Family Firm Ownership and Carbon Emissions*

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Abstract

This study examines the relationship between family firms 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. Paradoxically, we find that family-owned firms 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
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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 will be changed, its relative role is expected to increase further (Reilly et al., 2003). In order to address this problem, 196 country representatives unanimously agreed to commit themselves to reduce the emission of GHG, in particular CO_2, at the 2015 Paris Climate Summit. The Paris Agreement set out a global framework to avoid dangerous climate change by limiting 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. Bolton and Kacperczyk (2021) document that institutional investors are already demanding compensation for investments with higher total CO_2 emissions. In other words, polluting firms are paying higher financing costs, which may further increase in the future. Thus, the reduction of CO_2 emissions is becoming a meaningful financial goal for firms. In our study, we focus on the CO_2 emission of family firms over the last decade. Family firms are the most prevalent form of business around the world (Morck and Yeung, 2004). While there are some variations in the ownership across the world, it is estimated that between 65-80% of all businesses in the world are owned by a family (Gersick et al., 1997). In the United States, Colli (2003) argues that around 90% of all businesses can be considered as family firms. The share of family firms in East Asia is estimated to be around two-third (Carney and Child, 2013; Claessens et al., 2000), and 50% in Europe (Faccio and Lang, 2002). This also covers listed companies. In the US, a third of the largest public firms are family owned (Anderson and Reeb, 2004) and listed family firms control over 50% of all US companies (Villalonga and Amit, 2010). Even if these proportions have been challenged based on the definition of family ownership (see Berle and Means, 1932; Gadhoum et al., 2005; Holderness, 2009; Villalonga and Amit, 2009), family firms are considered to be the most important type of ownership across the world and contribute to more than half of the GDP and two-thirds of employment worldwide (PwC, 2021).

One might expect a distinct impact between carbon emission and family ownership because family firms are a unique type of shareholders (Anderson and Reeb, 2004; Bennedsen and Fan,

2014; Cheng, 2014; Chrisman et al., 2005) that is likely to affect both financial and non-financial environmental motives, as well as the type of agency conflicts within the firm.

First, 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). Family firms are likely to have a specific sensitivity to the financial gains associated with a reduction in pollution. 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.

Family-firms might also adopt specific actions on pollution for non-economic 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 greenhouse gas 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 decarbonisation policies than their non-family counterparts to demonstrate their commitment to environmental protection.

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 environment-friendly policies. We focus on CO_2 emissions, which are recognised as one of the most important factors responsible for climate catastrophes worldwide (Shahbaz et al., 2013) and it is one of the most understandable measures for sustainable development for politics and the public. We use a comprehensive sample comprising 6,610 non-financial from 44 countries over the period 2010-2019. Our sample include unique information about the ownership structure that we combine with the carbon emissions and firm-level controls. The final sample presents an unbalanced panel dataset covering 38,498 firm-year observations.

This study examines the relationship between family firms and carbon emissions by using the average intensity of the different Scope emissions (1, 1+2, and 1+2+3), where the intensity is measure as CO_2 emissions to firm's revenues. In order to define a family firm, we follow Anderson and Reeb (2003) and Villalonga and Amit (2006, 2009) and use an indicator variable equal to 1 if the founder or a member of the founding family is a board or executive member, or a large shareholder holding more than 5% of the firm's equity. Our results show that family firms have lower emissions, both direct and indirect, when compared to non-family firms, suggesting a higher commitment to environmental protection by family owners. However, cross-sectional analysis reveals that the positive effect of family owner on carbon emissions is

mainly clustered in three sectors (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. We find that for each emission Scope, the effect of family firms is negative and significant only after the Paris Accords, 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 sectors with higher abatement costs such as Consumption and Services. We further analyze whether the results might be explained by differences in the governance structure between family and non-family firms. We find that the positive effect of family ownership in reducing emissions persists even after including several board characteristics. Moreover, family firms with boards of a longer tenure display an additional reduction, suggesting that the long-term vision of family firms plays an important role. Finally, by using the ESG scores provided by Thomson Reuters we analyze the environmental commitments and performance of family versus non-family firms. We found that family-owned firms commit *less* to a reduction in their GHG emissions and have *lower* ESG scores, although polluting less. This paradox suggests a lower engagement in public display of such an outcome and a lower propensity for greenwashing.

Our results are robust to a set of additional tests. First, we use an alternative measurement for our emission intensity by using the absolute emissions levels. Second, we use different specifications to address the question of fixed-effects and clustering. Lastly, we employ a propensity score approach (PSM) to alleviate concerns about omitted variable bias. Overall, our initial results remain similar in all these different settings.

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 carbon 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 prone to reputation concerns (proxied by the family name included in the firm 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.

