

RESEARCH ARTICLE



WILEY

Firm, industry, and country effects on CO₂ emissions levels

Lucas López-Manuel | Xosé H. Vázquez | Antonio Sartal

ECOBAS, University of Vigo, Vigo, Pontevedra, Spain

Correspondence

Lucas López-Manuel, ECOBAS, University of Vigo, Vigo, Pontevedra, Spain.

Email: lucas.lopez@uvigo.gal

Abstract

We hinge on a panel data of 4660 firms across 79 countries and over 15 years to explore how country, industry, and firm effects influence firms' CO₂ emissions. Our results show that firm effects are the main factor influencing firms' CO₂ emissions (32.8% of the total variance), ahead of industry (30.6%), country (29.3%), or country-industry effects (4.0%). These results highlight the need to overhaul current public policy baselines that mainly focus on environmental regulation and technological development, for the dissemination of proactive environmental practices within the firm also appears to be—at least—as important to ground a low-carbon future. Our findings should also permeate the rhetoric of the agents setting business collective beliefs and influencing management training, as well as that of international organizations at the forefront of the crusade for decarbonization. By contrast, if the misleading idea of marginal firm effects entrenches in our set of beliefs, it could become a self-fulfilling prophecy in the normative system under which policymaking and organizational behavior unfold.

KEYWORDS

business decarbonization, climate change, CO₂ abatement, CO₂ emissions, country effects, firm effects, industry effects

1 | INTRODUCTION

The literature suggests that up to 55% of firm performance depends on firm effects, 20% is due to industry effects, and 25% can be assigned to other sources such as institutions or business cycles (Bamiatzi et al., 2016; Rumelt, 1991; Short et al., 2007). However, as the growing social unrest related to climate change pushes decarbonization to the forefront of firms' strategic concerns, the magnitude of all these effects on CO₂ emissions is yet to be assessed.

Academic literature and institutional reports have mainly developed around how country and industry effects can influence organizations' emissions, especially since the adoption of the Kyoto Protocol.

Diverse capital and labor markets, regulatory frameworks, the monitoring and enforcement of contracts and laws, access to information, or consumer requirements and preferences, to name a few, create diverse incentives and constraints that result in climate change concerns being addressed differently across countries (Department of State for Business Energy and Clean Growth, 2021; Dhanda et al., 2022; Sartal et al., 2017; Xinhua News Agency, 2021).

Similarly, CO₂ emissions have been linked to the pace with which innovation breaks technological barriers in each industry (Bernstein et al., 2007; IPCC, 2014), as well as to other industry-related economic factors such as the rate of capital stock turnover, limits to competition, or industry growth rates (Arthur, 1988; IPCC, 2014;

Abbreviations: ESG, Environmental, Social and Governance; HLM, Hierarchical linear models; IPCC, Intergovernmental Panel on Climate Change; IT, Information Technologies; SDGs, Sustainable Development Goals.

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2023 The Authors. Business Strategy and The Environment published by ERP Environment and John Wiley & Sons Ltd.

Worrell & Biermans, 2005). Idiosyncratic country-industry effects might also play a role (e.g., WEC, 2001), for the evolutionary path of industries is contingent on national institutions (Ghemawat, 2003; Porter, 1990). Regarding firm effects on decarbonization, research has hinted at a large heterogeneity in responses. Some organizations seem to be altering proactively traditional patterns of resource orchestration and capability creation to reduce their carbon footprint (Perotti et al., 2022; Sharma et al., 2022; The Sustainability Institute, 2021). However, there is also compelling evidence of firms neglecting decarbonization targets because of pervasive cost/profit concerns (Bowen, 2014; Dyllick & Muff, 2016; Wright & Nyberg, 2017).

To be sure, all these studies have contributed to unveiling the significance of country and industry effects in determining firms' CO₂ emissions, as well as the opportunities, strategies, challenges, and constraints that lead organizations to show different stances toward climate change.

Nevertheless, the lack of integration of this literature might not be giving the right insights to inspire public policies and managerial action. For example, studies highlighting the importance of country and industry effects usually overlook the role that firm effects might be actually playing. This view is entrenched in supranational organizations at the forefront of the crusade for decarbonization (IPCC, 2014), political bodies (Department of State for Business Energy and Clean Growth, 2021; Federal Ministry of Economic Affairs and Energy, 2019), academic research outside the management field (Bernstein et al., 2007; Lawrence & Schäfer, 2019), and even mass media (The Guardian, 2019; The New York Times, 2021).

Furthermore, whereas studies in the management field may suggest heterogeneity in organizational responses (and, therefore, significant firm effects), many doubts still remain about whether proactive environmental strategies actually explain a significant part of CO₂ emissions' variance (Bowen, 2014; King & Pucker, 2021). Differently put, skepticism abounds as to whether environmentally committed firms are "walking the talk" (i.e., orchestrating resources and capabilities in such a way that it actually reduces their carbon footprint). Overall, there is no evidence on the extent to which country, industry, or firm effects contribute to organizations' CO₂ emissions. This is, precisely, the leitmotiv of this paper.

We hinge on a panel data of 4660 firms across 79 countries and over 15 years (30,254 observations) to show that country, industry, and firm effects have each an important—but different—impact on organizations' CO₂ emissions. Our results therefore deliver a fundamental contribution: After providing a comprehensive account of the arguments behind the relevance of each effect, we reveal the determinants of firms' CO₂ emissions' variance. These findings highlight the need to overhaul current public policy baselines focusing on technological development and environmental regulation because the dissemination of proactive environmental practices is also essential for tackling climate change. Furthermore, the existence of firm effects implicitly reveals two underlying realities in our sample: Some organizations have been successful in deploying proactive decarbonization strategies, whereas others have failed or still lack sufficient resolution to go beyond the limits outlined by country and industry specificities.

We further address the implications of these results by (i) delving into the potential reasons behind firm effects on CO₂ abatement and (ii) warning that organizational inaction in climate change could become a self-fulfilling prophecy despite the opposing evidence. We also hope this study encourages academics and practitioners to engage in the exploration of potential decarbonization pathways that might be deployed from within organizations and, therefore, confront the relative marginalization of management research in climate change (Böttcher & Müller, 2015; Goodall, 2008; Nyberg & Wright, 2020).

The remainder of the paper is organized as follows. First, we review the potential role that country, industry, country-industry, and firm effects can have on determining organizations' CO₂ levels. In the second section, we present the sample and variables, as well as the econometric approach. Subsequently, we display the results, several robustness checks, and alternative analyses. Finally, we conclude with a discussion on the possible explanations for the role of firm effects in the fight against climate change, as well as on the implications our results have for the narratives of climate change.

2 | LITERATURE REVIEW

With predictions pointing to temperature increases of up to 5.7° C by 2100 (IPCC, 2021), the disruptions that climate change is prone to unleash threaten life on our planet as we currently know it (Hausfather & Peters, 2020; New et al., 2011). Indeed, our natural systems have already suffered irreversible changes and could shortly reach dangerous tipping points. Thus, further temperature increases will provoke additional releases of CO₂ (e.g., permafrost thaw and increases in methane releases by tropical wetlands) and impact the natural processes that remove it from the atmosphere (e.g., drier conditions and deforestation will reduce the amount of photosynthesis occurring in rainforests). The triggering of such carbon feedback loops could result in unpredictable situations that do not obey current climate models.

Despite the increasing societal awareness about these problems, global efforts have not been enough to reduce our carbon footprint. CO₂ emissions have increased, on average, by 1.4% since 2010, with pre-Covid-19 data showing a 1.1% increase in 2019 (UNEP, 2020). Even more, after huge promises of change in the aftermath of the pandemic, there is no signal for this trend to ease (CNBC, 2021). As business firms emerge as both the cause and the potential solution for climate change (Garnaut, 2008; Stern, 2007), two competing narratives shape the debate about which are the main effects behind organizations' CO₂ emissions and, ultimately, about how decarbonization should take place.

