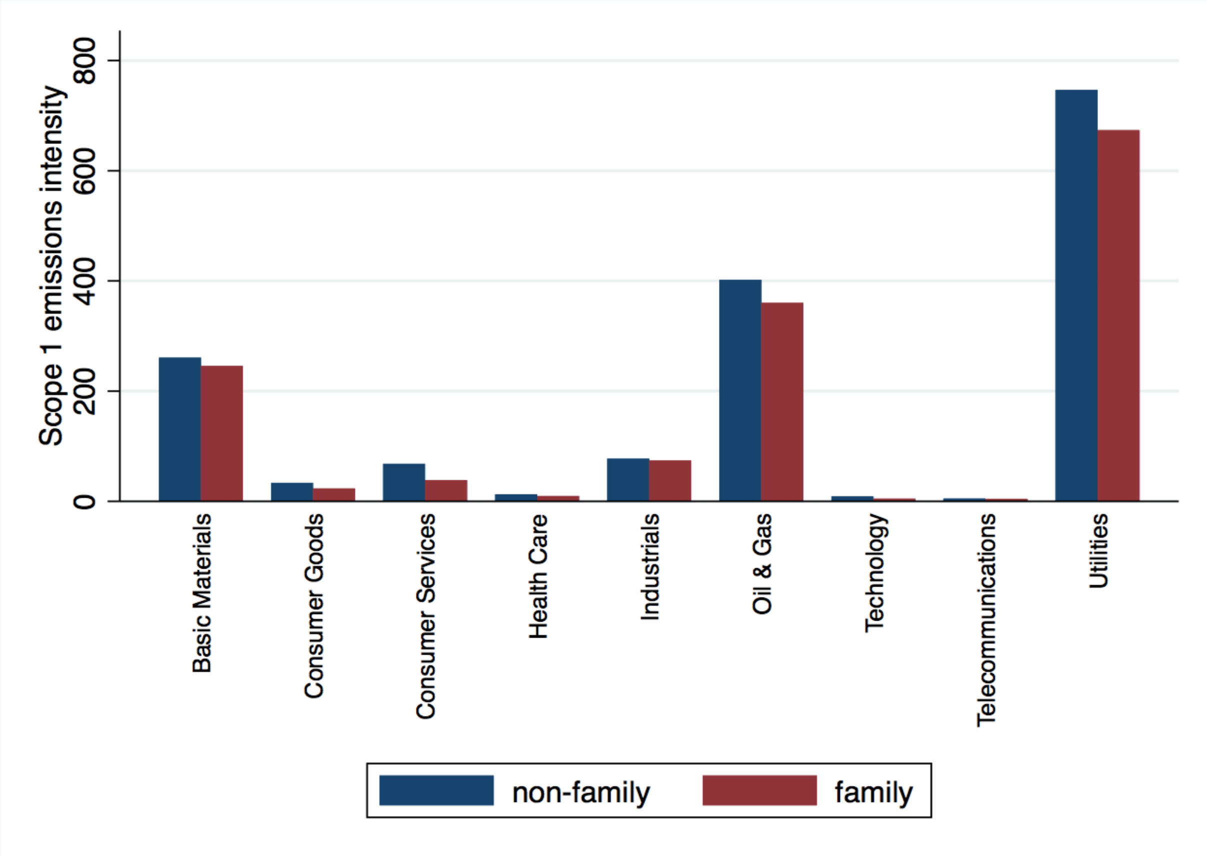

Figure 4 P-score before and after matching

The figure displays Kernel density function of propensity scores between the control (yellow dashed line) and treatment group (blue solid line) before (left) and after (right) the application of the propensity score matching approach.

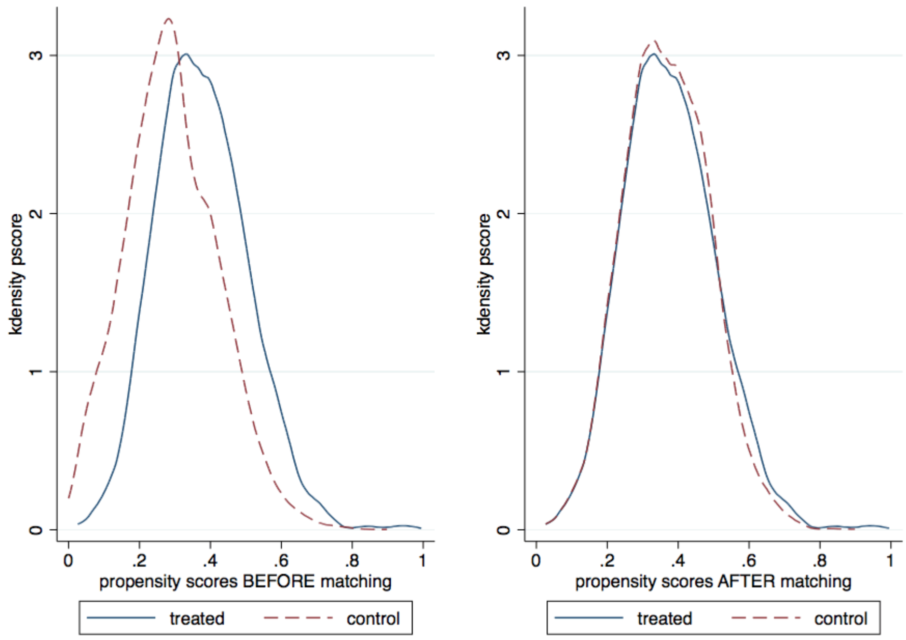

Figure 5 Dynamic treatment effect of the Paris Agreement

The figure displays the dynamic treatment effect of the Paris Agreement on firms' Scope 1 emission intensities (tons of CO_2 by millions of $US Revenues) along with the 95% confidence intervals. The point estimate represents the coefficient estimate of the dynamic DID analysis of Scope 1 emission intensities on relative year dummies interacted with *Family*.