Our study contributes more generally to the Corporate Social Responsibility (CSR) literature by showing the role of family ownership on a non-financial outcome. The results show that family firms are not only polluting less, but are also less engaged in communicating about it, notably in terms of CSR, suggesting an absence of greenwashing in such companies. 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 as opposed to non-economic benefits. The lower extent of greenwashing we observe in our results sheds a new light on these studies and suggests that while environmental communication is not at the benefit of family firms, they display better environmental outputs.

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 and Section 4 the results of additional analyses. Section 5 discusses the robustness of the results and Section 6 concludes the paper.

2. Data and empirical setting

To examine the relationship between family influence 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[3]. The different

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

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 carbon emissions data from Urgentem and retrieve the accounting and market data from Thomson Reuters. In addition, we obtain data on firms Environmental, Social, and Governance (ESG) issues from the Thomson Reuters Asset4 database. 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. In the Appendix we provide information on the definition of all the variables used in the study and its sources.

2.1. Firm carbon emissions data

Data on firm's carbon dioxide emission (CO_2) is retrieved from the Urgentem dataset that adopts the Greenhouse Gas Protocol (GGP) which sets the standard for measuring carbon emissions[4]. It distinguishes between three sources, or scopes, of emissions; data is annual. 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.

In our initial analysis, we employ the three different scopes to measure a firm's CO_2 emission intensity. We first focus on Scope 1 emissions, then aggregate Scope 2, and eventually Scope 3 emissions. Consequently, the third variable aggregates all scopes, which, according to Bolton and Kacperczyk (2021), is by far the most important measure for the emissions in some sectors, like the automobile manufacturing. We follow Ilhan et al. (2021) and Bolton and Kacperczyk (2021) and measure carbon emission intensity by scaling CO_2 emissions in units of tons by a firm's total revenues (in $millions). As a robustness test, we also employ the firm's absolute CO_2 emissions (see for example Azar et al., 2021) and find that the results remain largely unchanged.

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

4 See for more information: https://ghgprotocol.org/corporate-standard

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 from non-US studies which tend to use higher control thresholds (e.g., Faccio and Lang, 2002; La Porta et al., 1999). This suits our dataset, which is dominated by U.S. firms.

Adopting this definition, 38% of our sample is composed of family firms – restricting to US companies, this proportion reaches 39%. This proportion is consistent with the 37% of family ownership found in the study of Amit and Villalonga (2014) in the US. When looking at the per-country composition, there is limited variation across countries in our sample.

[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' *Age*, measured by the year of incorporation; *Size*, the natural logarithm of total assets; *PPP PPE*, the ratio of property, plant, and equipment over the firm's total assets; *MBV*, the market-to-book ratio; *Debt*, the ratio of total debt to total assets; *ROA*, return on assets, measured as the ratio of net income before extraordinary items to total assets; *CAPEX*, measured as Capital expenditure to total assets; and *Liquidity* measured as total current assets divided by total current liabilities.

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 country, industry, and year fixed effects in all our regressions. Table 2 presents the descriptive statistics for all the variables used in the study. The data on carbon emission shows large variation as well the corporate governance data, including the ownership data.

[Insert Table 2 here]

2.4. Empirical Setup

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

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

where $y_{i,c,t}$ denotes the CO_2 emission intensity by firm i located in country c in year t; $FF_{i,c,t}$ is the dummy variable that control for family firms, 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 endogeneity concerns. At a later stage, we further address the potential endogeneity issue by employing a propensity score matching as additional robustness test.

We also mitigate the omitted variable bias by introducing industry $\alpha_{i,t}$ and country-year fixed effects $\mu_{i,t}$, where the former controls for unobserved time-invariant industry factors while the later takes into account common time- and country-specific shocks. The standard errors of the error term $\epsilon_{i,c,t}$ are clustered by firm and year in order to allow for the clustering of shocks within a firm.

3. 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 pollute 12.8pp less as a size of their balance-sheet. 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 15.6pp. When the full indirect costs are accounted for, family firms end up polluting 71.5pp 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.

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 9 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. As robustness check we employ the other proxies for GHG emissions and find that the results do not change, yet we do not show them for brevity[5]. Results are reported in Table 4. Family ownership reduces the emission intensity of three sectors: Consumption of Goods, Health Care, and Oil and Gas. It exerts a non-significant impact on the other sectors.

[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 across these regions (Raupach et al., 2007). 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 section, we further explore these results and their potential origin.

4. Extensions

5 The results of the robustness test are available upon request.

We propose three extensions to our results. We first divide our sample around the Paris Agreement on climate change. We then explore the role of firms' characteristics and notably size and governance. We last report the effect of family ownership on emissions reductions commitments.

4.1. The Effect of Paris Agreement

The 2015 Paris Agreement has represented a sudden and somewhat unexpected change in the governments regulatory stance towards GHG emissions (Falkner, 2016). It 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 adopt this approach and study the evolution of emission intensities around the Paris Agreement for family and non-family firms.