One narrative advances that country and industry effects (especially regulation and technological advancement) are the main drivers of organizations' CO₂ emissions: Other effects at the organizational level are overlooked (IPCC, 2014, 2021) or deemed marginal because firms are supposed to have very little room for maneuver when it comes to resolving economic and environmental trade-offs (Rhodes, 2016; Wright & Nyberg, 2017). The other narrative, which does not neglect the role of country and industry effects, advocates

for a meaningful role of organizations because how resources are blended and how capabilities are created should also matter in decarbonizing products and processes (Perotti et al., 2022; Sartal et al., 2020; The Sustainability Institute, 2021).

In providing a comprehensive account of the arguments behind these two perspectives, we explore below why country, industry, country-industry, and firm effects matter to explain organizations' CO₂ emissions. The empirical part of this paper quantifies their influence.

2.1 | Why does country matter?

Country effects mainly represent the formal and informal institutions shaping human activity (North, 1990, 2005). Different cultures, capital and labor markets, access to information, regulatory frameworks, the monitoring and enforcement of contracts and laws, civic cooperation, or consumer tastes and preferences, to name a few, create diverse incentives and constraints across countries to which agents adapt their behavior. Because of that, institutions directly affect organizations' emissions (IPCC, 2014).

To begin with, countries take a stronger or weaker stance on environmental issues under the shape of “formal rules of the game” (North, 1990), be them written constitutions, laws, policies, rights, and regulations enforced by official authorities. The case of China (Xinhua News Agency, 2021), Germany (Federal Ministry of Economic Affairs and Energy, 2019), the UK (Department of State for Business Energy and Clean Growth, 2021), or Spain (Ministry for the Ecological Transition and Demographic Challenges, 2020) might provide good examples. On the one hand, these formal rules aim to limit environmental externalities by, for instance, increasing the relative price of emitting CO₂ (e.g., carbon pricing schemes) or banning the use and emission of toxic materials. On the other hand, reinforcing regulation and strengthening financial support (e.g., subsidies and tax credits) seek to encourage the implementation of a “green economy” by contributing to the development of low-carbon technologies or more sustainable practices and business models. On the opposite side of the spectrum, by contrast, many nations present lax or even no environmental regulation at all, which often transforms them into “pollution heavens” (Shen et al., 2019; Solarin et al., 2017).

Beyond formal norms under the basic shape of restrictive regulation and economic incentives, we must consider the existence of informal norms as well, such as social sanctions, values, beliefs, taboos, customs, or traditions, which are normally more persistent. They represent socially shared and unwritten rules that are created and enforced in a community outside of any external authority's monitoring or policing activity (North, 1990). In the case of climate change, the values of a particular society regarding the environment influence short-term priorities and long-term resilience in a way that regulation cannot (IPCC, 2014). At the business level, for instance, consumers and shareholders can pressure organizations if their environmental behavior does not comply with expectations. Other stakeholders in civil society can also force companies to change their behavior through the values that inspire social and political activism.

2.2 | Why does industry matter?

Industry effects gather the sectoral idiosyncrasies that draw the map of constraints in which decarbonization takes place. To be sure, the manufacturing processes of the steel industry, for instance, have little to do with those in the textile sector and, consequently, so do their total factor carbon productivity as well as their path toward decarbonization (Bernstein et al., 2007; IPCC, 2014). The rhythm of decarbonization varies substantially depending on the pace with which innovation breaks technological barriers in each industry (e.g., technological breakthroughs in physics or chemistry with practical applications to develop low-carbon production processes). Notwithstanding, there are other economic, industry-related factors involved as well in the industries' technological trajectory.

Diverse rates of capital stock turnover influence the evolutionary path of each industry toward the implementation of low-carbon innovations (Worrell & Biermans, 2005). Although some opportunities do exist for retrofitting capital stock, major innovations occur only when organizations replace it (Bernstein et al., 2007). Hence, carbon lock-in situations often occur in situations where the rate of capital stock turnover is low, so that fossil fuel-intensive systems end up perpetuating, delaying, or preventing the transition to low-carbon alternatives (Arthur, 1988; IPCC, 2014). As a result, the pace of decarbonization in industries such as cement or steel is lower vis-à-vis others such as the tech or textile industries.

Furthermore, limits to competition and industry growth also emerge as determinants of the industries' technological evolution (Porter, 1980). On the one hand, the more the difficulties for new organizations to join a particular industry, the lower the incumbents' necessity of continuous innovation to remain ahead of competition. Although incumbent firms purposefully search for limiting competition sometimes, note also that low rates of capital stock turnover might signal the existence of sunk costs to potential newcomers. This can act as a deterrent to the entry of new firms (Baumol & Willig, 1981), resulting in the production process itself, constraining the path toward a low-carbon paradigm. Additionally, the different innovative dynamics across the industry life cycle could equally shape the pace toward decarbonization. As the industry emerges or enters maturity, high competition based on, respectively, product and process innovation will enhance the possibility of organizations, introducing low-carbon alternatives (IPCC, 2014). Meanwhile, low prices and the significant constraints to competition and innovation in stagnated industries are prone to make the development of low-carbon alternatives unattractive (Harrigan, 1981; Rothaermel, 2017).

2.3 | Why do country-industry effects matter?

Because the evolutionary path of industries is contingent on the specificities of each country (Ghemawat, 2003; Porter, 1990), we can also expect this interaction to influence organizational decarbonization levels.



To begin, it is worth recalling that the distribution of factors of production is heterogeneous across countries. Taking the country's relative scarcity of each factor as the initial point (i.e., the abundance of one factor of production relative to another), idiosyncratic institutions alter the factors' relative prices to provide the resource endowment in which the economic activity of each country becomes entrenched.

Consequently, the relative production costs of each industry are different across countries and with them are the incentives and constraints that organizations have for choosing specific pathways of activity and technological development. Institutions and their evolution thus have the power to alter the rules of the game in each industry, making it possible to increase decarbonization efforts by altering the relative prices of the economy. Regulation encouraging the renewal of capital stock, such as Japan's subsidy program for new furnaces (WEC, 2001), and subsidies to resort to low-carbon energy sources are good examples.

Furthermore, in their evolution over time, this matrix of costs and incentives can create country "capabilities" (Kogut, 1991) or "competitive advantages" (Porter, 1990) in particular industries. For instance, India is specialized in IT, whereas Japan is specialized in automobile manufacturing. The technological edge that some countries present in particular industries might also contribute to the observed irregular patterns of CO₂ intensity in similar industries across countries.

2.4 | Do firm effects really matter?

Accumulating valuable and rare resources and blending them into unique capabilities lie at the heart of performance heterogeneity across firms (Barney, 1991; Conner, 1991; Prahalad & Hamel, 1990). In essence, managers' idiosyncratic perception of the firm's environment and their imagination and planning of future organizational pathways—those they believe will lead the firm toward survival and success in circumstances of pervasive uncertainty and change (Ferraro et al., 2005; Piazza & Abrahamson, 2020)—imbue the orchestration of resources with causal ambiguity and complexity (Oliver, 1997). This causal ambiguity and complexity, along with the irreversible and inertial nature of such managerial choices, raise barriers to imitation, leading competing firms to become a source of differential and inimitable value (Rumelt, 1991; Wright et al., 1994).