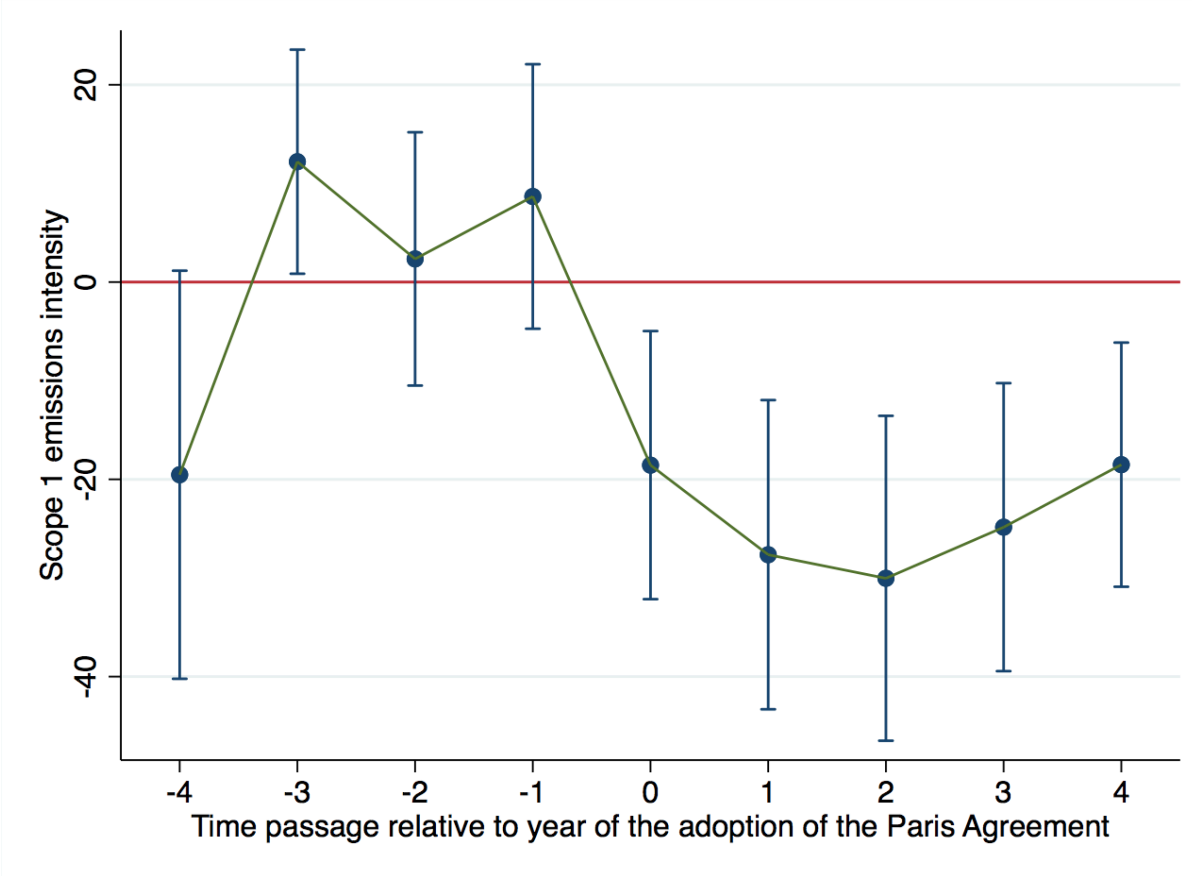

Table 1: Sample distribution

The table reports the number of observations across regions and industries, distinguishing between family and non-family firms in the sample.

		No. of firms		Freq. of
	Obs.	Family	Non-family	Family Firms
Panel A: Region				
Asia-Pacific	7,345	2,367	4,978	32.23%
Europe	16,564	5,429	11,135	32.78%
North America	14,589	4,673	9,916	32.03%
Panel B: Industries				
Basic Materials	3,755	992	2,763	26.42%
Consumer Goods	5,306	2,036	3,270	38.37%
Consumer Services	5,927	2,298	3,629	38.77%
Health Care	3,651	1,420	2,231	38.89%
Industrials	10,273	2,921	7,352	28.43%
Oil & Gas	2,910	765	2,145	26.29%
Technology	3,943	1,630	2,313	41.34%
Telecommunications	925	198	727	21.41%
Utilities	1,808	209	1,599	11.56%
Total	38,498	12,469	26,029	32.39%

Table 2: Descriptive statistics

The table provides summary statistics (Panel A), difference-in-means test (Panel B) and pairwise correlations (Panel C) of the variables employed in the main empirical specifications. The descriptive statistics are based on the full sample consisting of 38,498 observations for of the period 2010–2019. The variables' definition and their sources are presented in Appendix Table A1.

Panel A: Summary statistics

	N	Mean	SD	p25	Median	p75
Family	38,498	0.32	0.47	0.0	0.0	1
iai_1	38,498	124.41	260.55	5.7	11.3	101
iai_1_2	38,498	166.28	293.3	22.3	34.5	164.3
iai_1_2_3	38,498	1,506.36	1,961.88	256.2	673.65	1,837.8
Size	36,977	21.5	1.76	20.23	21.46	22.71
MBV	36,719	58.79	327.22	1.34	2.59	7.08
PPP	36,764	28.03	23.39	8.92	21.65	41.7
CAPEX	36,632	5.27	4.76	2.1	3.91	6.83
ROA	36,434	3.68	10.69	1.39	4.43	8.16
Leverage	36,974	54.97	21.26	40.71	55.73	69.16
Liquidity	36,168	2.05	1.75	1.09	1.54	2.32
Age	34,819	1983	30	1972	1993	2003

Panel B: Difference-in-means test

	Family firms		Non-family firms		
	N	Mean	N	Mean	Difference
iai_1	12,469	83.01	26,029	144.24	-61.24***
iai_1_2	12,469	118.85	26,029	189.0	-70.15***
iai_1_2_3	12,469	1,268.03	26,029	1,620.53	-352.50***
Size	11,942	21.13	25,035	21.68	-0.55***
MBV	11,890	58.59	24,829	58.89	-0.31
PPP	11,917	26.34	24,847	28.85	-2.51***
CAPEX	11,824	5.4	24,808	5.2	0.20***
ROA	11,774	3.46	24,660	3.79	-0.33***
Leverage	11,942	52.24	25,032	56.27	-4.03***
Liquidity	11,650	2.25	24,518	1.95	0.31***
Age	11,012	1988	23,807	1980	8***