[Insert Table 6 here]

We create a dummy variable *Paris Agreement* that equals to one 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. 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 emission 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 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 for Consumption of Goods, Consumption of Services and Utilities. The effect on the Health Care and Oil and Gas industries is not affected by the Paris Agreement. This pattern suggests 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, 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—with the exception of 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 more reacted to the new environment implied by the Paris Agreement.

4.2. Governance Structure

To explain this result, we now 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). 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 the board independence and board gender diversity have positive associations with carbon reduction initiatives. However, they do not find any relationship between other corporate governance variables and CO_2 emissions of a firm. Consequently, the empirical results on the impact of corporate governance on CO_2 emissions is ambiguous.

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). We explore whether such characteristics partly explain our results.

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 Skill*), and the average tenure of board members (*Board Tenure*). Appendix A presents the definitions

of the variables and their sources. We first control if our results are maintained when board characteristics are taken into account; we then interact our measure of family ownership for each board characteristics to document their role in explaining our results. Table 9 reports the results.

[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 model. This supports the view that the positive effect of family ownership in reducing emissions persists even after controlling for board characteristics. Two board characteristics contribute to a reduction in the levels of emissions: the presence of a woman in the board and boards with longer average tenure. Altunbas et al. (2022) have documented the positive effect a diverse management can have on emissions. The positive effect of longer tenure suggests that boards that can adopt more long-term strategies are more likely to cut emissions. The four next models interact boards' characteristics with the type of ownership. Women in 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. 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 of almost 8 years long for a reduction in emissions to materialize.

4.3. Greenwashing: Commitments, and ESG Scores

Our main results pertain to the observed reduction in emissions relative to firm size. This figure is provided by the Urgentem database but does not necessarily correspond to the perception the firm has of its own environmental performance. We propose two other measures that look at the subjective stance and performance of the firm: its environmental commitments and the firms' Environmental ESG scores.

Over the past decade, the ESG criteria have been a leading trend in the investment industry as the empirical research showed that it can significantly improve corporate performance and long-term value (Eccles et al., 2014; Krueger et al., 2020). However, 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 *Target Emissions* that equals to one if a firm has adopted such commitment and zero otherwise. Data is obtained from Refinitiv. We run a panel logit regression with random-effects at the firm-level. Column 1 of Table 10 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 odd of committing to a reduction in GHG by 42.1%. 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 10 correspond to an odd-ratio of 4.19—or a more than four time increase in commitments following the Agreement. However, this trend is not specifically observed for family firms. The interaction in the third column shows no significative difference based on ownership.

[Insert Table 10 here]

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. In Table 11, we report a negative effect of family ownership on ESG in general and Environmental ESG Score. 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 an absence of greenwashing. The specific business model, governance, 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 public display of such an outcome.

[Insert Table 11 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.

4.4. Founders / descendants / hired

[Insert Tabel x here]

4.1. R&D investments

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. 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 Tabel x here]

Results are reported in Table XXX. The first column relates R&D expenses to a string of independent variables, including family ownership and the amount of carbon emitted. We control for firm's size, book value relative to market value, fixed-assets, profitability, leverage, and liquidity. 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. We do observe that bigger and more profitable firms spend less on R&D, while more indebted and glamour firms tend to spend more. In the second column, we interact family ownership with the level of pollution. Again, 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 suddenly emitting less than other types of firms. We explore whether R&D expenses follow this phenomenon. The third column looks at the 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 partly explain our main result and show that the reduction in pollution level for family is notably backed by an increase in R&D, that is not observed for firms that are not owned by a family. The last column looks to see if this effect is more pronounced for highly polluting family firms, after the Paris Agreement. The 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 emissions by family firms after the Paris Agreement was accompanied by an increase in R&D spendings. This partly explains our results and goes along the view that family firms adopt a more long-term vision that leads them to being more environmentally friendly.

5. Robustness Checks

We offer three types of robustness checks for our findings. First, we document the impact on absolute emissions level. Second, we modify the set of fixed-effects and the clustering of standard-errors. Last, we conduct a Propensity Score Matching (PSM) approach.

5.1. Absolute Emissions Level

Our main measure of emission is based on emission intensity, scaled based on the size of the firm. We offer an alternative measurement in the form of absolute emissions levels. This serves two purposes. First, to ensure our results our robust to an alternative definition of pollution. Second, to assess 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 and run our main model with these dependent variables. Results are reported in Table 12. 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. This supports the view that difference in ownership type also affects emissions efficacy.

[Insert Table 12 here]

5.2. Fixed-Effects and Clustering

Our second robustness test addresses the question of fixed-effects and clustering. Our main model clusters by industries and employ industries and country by time fixed-effects. We propose alternative specifications. Columns 1 to 5 of Table 13 report the results; the dependent variable is scope 1 emissions intensity. 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 13 here]

Columns 6 to 9 of Table 13 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 level of the firm, the industry (baseline), the industry-country, and the industry-country-year. In all cases, the coefficient of *Family* remains significant.