Inasmuch as the resource-based view lays the grounds for differences in *business* performance across firms, its theoretical frame also sets the scaffoldings for the existence of heterogeneity in organizations' carbon footprint. Managers' perception, imagination, and planning will reflect the extent to which decarbonization needs have permeated their belief structure (Arruñada & Vázquez, 2013), prompting differences in how organizations address their negative environmental externalities through the orchestration of resources and capabilities (Aragón-Correa & Sharma, 2003; Post & Ahman, 1992; Sharma, 2000). Eventually, these managerial choices determine the normative frame in which firms perform their activities, therefore pushing organizations to embrace idiosyncratic paths with diverse

levels of environmental proactiveness (Andersson & Bateman, 2000; Hart, 1995). Accordingly, CO₂ emissions would be contingent not only on country, industry, and country-industry factors but also on firm effects. There is, nevertheless, an alternative perspective.

The relevance of firm effects in determining CO₂ emissions is challenged by what has been called an "inconvenient truth" (Wright & Nyberg, 2017). No matter the willingness to engage in CO₂ abatement, firms would not be able to change structurally their behavior because of a "ruthless market system" that leaves little space for introducing noneconomic considerations in decision-making (Bowen, 2014; Wright & Nyberg, 2017). To be sure, this does not mean organizations' carbon footprint cannot be enhanced through the blend of resources and the creation of capabilities. However, pervasive concerns for costs and profits for shareholders would be so embedded in managerial decision-making that the resulting trade-offs of engaging in CO₂ abatement would hinder proactive climate change strategies (Berrone et al., 2017; Bowen, 2014; Rhodes, 2016; Wright & Nyberg, 2017). Other stakeholders may suffer analogous trade-offs too. For instance, the prospects of job losses and divestitures of resources away from labor (Boodoo, 2020; Preuss, 2008), as well as increased operational costs and uncertainty for suppliers (Busse et al., 2017; Genovese et al., 2017), would be prone to increase the pressure upon those managers that strive to diverge from conventional business-as-usual paradigms. It is not surprising, therefore, that firms engage in greenwashing to avoid being the subject of environmental boycotting or to reap reputational benefits without actually changing their resource orchestration logics (Bowen, 2014). To sum up, this second view supports that actions to reduce firms' impact on CO₂ levels must be mainly taken from outside organizations (Dyllick & Muff, 2016).

3 | METHODS

3.1 | Data, sample, and variables

Data stems from the Thomson Reuters' Refinitiv database, which has been widely used in management research (Desender & Epure, 2021; Eccles et al., 2014; Hawn & Ioannou, 2016; Surroca et al., 2020). Our sample comprises all publicly traded organizations that reported their CO₂ emissions (4660 multinationals across 79 countries) between 2005 and 2019 (30,254 observations). As with many other issues addressed in the environmental literature (e.g., Mio et al., 2020; Sachs, 2012). This choice is congruent with many other studies in the environmental literature (e.g., Mio et al., 2020; Sachs, 2012) for multinational firms have a significant impact on climate change given their global reach and their ability to develop large-scale solutions (Garnaut, 2008; Stern, 2007).

We therefore have comparable data on the adoption of environmental, social, and corporate governance policies for companies listed on ASX300, Bovespa, CAC 40, DAX, FTSE 250, MSCI Emerging Markets, MSCI World, NASDAQ 100, S&P 500, SMI, and STOXX 600. The dataset includes 900 evaluation points per firm based on primary

data that are publicly available in stock exchange filings, financial and nonfinancial annual reports, nongovernmental organizations' websites, media coverage, and other sources. Thomson Reuters checks the validity of the data through diverse actions. Each measure is manually processed by trained and experienced analysts, and quality checks are performed through a combination of algorithmic and human processes to identify any inconsistency or inaccuracy. If any discrepancy is detected in the reported data by the company, analysts reach out to the investors' relation team of the company for further clarification. Furthermore, exhaustive independent audits and reviews are systematically performed.

The dependent variable of the model is the natural log of the organizations' total CO₂ and equivalents' emissions. This measure includes Scope 1 and 2 emissions. Scope 1 refers to the direct emissions from sources that are controlled or owned by the firm, whereas Scope 2 gathers those indirect emissions resulting from the firms' consumption of purchased electricity, heat, or steam. As control variables, we first included the natural log of value added. The rationale for this was controlling for firm output, which is associated with CO₂ emissions. Furthermore, we included the natural log of total assets to consider size effects because larger firms are prone to have higher carbon footprints. Table 1 presents the variables, whereas Table 2 reveals the number of firms, industries, countries, and country-industry interactions.

3.2 | Econometric approach

We build a hierarchical model to explore country, industry, country-industry, and firm effects on CO₂ emissions. Hierarchical linear models (HLMs) are widely used in studies with nested and longitudinal data to study the structural variance decomposition of a variable (Bamiatzi et al., 2016; Makino et al., 2004; Raudenbush et al., 2004). Specifically, HLM allows for explicitly estimating the contribution of each hierarchical level to the total variance of the model, while “accounting for the independence of errors assumptions that may be violated when using other techniques such as OLS regression” (Short et al., 2009). Hence, why this approach results to becoming appropriate for our research question: HLMs allow us to isolate the influence of (i) country idiosyncrasies, (ii) industry specificities, (iii) the specific evolution of each industry inside a particular country, and (iv) firm effects on the organizations' CO₂ emissions.

Because of the longitudinal nature of our data, the variability in organizations' CO₂ levels attributed to the evolution of time is gathered at Level 1 as a residual effect. Subsequently, variability between

firms is collected at Level 2, between industries at Level 3, and between countries at Level 4. Furthermore, firm effects are introduced in the model through the organizations' ID in our dataset, whereas industry effects are captured with six-digit North American Industry Classification System (NAICS) industry codes. Finally, we use the location of the headquarters to assess country effects following the approach of classic authors in strategic management who evaluated the magnitude of country, industry, and firm effects on business performance (Bamiatzi et al., 2016; Short et al., 2007). The use of this approach to measure the variability in organizations' environmental performance is widely supported by the literature, as formal and informal pressures arising in the home country are often decisive for understanding firms' environmental commitment (Birindelli et al., 2022; Dechezleprêtre & Glachant, 2014; Kolk, 2005; Kolk & Fortanier, 2013). On the one hand, the headquarters are responsible for strategic planning—including environmental issues—and play a key role as orchestrators of assets (Foss & Pedersen, 2002; Ghoshal et al., 1995). On the other hand, as extant research shows, firms respond primarily to home country institutional pressures because of the fundamental need to conform to the demands of their closest stakeholders (Dechezleprêtre & Glachant, 2014; Surroca et al., 2013). This, coupled with the fact that management practices tend to be standardized in multinational firms (Aguilera-Caracuel et al., 2012), means that environmental practices are likely to be homogenized toward the requirements of the institutional environment of the home country.