Panel C: Pairwise correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Family	1.00											
(2) iai_1	-0.11	1.00										
(3) iai_1_2	-0.11	0.98	1.00									
(4) iai_1_2_3	-0.08	0.59	0.63	1.00								
(5) Size	-0.15	0.24	0.24	0.18	1.00							
(6) MBV	0.00	0.01	0.02	0.05	0.03	1.00						
(7) PPP	-0.05	0.37	0.39	0.39	0.16	0.05	1.00					
(8) CAPEX	0.02	0.20	0.21	0.24	0.01	0.06	0.53	1.00				
(9) ROA	-0.01	-0.04	-0.04	-0.03	0.16	0.08	-0.01	0.06	1.00			
(10) Leverage	-0.09	0.05	0.03	-0.03	0.33	-0.02	0.02	-0.04	-0.11	1.00		
(11) Liquidity	0.08	-0.09	-0.07	-0.02	-0.30	-0.01	-0.17	-0.10	-0.12	-0.55	1.00	
(12) Age	0.12	0.00	0.00	0.01	-0.20	-0.04	0.02	0.08	-0.10	-0.05	0.08	1.00

Table 3: The impact of family ownership on emissions intensity

This table reports the OLS regression results of family ownership on firms' emission using data for 2010–2019. The dependent variables represent Scope 1, 2 and 3 emission intensity. Family is a dummy variable equal to 1 for family-owned firm and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors clustered at the firm level reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1 (1)	iai_1_2 (2)	iai_1_2_3 (3)
Family	-12.805**	-15.603***	-71.552*
	(5.207)	(5.706)	(37.466)
Size	21.609***	25.373***	146.754***
	(2.116)	(2.377)	(14.060)
MBV	-0.033	-0.032	-0.484*
	(0.022)	(0.025)	(0.250)
PPP	0.857***	1.078***	4.434***
	(0.093)	(0.103)	(0.598)
CAPEX	2.029***	2.378***	16.676***
	(0.579)	(0.628)	(3.939)
ROA	-1.420***	-1.720***	-993***
	(0.166)	(0.183)	(1.352)
Leverage	-0.501***	-0.589***	-3.966***
	(0.136)	(0.153)	(1.024)
Liquidity	-1.773	0.074	15.579
	(1.361)	(1.532)	(10.722)
Age	0.007	0.026	0.922
	(0.109)	(0.125)	(0.785)
Observations	25,596	25,596	25,596
Firms	5,016	5,016	5,016
R^2	0.469	0.476	0.456
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 4: Family firms and direct emission intensity – industry heterogeneity

This table reports the OLS regression results of Family ownership on firms' emissions for different economic sectors using data for 2010–2019. The dependent variables represent Scope 1 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. All regressions include country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Basic Materials (1)	Cons. Goods (2)	Cons. Services (3)	Health Care (4)	Industrials (5)	Oil & Gas (6)	Technology (7)	Telecommu nications (8)	Utilities (9)
Family	-8.145	-8.603**	-18.852	-5.578**	-11.732	-36.978*	-2.097	0.505	-77.284
	(21.607)	(4.302)	(14.691)	(2.720)	(10.764)	(19.176)	(1.668)	(1.154)	(63.522)
Size	58.973***	2.660*	24.641***	0.228	30.134***	20.916***	0.184	0.264	62.495***
	(9.030)	(1.416)	(5.680)	(0.717)	(6.382)	(7.689)	(0.495)	(0.244)	(18.837)
MBV	-0.024	0.006	-0.363	-0.012	0.006	0.165***	-0.023***	-0.005	-0.945
	(0.041)	(0.010)	(0.225)	(0.008)	(0.049)	(0.038)	(0.004)	(0.005)	(0.734)
PPP	0.555***	0.415***	0.765***	0.005	1.550***	1.722***	0.188***	0.007	-0.411
	(0.213)	(0.100)	(0.196)	(0.063)	(0.230)	(0.300)	(0.049)	(0.008)	(0.595)
CAPEX	1.439	-0.382	7.389***	0.399	-2.539*	4.840***	0.655*	-0.035	-6.587
	(1.378)	(0.479)	(1.796)	(0.491)	(1.460)	(1.303)	(0.365)	(0.107)	(5.277)
ROA	-1.678**	-0.267**	-1.999***	-0.028	-0.293	-2.054***	-0.147	0.055	-0.300
	(0.672)	(0.135)	(0.609)	(0.064)	(0.483)	(0.727)	(0.128)	(0.053)	(4.406)
Leverage	-0.652	-0.015	0.624**	-0.002	-1.463***	-1.394***	-0.045	0.008	1.128
	(0.563)	(0.081)	(0.277)	(0.044)	(0.408)	(0.492)	(0.037)	(0.028)	(2.658)
Liquidity	-2.044	3.376*	1.036	-0.329	-12.744**	-2.264	0.339	-0.151	-1.682
	(3.917)	(2.031)	(5.126)	(0.522)	(5.378)	(5.473)	(0.563)	(0.415)	(17.086)
Age	0.717**	-0.008	-0.194	0.010	0.025	0.464	-0.073***	0.042	-1.591
	(0.351)	(0.062)	(0.250)	(0.044)	(0.230)	(0.406)	(0.028)	(0.026)	(1.021)
Observations	2,602	33,55	3,952	2,170	6,887	1,866	2,503	575	1,118
Firms	459	614	798	581	1259	363	584	103	197
R^2	0.177	0.039	0.138	0.147	0.164	0.412	0.281	0.042	0.264
Country×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Family firms and direct emission intensity – geographical heterogeneity

This table reports the OLS regression results of Family ownership on firms' emissions for different geographical areas using data for 2010–2019. The dependent variables represent Scope 1 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Asia-Pacific (1)	Europe (2)	North America (3)
Family	-24.707	0.242	-13.772**
	(16.141)	(8.303)	(6.037)
Size	32.333***	20.670***	20.321***
	(6.424)	(3.505)	(2.795)
MBV	-0.016	-0.029	-0.085**
	(0.025)	(0.053)	(0.042)
PPP	1.185***	0.581***	1.135***
	(0.215)	(0.107)	(0.167)
CAPEX	1.789	1.462*	0.994
	(1.268)	(0.859)	(0.911)
ROA	-0.916*	-1.365***	-1.124***
	(0.521)	(0.284)	(0.180)
Leverage	-0.823*	-0.399*	-0.437***
	(0.483)	(0.234)	(0.147)
Liquidity	-1.941	3.534*	-2.337
	(4.606)	(2.124)	(1.531)
Age	-1.022***	0.040	0.349**
	(0.395)	(0.147)	(0.144)
Observations	5,132	10,295	10,169
Firms	837	1,849	2,340
R^2	0.411	0.428	0.562
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 6: Family firms and emission intensity– DiD Paris Agreement