5.3. Propensity Score Matching

Our results thus far indicate that family ownership is associated with both lower absolute GHG emissions and emission intensity. However, a particular concern is that the findings might be affected by potential endogeneity issues and sample selection bias. Therefore, we employ the propensity score matching (PSM) approach to adjust for possible endogeneity issues due to the observable differences in the characteristics between family firms and non-family firms. Rosenbaum and Rubin (1983) show that the PSM approach can efficiently eliminate sample selection bias because it deals with distributing the covariates between a treatment and control group and, creating matched balanced samples with characteristics similar to those of the treatment group.

We estimate propensity score by logit regression of the binary variable for family firm ownership on a vector of control characteristics 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. Precisely, 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. In other words, the propensity scores of two matched companies cannot differ by more than this value. Finally, the matching 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 14 here]

[Insert Figure 1 here]

Panel A of Table 14 presents that the firm characteristics of family and non-family companies are statistically different before implementing the propensity score matching technique, whereas Panel B shows that the sample is well balanced after implementing the propensity score matching technique. Specifically, family firms' characteristics are not statistically different from those of non-family firms after matching. This result reinforces the comparability of the two groups in terms of ex ante observables. Additionally, while the left-hand-side propensity density plot of Figure 1 demonstrates that predicted propensity scores differ considerably between family firms and non-family firms in the unmatched sample, the right-hand-side density plot of predicted scores after matching the density curves almost overlap. This similarity underpins the favorable balancing properties of the employed matching procedure.

[Insert Table 15 here]

Next, we re-assess the association between family ownership and the GHG emissions using the matched balance sample. This procedure reduces the number of observations specified in the estimations by approximately five thousand. In columns (1) – (3) of Table 15 we report results from regressing the Scope 1, (1+2) and (1+2+3) emission intensity on family ownership and all the covariates from our main analysis, as well as industry and country-time fixed effects. In column (4) – (6) we repeat this exercise for all the proxies using absolute emissions. Finally, in column (7) and (8) we focus on the differential treatment effect of the implementation of the Paris Agreement on firms' direct emission intensity and absolute GHG emissions, respectively. In line with our baseline estimates, the results in Table 15 document that the key coefficient of interest (*Family*) is consistently negative and statistically significant at conventional levels. In addition, we find—in the majority of the specifications—a stronger magnitude of the

coefficients of interest in the matched sample. Taken together, this section reinforces our main findings that family firms pollute less, are more energy efficient and reduce their emissions more than other firms after the implementation of the Paris Agreement in 2015.

5.4. Dynamic Treatment – Paris Agreement

[Insert Figure 2 here]

6. Conclusion

Using a large cross-country dataset, we examine the relationship between family ownership and CO_2 emissions by using different proxies for its intensity. Our results document a relationship between the type of ownership and the environmental footprint of a company. Family firms have lower emissions, both direct and indirect, when compared to non-family firms, suggesting a higher commitment to environmental protection by family owners. Looking into the governance characteristics of family firms reveals that it is the capacity of the board to adopt a long-term vision that explains much of the effect. In addition, we use the 2015 Paris Agreement as a quasi-exogeneous shock and study the evolution of emission intensity around this event for family and nonfamily firms. The results also show a different change in behavior and emissions levels following the Paris Agreement between both groups. In additional results, we show that family firms are not only polluting less but are also less engaged in communicating 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 that are induced by 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. P-score before and after matching

Note: 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.