In addition to these levels, we additionally introduced the interaction of industry and country to control for their combinatory idiosyncratic effects (Bamiatzi et al., 2016; Fielding & Goldstein, 2006). Before the interaction with the industry variables, we generated the set of explanatory variables for each country with equal variances and random intercepts uncorrelated. Note also that country and industry are introduced as crossed effects because there are no industries purely nested in countries. Finally, year fixed effects were included to account for potential cross-sectional shocks. We use maximum

TABLE 2 Description of the data

Hierarchical level	<i>n</i>
Countries	79
Industries	642
Country-industry interactions	2541
Firms	4660

TABLE 1 Data statistics

Variable	<i>N</i>	Mean	SD	Min	Max
Total Co ₂ emissions (tons of Co ₂)	30,254	4.13e + 6	1.59e + 7	0	6.03e + 8
Value added (\$)	47,022	4.08e + 09	9.41e + 09	−2.33e + 10	2.02e + 11
Total assets (\$)	61,689	1.57e + 11	4.55e + 11	89,205	3.86e + 12

likelihood to perform the estimation. The model follows the following hierarchical expression:

$$\begin{aligned}
 Y_{ti(j,k)jk} &= \pi_{0i(j,k)jk} + \pi_{1i(j,k)jk} * X' + e_{ti(j,k)jk} \\
 \pi_{0i(j,k)jk} &= b_{00(j,k)jk} + u_{0i(j,k)jk}^{(1)} \\
 b_{00(j,k)jk} &= \gamma_{000jk} + u_{00(j,k)jk}^{(2)} \\
 \gamma_{000jk} &= \delta_{0000k} + u_{000jk}^{(3)} \\
 \delta_{0000k} &= \theta_{00000} + u_{0000k}^{(4)} \\
 \pi_{1i(j,k)jk} &= b_{10(j,k)jk} \\
 b_{10(j,k)jk} &= \gamma_{100jk} \\
 \gamma_{100jk} &= \delta_{0000k} \\
 \delta_{1000k} &= \theta_{10000}
 \end{aligned} \quad (1)$$

where t represents time, i organizations, (j,k) the industry-country interaction, j the industry, k the country, and X' the vector of control variables and fixed effects at the first level. Consequently, the multilevel model results in:

$$Y_{ti(j,k)jk} = \theta_{00000} + \theta_{10000} * X' + u_{0000k}^{(4)} + u_{000jk}^{(3)} + u_{00(j,k)jk}^{(2)} + u_{0i(j,k)jk}^{(1)} + e_{ti(j,k)jk} \quad (2)$$

with:

$$\begin{aligned}
 e_{ti(j,k)jk} &\sim N(0, \sigma_{e_0}^2) \\
 u_{0i(j,k)jk}^{(1)} &\sim N(0, \sigma_{u_0^{(1)}}^2) \\
 u_{00(j,k)jk}^{(2)} &\sim N(0, \sigma_{u_0^{(2)}}^2) \\
 u_{000jk}^{(3)} &\sim N(0, \sigma_{u_0^{(3)}}^2) \\
 u_{0000k}^{(4)} &\sim N(0, \sigma_{u_0^{(4)}}^2)
 \end{aligned}$$

The calculation of the variance partition coefficient (VPC), which reflects the variance attributed to each level, is as follows:

$$\text{Level - 1 (residual) VPC: } \left[\sigma_{e_0}^2 / (\sigma_{e_0}^2 + \sigma_{u_0^{(1)}}^2 + \sigma_{u_0^{(2)}}^2 + \sigma_{u_0^{(3)}}^2 + \sigma_{u_0^{(4)}}^2) \right]$$

$$\text{Level - 2 (firm effects) VPC: } \left[\sigma_{u_0^{(1)}}^2 / (\sigma_{e_0}^2 + \sigma_{u_0^{(1)}}^2 + \sigma_{u_0^{(2)}}^2 + \sigma_{u_0^{(3)}}^2 + \sigma_{u_0^{(4)}}^2) \right]$$

$$\text{Level - 3 (industry effects) VPC: } \left[\sigma_{u_0^{(2)}}^2 / (\sigma_{e_0}^2 + \sigma_{u_0^{(1)}}^2 + \sigma_{u_0^{(2)}}^2 + \sigma_{u_0^{(3)}}^2 + \sigma_{u_0^{(4)}}^2) \right]$$

$$\text{Level - 4 (country effects) VPC: } \left[\sigma_{u_0^{(3)}}^2 / (\sigma_{e_0}^2 + \sigma_{u_0^{(1)}}^2 + \sigma_{u_0^{(2)}}^2 + \sigma_{u_0^{(3)}}^2 + \sigma_{u_0^{(4)}}^2) \right]$$

$$\text{Industry - country interaction VPC: } \left[\sigma_{u_0^{(4)}}^2 / (\sigma_{e_0}^2 + \sigma_{u_0^{(1)}}^2 + \sigma_{u_0^{(2)}}^2 + \sigma_{u_0^{(3)}}^2 + \sigma_{u_0^{(4)}}^2) \right]$$

4 | RESULTS

Table 3 provides the variance component estimates and the percentages of the total variance attributed to country, industry, country-industry, and firm effects, as well as a residual component accounting for variance across the years (i.e., variance attributed to time effects). Our results show that firm effects are the main factor influencing organizations' CO2 emissions (32.8% of the total variance), ahead of industry (30.6%), country (29.3%), or country-industry (4.0%) effects.

4.1 | Robustness checks

To begin with, we checked the robustness of our main findings by changing the estimation method to restricted maximum likelihood, obtaining identical results. We then built alternative specifications of our main model (Table 4). The first alternative specification (*Model 0*) is similar to the main model but without including the control variables to explore the results of the unrestricted model. Next, as Japan and the UK are overrepresented in our sample, we build a specification without the firms of these countries (*Model R2*). Furthermore, in another specification (*Model R3*), we dropped, additionally, the organizations based in the US, the UK, and Japan because they account for almost half (49%) of the total observations in our sample. Finally, the

Effect	VC	VPC	[95% Conf. interval]
Firm effects	2.03 (.063)	32.8%	[1.913, 2.162]
Industry effects	1.89 (.149)	30.6%	[1.622, 2.210]
Country effects	1.81 (.372)	29.3%	[1.216, 2.716]
Country-industry effects	0.25 (.063)	4.0%	[0.170, 0.382]
Residual	0.197 (.0018)	3.2%	[0.194, 0.201]
LR test $\chi^2(4)$	68,289.37***		
N/n	26,193/4105		

Note: Standard errors in parentheses.

Abbreviations: VC, variance component; VPC, variance partition coefficient.

***Prob> χ^2 significant at 0.001.

TABLE 3 Estimation results

TABLE 4 Robustness checks

Variable	Model 0 VC	Model R2			Model R3		Model R4	
		VPC	VC	VCP	VC	VCP	VC	VCP
Firm effects	3.03 (.08)	48.5%	2.18 (.08)	33.7%	2.42 (.10)	35.6%	2.09 (.09)	34.8%
Industry effects	2.26 (.18)	36.2%	1.94 (.16)	30.0%	2.17 (.20)	32.0%	1.95 (.22)	32.5%
Country effects	0.34 (.09)	5.4%	1.90 (.40)	29.4%	1.75 (.38)	25.8%	1.41 (.32)	23.5%
Country-industry effects	0.38 (.07)	6.1%	0.23 (.06)	3.6%	0.21 (.08)	3.1%	0.31 (.09)	5.2%
Residual	0.24 (.002)	3.8%	0.22 (.002)	3.4%	0.24 (.003)	3.5%	0.24 (.003)	4.0%
LR test $\chi^2(4)$	77,468.74***	48,061.02***			34,424.33***		29,934.38***	
N/n	30,254/4660	19,475/3331			14,328/2524		12,555/2157	

Note: Model R1 includes the full sample without control variables; Model R2 does not include firms from the UK and Japan; Model R3 does not include firms with headquarters in the UK, Japan, or the US; Model R4 does not include firms belonging to the manufacturing sector. Standard errors in parentheses. All estimates are within the 95% intervals.

Abbreviations: VC, variance component; VPC, variance partition coefficient.