This table reports the OLS regression results of Family ownership on firms' emission using data for 2010–2019. The dependent variables represent Scope 1, 2 and 3 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1 (1)	iai_1_2 (2)	iai_1_2_3 (3)
Family	-0.663	-2.303	-34.043
	(5.345)	(5.929)	(44.509)
Paris×Family	-23.813***	-26.083***	-73.562*
	(5.263)	(5.795)	(42.220)
Size	21.631***	25.396***	146.820***
	(2.116)	(2.376)	(14.062)
MBV	-0.033	-0.032	-0.483*
	(0.022)	(0.025)	(0.250)
PPP	0.859***	1.080***	4.441***
	(0.093)	(0.103)	(0.598)
CAPEX	2.025***	2.373***	16.663***
	(0.579)	(0.628)	(3.939)
ROA	-1.431***	-1.732***	-9.228***
	(0.166)	(0.183)	(1.353)
Leverage	-0.501***	-0.589***	-3.964***
	(0.136)	(0.153)	(1.023)
Liquidity	-1.747	0.102	15.659
	(1.358)	(1.530)	(10.717)
Age	0.007	0.026	0.921
	(0.109)	(0.125)	(0.784)
Observations	25,596	25,596	25,596
Firms	5,016	5,016	5,016
R^2	0.470	0.476	0.456
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 7: DiD Paris Agreement - industry heterogeneity

This table reports the OLS regression results of Family ownership on firms' emission for different economic sectors using data for 2010–2019. The dependent variables represent Scope 1emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Basic Materials	Cons. Goods	Cons. Services	Health Care	Industrials	Oil & Gas	Technology	Telecommunications	Utilities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Family	-24.515	-3.500	-6.707	-4.654*	-12.675	-41.510**	-1.354	1.370	16.478
	(19.671)	(3.991)	(16.715)	(2.721)	(10.463)	(18.028)	(2.185)	(1.250)	(77.451)
Paris×Family	34.100	-9.690**	-23.430**	-1.587	1.852	9.509	-1.434	-1.533	-177.086**
	(27.588)	(3.766)	(11.900)	(3.503)	(9.587)	(23.638)	(1.679)	(1.281)	(83.401)
Size	58.966***	2.683*	24.679***	0.241	30.127***	20.917***	0.177	0.265	61.931***
	(9.026)	(1.417)	(5.681)	(0.715)	(6.380)	(7.691)	(0.499)	(0.243)	(18.746)
MBV	-0.023	0.006	-0.364	-0.012	0.006	0.165***	-0.023***	-0.006	-0.926
	(0.041)	(0.010)	(0.225)	(0.008)	(0.049)	(0.038)	(0.004)	(0.005)	(0.737)
PPP	0.549**	0.416***	0.770***	0.006	1.549***	1.722***	0.188***	0.006	-0.369
	(0.213)	(0.100)	(0.196)	(0.062)	(0.230)	(0.300)	(0.049)	(0.008)	(0.596)
CAPEX	1.492	-0.364	7.383***	0.400	-2.538*	4.840***	0.653*	-0.027	-7.571
	(1.381)	(0.478)	(1.798)	(0.492)	(1.460)	(1.303)	(0.364)	(0.106)	(5.360)
ROA	-1.690**	-0.267**	-2.034***	-0.029	-0.293	-2.070***	-0.148	0.056	-0.367
	(0.673)	(0.134)	(0.611)	(0.064)	(0.483)	(0.725)	(0.128)	(0.053)	(4.331)
Leverage	-0.639	-0.015	0.616**	-0.002	-1.463***	-1.401***	-0.045	0.009	1.393
	(0.566)	(0.081)	(0.278)	(0.044)	(0.408)	(0.490)	(0.037)	(0.028)	(2.680)
Liquidity	-2.066	3.357*	1.134	-0.329	-12.757**	-2.340	0.342	-0.154	-1.182
	(3.930)	(2.029)	(5.122)	(0.522)	(5.380)	(5.481)	(0.563)	(0.418)	(16.998)
Age	0.721**	-0.009	-0.194	0.011	0.025	0.463	-0.073***	0.043	-1.581
	(0.352)	(0.062)	(0.250)	(0.044)	(0.230)	(0.407)	(0.028)	(0.026)	(1.023)
Observations	2,602	3,355	3,952	2,170	6,887	1,866	2,503	575	1,118
Firms	459	614	798	581	1259	363	584	103	197
R^2	0.177	0.040	0.139	0.147	0.164	0.412	0.281	0.044	0.266
Country×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: DiD Paris Agreement - Geographical Heterogeneity

This table reports the OLS regression results of Family ownership on firms' emission for different geographical areas using data for 2010–2019. The dependent variables represent Scope 1 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Asia-Pacific	Europe	North America
	(1)	(2)	(3)
Family	-1.841	10.976	-3.239
	(15.773)	(8.301)	(6.647)
Paris×Family	-46.580***	-21.339***	-20.053***
	(16.859)	(7.888)	(7.010)
Size	32.386***	20.692***	20.335***
	(6.424)	(3.502)	(2.795)
MBV	-0.015	-0.031	-0.083*
	(0.025)	(0.053)	(0.042)
PPP	1.186***	0.584***	1.136***
	(0.214)	(0.107)	(0.167)
CAPEX	1.838	1.439*	0.988
	(1.272)	(0.859)	(0.912)
ROA	-0.918*	-1.373***	-1.135***
	(0.522)	(0.283)	(0.180)
Leverage	-0.820*	-0.394*	-0.438***
	(0.483)	(0.234)	(0.147)
Liquidity	-2.000	3.613*	-2.321
	(4.587)	(2.124)	(1.528)
Age	-1.028***	0.039	0.350**
	(0.395)	(0.147)	(0.144)
Observations	5,132	10,295	10,169
Firms	837	1,849	2,340
R^2	0.412	0.428	0.562
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 9: Family firms, board characteristics and direct emission intensity

