sustainability

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Ownership Structure and Carbon Emissions of SMEs: Evidence from OECD Countries

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Abstract: This work investigates the impact that the ownership structure of small- and medium-sized enterprises (SMEs) in Organization for Economic Co-operation and Development (OECD) countries exerts on the level of corporate carbon emissions, as well as the moderating effect of innovation on this relationship. Based on panel data from 32 OECD countries during 2015–2020, a pooled least-square panel model was developed for estimation. The results show that public, foreign, and institutional investors have a significant negative effect on carbon emissions. Conversely, strategic investors contribute to increasing carbon emissions. Moreover, findings provide evidence of mixed moderating effects of innovation on the relationship between types of owners and carbon emissions. Hence, strategic shareholders contribute to implementing environmental policies through innovation, while public and foreign investors incur Research and Development expenditures to boost firms' economic activity, ignoring social and environmental commitments. Our results confirm the relationship between ownership structure and carbon emissions and the moderating effects of innovation on this association. Environmental innovation allows for improving worldwide firms' competitiveness and long-term performance.

Keywords: stakeholder theory; legitimacy; signal theory; climate change; ecological transition

Citation: Ghachem, D.A.; Basty, N.; Zureigat, Q. Ownership Structure and Carbon Emissions of SMEs: Evidence from OECD Countries. *Sustainability* **2022**, *14*, 14408. https://doi.org/10.3390/su142114408

Academic Editors: Ishaq Bhatti, Sabri Boubaker and Imen Derouiche

Received: 6 September 2022
Accepted: 27 October 2022
Published: 3 November 2022

1. Introduction

Challenges posed by environmental and climate changes are becoming unavoidable and thus increasingly considered in business practices [1]. Governments are adopting new laws to reduce carbon emissions and decarbonize the economy, as claimed by the Intergovernmental Panel on Climate Change in 2018. Reducing net carbon emissions by mid-century is becoming necessary. This challenge requires a long-term structural change [2], which would give rise to some new processing technologies and the phasing out of fossil fuel companies. This concept is called a carbon bubble, and it aims to limit worldwide global warming. Consequently, a low-carbon transition is mainly based on carbon performance; the objective set by the European Commission is to decrease GHG by 40% by 2030 and reach a decarbonization threshold of 80–95% by 2050. Public Interest Entities are responsible for environmental operations and therefore encourage investors and all firms' stakeholders to take environmental and carbon performance into account. Nevertheless, previous research argues that shareholders adopt different strategic decisions depending on their nature. As a result, they differently impact corporate social and environmental responsibilities [3–5].

Previous strands of literature established that ownership structure might affect companies' Corporate Social Responsibility (CSR) attitudes and behaviors [6]. For example, institutional investors such as mutual funds, investment advisors, and individuals have been recognized as major players in the transition to a green economy [7]. In turn, government agencies are considered as heavily involved in carbon-intensive firms [8]. In addition, Ref. [9] showed that foreign ownership moderately impacts the relationship between carbon disclosure and firm value. Ref. [10] note that companies tend to display a responsible

attitude, particularly by reducing carbon emissions, to affirm their legitimacy in the market. Moreover, low-carbon-intensity firms use CSR disclosure as a means of governance rather than legitimacy. Consequently, the ownership structure seems to play a crucial role in the firm's responsible investments and decarbonization decisions.

In recent years, several studies have documented a relationship between firm ownership structure and CSR strategies [11–13]. They have stated that each type of shareholder has specific economic incentives to engage with firms on environmental issues. Unlike public firms, corporate ownership dispersion is positively associated with CSR. State-owned firms tend to divulge more non-financial information in favor of the public interests [14,15]. Notwithstanding this, Ref. [8] found that governments show a marked preference for carbon-intensive firms, while individual investment advisors and mutual funds become aware of environmental risk and thus reject carbon-intensive firms.

Furthermore, institutional investors tend to be risk-averse [16]. They invest more in sustainable companies that better manage climate-related risks and consider factors impacting their environmental performance [8]. Additionally, some institutional investors believe that the climate risks of their portfolios' securities, particularly regulatory risks, have financial implications and could materialize [17]. Foreign investors oblige managers to disclose Environmental, Social, and Governance (ESG) issues to ensure better management of agency conflicts. Indeed, Ref. [18] show that foreign investors are more concerned with environment issues and attach great importance to ecological laws. Therefore, they put pressure on firms to be responsible for legitimacy purposes [9]. Globally, ownership structure, concentration (the distribution of shares owned by majority shareholders), and identity (especially foreign investors and institutional investors) seem to be the most important factors that influence the level of firms' involvement in climate-related activities, notably carbon emissions. Nevertheless, findings seem ambiguous due to the inconclusive results on the relationship between carbon emission and financial performance [19]. If a company's communication is based on greenwashing, managers may use the carbon performance to justify a negative financial reporting quality. A decrease in carbon emissions leads to the decline of the production units and thus to a regression in financial results, while innovation could provide a solution to improve product quality and quantity and optimize the management process by reducing environmental costs and considering energy efficiency [20]. The company's level of involvement in innovation may moderate the relationship between the ownership structure and corporate carbon emissions [21]. According to previous studies, innovation allows improvements of production processes and notably should boost the decrease in emissions [7,22]. Moreover, the less innovative companies have higher-carbon activities. Consequently, innovation is a moderator of corporate carbon emissions and therefore could minimize its negative effects.