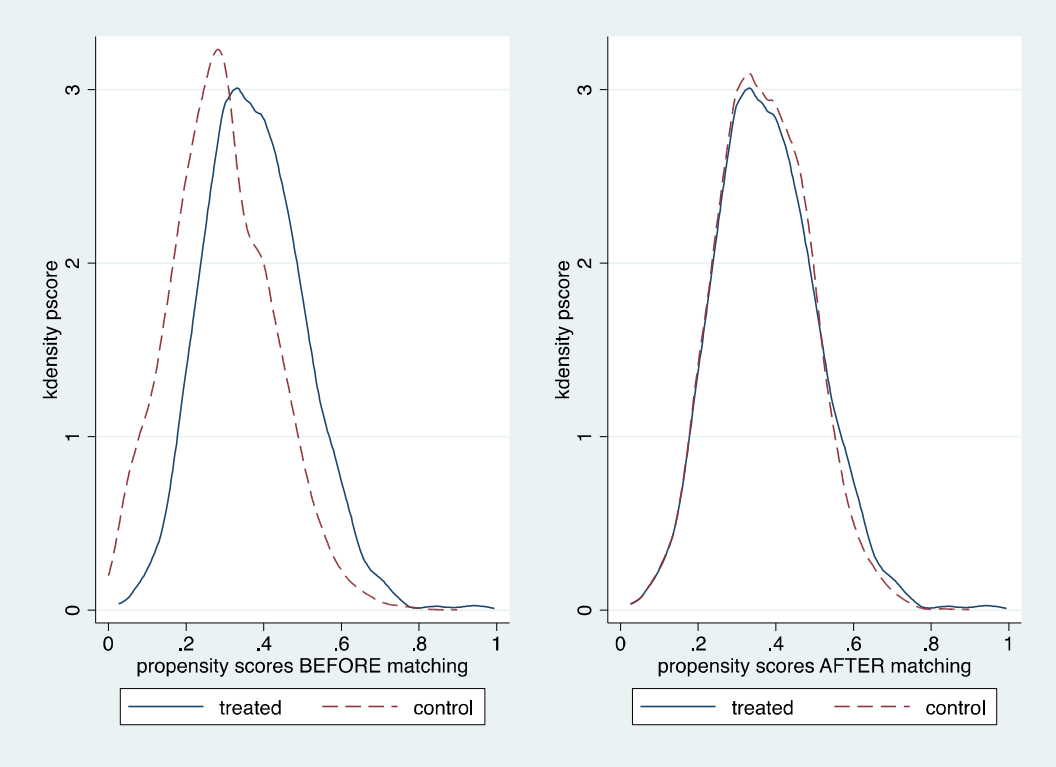

Figure 2. Dynamic treatment – Paris Agreement

Note: The figure displays …

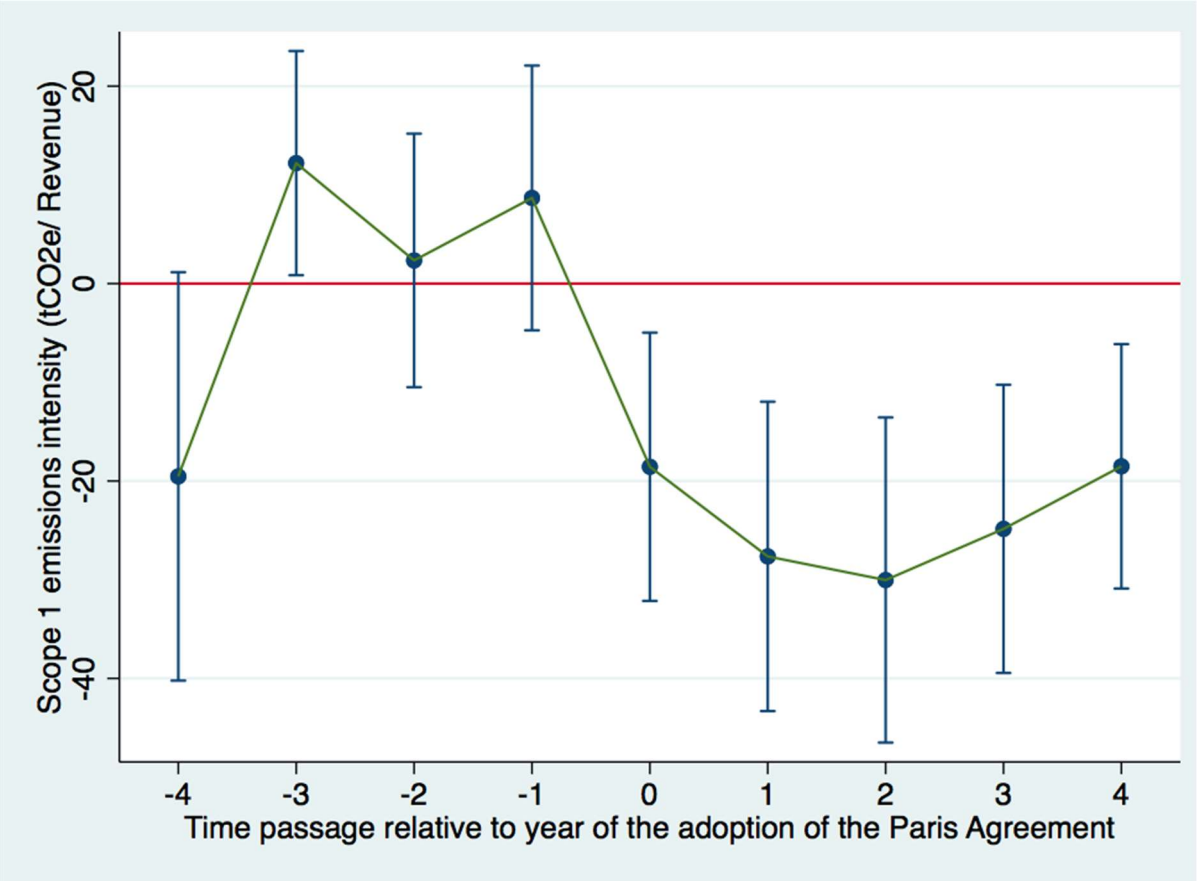
Scope 1 emissions intensity (tCO2e/ Revenue)
20
0
-20
-40
-4
-3
-2
-1
0
1
2
3
4
Time passage relative to year of the adoption of the Paris Agreement

Table 1 Sample
The table shows the number of firms and observation in a given country in the sample, and the average number of firms and family firms the years 2010 to 2019.