This table reports the OLS regression results of Family ownership on firms' emission conditional on board characteristics using data for 2010–2019. The dependent variables represent Scope 1 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Board Gender* is a dummy variable equal to one if the CEO is a woman, zero otherwise. *Board Size* records the number of board members. *Board Skills* is the percentage of board members with specific skills. *Board Tenure* is the average board tenure in years. All specifications include constant, industry, and country-time fixed effects, as well as firm-level control variables, as in Table 3, which are not presented here for brevity. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1 (1)	iai_1 (2)	iai_1 (3)	iai_1 (4)	iai_1 (5)
Family	-12.337*	-20.952**	-9.611	-12.562	28.305*
	(6.957)	(10.381)	(20.106)	(14.011)	(15.447)
Board Gender	-0.863***	-0.931***			
	(0.261)	(0.307)			
Family×Board Gender		0.358			
		(0.411)			
Board Size	0.051		0.170		
	(1.430)		(1.650)		
Family×Board Size			-0.387		
			(2.268)		
Board Skills	-0.139			-0.110	
	(0.130)			(0.154)	
Family×Board Skills				-0.012	
				(0.225)	
Board Tenure	-1.312				1.238
	(0.880)				(1.228)
Family×Board Tenure					-4.614***
					(1.530)
Observations	17,586	17,798	17,799	17,800	17,597
Firms	3,826	3,863	3,863	3,863	3,828
R^2	0.474	0.474	0.473	0.473	0.474
Firm Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes

Table 10: Family Values

This table reports the OLS regression results of different proxies for family values on firms' Scope 1 emission intensity using data for 2010–2019. *Family Share* is a continuous variable that records the percentage of family ownership in the firm. *Family Board* (F. Board) is the ratio of the number of family members in the board to the total number of board members. *Family CEO* (F. CEO) and *Family Dual* (F. Dual) are a dummy variables equal to 1 if the founder or descendant is the CEO or the CEO and Chairman, respectively, and 0 otherwise. *Founder CEO* (FCEO) and *Descendant CEO* (DCEO) are dummy variables equal to 1 if the founder or the descendant is the CEO, respectively, and 0 otherwise. *Founder Dual* (FDual) and *Descendant Dual* (DDual) are dummy variables equal to 1 if the founder or the descendant is the CEO and Chairman, respectively, and 0 otherwise. All specifications include constant, industry, and country-time fixed effects, as well as firm-level control variables, as in Table 3, which are not presented here for brevity. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1 (1)	iai_1 (2)	iai_1 (3)	iai_1 (4)	iai_1 (5)
Family Share	-0.566**	-0.476**	-0.304*	-0.481**	-0.306*
	(0.275)	(0.197)	(0.171)	(0.197)	(0.171)
F. Board	-0.883***				
	(0.283)				
Family Share ×F. Board	0.027***				
	(0.010)				
F. CEO		-12.389**			
		(6.272)			
Family Share ×F. CEO		0.702**			
		(0.282)			
F. Dual			-16.315**		
			(8.316)		
Family Share ×F. Dual			0.503*		
			(0.281)		
FCEO				0.768	
				(7.228)	
Family Share ×FCEO				0.305	
				(0.318)	
DCEO				-37.385***	
				(10.940)	
Family Share ×DCEO				1.283***	
				(0.376)	
FDual					-9.807
					(9.321)
Family Share ×FDual					0.395
					(0.351)
DDual					-32.118**
					(15.391)
Family Share ×DDual					0.751*
					(0.419)
Observations	22,275	25,596	25,596	25,596	25,596
Firms	4,463	5,016	5,016	5,016	5,016
R^2	0.464	0.469	0.469	0.470	0.469
Firm Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes

Table 11: Family ownership and R&D

This table reports the OLS regression results of Family ownership on firms' Research and development (R&D) expenses using data for 2010–2019. The dependent variables represent R&D expenses scaled by total assets. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *iai_1* is the scope 1 emission intensity in CO_2 tons per USD millions of revenues. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All specifications include constant, industry, and country-time fixed effects, as well as firm-level control variables, as in Table 3, which are not presented here for brevity. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	R&D (1)	R&D (2)	R&D (3)	R&D (4)
Family	0.315	0.427	-0.133	-0.009
	(0.304)	(0.349)	(0.358)	(0.285)
iai_1	-0.000	0.000	-0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Family×iai_1		-0.001		-0.001
		(0.001)		(0.001)
Paris×Family			0.869**	0.855**
			(0.372)	(0.322)
Paris×iai_1				-0.001
				(0.001)
Paris×Family×iai_1				-0.000
				(0.002)
Size	-0.692***	-0.691***	-0.692***	-0.692***
	(0.107)	(0.107)	(0.107)	(0.121)
MBV	0.002***	0.002***	0.002***	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
PPP	-0.014***	-0.014***	-0.014***	-0.014**
	(0.004)	(0.004)	(0.004)	(0.006)
ROA	-0.202***	-0.202***	-0.201***	-0.201**
	(0.017)	(0.017)	(0.017)	(0.066)
Leverage	-0.008	-0.008	-0.008	-0.008
	(0.010)	(0.010)	(0.010)	(0.016)
Liquidity	0.342***	0.341***	0.342***	0.341**
	(0.079)	(0.079)	(0.079)	(0.115)
Age	0.005	0.005	0.005	0.005*
	(0.004)	(0.004)	(0.004)	(0.002)
Observations	8,949	8,949	8,949	8,949
Firms	1,987	1,987	1,987	1,987
R^2	0.450	0.450	0.451	0.451
Industry FE	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes

Table 12: Family ownership and firms' CO2 commitments

This table reports the logit random-effects model results of Family ownership on firms' emission reduction targets. The dependent variable *Commitment* equals 1 if the firm announced emission reduction target. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry, country and time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors clustered at the firm level reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Commitment (1)	Commitment (2)	Commitment (3)
Family	-0.546***	-0.546***	-0.779***
	(0.206)	(0.206)	(0.280)
Paris		1.433***	1.340***
		(0.217)	(0.229)
Paris×Family			0.391
			(0.273)
Size	2.187***	2.187***	2.190***
	(0.102)	(0.102)	(0.103)
MBV	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
PPP	0.017***	0.017***	0.017***
	(0.002)	(0.002)	(0.002)
CAPEX	-0.025	-0.025	-0.025
	(0.018)	(0.018)	(0.018)
ROA	0.022***	0.022***	0.022***
	(0.008)	(0.008)	(0.008)
Leverage	-0.000	-0.000	-0.000
	(0.005)	(0.005)	(0.005)
Liquidity	-0.051	-0.051	-0.053
	(0.058)	(0.058)	(0.058)
Age	-0.024***	-0.024***	-0.024***
	(0.003)	(0.003)	(0.003)
Observations	17,941	17,941	17,941
Firms	3,953	3,953	3,953
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Table 13: The impact of Family ownership on ESG rating