***Prob> χ^2 significant at 0.001.

TABLE 5 Leader and laggard firms in the path toward decarbonization

Variable	Manufacturing industry				Nonmanufacturing, nonutilities' industries			
	Model A1 (leaders)		Model A2 (laggards)		Model A3 (leaders)		Model A4 (laggards)	
	VC	VPC	VC	VCP	VC	VCP	VC	VCP
Firm effects	0.51 (.04)	24.8%	1.57 (.09)	53.2%	0.78 (.05)	31.6%	1.71 (.10)	50.9%
Industry effects	0.585 (.08)	28.5%	0.28 (.07)	9.5%	0.84 (.12)	34.0%	0.55 (.11)	16.4%
Country effects	0.80 (.21)	38.9%	0.94 (.27)	31.9%	0.63 (.15)	25.5%	0.69 (.21)	20.5%
Country-industry effects	0.10 (.05)	4.9%	0.06 (.05)	2.0%	0.09 (.04)	3.6%	0.22 (.10)	6.5%
Residual	0.06 (.002)	2.9%	0.1 (.002)	3.4%	0.13 (.002)	5.3%	0.19 (.004)	5.7%
LR test $\chi^2(4)$	16,665.92***		11,499.94***		16,300.95***		8444.77***	
N/n	5983/796		5966/1088		7260/1131		5295/1247	

Note: Model A1 explores leader firms in decarbonization, whereas Model A2 explores laggards, both in the manufacturing industries; Model A3 explores leaders, whereas Model A4 explores laggards, both in nonmanufacturing, nonutilities' industries. Standard errors in parentheses. All estimates are within the 95% intervals.

Abbreviations: VC, variance component; VPC, variance partition coefficient.

***Prob> χ^2 significant at 0.001.

last specification (*Model R4*) does not include manufacturing firms (NAICS 31–33) because they are the most common firms in our sample. Results are substantially similar across alternative subsamples, therefore supporting the robustness of our main findings.

4.2 | Alternative analyses: Comparing leader and laggard firms on the path toward decarbonization

We explored differences in the role of firm effects between those organizations taking the lead in the fight against climate change (i.e., with CO₂ levels below the industry's median) and the laggards (i.e., CO₂ levels above the industry's median) through four alternative specifications. We divided the sample into manufacturing and nonmanufacturing firms, excluding utilities employed in the generation of

electricity (NAICS 22) from the latter. Note that the median levels of CO₂ in the manufacturing industry (436,303 tons of CO₂) are far higher than those in the nonmanufacturing, nonutilities' industries (120,055 tons of CO₂). Without this division, our results would be misleading because the overall median of the sample would not be representative of the division between leaders and laggards in decarbonization. For instance, a manufacturing firm meaningfully engaging in CO₂ abatement initiatives will probably still be polluting more than a high-polluting firm in the financial sector.

Table 5 below compares the role that firm effects play in determining the CO₂ levels of leader and laggard firms in the manufacturing (*Model A1* and *Model A2*) and nonmanufacturing, nonutilities' industries (*Model A3* and *Model A4*).

When the most and the least decarbonized firms are compared, the results show differences in the role played by firm effects. They

entail a 24.8% of variance in CO₂ levels when assessing leader firms belonging to manufacturing industries and a 31.6% in the case of non-manufacturing, nonutilities' firms. Meanwhile, when exploring the magnitude of firm effects in laggard firms, they become the main driver of CO₂ abatement, contributing more than 50% for both manufacturing and nonmanufacturing, nonutilities' businesses (*Model A2* and *Model A4*).

5 | DISCUSSION

Our findings corroborate empirically the influence of formal and informal institutions (Dhanda et al., 2022; IPCC, 2014; Xinhua News Agency, 2021), as well as the impact of industry-specific factors, such as the pace of technological evolution, the rate of capital stock turnover, or sector growth rates (e.g., Bernstein et al., 2007; IPCC, 2014; Worrell & Biermans, 2005), on organizations' emissions. They also show that the idiosyncratic evolution of industries across countries (i.e., country-industry effects) (Ghemawat, 2003) matters, though to a lesser extent. The lower contribution of the country-industry interaction to firms' CO₂ emissions is indeed congruent with extant literature suggesting that global sectoral patterns of innovation may be homogenizing the type of technologies deployed in each industry (e.g., Faria & Andersen, 2017; Martínez-Senra et al., 2013). Most importantly, our main contribution is to provide evidence that the orchestration of resources and the creation of capabilities play a key role in the fight against climate change.

Given organizations' needs to meet expectations of continued growth and economic profit, it seems plausible that those resources and capabilities leading to CO₂ reductions beyond what is required by country and industry effects allow organizations to achieve both environmental and economic objectives (Hart, 1995). Environmental initiatives, such as environmental training for workers, "green" R&D, or the use of new routines such as life cycle assessment could therefore become the source of win-win strategies, providing gains that more than offset the costs of the investments, making the process of decarbonization less costly (Buysse & Verbeke, 2003; Hart, 1995). Although the very existence of such strategies has been highly questioned in the past (King & Pucker, 2021), some authors have found that decarbonization initiatives can enhance materials' efficiency in lean manufacturing operations (Sartal et al., 2020), whereas others show that introducing these initiatives in strategic decision-making can indeed lead to the creation of new competitive advantages (França et al., 2021). However, even if it is not probably a common phenomenon, we also recognize that some of the large organizations we study here may frame climate change as a *Grand Challenge* that needs to be addressed from within, and, consequently, they push decarbonization initiatives forward despite uncertain benefits, which do not offset its costs (Hengst et al., 2020; King & Pucker, 2021; Slawinski & Bansal, 2015).

If CO₂ abatement is to take place at a faster pace, our results should impregnate the rhetoric of the agents, setting business collective beliefs and influencing management training, as well as that of national and international organizations at the forefront of the

crusade for decarbonization. To begin with, not only engaged and successful organizations but also consulting firms, business magazines, business schools, industry associations, or management scholars can spread a narrative forwarding that firm effects are playing an important role in CO₂ emissions. Only then might laggard businesses on the path toward a low-carbon future realize that embracing proactive environmental strategies is possible and potentially advantageous. Instead, with the misleading belief of organizations being hamstrung agents in climate change and all confidence placed upon advancements in country and industry domains (particularly, in regulation and technological development), the necessary proactiveness of businesses in CO₂ abatement is prone to be lower than it could potentially be.

Furthermore, national and international organizations need to complement their macro and industrial policies focused on country and industry effects with management insights on the determinants, facilitators, and barriers of proactive environmental strategies (Böttcher & Müller, 2015; Goodall, 2008; Nyberg & Wright, 2020). Without considering organizational factors, climate strategies reliant solely on country and industry effects may backfire as constraints can fall short or be bypassed and new technologies can be overlooked (CNBC, 2021; Dowell & Muthulingam, 2017; Li & Zhou, 2017; Van Renssen, 2018). A set of policies aimed at fostering proactive environmental commitment from within (i.e., "the carrot") should also complement those focused on coercively limiting the firm's negative environmental externalities (i.e., "the stick"). From a broader perspective, the need to calibrate climate change-related issues with accuracy and not with worst-case scenarios has actually become an important issue to build more realistic baselines in policymaking (Hausfather & Peters, 2020).

It is also worth noting that our results are consistent with insights arising from the literature on United Nations' Sustainable Development Goals (SDGs), which suggest that businesses play a key role in achieving the sustainable development promoted by the SDGs (Mio et al., 2020; Scheyvens et al., 2016). Most importantly though, this work speaks to the need for assessing organizations' true impact on SDGs and providing empirical evidence of changes in the way business is done (Mio et al., 2020). In this sense, our findings show that with regard to SDG 13 on climate action, at least some businesses are considering society's demands in their operations, providing also support to extant anecdotal evidence. For instance, international investors are increasingly employing Environmental, Social and Governance (ESG) indicators to nurture their decisions (Financial Times, 2020; Greenbiz, 2021) and seem even ready to risk short-term gains for more sustainable business operations. In the first 6 months of 2021, BlackRock voted against 255 directors for climate change issues, five times more than throughout the year 2020 (Bloomberg, 2021). Perhaps, this kind of behavior could be somehow coherent with experimental research showing that economic agents are willing to incur in economic losses to punish "free-riders" in cooperative environments and, therefore, stop the "tragedy of the commons" (Fehr & Gächter, 2000). More evidence is still needed, however, to assess whether this is only an exception or businesses are actually aligning their operations with the SDGs.

6 | CONCLUSIONS

By hinging on a panel data of 4660 firms across 79 countries and over 15 years, we show that firm effects are the main factor influencing firm's CO₂ emissions (32.8% of the total variance), ahead of industry (30.6%), country (29.3%), and country-industry effects (4.0%). Several contributions and implications follow.

To begin with, our work quantifies for the first time the relevance of the three major underlying factors to firms' carbon footprint, namely, country, industry, and firm effects. By demonstrating the key role of organizations in the fight against climate change, the results qualify the narratives that see country and industry effects as main drivers of firms' CO₂ emissions (e.g., IPCC, 2021; King & Pucker, 2021). To be sure, we do not suggest that a proactive decarbonization is taking place in all organizations. Indeed, the very existence of firm effects implicitly reveals two underlying realities in our sample: Some organizations have been successful in deploying proactive decarbonization strategies, whereas others have failed or still lack sufficient resolution to go beyond what country and industry specificities force them to do. We do not underestimate the role of country and industry effects either, for they account for 2/3 of the total variance in organizations' CO₂ emissions. What we are positing is that despite the pervasive concerns for costs and profits that can hinder proactive climate change strategies (Bowen, 2014; Dyllick & Muff, 2016; Wright & Nyberg, 2017), proactive environmental initiatives play an important role beyond country and industry effects. Our findings should therefore preclude the widespread conviction that firm effects are marginal at best (IPCC, 2014; King & Pucker, 2021; The New York Times, 2021; Wright & Nyberg, 2017) from entrenching in our set of beliefs. The danger in it is that it may well become a self-fulfilling prophecy in the normative system under which not only organizational behavior but also policymaking unfold (Ferraro et al., 2005).

Our study is not without limitations. Our empirical model relies on the organizations' country of headquarters to assess the influence of country effects. This is congruent with the body of research in strategic management, exploring the underlying drivers of firm performance (Short et al., 2007), as well as with different streams of literature showing that it is also a good approach to explore the role of country effects on firms' CO₂ emissions (e.g., Birindelli et al., 2022; Dechezleprêtre & Glachant, 2014; Kolk, 2005; Kolk & Fortanier, 2013). To be sure, however, this approach does not allow to assess whether host-country effects are playing a significant role in organizations' CO₂ emissions. Exploring this issue should open a fruitful avenue for research, especially when there exist important differences in environmental regulatory stringency, stakeholder pressures, or customer preferences across the countries. It is worth noticing that country, industry, and firm effects are aggregated effects, meaning that further research is needed to understand the impact of the different factors that are embedded in each level. For instance, future studies could address how the level of technological development (industry-level factor) and the kind of competitive strategy used by the firm (firm-level factor) affect organizations' CO₂ emissions.

Overall, management research must urgently look further into the "black box" of organizations if decarbonization is to take place at a faster pace.

ACKNOWLEDGMENTS

Funding for open access charge: Universidade de Vigo/CISUG.

ORCID

Lucas López-Manuel  <https://orcid.org/0000-0002-2067-3179>

Antonio Sartal  <https://orcid.org/0000-0001-6827-134X>

REFERENCES

- Aguilera-Caracuel, J., Aragón-Correa, J. A., Hurtado-Torres, N. E., & Rugman, A. M. (2012). The effects of institutional distance and headquarters' financial performance on the generation of environmental standards in multinational companies. *Journal of Business Ethics*, 105(4), 461–474. <https://doi.org/10.1007/s10551-011-0978-7>
- Andersson, L. M., & Bateman, T. S. (2000). Individual environmental initiative: Championing natural environmental issues in U.S. business organizations. *Academy of Management Journal*, 43, 548–570. <https://doi.org/10.2307/1556355>
- Aragón-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *The Academy of Management Review*, 28(1), 71. <https://doi.org/10.2307/30040690>
- Arruñada, B., & Vázquez, X. H. (2013). The impact of behavioural assumptions on management ability: A test based on the earnings of MBA graduates. *Management and Organization Review*, 9(2), 209–232. <https://doi.org/10.1017/S1740877600003259>
- Arthur, B. (1988). Self-reinforcing mechanisms in economics. In P. W. Anderson & K. J. Arrow (Eds.), *The economy as an evolving complex system*. Addison-Wesley.
- Bamiatzi, V., Bozos, K., Cavusgil, S. T., & Hult, G. T. M. (2016). Revisiting the firm, industry, and country effects on profitability under recessionary and expansion periods: A multilevel analysis. *Strategic Management Journal*, 37(7), 1448–1471. <https://doi.org/10.1002/smj.2422>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Baumol, W. J., & Willig, R. D. (1981). Fixed costs, sunk costs, entry barriers, and sustainability of monopoly. *The Quarterly Journal of Economics*, 96(3), 405–431. <https://doi.org/10.2307/1882680>
- Bernstein, L., Roy, J., Delhotal, K. C., Harnisch, J., Matsushashi, R., et al. (2007). Industry. In B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, & L. A. Meyer (Eds.), *Climate change 2007: Mitigation. Contribution of working group III to the fourth assessment report of the intergovernmental panel on climate change*. Cambridge University Press.
- Berrone, P., Fosfuri, A., & Gelabert, L. (2017). Does greenwashing pay off? Understanding the relationship between environmental actions and environmental legitimacy. *Journal of Business Ethics*, 144(2), 363–379. <https://doi.org/10.1007/s10551-015-2816-9>
- Birindelli, G., Bonanno, G., Dell'Atti, S., & Iannuzzi, A. P. (2022). Climate change commitment, credit risk and the country's environmental performance: Empirical evidence from a sample of international banks. *Business Strategy and the Environment*, 31(4), 1641–1655. <https://doi.org/10.1002/bse.2974>
- Bloomberg. (2021). BlackRock voted against 255 directors for climate issues. <https://www.bloomberg.com/news/articles/2021-07-20/blackrock-voted-against-255-directors-for-climate-related-issues>
- Boodoo, M. U. (2020). The influence of unions on CSR: Is there a trade-off between employee-oriented and non-employee-oriented policies? *British Journal of Industrial Relations*, 58(4), 816–843. <https://doi.org/10.1111/bjir.12530>

- Böttcher, C. F., & Müller, M. (2015). Drivers, practices and outcomes of low-carbon operations: Approaches of German automotive suppliers to cutting carbon emissions. *Business Strategy and the Environment*, 24(6), 477–498. <https://doi.org/10.1002/bse.1832>
- Bowen, F. (2014). *After greenwashing: Symbolic corporate environmentalism and society*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139541213>
- Busse, C., Meinelshmidt, J., & Foerstl, K. (2017). Managing information processing needs in global supply chains: A prerequisite to sustainable supply chain management. *Journal of Supply Chain Management*, 53(1), 87–113. <https://doi.org/10.1111/jscm.12129>
- Buyse, K., & Verbeke, A. (2003). Proactive environmental strategies: A stakeholder management perspective. *Strategic Management Journal*, 24(5), 453–470. <https://doi.org/10.1002/smj.299>
- CNBC. (2021). CO2 emissions set to hit record levels in 2023 and there's 'no clear peak in sight,' IEA says. <https://www.cnbc.com/2021/07/20/co2-emissions-will-hit-record-levels-in-2023-iea-says.html>
- Conner, K. R. (1991). A historical comparison of resource-based theory and five schools of thought within industrial organization economics: Do we have a new theory of the firm? *Journal of Management*, 17(1), 121–154. <https://doi.org/10.1177/014920639101700109>
- Dechezleprêtre, A., & Glachant, M. (2014). Does foreign environmental policy influence domestic innovation? Evidence from the wind industry. *Environmental and Resource Economics*, 58(3), 391–413. <https://doi.org/10.1007/s10640-013-9705-4>
- Department of State for Business Energy and Clean Growth. (2021). Industrial decarbonisation strategy.
- Desender, K., & Epure, M. (2021). The pressure behind corporate social performance: Ownership and institutional configurations. *Global Strategy Journal*, 11(2), 210–244.
- Dhanda, K. K., Sarkis, J., & Dhavale, D. G. (2022). Institutional and stakeholder effects on carbon mitigation strategies. *Business Strategy and the Environment*, 31(3), 782–795. <https://doi.org/10.1002/bse.2917>
- Dowell, G. W. S., & Muthulingam, S. (2017). Will firms go green if it pays? The impact of disruption, cost, and external factors on the adoption of environmental initiatives. *Strategic Management Journal*, 38(6), 1287–1304. <https://doi.org/10.1002/smj.2603>
- Dyllick, T., & Muff, K. (2016). Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability. *Organization and Environment*, 29(2), 156–174. <https://doi.org/10.1177/1086026615575176>
- Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Management Science*, 60(11), 2835–2857. <https://doi.org/10.1287/mnsc.2014.1984>
- Faria, L. G., & Andersen, M. M. (2017). Sectoral dynamics and technological convergence: An evolutionary analysis of eco-innovation in the automotive sector. *Industry and Innovation*, 24(8), 837–857. <https://doi.org/10.1080/13662716.2017.1319801>
- Federal Ministry of Economic Affairs and Energy. (2019). Integrated national energy and climate plan for Germany. https://ec.europa.eu/energy/sites/default/files/documents/de_final_necp_main_en.pdf
- Fehr, B. E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *The American Economic Review*, 90(4), 980–994. <https://doi.org/10.1257/aer.90.4.980>
- Ferraro, F., Pfeffer, J., & Sutton, R. I. (2005). Economics language and assumptions: How theories can become self-fulfilling. *Academy of Management Review*, 30(1), 8–24. <https://doi.org/10.5465/amr.2005.15281412>
- Fielding, A., & Goldstein, H. (2006). Cross-classified and multiple membership structures in multilevel models: An introduction and review (Research Report No. 791).
- Financial Times. (2020). How investor pressure prompted oil majors to wake up to climate change. <https://www.ft.com/content/83b4ba6b-bef9-45d3-a6fb-087ef3143a43>
- Foss, N. J., & Pedersen, T. (2002). Transferring knowledge in MNCs: The role of sources of subsidiary knowledge and organizational context. *Journal of International Management*, 8(1), 49–68. [https://doi.org/10.1016/S1075-4253\(01\)00054-0](https://doi.org/10.1016/S1075-4253(01)00054-0)
- França, A., Sartal, A., & Vázquez, X. H. (2021). How does decarbonization impact the business strategy-performance nexus? *Michigan Business Papers*, 2021(1), 13160. <https://doi.org/10.5465/AMBPP.2021.13160abstract>
- Garnaut, R. (2008). *The Garnaut climate change review*. Cambridge University Press.
- Genovese, A., Acquaye, A. A., Figueroa, A., & Koh, S. C. L. (2017). Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications. *Omega*, 66, 344–357. <https://doi.org/10.1016/j.omega.2015.05.015>
- Ghemawat, P. (2003). Semiglobalization and international business strategy. *Journal of International Business Studies* 34:2, 34(2), 138–152. <https://doi.org/10.1057/palgrave.jibs.8400013>
- Ghoshal, S., Moran, P., & Almeida-Costa, L. (1995). The essence of the mega-corporation. *Journal of International and Theoretical Economics*, 151(4), 748–759.
- Goodall, A. H. (2008). Why have the leading journals in management (and other social sciences) failed to respond to climate change? *J Manag Inq*, 17(4), 408–420. <https://doi.org/10.1177/1056492607311930>
- Greenbiz. (2021). BlackRock steps up investor pressure on its portfolio polluters. <https://www.greenbiz.com/article/blackrock-steps-investor-pressure-its-portfolio-polluters>
- Harrigan, K. R. (1981). Barriers to entry and competitive strategies. *Strategic Management Journal*, 2(4), 395–412. <https://doi.org/10.1002/smj.4250020407>
- Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014. <https://doi.org/10.2307/258963>
- Hausfather, Z., & Peters, G. P. (2020). Emissions—The 'business as usual' story is misleading (Vol. 577, pp. 618–620). Nature. Nature Publishing Group. <https://doi.org/10.1038/d41586-020-00177-3>
- Hawn, O., & Ioannou, I. (2016). Mind the gap: The interplay between external and internal actions in the case of corporate social responsibility. *Strategic Management Journal*, 37(13), 2569–2588.
- Hengst, I.-A., Jarzabkowski, P., Hoegl, M., & Muethel, M. (2020). Toward a process theory of making sustainability strategies legitimate in action. *Academy of Management Journal*, 63(1), 246–271. <https://doi.org/10.5465/amj.2016.0960>
- IPCC. (2014). *Fifth assessment report (AR5) climate change 2014: Mitigation of climate change, working group III contribution to the fifth assessment report of the intergovernmental panel on climate change*. Cambridge University Press.
- IPCC. (2021). Climate change 2021: The physical basis. IPCC.
- King, A., & Pucker, K. (2021). *The dangerous allure of win-win strategies* (pp. 35–39). Stanford Social Innovation Review.
- Kogut, B. (1991). Country capabilities and the permeability of borders. *Strategic Management Journal*, 12(S1), 33–47. <https://doi.org/10.1002/smj.4250120905>
- Kolk, A. (2005). Environmental reporting by multinationals from the triad: Convergence or divergence? *Management International Review*, 45-(Special issue 2005/1), 145–166.
- Kolk, A., & Fortanier, F. (2013). *Internationalization and environmental disclosure: The role of home and host institutions*. Multinational Business Review.
- Lawrence, M. G., & Schäfer, S. (2019). Promises and perils of the Paris Agreement. *Science*, 364(6443), 829–830.
- Li, X., & Zhou, Y. M. (2017). Offshoring pollution while offshoring production? *Strategic Management Journal*, 38, 2310–2329. <https://doi.org/10.1002/smj.2656>

- Makino, S., Isobe, T., & Chan, C. M. (2004). Does country matter? *Strategic Management Journal*, 25(10), 1027–1043. <https://doi.org/10.1002/smj.412>
- Martínez-Senra, A. I., Quintás, M. A., Sartal, A., & Vázquez, X. H. (2013). ¿Es rentable «pensar por pensar»? Evidencia sobre innovación en España. *Cuadernos de Economía Y Dirección de la Empresa*, 16, 142–153. <https://doi.org/10.1016/j.cede.2012.08.001>
- Ministry for the Ecological Transition and Demographic Challenges. (2020). National plan of adaptation to climate change.
- Mio, C., Panfilo, S., & Blundo, B. (2020). Sustainable development goals and the strategic role of business: A systematic literature review. *Business Strategy and the Environment*, 29(8), 3220–3245.
- New, M., Liverman, D., Schroeder, H., & Anderson, K. (2011). Four degrees and beyond: The likelihood and implications of a global climate change of 4+ degrees. *Philosophical Transactions of the Royal Society A*, 369, 6–19.
- North, D. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511808678>
- North, D. (2005). *Understanding the process of economic change*. Princeton University Press. <https://doi.org/10.1515/9781400829484>
- Nyberg, P. D., & Wright, P. C. (2020). Climate-proofing management research. *Acad Manag Perspect*, 36, 713–728. <https://doi.org/10.5465/AMP.2018.0183>
- Oliver, C. (1997). Sustainable competitive advantage: Combining institutional and resource-based views. *Strategic Management Journal*, 18(9), 697–713.
- Perotti, S., Pratavia, L. B., & Melacini, M. (2022). Assessing the environmental impact of logistics sites through CO2eq footprint computation. *Business Strategy and the Environment*, 31(4), 1679–1694. <https://doi.org/10.1002/bse.2976>
- Piazza, A., & Abrahamson, E. (2020). Fads and fashions in management practices: Taking stock and looking forward. *International Journal of Management Reviews*, 22(3), 264–286. <https://doi.org/10.1111/ijmr.12225>
- Porter, M. (1980). *Competitive strategy*. Free Press.
- Porter, M. (1990). *The competitive advantage of nations*. Free Press. <https://doi.org/10.1007/978-1-349-11336-1>
- Post, J. E., & Ahman, B. W. (1992). Models of corporate greening: How corporate social policy and organizational learning inform leading-edge environmental management. In J. E. Post (Ed.), *Research in corporate social performance and policy* (pp. 3–30). JAI Press.
- Prahalad, C. K., & Hamel, G. (1990). *The core competence of the corporation*. Springer.
- Preuss, L. (2008). A reluctant stakeholder? On the perception of corporate social responsibility among European trade unions. *Business Ethics: A European Review*, 17(2), 149–160. <https://doi.org/10.1111/j.1467-8608.2008.00528.x>
- Raudenbush, S., Bryk, A., Cheong, Y., & Congdon, R. (2004). *HLM 6: Hierarchical linear & nonlinear modeling*. SSI Scientific Software International.
- Rhodes, C. (2016). Democratic business ethics: Volkswagen's emissions scandal and the disruption of corporate sovereignty. *Organization Studies*, 37(10), 1501–1518. <https://doi.org/10.1177/0170840616641984>
- Rothaermel, F. (2017). *Strategic management*. McGraw-Hill Education.
- Rumelt, R. P. (1991). How much does industry matter? *Strategic Management Journal*, 12(3), 167–185. <https://doi.org/10.1002/smj.4250120302>
- Sachs, J. D. (2012). From millennium development goals to sustainable development goals. *The Lancet*, 379(9832), 2206–2211.
- Sartal, A., Martínez-Senra, A. I., & García, J. M. (2017). *Balancing offshoring and agility in the apparel industry: Lessons from benetton and inditex* (Vol. 25) (pp. 16–23). *Fibres & Textiles in Eastern Europe*. <https://doi.org/10.5604/12303666.1228148>
- Sartal, A., Rodríguez, M., & Vázquez, X. H. (2020). From efficiency-driven to low-carbon operations management: Implications for labor productivity. *Journal of Operations Management*, 66(3), 310–325. <https://doi.org/10.1002/joom.1060>
- Scheyvens, R., Banks, G., & Hughes, E. (2016). The private sector and the SDGs: The need to move beyond ‘business as usual’. *Sustainable Development*, 24(6), 371–382.
- Sharma, M., Kumar, A., Luthra, S., Joshi, S., & Upadhyay, A. (2022). The impact of environmental dynamism on low-carbon practices and digital supply chain networks to enhance sustainable performance: An empirical analysis. *Business Strategy and the Environment*, 31, 1776–1788. <https://doi.org/10.1002/bse.2983>
- Sharma, S. (2000). Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. *Academy of Management Journal*, 43(4), 681–697. <https://doi.org/10.2307/1556361>
- Shen, J., Wang, S., Liu, W., & Chu, J. (2019). Does migration of pollution-intensive industries impact environmental efficiency? Evidence supporting “pollution haven hypothesis”. *Journal of Environmental Management*, 242(March), 142–152. <https://doi.org/10.1016/j.jenvman.2019.04.072>
- Short, J. C., Ketchen, D. J., Palmer, T. B., & Hult, G. T. M. (2007). Firm, strategic group, and industry influences on performance. *Strategic Management Journal*, 28(2), 147–167. <https://doi.org/10.1002/smj.574>
- Short, J. C., McKelvie, A., Ketchen, D. J., & Chandler, G. N. (2009). Firm and industry effects on firm performance: A generalization and extension for new ventures. *Strategic Entrepreneurship Journal*, 3(1), 47–65. <https://doi.org/10.1002/sej.53>
- Slawinski, N., & Bansal, P. (2015). Short on time: Intertemporal tensions in business sustainability. *Organization Science*, 26(2), 531–549. <https://doi.org/10.1287/orsc.2014.0960>
- Solarin, S. A., Al-Mulali, U., Musah, I., & Ozturk, I. (2017). Investigating the pollution haven hypothesis in Ghana: An empirical investigation. *Energy*, 124, 706–719. <https://doi.org/10.1016/j.energy.2017.02.089>
- Stern, N. (2007). *The economics of climate change: The Stern review*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511817434>
- Surroca, J., Tribó, J. A., & Zahra, S. A. (2013). Stakeholder pressure on MNEs and the transfer of socially irresponsible practices to subsidiaries. *Academy of Management Journal*, 56(2), 549–572. <https://doi.org/10.5465/amj.2010.0962>
- Surroca, J. A., Aguilera, R. V., Desender, K., & Tribó, J. A. (2020). Is managerial entrenchment always bad and corporate social responsibility always good? A cross-national examination of their combined influence on shareholder value. *Strategic Management Journal*, 41(5), 891–920.
- The Guardian. (2019). Major Global Firms Accused of Concealing their Environmental Impact. <https://www.theguardian.com/environment/2019/jun/16/major-global-firms-accused-of-concealing-their-environmental-impact>
- The New York Times. (2021). What's Really Behind Corporate Promises on Climate Change? <https://www.nytimes.com/2021/02/22/business/energy-environment/corporations-climate-change.html>
- The Sustainability Institute. (2021). Unilever partners with suppliers and consumers to deliver net zero ambition. <https://www.sustainability.com/thinking/an-interview-with-unilever/>
- UNEP. (2020). Emissions Gap Report 2020. United Nations Environment Programme, United Nations. <https://www.unep.org/emissions-gapreport-2020>
- Van Renssen, S. (2018). The inconvenient truth of failed climate policies. *Nature Climate Change*, 8(5), 355–358. <https://doi.org/10.1038/s41558-018-0155-4>
- WEC. (2001). *Energy efficiency policies and indicators policies*. World Energy Council.

- Worrell, E., & Biermans, G. (2005). Move over! Stock turnover, retrofit and industrial energy efficiency. *Energy Policy*, 33(7), 949–962. <https://doi.org/10.1016/j.enpol.2003.10.017>
- Wright, C., & Nyberg, D. (2017). An inconvenient truth: How organizations translate climate change into business as usual. *Academy of Management Journal*, 60(5), 1633–1661. <https://doi.org/10.5465/amj.2015.0718>
- Wright, P. M., McMahan, G. C., & McWilliams, A. (1994). Human resources and sustained competitive advantage: A resource-based perspective. *The International Journal of Human Resource Management*, 5(2), 301–326. <https://doi.org/10.1080/09585199400000020>
- Xinhua News Agency. (2021). Outline of the People's Republic of China 14th five-year plan for national economic and social development and long-range objectives for 2035, (October 2020): 1–31.

How to cite this article: López-Manuel, L., Vázquez, X. H., & Sartal, A. (2023). Firm, industry, and country effects on CO2 emissions levels. *Business Strategy and the Environment*, 1–12. <https://doi.org/10.1002/bse.3348>