Country	Observations	No of firms	No of family firms
Australia	1,737	299	99
Austria	299	45	15
Belgium	533	80	39
Bermuda	1	1	1
Canada	2,133	384	154
China	462	72	39
Croatia	58	6	2
Cyprus	17	3	4
Czech Republic	53	7	2
Denmark	479	82	22
Faroe Islands	1	1	1
Finland	658	105	23
France	2,051	346	198
Germany	2,055	299	126
Greece	435	83	52
Hong Kong	317	40	27
Hungary	44	7	1
Iceland	9	2	1
India	753	86	60
Indonesia	339	49	19
Ireland	221	39	16
Italy	1,157	184	105
Japan	1,817	205	26
Luxembourg	3	1	1
Malaysia	261	39	13
Malta	14	3	3
Netherlands	568	107	28
New Zealand	172	30	6
Norway	852	161	48
Philippines	263	32	21
Poland	195	27	10
Portugal	244	35	16
Romania	47	5	1
Russian Federation	400	55	11
Singapore	472	68	31
Slovenia	69	11	1
South Korea	202	23	10
Spain	675	104	43
Sweden	1,232	223	68
Switzerland	1,046	167	56
Taiwan	164	23	16

Thailand	388	56	24
United Kingdom	3,254	505	121
United States	12,462	2510	979
Total	38,612	6,610	2,539

Table 2 Descriptive Statistics

The table provides descriptive statistics of the variables employed in the empirical specifications. The summary statistics is 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 Table A1.

	Mean	Min	Max	SD	p25	Median	p75
iai 1	124.41	.5	1480.5	260.55	5.7	11.3	101
iai 1 2	166.28	3.8	1746.3	293.3	22.3	34.5	164.3
iai 1 2 3	1506.36	54.4	10433.5	1961.88	256.2	673.65	1837.8
aai 1	1000000	36.51	29000000	3900000	4239.55	25232.01	200000
aai 1 2	1300000	172.76	34000000	4600000	16153.03	76454.41	410000
aai 1 2 3	11000000	1276.83	2.500e+08	34000000	220000	1100000	5200000
Size	21.5	17.57	25.65	1.76	20.23	21.46	22.71
MBV	58.79	-8.03	3056.45	327.22	1.34	2.59	7.08
PPE	28.03	.38	90.24	23.39	8.92	21.65	41.7
CAPEX	5.27	.1	26.09	4.76	2.1	3.91	6.83
ROA	3.68	-51.29	30.04	10.69	1.39	4.43	8.16
Leverage	54.97	7.76	117.32	21.26	40.71	55.73	69.16
Liquidity	2.05	.35	11.85	1.75	1.09	1.54	2.32

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. Appendix A 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	iai_1_2	iai_1_2_3
	(1)	(2)	(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-squared	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. Appendix A 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 (4)	Oil & Gas (5)	Technology (6)	Telecommunications (7)	Utilities (8)
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-squared	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. Appendix A 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-squared	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. Appendix A 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
	(1)	(2)	(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-squared	0.470	0.476	0.456
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 7. Family firms and direct emission intensity: industry heterogeneity – DiD Paris Agreement

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. Appendix A 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 (4)	Oil & Gas (5)	Technology (6)	Telecommunications (7)	Utilities (8)
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-squared	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. Family firms and direct emission intensity: geographical heterogeneity – DiD Paris Agreement

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. Appendix A 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-squared	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. All regressions include industry and country-time fixed effects, and a constant term. Appendix A 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	iai_1	iai_1	iai_1
	(1)	(2)	(3)	(4)	(5)
Family	-12.053*	-18.898*	-7.246	-10.426	27.663*
	(6.955)	(10.556)	(20.012)	(14.120)	(15.569)
Board gender	-0.865***	-0.872***			
	(0.268)	(0.316)			
Family×Board gender		0.231			
		(0.420)			
Board size	0.190		0.396		
	(1.457)		(1.680)		
Family×Board size			-0.647		
			(2.250)		
Board skills	-0.122			-0.080	
	(0.132)			(0.156)	
Family×Board skills				-0.057	
				(0.227)	
Board tenure	-1.502*				0.991
	(0.884)				(1.240)
Family×Board tenure					-4.497***
					(1.544)
Size	25.172***	25.448***	24.103***	24.229***	24.636***
	(3.130)	(2.854)	(3.084)	(2.769)	(2.831)
MBV	-0.055*	-0.045*	-0.047*	-0.048*	-0.057**
	(0.028)	(0.027)	(0.027)	(0.027)	(0.028)
PPP	1.001***	0.995***	0.995***	0.995***	1.014***

	(0.128)	(0.126)	(0.127)	(0.126)	(0.128)
CAPEX	1.879**	1.880**	1.936***	1.951***	1.857**
	(0.740)	(0.730)	(0.731)	(0.734)	(0.739)
ROA	-1.367***	-1.436***	-1.478***	-1.484***	-1.445***
	(0.206)	(0.205)	(0.207)	(0.208)	(0.211)
Leverage	-0.513***	-0.507***	-0.519***	-0.520***	-0.515***
	(0.171)	(0.169)	(0.170)	(0.170)	(0.171)
Liquidity	-2.003	-1.935	-1.729	-1.685	-2.040
	(1.712)	(1.696)	(1.699)	(1.702)	(1.714)
Age	-0.110	-0.080	-0.065	-0.064	-0.078
	(0.143)	(0.138)	(0.138)	(0.138)	(0.141)
Observations	17,586	17,798	17,799	17,800	17,597
Firms	3,826	3,863	3,863	3,863	3,828
R-squared	0.474	0.474	0.473	0.473	0.474
Industry FE	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes

Table 10. The impact of Family ownership on firms' commitments to reduce emissions

This table reports the logit random-effects model results of Family ownership on firms' emission reduction targets. The dependent variable equals 1 if the firm announced emission reduction target. *Family* is a dummy variable equal to 1 for Family-owned firm and 0 otherwise. All regressions include industry, country and time fixed effects, and a constant term. Appendix A 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.

	(1)	(2)	(3)
Family	-0.546***	-0.546***	-0.779***
	(0.206)	(0.206)	(0.280)
Paris		1.433***	1.340***
		(0.217)	(0.229)
paris_ffdef4			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 11. 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, environmental and social, governance ratings, respectively. *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. Appendix A 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	ESG_E	ESG_S	ESG_G	ESG	ESG_E	ESG_S	ESG_G
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Family	-3.881***	-3.812***	-3.111***	-5.449***	-4.018***	-4.136***	-3.459***	-5.522***
	(0.598)	(0.811)	(0.714)	(0.772)	(0.781)	(1.071)	(0.951)	(1.011)
Paris×Family					0.236	0.560	0.601	0.126
					(0.620)	(0.872)	(0.775)	(0.841)
Size	5.879***	10.678***	8.011***	4.600***	5.880***	10.680***	8.013***	4.601***
	(0.202)	(0.251)	(0.221)	(0.242)	(0.202)	(0.251)	(0.221)	(0.242)
MBV	0.006**	0.004	0.006*	0.006**	0.006**	0.004	0.006*	0.006**
	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)	(0.003)
PPP	0.030***	0.067***	0.026***	0.023**	0.030***	0.067***	0.026***	0.023**
	(0.007)	(0.009)	(0.008)	(0.009)	(0.007)	(0.009)	(0.008)	(0.009)
CAPEX	-0.119**	-0.137**	-0.046	-0.004	-0.119**	-0.136**	-0.045	-0.004
	(0.048)	(0.065)	(0.058)	(0.068)	(0.048)	(0.065)	(0.058)	(0.068)
ROA	0.137***	0.122***	0.097***	0.110***	0.138***	0.122***	0.097***	0.110***
	(0.020)	(0.028)	(0.026)	(0.025)	(0.020)	(0.028)	(0.026)	(0.025)
Leverage	-0.004	-0.016	-0.014	-0.001	-0.004	-0.016	-0.014	-0.001
	(0.014)	(0.019)	(0.017)	(0.017)	(0.014)	(0.019)	(0.017)	(0.017)
Liquidity	-0.048	0.106	0.288	0.033	-0.048	0.107	0.290	0.033
	(0.161)	(0.207)	(0.183)	(0.218)	(0.161)	(0.207)	(0.183)	(0.218)
Age	-0.045***	-0.077***	-0.057***	-0.016	-0.045***	-0.077***	-0.057***	-0.016
	(0.009)	(0.013)	(0.011)	(0.012)	(0.009)	(0.013)	(0.011)	(0.012)
Observations	18,287	18,278	18,278	18,287	18,287	18,278	18,278	18,287
Firms	3,962	3,961	3,961	3,962	3,962	3,961	3,961	3,962
R-squared	0.358	0.506	0.401	0.142	0.358	0.506	0.401	0.142
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table x. The impact of Family ownership on 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. All regressions include industry and country-time fixed effects, and a constant term. Appendix A 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)
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)
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)
Observations	8,949	8,949	8,949	8,949
Firms	1,987	1,987	1,987	1,987
R-squared	0.450	0.450	0.451	0.451
Industry FE	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes

Table x. Hire/descendent/founder

This table reports the OLS regression results of …. on firms' … using data for 2010–2019. The dependent variables represent …s. ..... All regressions include industry and country-time fixed effects, and a constant term. Appendix A 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: Scope 1 emissions intensity		
	(1)	(2)	(3)
hire	5.895		
	(5.916)		
descendant		-13.770	
		(9.720)	
founder			0.192
			(6.646)
Observations	24.242	24.242	24.242
Firms	4.940	4.940	4.940
R-squared	0.471	0.471	0.471
	Panel B: Scope 1 absolute emissions		
	(1)	(2)	(3)
hire	0.158***		
	(0.056)		
descendant		0.008	
		(0.083)	
founder			-0.237***

			(0.067)
Observations	24.242	24.242	24.242
Firms	4.940	4.940	4.940
R-squared	0.757	0.757	0.757
	Panel C: 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-squared	0.365	0.360	0.360
	Panel D: 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-squared	0.513	0.510	0.511
Control variables	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes

Table 12. The impact of Family ownership on absolute emissions

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 absolute emissions. *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. Appendix A 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.

	aai_1	aai_1_2	aai_1_2_3	aai_1	aai_1_2	aai_1_2_3
	(1)	(2)	(3)	(4)	(5)	(6)
Family	-0.212***	-0.143***	-0.098***	-0.155***	-0.117***	-0.089**
	(0.045)	(0.035)	(0.031)	(0.050)	(0.039)	(0.035)
Paris×Family				-0.113***	-0.051	-0.019
				(0.040)	(0.032)	(0.033)
Size	1.002***	0.958***	0.954***	1.002***	0.958***	0.954***
	(0.014)	(0.011)	(0.009)	(0.014)	(0.011)	(0.009)
MBV	0.000	0.000	-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PPP	0.010***	0.008***	0.005***	0.010***	0.008***	0.005***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
CAPEX	0.014***	0.010***	0.003	0.014***	0.010***	0.003
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)
ROA	0.010***	0.012***	0.016***	0.010***	0.012***	0.016***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Leverage	0.004***	0.003***	0.003***	0.004***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity	-0.019	-0.028***	-0.048***	-0.019	-0.028***	-0.048***

	(0.012)	(0.010)	(0.010)	(0.012)	(0.010)	(0.010)
Age	-0.002**	-0.001**	-0.001***	-0.002**	-0.001**	-0.001***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	25,596	25,596	25,596	25,596	25,596	25,596
Firms	5,016	5,016	5,016	5,016	5,016	5,016
R-squared	0.757	0.790	0.781	0.757	0.790	0.781
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country×Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 13. 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. All regressions include industry and country-time fixed effects, and a constant term. Appendix A 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	iai_1	iai_1	iai_1	iai_1	iai_1	iai_1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(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-squared	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			Yes	Yes	Yes
Country×Time FE	No	No	No	Yes		Yes	Yes	Yes

Country×Time×Industry FE	No	No	No	Yes

Table 14. 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 analysis (Section x.x), 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.

	(1)	(2)	(3)
Variables	Treated	Control	t-test
	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 15. 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. Appendix A 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-squared	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

Appendix

Table A1 Definitions of the variables and their sources

Variable	Description of variables	Source
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)	
iai_1_2_3	Intensity Average Inference Scope 1, 2 & 3 Total (tCO_2e/$m Revenue)	
aai_1	Absolute - Average Inference Scope 1 (tCO2e)	
aai_1_2	Absolute - Average Inference Scope 1 & 2 Total (tCO_2e)	
aai_1_2_3	Absolute - Average Inference Scope 1, 2 & 3 Total (tCO_2e)	
Family	Equals 1 if the Founder or Descendant or Family Member is Director or Officer or Large Shareholder>5%, 0 otherwise	NRG
Paris	Equals 1 for the time period between 2015–2019, 0 otherwise	Refinitiv
Size	Logarithm of total assets	
MBV	Price to book value per share calculated by dividing the company's latest closing price by its book value per share	
PPP	Property, plant and equipment divided by total assets	
CAPEX	Capital expenditure divided by total assets	
ROA	Net income divided by total assets	
Leverage	Total long-term debt divided by total assets	
Liquidity	Total current assets divided by total current liabilities.	
Age	Date of Incorporation (registration)	
Board gender	Percentage of female on the board.	
Board size	Total number of board members which are in excess of ten or below eight.	
Board skills	Percentage of board members with specific skills.	
Board tenure	Average board tenure in years	
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)
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.
ESG_S	The social pillar measures a company's capacity to generate trust and loyalty with its workforce, customers and society, through its use of best management practices.
ESG_G	The corporate governance pillar measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long term shareholders
Commitment	Equals 1 if the firm announced emission reduction target
R&D	Research and development (R&D) expenses divided by total assets