This table reports the OLS regression results of Family ownership on firms' ESG rating using data for 2010–2019. The dependent variables represent ESG combined, and ESG environmental (ESG_E) ratings, respectively. Refinitiv's ESG scores range from 0 to 100, with higher scores indicating better performance in ESG dimensions. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	ESG (1)	ESG_E (2)	ESG (5)	ESG_E (6)
Family	-3.881***	-3.812***	-4.018***	-4.136***
	(0.598)	(0.811)	(0.781)	(1.071)
Paris×Family			0.236	0.560
			(0.620)	(0.872)
Size	5.879***	10.678***	5.880***	10.680***
	(0.202)	(0.251)	(0.202)	(0.251)
MBV	0.006**	0.004	0.006**	0.004
	(0.002)	(0.003)	(0.002)	(0.003)
PPP	0.030***	0.067***	0.030***	0.067***
	(0.007)	(0.009)	(0.007)	(0.009)
CAPEX	-0.119**	-0.137**	-0.119**	-0.136**
	(0.048)	(0.065)	(0.048)	(0.065)
ROA	0.137***	0.122***	0.138***	0.122***
	(0.020)	(0.028)	(0.020)	(0.028)
Leverage	-0.004	-0.016	-0.004	-0.016
	(0.014)	(0.019)	(0.014)	(0.019)
Liquidity	-0.048	0.106	-0.048	0.107
	(0.161)	(0.207)	(0.161)	(0.207)
Age	-0.045***	-0.077***	-0.045***	-0.077***
	(0.009)	(0.013)	(0.009)	(0.013)
Observations	18,287	18,278	18,287	18,278
Firms	3,962	3,961	3,962	3,961
R^2	0.358	0.506	0.358	0.506
Industry FE	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes

Table 14: Alternative measurements

This table reports the OLS regression results of family ownership on firms' emission using alternative measurements for the dependent variables and family firm. In Panel A, the dependent variables represent the natural logarithm of the absolute level of Scope 1, 2 and 3 emissions instead of emission intensity. In Panel B, alternative definitions for *Family* are employed. All regressions include industry and country-time fixed effects, and a constant term. Table A1 reports variables definition. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Absolute Emissions

	aai_1 (1)	aai_1_2 (2)	aai_1_2_3 (3)
Family	-0.212***	-0.143***	-0.098***
	(0.045)	(0.035)	(0.031)
Observations	25,596	25,596	25,596
Firms	5,016	5,016	5,016
R^2	0.757	0.790	0.781
Firm Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Panel B: Alternative definitions for Family

	iai_1 (1)	iai_1 (2)	iai_1 (3)	iai_1 (4)	iai_1 (5)
Family (alt. def. 1)	-12.928**				
	(5.194)				
Family (alt. def. 2)		-12.700*			
		(6.507)			
Family (alt. def. 3)			-12.038*		
			(6.616)		
Family (alt. def. 4)				-17.843***	
				(6.764)	
Family (alt. def. 5)					-13.855**
					(6.535)
Observations	25,596	25,596	25,596	25,596	25,596
Firms	5,016	5,016	5,016	5,016	5,016
R^2	0.469	0.469	0.469	0.469	0.469
Firm Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes

Table 15: The impact of Family ownership on emissions intensity: the effect of FE and different ways of clustering

This table reports the OLS regression results of Family ownership on firms' emission using data for 2010–2019. The dependent variables represent Scope 1 emission intensity. *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1 (1)	iai_1 (2)	iai_1 (3)	iai_1 (4)	iai_1 (5)	iai_1 (6)	iai_1 (7)	iai_1 (8)
Family	-61.238***	-36.412***	-6.538	-12.805**	-13.424***	-12.805**	-12.805**	-12.805***
	(6.313)	(6.806)	(5.198)	(5.207)	(5.197)	(4.220)	(5.002)	(2.553)
Size		37.613***	19.084***	21.609***	21.520***	21.609***	21.609***	21.609***
		(2.612)	(1.868)	(2.116)	(2.296)	(6.032)	(3.066)	(1.291)
MBV		0.007	0.020**	-0.033	-0.009	-0.033	-0.033	-0.033**
		(0.011)	(0.009)	(0.022)	(0.020)	(0.021)	(0.021)	(0.014)
PPP		1.128***	0.820***	0.857***	0.898***	0.857**	0.857***	0.857***
		(0.119)	(0.090)	(0.093)	(0.096)	(0.267)	(0.156)	(0.071)
CAPEX		6.224***	1.865***	2.029***	1.911***	2.029	2.029***	2.029***
		(0.764)	(0.585)	(0.579)	(0.618)	(1.416)	(0.759)	(0.432)
ROA		-2.945***	-1.352***	-1.420***	-1.218***	-1.420***	-1.420***	-1.420***
		(0.210)	(0.157)	(0.166)	(0.175)	(0.296)	(0.213)	(0.131)
Leverage		-0.779***	-0.526***	-0.501***	-0.434***	-0.501	-0.501***	-0.501***
		(0.183)	(0.142)	(0.136)	(0.137)	(0.375)	(0.173)	(0.084)
Liquidity		-1.888	-2.193*	-1.773	-1.436	-1.773	-1.773	-1.773*
		(1.801)	(1.324)	(1.361)	(1.321)	(2.405)	(1.799)	(0.935)
Age		0.510***	0.111	0.007	0.027	0.007	0.007	0.007
		(0.137)	(0.102)	(0.109)	(0.115)	(0.136)	(0.128)	(0.054)
Observations	38,498	25,618	25,618	25,596	25,028	25,596	25,596	25,596
Firms	6,516	5,016	5,016	5,016	4,955	5,016	5,016	5,016
R^2	0.012	0.141	0.447	0.469	0.513	0.469	0.469	0.469
Cluster	Firm	Firm	Firm	Firm	Firm	Industry	Country# Industry	Country# Industry#Time
Industry FE	No	No	Yes	No	No	Yes	Yes	Yes
Country×Time FE	No	No	No	Yes	No	Yes	Yes	Yes
Country×Time× Industry FE	No	No	No	No	Yes	No	No	No

Table 16: Pretreatment firm characteristics and matching procedure

This table shows firm-specific characteristics, averaged for the pretreatment period (2010-2014), for the control and the treatment group. The table is divided in two panels. Panel A reports descriptive statistics for the unmatched sample of firm covariates employed in the main analysis, whilst Panel B reports descriptive statistics for the matched sample. The PSM applies a logit model and one-to-one nearest neighbor, imposing a tolerance level on the maximum propensity score distance (caliper) between the control and the treatment group equals to 0.01. *, **, *** indicate statistical significance of 1%, 5% and 10% respectively.