Considering that ownership structure has a significant impact on corporate carbon emissions, we aim to examine in this paper the relationship between different types of ownership structures (public, strategic, institutional, and foreign investors) and carbon emissions, as well as how investments in innovation could moderate this relationship. The choice of this sample is based on the fact that the OECD has made considerable efforts to help its countries engage in and contribute to adopting and implementing climate change energy transition policies, both at the national and international levels. To do so, we adopt the panel linear regression models from 2015–2020.

Despite the negative GHG emissions' externalities, there is yet little literature on the relationship between corporate governance and carbon emissions, except for some recent empirical studies, such as those by [7,20,23].

Our paper is in line with this strand of literature. It makes a three-level contribution to existing literature. First, we focus on the impact of the ownership structure on the level of corporate carbon emissions for firms. Hence, we allow the CSR literature to expand by examining the link between types of ownership structures and the carbon emissions of firms. Second, we examine the moderating role of innovation in the relationship between ownership structure and carbon emission. Therefore, we enhance the understanding of

the impact of innovation on stakeholders' pressure on firms' carbon emissions. Third, we consider OECD countries especially concerned about climate change. Ref. [24] highlighted the urgent need to significantly scale up investment in less energy-intensive and low-carbon alternatives. It also emphasized shifting investment away from fossil fuels.

Finally, our study may have several managerial contributions. First, it should be useful for policymakers concerned about foreign investments and environmental risks, the energy transition being a good signal to ensure transparent climate change strategies and attract foreign investors. Second, it may also be helpful for top management looking for institutional investments that allow firms to benefit from a leverage effect to access other financing sources. Thus, innovation could motivate different stakeholders to work together and ensure energy transition and firm value maximization. Third, innovation could be a major player in ensuring a sustainable future and thus be considered as a policy instrument to manage responsible investments.

The remainder of this paper is organized as follows. The next section displays the theoretical framework and hypotheses development. It is followed by the methodological approach, sample and data collection, variable definitions and measurement, and empirical model. The subsequent section shows our empirical findings. The conclusions, limitations, and recommendations are given in the final section.

2. Literature Review and Hypotheses

As previously mentioned, we discuss in this section several hypotheses related to ownership structure and carbon emission as well as the moderating effect of innovation on their relationship.

2.1. Ownership Structure and CSR Activities

CO_2 emissions are considered the primary source of climate change and therefore contribute to amplifying a country's vulnerability. Therefore, high-carbon companies should develop technological innovation capacities that make them able to consider the financial climate risk and evaluate climate issues and impacts. That brings a good reputation to these firms, which conveys a positive image for their stakeholders following the recently imposed decarbonization strategy. Additionally, governments can impose national emission reduction mechanisms, which imply the necessity to define the total amount of GHG emissions by sectors and firms [25]. The firms are imposed upon to deal with potential additional costs due to carbon taxes or to provide allowances based on their carbon emissions. Given the scale of their corporate emissions, firms are called to adopt CO_2 reduction policies and control their emissions. This responsibility is assigned to managers who report their actions and policies to stakeholders [26]. Indeed, the climate change challenge is involved in CSR activities and sustainability initiatives.

Several theories relating to responsible management and the impact it has on firm performance have tried to explain the role of the owners in controlling firms' engagement in CSR activities, notably the legitimacy theory, the resource-based theory, the signaling theory, and the agency theory. The legitimacy theory is one of the most referenced in CSR literature [10]. It allows linking management with social values in business activities [27]. Ref. [28] shows that companies gain legitimacy when they prove to communities that their business processes are favorable for the global environment. Hence, good CSR could be a mechanism of legitimization [29]. Accordingly, companies neglecting responsible activities could lose legitimacy among stakeholders. Furthermore, legitimacy theory highlights that companies' engagement in CSR activities is due to investors' pressure. Moreover, the analysis of the motivations to adopt CSR in companies should consider all of a firm's stakeholders, whose interactions can both facilitate and hinder CSR [30]. Thus, managers should be considered moral actors. In other words, a good corporate governance system should respect the norms of democratic decision making and the transparency of the directors' board as well as the stakeholders' interests: additionally, it has to ensure alignment with shareholders' financial objectives [31].

For its part, the resource-based theory is often used to analyze why some firms perform better in terms of carbon emissions. Previous studies argued that CSR activities could be costly for companies, because of the high cost and the difficulty of accessing technology. Firms' resources can be of many kinds ranging from financial to intangible, such as directors' knowledge and experience, communication channels with external stakeholders, advice and counsel, legitimacy, and preferential access to markets or external resources [32]. These intangible resources help firms to achieve their green objectives [33].

Signaling theory is also a theoretical issue that highlights how CSR contributes to financial performance. It suggests that carbon disclosure allows companies to convey a positive image [34]. CSR practices signal to investors' companies strength to fulfill the institutional vacuum of the environment in which they operate. This signal becomes louder in developing and emerging markets. Additionally, a good social corporate reputation is considered by institutional investors as an indicator of competent managerial behavior [35].

The agency theory [36], based on the dissociation between ownership and management, reflects a manager's opportunistic behavior. The latter is aroused by the information asymmetry that exists between managers and investors, especially foreign ones. As suggested by [37], engagement in responsible activities as well as the overinvestment it generates may provide social support to conceal the possible incompetence of some managers, which illustrates the entrenchment strategy. Consequently, separating the roles of chairman and CEO reduces agency problems and improves CSR disclosures [38].

Finally, based on agency, stakeholder, and resource-based theories, companies draw on the relationship between board composition, leadership, and sustainability policy to prove their legitimacy and negotiate with stakeholders [29,39]. Moreover, this relationship seems ambiguous and depends on the specific characteristics of the directors [5]. Each of these theories partly explains the link between corporate ownership and the commitment to climate change. While legitimacy and stakeholder theories highlight the impact of stakeholders on the decision making of managers, agency and resource-based theories focus on the interests conflicts between managers and shareholders, on one hand, and between green-oriented and finance-oriented shareholders, on the other hand [7].

Empirically, Ref. [40] stated that engaging in CSR activities can be viewed as a misallocation of resources. However, in the context of climate change, the problem mainly arises between shareholders who are looking for financial gains and those looking for green goals. Related to this, it would be preferable to invest in socially responsible activities that guarantee shareholder wealth [41], and lead to win–win scenarios. Ref. [13] show a positive relationship between top management equity and social performance in terms of environment and product quality. Because of owing significant equity, the manager is more likely to undertake strategies and policies maximizing the shareholders' value [42]. In this vein, if socially responsible actions increase the firm's value, stock ownership might increase the managers' incentives to engage in CSR.

The study of the impact of the shareholding structure on the challenges of CSR and responsible investment is of great importance to better CSR disclosure and to discerning the most engaged stakeholders. Firms become particularly CSR aware when they face strong pressure group activism [14]. Different types of shareholders were found to have distinct motivations regarding the firm's CSR engagement. Dispersed ownership might be a tool to control the CSR commitment of companies despite the agency problems it could generate between shareholders [36]. In short, a high number of owners aids in evaluating the controlling actions and contributes to the performance of the business, which explains the positive effect of the total concentration of ownership on the performance of the business [43].

Previous studies show that investors have become fully aware of climate risks [7]. However, some kinds of investors are reported to be particularly concerned by the need for the green transition [9].

Additionally, institutional investors as well as hedge funds and private equity have significant market shares and become more prudent in decision making and more concerned

about corporate responsibility issues [44,45]. Thus, they play an important role in the transition to a green economy [7]. Ref. [12] find evidence of a positive relationship between the number of institutions holding the shares of a firm and its CSR rating. However, Ref. [40] do not find significant empirical evidence relating the power of institutional investors with CSR. Ref. [44] also show evidence of a significant positive relationship between institutional ownership and environmental disclosure as well as social performance. Further, Ref. [46] focus on Jordanian manufacturing firms listed on the Amman Stock Exchange during the period 2013–2015 and find that board ownership, as well as institutional investors' concentration, have a significant negative impact on CSR disclosure level. Based on the literature, we propose to test the following hypothesis:

Hypothesis 1. *There is a negative relationship between institutional ownership and carbon emissions.*

With regard to foreign investors, their presence in the ownership structure creates pressure on managers to adopt CSR approaches [9]. Foreign investors are particularly sensitive to legitimacy and value maximization. Furthermore, they are greatly interested in ecological laws [18]. Ref. [47] argued that globalization enhances firms' CSR engagement in Asian countries. American shareholders have been reported to have pressed firms to consider social responsibility issues for more than 60 years. Indeed, investing in a foreign country is risky and uncertain due to problems caused by information asymmetries [48]. In this case, foreign investors prefer to invest in socially responsible firms to reduce risk. Altogether, the working hypothesis to test is as follows:

Hypothesis 2. *There is a negative relationship between foreign ownership and carbon emissions.*

On the government side, the relationship with CSR attitude seems ambiguous. On one side, environmental engagement requires considerable support and funding from governmental institutions [49]. In addition, [50] argued that investment in the green economy is conditioned by a firm's ability to adapt to regulations and conditions subject to environmental inspection. On the other side, [8] provide evidence of a high public ownership share of carbon-intensive firms. This could be explained by the strong state presence in heavy carbon sectors, including electricity and gas. Nevertheless, [51] conclude there is a positive relationship between environmental performance and state ownership, despite the state's strong presence in ownership of highly polluting industries. Overall, we formulate the following hypothesis:

Hypothesis 3. *There is a negative relationship between governmental ownership and carbon emissions.*

For their part, strategic business groups and family firms engage in CSR to maintain a positive family image and reputation [52]. However, the dual function that defines these groups could be detrimental to liberating the company of conflicting interests and ensuring sustainable performance [39]. Indeed, Ref. [53] show that CEO ownership is not associated with carbon performance. Conversely, Ref. [54] analyze a dataset of Indian firms over the period 2008 to 2015 and find that business group and family ownership are beneficial for community-related CSR. They explain that community-related CSR becomes a culturally accepted norm in emerging markets such as India, which makes firms more sensitive to institutional pressures from stakeholders. Therefore, we formulate the following hypothesis:

Hypothesis 4. *There is a negative relationship between strategic group ownership and carbon emissions.*

2.2. The Moderating Effect of Innovation

Innovation is considered a complex process, based on a set of resources that permits the evolution of the functions and the production processes of companies. Innovation enables

firms to develop distinctive technological skills and hence improve their competitiveness and market positions. Additionally, Ref. [55] defined innovation as the process of turning knowledge into economic and social benefits. Using innovation, firms increase productivity and profitability and can easily access new markets and grow their existing market share. In this sense, some previous studies provide evidence of a positive association between corporate green innovation and the number of equity analysts following the firm [56,57]. Thus, innovation could be a key success factor that provides innovative firms with a competitive advantage on a global scale.

Regarding the link between ownership structure and innovation, Ref. [58] conclude that the ownership structure impacts the level of a company's sustainable product innovation. Ref. [59] display that a high concentration of ownership leads to more innovative firms. Ref. [60] found that foreign ownership increases the probability of obtaining product innovations. Ref. [61] found that the differences between the innovation levels of foreign and national companies are mainly due to the dominant presence of foreign investors in large companies, which have more resources to support innovation. These findings are consistent with the study of [62] which display that foreign-owned firms tend to be larger and have higher export intensity. Additionally, they stated that larger firms, as measured by assets, sales, or age, tend to be more innovative. More recently, Ref. [63] conclude that owners' diversity would be a greater driver of a firm's innovation than ownership concentration. Additionally, Ref. [64] show that carbon-intensive firms promote green innovation in countries with deep stock markets. First, bank loans are inappropriate for high-risk and high-return projects, such as innovative projects. Second, for financial reasons, banks tend to be technologically conservative and do not promote green innovation projects. Evaluation of underlying guarantees of outdated technologies could be eroded because of financing of new technologies. Moreover, financing green innovation involves intangible and firm-specific assets that are difficult to collateralize.

As a result, innovation increases employment sustainable growth, social welfare, and quality of life [55,65]. Furthermore, investing in green innovation permits improving processes to prevent dangerous climate change [66,67]. Firms based on green investment principles are continuously looking for new eco-technologies. While the general innovative level of a firm does not affect its carbon emissions, environmental innovation does, although proportionately less than the increased economic activity effects [22]. Environmental innovation could entail, for instance, developing safer or more efficient products, saving materials in production, consuming less energy, streamlining production lines, reuse of byproducts, converting waste into new products, reducing storage, and reducing the costs of waste disposal [68]. Globally, investment in innovation is a positive indicator that impacts the perceptions of stakeholders as proof of becoming more energy-efficient [69]. The impact of innovation by carbon emissions reduction makes the firm more energy-efficient and improves its performance. Ref. [70] highlight the dynamic between strategic CSR activities and innovation mechanisms. This dynamic lets firms improve their social performance and competitiveness. Ref. [71] show that high-sustainability stocks are highly requested on financial markets and thus are subject to significant price pressure. Ref. [44] highlight the outperformance of institutions with better sustainability footprints. In addition, there is a growing investor preference for sustainable values, and thus, price pressure pertains to stocks with good environmental scores. Notwithstanding this, Ref. [22] showed that innovation effects differ across countries, with a higher level of heterogeneity for the least developed countries. Other authors provide evidence of a positive linear relationship between green innovation and different performance measures [72]. These nuanced effects of green innovation on firm performance were also corroborated by [56], who noted a negative relationship between green innovation and the number of financial analysts of market-oriented firms, in the sense that the latter invest less in green innovation when they are in a growth phase. Ref. [73] highlighted that innovation enhances firms' financial risks, while CSR decreases it.

These arguments lead us to formulate the following hypothesis:

Hypothesis 5. *The effect of ownership on a firm's carbon emissions is moderated by the innovation level.*

3. Research Design

3.1. Data

We used panel data of SMEs of OECD countries, for the period 2015–2020. The choice of OECD countries is due to the increased focus of OECD organizations on climate change. As noted in the [24]: "*There is an urgent need to significantly scale-up investments to low-carbon, more energy-efficient alternatives and to shift investment away from fossil fuel use. The low-carbon transition will require mobilizing of all sources of public and private sector investment and finance, including institutional investors*". Ownership data were extracted from BEEPS database (Business Environment and Enterprise Performance Surveys), based on enterprise surveys (ES) in manufacturing and key service sectors in all regions of the world. The data collection methodology includes standardized survey instruments and a uniform sampling methodology, which required the deployment of joint EBRD, EIB, and WB enterprise surveys covering Europe, Central Asia, and the Middle East and North Africa. Ownership structure information is considered general and concerns both manufacturing and services sectors. For the purposes of our study and given the availability of data over the study period, we initially selected 34 OECD countries in which small and medium-sized firms account for approximately 99% of all enterprises (OECD Library). Then, we excluded countries in which data were incomplete or unavailable. Our final sample consists of 192 country-year observations.

For their part, market capitalization, rule of law index, manufacturing value-added, GDP, and population variables are extracted from OECD and Global Economy databases. The carbon emission data are extracted from the KNOEMA database, and the innovation data are from the World Bank Group (WBG).

3.2. Variables

Our dependent variable CO_2 denotes SME carbon emission per GDP, which reflects the carbon emission weighted by the contribution of SME to GDP for each country for the 2015–2020 period. The carbon CO_2 contains fossil CO_2 and GHG emissions per GDP (measured by ton CO_2 per 1000$ GDP direct greenhouse gases). Direct GHG include Carbon Dioxide (CO_2), Methane (CH4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFC-23, 32, 125, 134a, 143a, 152a, 227ea, 236fa, 245fa, 365mfc, 43-10-mee), Perfluorocarbons (PFCs: CF4, C2F6, C3F8, c-C4F8, C4F10, C5F12, C6F14, C7F16), Sulfur Hexafluoride (SF6), Nitrogen Trifluoride (NF3), and Sulfuryl Fluoride (SO2F2).

Our independent variables concern the ownership structure, which significantly impacts the capital allocation as well as the insider owners' control and the decision-making process, according to the investors' category. Thus, as claimed in [74], we classify the investors into five categories:

PS: Public sector, measured as the percentage of shares of central governments, local governments, public pension funds, state-owned enterprises (SOEs), and sovereign wealth funds (SWFs) ownership.

STRATI: Strategic individuals and families, measured as the percentage of shares of natural persons who are either the owner–managers or the members of a controlling family, or even the holders of blocks and family offices.

II: Institutional investors, measured as the percentage of shares of pension funds, insurance companies, mutual funds, and hedge funds.

FI: Measured as the percentage of shares of foreign investors' ownership.

We include also a set of control variables to prevent the potential bias of correlated omitted variables; notably:

MC: Market capitalization to GDP ratio [43]. The financial theory provides a link between market capitalization and the company's future profits. Within a given level of

risk, the larger the market capitalization can be, the higher the expected profits are, hence the company's ability to adopt a responsible attitude.

RL: rule of law index. Previous studies have found a long-term causal relationship between ownership structure behavior and the legal framework [75] as well as between environmental and economic growth and the rule of law index [76]. Compliance with institutional reforms seems to have an unequivocal effect on alignment with environmental standards. The rule of law has a negative effect on pollution. Thus, compliance with the rules is "a sine qua non" for controlling carbon emissions.

MVA: Manufacturing value added to GDP ratio. It is assumed that the growth of CO_2 emissions is greatly related to the added value of the manufacturing sector [77]. The manufacturing industry requires high energy consumption and carbon emission. That is why we assume that manufacturing value added to GDP ratio positively affects carbon emissions.

GDP: Gross domestic product. Economic activities are mainly responsible for climate change around the world, through the carbon emissions they generate [78]. Therefore, the relationship between GDP and carbon emission is assumed to be positive.

POP: Population size is also responsible for increased energy consumption and thus carbon emission [78]. The relationship is therefore assumed to be increasing between the population and carbon emission variables.

Finally, we introduce innovation as a moderating variable of the relationship between ownership structure and carbon emission. It is noted as **INNOV** and measured as the ratio of R&D expenditures per GDP. The literature points out that R&D is the main driver of innovation and that R&D expenditure and intensity are the two key indicators used to assess resources devoted to science and technology [79]. R&D intensity (R&D expenditure as a percentage of GDP) is used as an indicator of an economy's relative degree of investment in generating new knowledge [80]. Several countries have adopted targets for this indicator to help focus policy decisions and public funding.

3.3. Model

Consistent with the conceptual framework proposed in Section 2, the models estimated in this study include carbon emission as a function of ownership structure. Models estimated in this study include carbon emission as a function of ownership structure, innovation and control variables, and errors (Equation (1)). Unlike previous studies, this study estimated panel data models, which could be expressed mathematically as follows:

$$\mathbf{CO_{it}^2} = \mathbf{f}\left(\mathbf{Ownership\ structure_{it}}, \mathbf{Innovation_{it}}, \mathbf{Control\ Variables_{it}}\right) + \varepsilon_i \quad (1)$$

To isolate the impact of ownership by investor category, we begin with a regression without considering the interaction variable (Equation (1)), and then we separately integrate the interaction variable using the following model (Equation (2)):

$$\mathbf{CO_{it}^2} = \mathbf{f}\left(\mathbf{Ownership\ structure_{it}}, \mathbf{Innovation_{it}}, \mathbf{Ownership\ structure} * \mathbf{Innovation_{it}} + \mathbf{Control\ Variables_{it}}\right) + \varepsilon_i \quad (2)$$

Equations (1) and (2) are estimated in two ways. First, we perform a fixed-effect panel regression analysis to control the unobservable heterogeneity across units. We use fixed-effect regression rather than random-effect regression regarding the Hausman test, as specified in Table 1 (Prob > chi2 = 0.0005). Second, we applied robust standard errors in all models to capture any expected unobserved heteroscedasticity and autocorrelation in the sample [81].

Table 1. Hausman (1978) specification test.

	Coef.
Chi-square test value	31.448
p-value	0

3.4. Descriptive Statistics

Table 2 below displays descriptive statistics of studied variables. On average over the study period, CO_2 emission is about 12%, with a maximum of 30.7% and a minimum of 1.5%. Regarding the ownership structure, we note that foreign and public shareholders are minor, with ownerships averaging 0.7% and 2.4% of the sample equities, while strategic and institutional investors are the majority, with ownerships averaging 7.2% and 12% of the sample equities. The mean global variability in ownership structure proxies is about 8%, which reveals the sample data homogeneity. Pearson's pair-wise correlation matrix (Table 3) and VIF test confirm the absence of a significant correlation between variables.

Table 2. Descriptive statistics of variables.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
CO_2	192	0.12	0.067	0.015	0.307
STARTI	192	0.072	0.077	0	0.5
FI	192	0.007	0.031	0	0.236
PS	192	0.024	0.079	0	0.704
II	192	0.12	0.126	0	0.537
RD	192	0.834	0.847	0	4.94
MC	192	20.453	19.01	0	72.778
MVA	192	13.019	4.99	3.72	24.03
RL	192	0.183	0.651	−1.02	1.29
GDP	192	9.125	0.874	7.022	10.691
POP	192	15.144	2.584	7.057	18.789

Table 3. Correlation matrix of variables.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
(1) CO_2	1.000										
(2) STRATI	0.170	1.000									
(3) FI	−0.120	0.016	1.000								
(4) PS	−0.044	0.033	−0.026	1.000							
(5) II	−0.239	−0.137	−0.034	−0.083	1.000						
(6) INNOV	−0.120	−0.006	−0.064	−0.158	0.332	1.000					
(7) MC	−0.075	−0.077	−0.170	−0.018	0.578	0.537	1.000				
(8) MVA	0.040	0.188	0.274	−0.111	0.091	0.263	0.136	1.000			
(9) RL	−0.015	0.246	−0.245	−0.084	0.176	0.527	0.203	0.151	1.000		
(10) GDP	−0.117	0.070	−0.082	−0.178	0.332	0.615	0.270	0.086	0.775	1.000	
(11) POP	−0.117	0.023	0.066	0.061	−0.075	0.088	0.075	0.307	−0.301	−0.244	1.000

3.5. Empirical Results

We first present the effects of the regression of ownership structure variables on carbon emissions without integrating the moderating innovation variable (Model I), and then we extend the exploration by considering the moderating impact of innovation on relationships between public (Model II), strategic (Model III), institutional (Model IV), and foreign ownerships (Model V) and carbon emissions.

Results of regression of Model I (Table 3) show that the strategic investor and population variables are positive and significant, while innovation and GDP contribute significantly to reducing carbon emissions at 5% and 1%, respectively. These first results corroborate previous research's findings [78], except for GDP and strategic investors. Regarding population, our findings are consistent with the results of [82], who performed a

cost–benefit analysis of reducing carbon emissions by controlling population growth and showed that family planning could significantly reduce carbon emissions. Furthermore, the negative correlation between innovation and carbon emissions suggests that Research and Development expenditures in the study's sample SMEs are not allocated to heavy and non-green industries. On the contrary, it seems that the innovation adopted by the SMEs of the OECD countries is dedicated to ensuring a green transition and thus allows reducing carbon emissions. Surprisingly, we find a negative relationship between GDP and carbon emissions, which is not in line with anterior studies [80]. This result could be explained by the fact that countries with significant economic growth have a solid economic readiness and thus dispose of adaptation finance, which consolidates their means to reduce carbon emissions and face climate changes [83]. In addition, the weaker association and significance of the public sector to carbon emissions could indicate that the impact of the CSR measures takes time to materialize. States hold huge parts of firms operating in heavy industries, which cause the most pollution and consume the most energy (chemical, metallurgy, cement, automobile, etc.). Therefore, they should take time to adopt energy transition. Furthermore, the positive association between carbon emissions and strategic investors could be explained by the fact that reducing carbon emissions is coupled with an increase in environmental costs, which negatively affects short-term financial performance [8]. Additionally, strategic investors tend to compromise environmental policies to minimize agency costs [39]. While the adoption of a low-carbon policy is consistent with the corporate value maximization theory, it appears that strategic investors are more focused on profit than value maximization, which does not take into account business risks. Profit maximization focuses on short-term objectives and ignores long-term targets. As a result, it could lead strategic investors to adopt sub-optimal decisions, which would negatively affect shareholder wealth. The other owner types (public, foreign, and institutional) seem not to be concerned with carbon reduction. This result confirms the ambiguity of their position concerning the adoption of an energy transition policy [7,44].

In models II, III, IV, and V (Table 4), we test the moderating effect of innovation on ownership variables. Findings corroborate the significance of positive strategic investors and population effects on carbon emissions and confirm the absence of effects of institutional and foreign presences on carbon emissions. Regarding institutional investors, we explain this finding by the fact that their incentives are not always aligned. They have distinctive motivations and time horizons [4]. Reducing carbon emissions is coupled with an increase in environmental costs, which negatively affects short-term financial performance [8]. Some institutional investors are mainly interested in short-term performance, while others focus on long-term performance. Since the returns from CSR are expected to be realized mostly in the long run, some investors may be less supportive of corporate carbon reduction engagement. In the same way, we do not find a significant association between foreign ownership and firms 'carbon emissions, even with the introduction of innovation as an interaction variable. We explain this finding by the fact that foreign investment has mixed effects on carbon emissions according to the region [84]. This depends on the country's level of development. It could be insignificant for countries with high economic growth, increasing for countries with low economic growth, and decreasing for countries with lower average growth. Hence, the lack of a significant effect of foreign investors' presence on carbon emissions could be explained by our study sample diversity in terms of economic growth.

More interestingly, model II, which considers innovation as an interaction variable with public sector presence, highlights its significant impact on a firm's carbon emission. The findings indicate that the public sector coefficient is negative and significant at 5% and becomes significantly positive with the introduction of the moderating variable. This result is in line with previous findings [49]. Typically, governments are both the sources and key drivers of prospective climate change regulations. Governmental shareholders are playing a considerable role in implementing environmental policies to deal with climate change externalities [14,51,85]. Consequently, public companies are expected to enforce

these environmental policies and implement the necessary means to achieve climate goals. However, public companies' incentives to reduce carbon emissions are significantly altered by the introduction of innovation. It seems that public companies that invest in Research and Development remain primarily in search of economic advantages, competitiveness, and scale economies, letting social and environmental objectives fade into the background [8].

Table 4. Impact of ownership structure on carbon emissions and the moderating effect of innovation.

	Model I	***Model II***	***Model III***	***Model IV***	***Model V***
Variables					
PS	−0.0000 (0.932)	−0.0008 ** (0.016)	0.0001 (0.389)	−0.0000 (0.993)	−0.0000 (0.932)
STRATI	0.0004 ** (0.018)	0.0005 *** (0.006)	0.0003 (0.386)	0.0004 ** (0.017)	0.0004 ** (0.018)
II	−0.0000 (0.844)	−0.0001 (0.659)	−0.0000 (0.912)	0.0002 (0.703)	−0.0000 (0.844)
FI	0.0071 (0.173)	0.0010 (0.258)	0.0014 (0.149)	0.0014 (0.149)	0.0071 (0.173)
INNOV	−0.0305 ** (0.038)	−0.0430 *** (0.004)	−0.0338 ** (0.024)	−0.0313 ** (0.035)	−0.0305 ** (0.038)
MC	−0.0002 (0.458)	−0.0000 (0.921)	−0.0002 (0.567)	−0.0002 (0.491)	−0.0002 (0.458)
MVA	0.0026 (0.261)	0.0020 (0.366)	0.0019 (0.411)	0.0018 (0.413)	0.0026 (0.261)
RL	−0.0107 (0.687)	−0.0236 (0.376)	−0.0120 (0.567)	−0.0123 (0.647)	−0.0107 (0.687)
GDP	−0.0671 *** (0.000)	−0.0643 *** (0.000)	−0.0668 *** (0.000)	−0.0685 *** (0.000)	−0.0671 *** (0.000)
POP	0.0126 ** (0.010)	0.0113 (0.019) **	0.0132 *** (0.007)	0.0131 *** (0.008)	0.0126 *** (0.010)
Const.	0.5392 *** (0.000)	0.5497 *** (0.000)	0.5398 *** (0.000)	0.5530 *** (0.000)	0.5392 (0.000)
INNOV:PS	-	0.0029 *** (0.007)		-	-
INNOV:STRATI	-	-	0.0001 (0.727)	-	-
INNOV:II	-	-	-	−0.0000 (0.583)	-
INNOV: FI	-	-	-	-	−0.0086 (0.266)
Overall R2	0.393	0.417	0.388	0.389	0.393
Nb. Observations	192	192	192	192	192

Note. ***, ** denote significance at 1%, 5%, and 10%.

Table 5 below displays the robust standard errors regression results (Model VI without interaction term and Models VII, VIII, XI, and XX with interaction term for public sector, strategic, institutional, and foreign investors, respectively).

Table 5. Impact of ownership structure on carbon emissions and the moderating effect of innovation (robust standard errors).

	Model VI	***Model VII***	***Model VIII***	***Model IX***	***Model XX***
Variables					
PS	−0.0005 ** (0.022)	−0.0024 *** (0.002)	−0.0003 * (0.094)	−0.0005 ** (0.031)	−0.0006 ** (0.015)
STRATI	0.0012 * (0.082)	0.0012 ** (0.068)	0.0033 *** (0.000)	0.0012 * (0.084)	0.0012 * (0.091)
II	−00035 ** (0.022)	−0.0040 *** (0.000)	−0.0012 *** (0.007)	−0.0008 (0.213)	−0.0015 *** (0.000)
FI	−0.0035 *** (0.000)	−0.0047 *** (0.000)	−0.0021 *** (0.006)	−0.0035 *** (0.000)	−0.0222 ** (0.021)
INNOV	−0.005 *** (0.000)	−0.0061 *** (0.000)	−0.0052 *** (0.000)	−0.0054 *** (0.000)	−0.0057 *** (0.000)
MC	0.0004 (0.307)	0.0004 (0.380)	0.0006 (0.186)	0.0003 (0.485)	0.0004 (0.294)
MVA	0.0022 * (0.063)	0.0020 * (0.095)	−0.0001 (0.934)	0.0018 (0.196)	0.0021 * (0.072)
RL	−0.0095 (0.404)	−0.0220 * (0.057)	−0.0093 (0.396)	−0.0101 (0.381)	−0.0089 (0.429)
GDP	−0.0039 (0.617)	0.0055 (0.539)	−0.0144 * (0.076)	−0.0061 (0.463)	−0.0063 (0.417)
POP	−0.004 (0.648)	−0.0047 (0.606)	0.0183 ** (0.039)	0.0076 (0.741)	−0.0043 (0.632)
Const.	0.2221 *** (0.002)	0.1496 * (0.064)	0.3447 *** (0.000)	0.2372 *** (0.002)	0.2481 *** (0.001)
INNOV:PS	-	0.0072 ** (0.017)		-	-
INNOV:STRATI	-	-	0.0061 *** (0.000)	-	-
INNOV:II	-	-	-	−0.0004 (0.398)	-
INNOV: FI	-	-	-	-	0.0317 ** (0.049)
Overall R2	0.151	0.175	0.274	161	0.163
Nb. Observations	192	192	192	192	192

Note. ***, **, and * denote significance at 1%, 5%, and 10%.

Globally, findings remain the same. Obtained results corroborate the significant effect of strategic investors on enhancing carbon emissions, and they highlight significant favorable associations between public, institutional, and foreign investors and carbon transition. For strategic owners, reducing carbon emissions allows firms to improve their images within markets and to communicate their concerns about ecological laws, which reassures stakeholders. On the other hand, green transition gives companies legitimization through transparent disclosures of environmental information, including carbon emissions [53]. These effects are enhanced by innovative process implementation. It seems that innovation emphasizes their tendency to emit carbon. This finding is in line with [86], who highlight that family firms conduct less sustainable and social activities. For the other owner types (public, foreign, and institutional), it seems that the innovation process enables companies

to be more economically competitive and profitable, regardless of ecological concerns; thus, there is a positive moderating effect of innovation on these types of variables.

Moreover, findings highlight the favorable impact of rule of law index and GDP to ensure a green transition (Model VII). Carbon reduction policies are particularly effective in countries with a high rule of law index. This result is predictable in a context where climate change is affecting the survival of worldwide populations and where international authorities have called for the need to adopt socially responsible attitudes through laws and decrees. Thus, overall, it seems that SME owners are more motivated by environmental objectives than economic ones.

Overall, the obtained results allow us to accept hypotheses 1, 2, 3, and 5 and reject hypothesis 4. They show the significant positive association between strategic investors and carbon emissions as well as the negative effect of public, foreign, and institutional sectors. Moreover, the mixed moderating effect of innovation on ownership structure is also confirmed. Innovation enhances the positive impact of strategic investors' presence on low-carbon firms [52]. In contrast, innovation alters the positive effects of the presence of public and foreign investors on ensuring green transition. It seems that the latter invest in innovation to ensure economic benefits regardless of environmental objectives [8].

Limited by the data availability, our paper contains two major limitations. First, our study does not take into account the specific development of technologies or R&D investments in different sectors. Second, it does not consider the dynamic relationship between innovation and carbon dioxide reduction policies.

4. Conclusions, Implications, and Limitations

The shareholders' engagement in responsible investments has been of growing concern in the past few years. This paper first investigates the impact of ownership structure (public, foreign, institutional, and strategic investors) on carbon emission based on a sample of SMEs in 32 developed and developing countries during the 2015–2020 period and, second, focuses on innovation moderating effect on these relationships. Results provide evidence of a significant effect of ownership structure on carbon transition as well as the moderating effect of innovation on this relationship. Particularly, they reveal a significant positive association between strategic investors and carbon emissions as well as the favorable role of public, institutional, and foreign investors in ensuring green transition. In addition, it appears that innovation is further deteriorating the concerns of all types of investors regarding corporate environmental commitments. Moreover, findings highlight the favorable impact of rule of law index and GDP on ensuring a green transition.

Globally, our study has both theoretical and practical implications. From the theoretical standpoint, the obtained results establish the link between ownership structure and reducing carbon emissions of firms. According to value maximization and both agency and legitimacy theories, engaging in energetic transition reassures investors and ensures long-term financial performance. From a public policy perspective, our results highlight the importance of corporate governance in carbon emission engagement. This relationship is enhanced by adopting innovation and engaging in R&D expenditures. For its part, public ownership should be more accountable and ensure greater commitment to environmental goals, such as carbon reduction and social sustainability. Finally, the existence of auditors as a driver of carbon performance should also be supported by the authorities in place. It is up to senior management to solve environmental problems by putting in place legitimacy mechanisms based on concerted efforts from all partners in the company. In fact, pressure from stakeholders could gradually drive firms to take environmentally responsible actions. Hence, environmental innovation seems crucial to reduce financing costs and environmental risks as well as to enhance economic and financial long-term performance.

Author Contributions: Conceptualization and methodology N.B. and D.A.G.; software N.B.; validation, N.B. and D.A.G.; data curation, D.A.G.; writing—original draft preparation, N.B. and D.A.G.; writing—review and editing, N.B., Q.Z. and D.A.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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