Variables	Treated (1)	Control (2)	t-test (3)
	Panel A: Before matching		
Size	21.307	21.83	-17.09***
MBV	71.362	63.327	1.17
PPP	49.304	58.209	-11.65***
CAPEX	6.1331	5.6402	5.05***
ROA	5.6152	4.963	4.01***
Leverage	50.766	55.348	-12.03***
Liquidity	2.1649	1.9213	8.28***
Age	1985.7	1978.7	12.66***
	Panel B: After matching		
Size	21.331	21.287	1.27
MBV	64.458	60.69	0.47
PPP	49.826	49.669	0.19
CAPEX	6.0486	5.9685	0.64
ROA	5.5032	5.4186	0.42
Leverage	51.232	51.587	-0.77
Liquidity	2.1377	2.1219	0.43
Age	1985.4	1985.3	0.13

Table 17: Propensity score matching analysis

This table reports the OLS regression results of Family ownership on firms' emissions using data for 2010–2019. The dependent variables represent Scope 1, 2 and 3 emission intensity (Column (1-3) and (7)) and the logarithm of absolute emissions (Column (4-6) and (8)). *Family* is a dummy variable equal to 1 for family-owned firm and 0 otherwise. *Paris* is a dummy variable equal to 1 for the time period between 2015–2019 and 0 otherwise. All regressions include industry and country-time fixed effects, and a constant term. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	iai_1	iai_1_2	iai_1_2_3	aai_1	aai_1_2	aai_1_2_3	iai_1	aai_1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Family	-16.608***	-19.982***	-95.362**	-0.233***	-0.159***	-0.101***	-7.213	-0.172***
	(6.027)	(6.576)	(43.428)	(0.052)	(0.040)	(0.035)	(5.411)	(0.051)
Paris×Family							-21.397***	-0.138***
							(6.107)	(0.044)
Size	21.965***	24.954***	139.143***	0.997***	0.952***	0.945***	22.029***	0.997***
	(2.435)	(2.719)	(16.361)	(0.017)	(0.013)	(0.012)	(2.434)	(0.017)
MBV	-0.046**	-0.047*	-0.684**	-0.000	-0.000	-0.000**	-0.046**	-0.000
	(0.023)	(0.027)	(0.288)	(0.000)	(0.000)	(0.000)	(0.023)	(0.000)
PPP	0.910***	1.169***	5.089***	0.012***	0.010***	0.005***	0.912***	0.012***
	(0.104)	(0.114)	(0.722)	(0.001)	(0.001)	(0.001)	(0.104)	(0.001)
CAPEX	2.266***	2.506***	16.352***	0.014***	0.009**	0.002	2.264***	0.014***
	(0.663)	(0.714)	(4.619)	(0.005)	(0.004)	(0.004)	(0.663)	(0.005)
ROA	-1.634***	-1.968***	-11.927***	0.010***	0.013***	0.016***	-1.634***	0.010***
	(0.216)	(0.237)	(1.830)	(0.002)	(0.002)	(0.002)	(0.216)	(0.002)
Leverage	-0.505***	-0.567***	-3.758***	0.004***	0.003***	0.003***	-0.508***	0.004***
	(0.159)	(0.178)	(1.224)	(0.001)	(0.001)	(0.001)	(0.159)	(0.001)
Liquidity	-1.890	0.248	29.202**	-0.021	-0.027**	-0.043***	-1.909	-0.021
	(1.700)	(1.914)	(13.752)	(0.015)	(0.012)	(0.012)	(1.699)	(0.015)
Age	-0.022	-0.004	1.003	-0.001	-0.001	-0.001*	-0.022	-0.001
	(0.121)	(0.136)	(0.869)	(0.001)	(0.001)	(0.001)	(0.121)	(0.001)
Observations	19,623	19,623	19,623	19,623	19,623	19,623	19,623	19,623
Firms	2,909	2,909	2,909	2,909	2,909	2,909	2,909	2,909
R^2	0.434	0.453	0.462	0.724	0.760	0.748	0.434	0.725
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CtryxTime FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 18: Instrumental variable approach (2SLS-IV)

This table reports the single-equation instrumental-variables regression results of Family ownership on firms' emissions using data for 2010–2019. *Panel A* presents the first stage regression results. *Panel B* reports second-stage regression results. The dependent variable in column (1) and (2) is a dummy variable equal to 1 for family-owned firm and 0 otherwise. The dependent variable in column (3) and (4) is Scope 1 emission intensity. *CEO Tenure* is defined as the average tenure of the CEO at the firm level. *Children* is a mean score response at the country level to the question from the World Value Survey about the number of children in the family. All specifications include constant, industry, and country-time fixed effects, as well as firm-level control variables, as in Table 3, which are not presented here for brevity. Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: First stage		*Panel B: Second stage*	
	Family	Family	iai_1	iai_1
	(1)	(2)	(3)	(4)
CEO tenure	0.015***	0.150***		
	(0.001)	(0.001)		
Children		0.048***		
		(0.013)		
Family			-29.388**	-39.199***
			(14.388)	(14.921)
Observations	23,877	17,689	23,877	17,689
Firms	4,878	3,696	4,878	3,696
R^2	0.205	0.183	0.481	0.503
Firm Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes
F-statistics	394	161		
(p-value)	0.000	0.000		
Hansen J-statistics				0.141
(p-value)				0.707

Appendix

Table A1 Variables

Definitions and source of the variables employed in the study.

Variable	Description of variables	Source
	Emission Variables	
iai_1	Intensity Average Inference Scope 1 (tCO_2e/\$m Revenue)	Urgentem
iai_1_2	Intensity Average Inference Scope 1 & 2 Total (tCO_2e/\$m Revenue)	Urgentem
iai_1_2_3	Intensity Average Inference Scope 1, 2 & 3 Total (tCO_2e/\$m Revenue)	Urgentem
aai_1	Log of Absolute Average Inference Scope 1 (tCO_2e)	Urgentem
aai_1_2	Log of Absolute Average Inference Scope 1 & 2 Total (tCO_2e)	Urgentem
aai_1_2_3	Log of Absolute Average Inference Scope 1, 2 & 3 Total (tCO_2e)	Urgentem
	Ownership Variables	
Family	Equals 1 if the founder or descendant or family member is director or officer or large shareholder>5%, 0 otherwise	NRG
Family Share	The ratio of the number of shares held by the family to total shares outstanding	NRG
Family (alt. def. 1)	Equals 1 if the founder or descendant or family member is director or officer or large shareholder, 0 otherwise	NRG
Family (alt. def. 2)	Equals 1 if the family is the largest voteholder, 0 otherwise	NRG
Family (alt. def. 3)	Equals 1 if the family is the largest shareholder, 0 otherwise	NRG
Family (alt. def. 4)	Equals 1 if there are at least two family members as board member or executive officer or large shareholder >5%, 0 otherwise	NRG
Family (alt. def. 5)	Equals 1 if the family is the largest voteholder and at least one member of the family is board member, 0 otherwise	NRG
	Financial Variables	
Size	Logarithm of total assets	Refinitiv
MBV	Price to book value per share calculated by dividing the company's latest closing price by its book value per share	Refinitiv
PPP	Property, plant and equipment divided by total assets	Refinitiv
CAPEX	Capital expenditure divided by total assets	Refinitiv
ROA	Net income divided by total assets	Refinitiv
Leverage	Total long-term debt divided by total assets	Refinitiv
Liquidity	Total current assets divided by total current liabilities	Refinitiv
Age	Date of Incorporation (registration)	Refinitiv
R&D	Research and development (R&D) expenses divided by total assets	Refinitiv
	Governance Variables	
Board Gender	Percentage of female on the board	Refinitiv
Board Size	Total number of board members.	Refinitiv
Board Skills	Percentage of board members with specific skills	Refinitiv
Board Tenure	Average length of the board tenure in years	Refinitiv
Family Board	The ratio of the number of family members in the board to the total number of board members	NRG
Family CEO	Equals 1 if the founder or descendant is the CEO, 0 otherwise	NRG
Family Dual	Equals 1 if the founder or descendant is the CEO and Chairman, 0 otherwise	NRG
Founder CEO	Equals 1 if the founder is the CEO, 0 otherwise	NRG
Descendant CEO	Equals 1 if the descendant is the CEO, 0 otherwise	NRG
Founder Dual	Equals 1 if the founder is the CEO and Chairman, 0 otherwise	NRG

Descendant Dual	Equals 1 if the descendant is the CEO and Chairman, 0 otherwise	NRG
	Environmental Variables	
Paris Agreement	Equals 1 for the time period between 2015–2019, 0 otherwise	
Commitment	Equals 1 if the firm announced emission reduction target	Refinitiv
ESG	Refinitiv ESG Combined Score is an overall company score based on the reported information in the environmental, social and corporate governance pillars (ESG Score)	Refinitiv
ESG_E	The environmental pillar measures a company's impact on living and non-living natural systems, including the air, land and water, as well as complete ecosystems	Refinitiv
	Instrument Variables	
Children	Mean score response at the country level to the question about the number of children in the family.	World Value Survey
CEO Tenure	Average length of CEO tenure in years	NRG

Table A2: Descriptive statistics additional variables

The table provides summary statistics of the additional variables employed in the study. The descriptive statistics are based on the full sample consisting of 38,498 observations for the period 2010–2019. The variables' definition and their sources are presented in Table A1.

	N	Mean	SD	p25	Median	p75
Board Gender	24,323	17.15	12.81	8.33	16.67	25
Board Size	24,324	9.93	3.26	8	9	12
Board Skills	24,325	52.65	22.29	37.5	53.85	69.23
Board Tenure	24,028	7.6	3.79	4.89	6.95	9.61
Family Ownership	38,498	6.92	16.55	0	0	1.2
Family Board	33,743	6.28	11.54	0	0	11.11
Family CEO	38,498	.16	0.37	0	0	0
Family Dual	38,498	.09	0.28	0	0	0
Founder CEO	38,498	.1	0.31	0	0	0
Descendant CEO	38,498	.06	0.23	0	0	0
Founder Dual	38,498	.06	0.24	0	0	0
Descendant Dual	38,498	.03	0.16	0	0	0
R&D	12,656	6.2	8.95	.91	2.92	7.82
ESG	24,964	45.13	18.85	30.34	44.49	59.29
ESG_E	24,945	39.55	28.72	12.18	39.26	63.87
Commitment	24,480	.39	0.49	0	0	1
aai_1	38,498	10.29	2.87	8.35	10.14	12.21
aai_1_2	38,498	11.34	2.45	9.69	11.24	12.93
aai_1_2_3	38,498	13.86	2.41	12.31	13.92	15.47
Family (alt. def. 1)	38,498	.33	0.47	0	0	1
Family (alt. def. 2)	38,498	.18	0.39	0	0	0
Family (alt. def. 3)	38,498	.18	0.38	0	0	0
Family (alt. def. 4)	38,498	.17	0.37	0	0	0
Family (alt. def. 5)	38,498	.16	0.37	0	0	0
CEO Tenure	35,344	9.7	8.64	3	7	13
Children	26,923	.83	1.75	0.22	1.47	1.65

Table A3 CEO Type, Commitments, and ESG Score

This table reports OLS regression results of commitments to reduce emissions (Panel A), total ESG scores (Panel B), and Environmental ESG score (Panel C) on CEO type, using data from 2010 to 2019. The reported independent variables are dummy variables that capture the type of CEO. *Hire* corresponds to a hired CEO, who is not part of the family. *Founder* and *Descendent* are family members CEO, respectively from the first or following generations. All specifications include constant, industry, and country-time fixed effects, as well as firm-level control variables, as in Table 3, which are not presented here for brevity. Appendix Table A1 provides detailed definitions of the variables. Robust standard errors are clustered at firm level and are indicated in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Emission Commitments

	(1)	(2)	(3)
Hire	0.076***		
	(0.019)		
Descendant		-0.084***	
		(0.032)	
Founder			-0.053***
			(0.019)
Observations	16,263	17,129	17,129
Firms	3,615	3,901	3,901
R^2	0.335	0.338	0.337

Panel B: ESG combined score

	(1)	(2)	(3)
Hire	5.725***		
	(0.777)		
Descendant		-5.887***	
		(1.421)	
Founder			-4.811***
			(0.809)
Observations	17.451	17.451	17.451
Firms	3.908	3.908	3.908
R^2	0.365	0.360	0.360

Panel C: ESG environmental score

	(1)	(2)	(3)
Hire	6.145***		
	(0.984)		
Descendant		-5.865***	
		(1.752)	
Founder			-5.465***
			(1.057)
Observations	17.443	17.443	17.443
Firms	3.906	3.906	3.906
R^2	0.513	0.510	0.511
Control variables	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes