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# Institutional investors and corporate environmental costs: The roles of investment horizon and investor origin

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## Abstract

Using an international data set that quantifies corporate environmental costs, we analyze the influence of institutional investor ownership, particularly investment horizon and investor origin, on the monetized environmental impact generated by their investee firms. Institutional investor ownership is negatively related to corporate environmental costs. This effect is driven by long-term foreign institutional investors, especially investors from advanced economies. Corporate environmental costs are negatively correlated with firm valuation and positively correlated with the cost of equity. Since corporate environmental costs are not reflected in environmental, social and governance

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Investor interest in climate risk has not waned during the pandemic. Businesses face a risk of losing access to cheaper capital if they are not doing enough on climate action.

Susan Lloyd-Hurwitz, CEO & Managing Director of Mirvac

United Nations Global Compact (2021)

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ratings, our results shed new light on the role of institutional investors in shaping corporate environmental impact.

**KEYWORDS**

corporate environmental costs, cost of equity, foreign investors, institutional investors, investment horizon, sustainability

**JEL CLASSIFICATION**

G32

## 1 | INTRODUCTION

Sustainability has become a mainstream concern in the corporate world. In 2021, the United Nations Global Compact (2021) interviewed 1232 chief executive officers (CEOs) in 113 countries across 21 industries. It reports that 72% of CEOs claim sustainability has become an immediate priority. Corporations have recognized the importance of sustainability, as it helps attract customers (Servaes & Tamayo, 2013), retain employees and differentiate from competitors (Ferrell et al., 2016; Kitzmueller & Shimshack, 2012). As Mirko Bibic, president and CEO of BCE & Bell, emphasizes in his interview, “[...] sustainability is a critical differentiator for a business. It will help [this corporation] recruit the top talent and attract capital from investors.”

The same survey reveals that one in three CEOs agrees that institutional investors are the most influential stakeholders for firms' future sustainability efforts. In a similar review, Stroebl and Wurgler (2021) show that academics and practitioners view institutional investors as the most powerful financial mechanism to induce corporate changes in response to climate risk exposure. Motivated by this prominent role, we examine the relationship between institutional investor ownership and corporate environmental costs, one of the most important aspects of firms' sustainability considerations. According to the United Nations (2001, p. 11), “environmental costs comprise both internal and external costs and relate to all costs occurred in relation to environmental damage and protection. Environmental protection costs include costs for prevention, disposal, planning, control, shifting actions and damage repair that can occur at companies and affect governments or people.” Therefore, while environmental costs do not directly affect firms' profits, they provide a measure of their negative environmental impact on society.

According to classical economic theory, firms should internalize the environmental costs they generate (Coase, 1960). However, in practice, it is challenging to establish a direct link between environmental impact and financial profits because resource prices are not necessarily reflected in production and disposal costs.<sup>1</sup> In our empirical analysis, we follow Freiberg et al. (2022) and measure environmental costs as the sum of input costs associated with waste generation, disposal and storage.

<sup>1</sup>One reason for this price mismatch is the existence of government regulations and subsidies. For example, consider the price of water. In most geographic areas, there is little correlation between water prices, availability and production costs (Bernick et al., 2017). Governments distort water prices for various reasons, including political and economic, and thus firms are not required to pay for the actual cost of water production.

In contrast to financial cost indicators, environmental cost accounting aims to reflect corporations' sustainability efforts. Corporate environmental costs measure the actual (monetized) costs to society, such as resource availability and production fees, which are not reflected in traditional financial accounts (Joshi et al., 2001), enabling firms and investors to arrive at sustainable investment decisions in the first place (Gren, 2003). The International Federation of Accountants (2005) further notes that environmental cost accounting helps firms reduce the environmental impact of all types of waste and emissions. Overall, knowing and measuring a firm's environmental costs provide a foundation for the pathway to "net zero."

There is mounting empirical evidence that institutional investor ownership in general, and institutional investor engagement in particular, affect firms' activities related to environmental, social and governance (ESG) issues (see Gillan et al. (2021) for a comprehensive review of the literature). For example, Azar et al. (2021) find a strong negative association between "Big Three" ownership and subsequent carbon emissions among mid- and small-cap indexes constituents. However, little is known about how institutional investors, particularly their investment horizon and country of origin, affect corporate environmental costs. Given that environmental costs exhibit only a moderate correlation with conventional environmental ratings across firms and industries and no correlation across firms within industries (Freiberg et al., 2022), analyzing the impact of institutional investors on corporate environmental costs is an important research gap in the sustainable finance literature.

We estimate regression models based on monetized environmental impact data from Freiberg et al. (2022) to examine the relationship between corporate environmental costs and institutional investor ownership. Our international sample covers 42 countries from 12 industries over the period 2010–2018. Controlling for a large set of firm- and country-level characteristics that affect firms' environmental intensity, our baseline model provides evidence that institutional investor ownership is negatively related to firms' environmental costs.

To explore heterogeneity across different types of institutional investors, we start by focusing on institutional investment horizons. Our results indicate that the negative relationship between institutional ownership and corporate environmental costs is predominantly driven by long-term institutional investors. Long-term investors serve as natural monitors because they hold shares long enough to realize the benefits of active engagement (see McCahery et al., 2016, for a survey of this literature). In contrast, we find no reliable association between short-term institutional ownership and corporate environmental costs.

Investor origin is another relevant dimension for analyzing the effect of institutional ownership on firm outcomes. In line with a growing strand of the literature (Aggarwal et al., 2011; Brockman et al., 2023; Cumming et al., 2017; Ferreira & Matos, 2008), our results indicate that foreign institutional investors are driving the negative and statistically significant relation between total institutional ownership and corporate environmental costs. As expected, testing the combined effect of investment horizon and investor origin, we find that the negative link between institutional ownership and corporate environmental costs is mainly driven by the subgroup of long-term foreign institutional investors.

Next, we investigate cross-country variation in the effect of foreign institutional ownership on corporate environmental costs. We suggest that some degree of substitutability exists between outside corporate governance (i.e., the quality of country-level governance rules) and insider corporate governance (i.e., institutional investor ownership). Consistent with this substitution argument, our results indicate that the negative impact of foreign institutional ownership on corporate environmental costs is stronger in emerging economies, such as the BRICS countries (Brazil, Russia, India, China and South Africa). These countries suffer from

weaker corporate governance, poor environmental regulation and lack of external oversight. In contrast, the effect is much less pronounced in G7 countries, which have higher corporate governance and regulation standards.<sup>2</sup>

Analyzing the role of investor origin, we further find that observed cost effect is mainly driven by foreign institutional investors originating from advanced economies, where both the public perception and the regulatory framework put a stronger focus on environmental dimensions. As a result, institutional investors from advanced economies may possess greater expertise in managing environmental risks and can better pressure firms to reduce their environmental costs. More generally, this group of investors seems to transfer higher environmental norms from their home countries to their investee firms.

While our results indicate a negative relation between (foreign) institutional investor ownership and corporate environmental costs, establishing direct causation is challenging because firms are not assigned to institutional investors randomly. First, prior research documents that institutional investors prefer to invest in less opaque firms (Yu & Wahid, 2014). Because our sample is restricted to firms with environmental cost data, sample selection may be problematic in our analyses. As a result, firms that are more likely to attract institutional investors may be overrepresented in our data set. To mitigate potential estimation biases, we implement a Heckman selection correction. Our main results continue to hold.

Second, to address a potential omitted variables bias, we test various fixed effect specifications. Third, we consider two alternative measures of firms' environmental costs by using different assumptions for the discount rate and missing observations. We also test our hypotheses by using alternative environmental cost data from Trucost. To avoid the possibility that large countries drive our results, we run a weighted least squares (WLS) regression as well as a regression based on non-US and non-Japan samples. These robustness tests all confirm that increased (foreign) institutional ownership is related to lower corporate environmental costs.

Finally, we test the financial benefits and valuation implications of firms' environmental costs. We use the market-to-book ratio and the cost of equity as dependent variables. If environmental considerations are material, we expect a negative (positive) relation between corporate environmental costs and the market-to-book ratio (cost of equity). Our empirical results corroborate this conjecture, that is, corporate environmental costs are negatively correlated with the market-to-book ratio, and positively correlated with cost of equity measures.

Collectively, our evidence demonstrates a reliable link between institutional ownership and corporate environmental costs. We contribute to the literature in four key ways. First, using a novel measure of firms' environmental impact, we add to research on the environmental consequences of business operations. While prior literature uses ESG scores as a proxy for corporate environmental policies (Fernando et al., 2017; Hwang et al., 2021), our focus is on firms' actual (negative) impact on society. Environmental cost measures are not subject to concerns about measurement errors generated by the preferences of rating agencies (see Berg et al., 2022, for more information about the measurement errors of ESG scores). Our analysis uses monetized environmental costs data computed and made publicly available by Freiberg et al. (2022). An additional advantage of using these data is that environmental costs capture resource scarcity and production costs that are not correctly reflected in traditional financial accounts or conventional ESG scores.

<sup>2</sup>The G7 countries include Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

Second, we identify institutional ownership as a determinant of corporate environmental costs. By examining different types of institutional investors, we analyze the heterogeneous effects of various investor groups. Our findings suggest that the effects of institutional investors on environmental costs are driven by long-term foreign investors, particularly investors originating from advanced economies. We contribute to the literature by showing that investors' horizon (Chen et al., 2007; Döring et al., 2021; Driss et al., 2021; Faure-Grimaud & Gromb, 2004; Gaspar et al., 2005) and origin (Aggarwal et al., 2011; Bena et al., 2017; Brockman et al., 2023; Döring et al., 2023; Ferreira & Matos, 2008) play important roles in determining firms' impact on society.

Third, our analysis contributes to the literature on how ESG behavior affects firms' financing costs and valuation (Chava, 2014; Deng et al., 2013; El Ghouli et al., 2011, 2017, 2018; Matsumura et al., 2014; Servaes & Tamayo, 2013). We document that lower environmental costs are associated with higher firm valuation, and this effect is driven, at least in part, by a discount rate (cost of equity) effect.<sup>3</sup> This has implications for institutional investors, who benefit from incorporating environmental considerations into their engagement strategies.

Fourth, our work is related to studies on climate impact investing. The idea is that negative screening leads to a higher (lower) cost of capital for firms with poor (strong) environmental performance. The magnitude of this effect depends on the proportion of environmentally conscious investors in the market (Fama & French, 2007; Heinkel et al., 2001). Berk and Van Binsbergen (2022) and De Angelis et al. (2022) conclude that the impact of a divestiture strategy on the cost of capital is too small to affect real investment decisions meaningfully. Our results support this conclusion. Instead of divesting, environmentally-conscious investors with long investment horizons should exercise their control rights and actively induce changes in firm policies, for example, consider resource scarcity in all corporate activities and minimize monetized environmental costs.

## 2 | HYPOTHESIS DEVELOPMENT

The classical view holds that investors focus solely on financial performance and pay no attention to other responsibilities, such as environmental considerations, as long as the firm conforms to the law and the rules embodied in ethical custom (Friedman, 1970). In the worst case, according to this Friedman doctrine, firms may even pollute the environment *more* in pursuing the primary objective of firm value maximization. Supporting this notion, Borghesi et al. (2014) document that firms with large institutional ownership are less likely to invest in activities positively related to environmental issues. Krüger (2015) shows that investors react negatively to positive events surrounding a firm's ESG responsibility. In contrast, Gillan et al. (2010) find no relation between institutional ownership and firms' ESG-related behaviors. Therefore, one hypothesis on the relationship between corporate environmental costs and institutional ownership is:

<sup>3</sup>We cannot rule out alternative explanations for the value effect, such as increasing cash flows, for example, customers wishing to buy products from firms with low environmental costs, or maximizing shareholder welfare, for example, investors have nonpecuniary preferences reflected in their utility functions. Gillan et al. (2021) provide a review of studies that examine the relationship between firms' ESG attributes and firm performance.

**Hypothesis 1a.** Corporate environmental costs are uncorrelated or increase with increasing institutional ownership.

Beyond this narrow view, however, the literature discusses various arguments that can explain why institutional investors are concerned with corporate environmental costs. Other than purely altruistic reasons, at least two reasons exist for why a higher level of institutional ownership *reduces* firms' environmental costs.

The first argument holds that incorporating environmental considerations into the investment process mitigates uncompensated portfolio risks, such as supply chain, product and technology, litigation, reputational and physical risks. Insurance against these risks is a crucial driver of shareholder engagement (Bolton & Kacperczyk, 2021; Griffin et al., 2017; Jagannathan et al., 2018; Matsumura et al., 2014). In addition, environmentally responsible behavior may reduce the risk of regulatory or legislative actions against the firm.

Several empirical studies support this view. Avoiding irresponsible corporate behavior reduces the possibility of downside risk that negatively impacts revenues (Lins et al., 2017; Nofsinger et al., 2019; Sharfman & Fernando, 2008). Lowering environmental costs can also reduce the likelihood of unexpected expenses, such as cleanup costs and compensation fees (El Ghoul et al., 2018). For example, Dyck et al. (2019) explore the 2010 BP Deepwater Horizon oil spill, which led to significant compensation costs for BP. Moreover, firms most reliant on fossil energy are more exposed to technology risk from lower-cost renewable energy. This creates the problem of "stranded" assets and an increase in the "cost of doing business" (Litterman, 2016).

Krueger et al. (2020) document that firms with negative environmental impact tend to have higher regulatory risk, which results in revenue loss and greater stock price volatility. Ilhan et al. (2021) show that the cost of hedging against downside-tail risks is higher for firms with more carbon-intense business models. Some studies even argue that climate risk is a systematic risk factor, and find that investors demand compensation for exposure to environment-related risks (Bolton & Kacperczyk, 2021). Pástor et al.'s (2021) asset pricing model is based purely on investors' tastes for holding sustainable firms. In the model's equilibrium, environmentally responsible firms benefit from a lower cost of capital because some investors prefer holding sustainable firms, and they hedge against climate risk. In turn, the resulting negative risk premium implies that investors require a higher cost of capital for firms with higher environmental costs.<sup>4</sup>

The second argument is related to social pressure and reputation effects. Firms with deficient environment-related activities suffer from a poor reputation, which can lead to consumer boycotts and employee backlash (Benabou & Tirole, 2010; Houston & Shan, 2022). In contrast, firms with positive environment-related activities enhance customer loyalty, which grants them greater pricing power and reduces risk (Albuquerque et al., 2019). These "good" firms are better able to differentiate themselves from "bad" firms, signaling their willingness to cope with externalities generated in the process of pursuing profit maximization (Liang & Renneboog, 2017).

Shareholders and lenders may also face reputational risks from an association with polluting firms (Chava, 2014) and sin stocks, that is, alcohol, tobacco and gaming firms (Hong & Kacperczyk, 2009). If investors react by screening and avoiding these firms, lower risk

<sup>4</sup>Similarly, lenders and bond investors perceive firms with better environmental activities as creditworthy borrowers with low risks. Hasan et al. (2017) document that these firms enjoy looser nonprice loan terms and lower bond spreads.



sharing increases firms' cost of equity capital (Heinkel et al., 2001). Moreover, fear of reputation risk may incentivize investors to intervene in firms' decisions beforehand (Houston & Shan, 2022).

On the basis of these arguments, institutional investors should have strong incentives to monitor and actively influence corporate environmental costs. Survey data in Krueger et al. (2020) support this view. Around 30% of responding institutional investors submit shareholder proposals on environmental issues. Flammer (2015) shows that adopting close-call environment-related shareholder proposals delivers positive announcement returns. Moreover, firms with institutional shareholders that actively care about environmental issues benefit from lower downside risk (Hoepner et al., 2022). Conversely, when institutional investors are distracted, firms may endorse lax environmental policies (Chen et al., 2020). Overall, an alternative hypothesis holds that firms with a higher fraction of institutional ownership exhibit lower environmental costs:

**Hypothesis 1b.** Corporate environmental costs decrease with increasing institutional ownership.

One way investors can exert influence over a firm is to exercise their “voice,” that is, to actively engage in firm operations (Hirschman, 1970). Long-term investors specialize in monitoring and are better equipped to intervene in firms' decision-making processes at a lower cost (Attig et al., 2012, 2013; Chen et al., 2007; McCahery et al., 2016). Long-term investors know more about the firm, have better access to top management (Ramalingegowda & Yu, 2012), and remain invested long enough to capture the benefits of effectively managing environment-related risks (Deng et al., 2013). Accordingly, long-term institutional ownership is positively related to firms' ESG ratings (Gloßner, 2019; Kim, Kim, et al., 2019; Starks et al., 2023).

On the basis of survey data, Krueger et al. (2020) demonstrate that long-term investors are more concerned about environmental dimensions. They are also more likely to engage in firms' operations and manage environmental risks rather than divest. Similarly, Flammer et al. (2021) confirm that long-term institutional investors' environmental activism increases the voluntary disclosure of climate change risks. We propose that long-term institutional investors have incentives to reduce a firm's negative environmental impact (and related costs). Therefore, our second hypothesis is:

**Hypothesis 2.** Corporate environmental costs decrease with increasing long-term institutional ownership.

Another way institutional investors can influence corporate decisions is to “vote with their feet” (Admati & Pfleiderer, 2009). Short-term institutional investors' exit can exert downward pressure on the share price, penalizing managers ex post by reducing the value of their stock-based compensation. Whether short-term investors also bring about pernicious short-termism that damages the environment, the climate and other stakeholders remains controversial in the literature. For example, survey evidence from McCahery et al. (2016) suggests that short-term institutional investors are less likely to invest in extensive monitoring and information collection. In contrast, Roe et al. (2020) argue that the holding period of a shareholder is critically different from her time horizon. In other words, short-term selling can be triggered by long-term information about the firm. For instance, in situations when the firm, based on its intangible assets and beyond the mere earnings numbers, jeopardizes its long-term future,



short-term selling needs not induce managerial short-termist behavior (Edmans, 2017). On the contrary, it may even discipline managers through “governance by (threat of) exit” (Edmans, 2009). Overall, whether short-term investors care about the risks associated with environmental costs remains an empirical question, and we test two competing hypotheses:

**Hypothesis 3a.** Corporate environmental costs increase with increasing short-term institutional ownership.

**Hypothesis 3b.** Corporate environmental costs decrease with increasing short-term institutional ownership.

Another strand of corporate governance research examines how the origin of investors influences corporate control and corporate policies (Aggarwal et al., 2011; Aguilera et al., 2017; Bena et al., 2017; Brockman et al., 2023; Cumming et al., 2017; Ferreira & Matos, 2008; Kim, Wan, et al., 2019). These studies suggest that foreign shareholders export their home-country governance practices to host countries, that is, they are the channel through which domestic governance policies and environmental perceptions become internationally mobile. Two arguments help explain foreign institutional investors' incentives toward active monitoring and engagement.<sup>5</sup>

First, Kang and Kim (2010) and Bell et al. (2012) suggest that institutional and cultural distance increases the cost of active engagement for foreign institutional investors. Therefore, they have stronger incentives to reduce information asymmetry relative to their domestic peers by promoting corporate transparency through formal channels, for example, by increasing the quality of financial and environmental disclosure (Döring et al., 2023; Fang et al., 2015; Lel, 2019).<sup>6</sup> Second, Lel (2019) argues that foreign investors are less tolerant of incumbent management because they must comply with home- and host-country regulations. Without close ties to local firms, this group of investors can actively promote corporate governance and policy changes (Aggarwal et al., 2011; Chen et al., 2007; Ferreira & Matos, 2008). Overall, foreign institutional investors are in a privileged position to play an active role in bringing down a firm's negative environmental impact.<sup>7</sup> Our hypothesis related to investor origin is:<sup>8</sup>

<sup>5</sup>These arguments contradict a more negative view about the role of foreign investors. For example, foreign investors could engage in some kind of environmental regulatory arbitrage, that is, actively intervene to bring down environmental costs at home, but, in search for higher financial performance, ignore if their foreign investee firms fail to improve environmental intensity. However, our empirical results do not support this alternative view.

<sup>6</sup>Firms have incentives to acquiesce to such demands because lower information asymmetry helps them broaden their investor base and lower their cost of capital.

<sup>7</sup>In a more general context, earlier studies show that foreign institutional investors promote better corporate governance and improve firm performance (Aggarwal et al., 2011; Döring et al., 2021; Ferreira & Matos, 2008), constrain opportunism by promoting long-term investments (Bena et al., 2017), and are associated with higher investment efficiency (Chen et al., 2007; Luong et al., 2017) as well as a higher stock price informativeness (Kacperczyk et al., 2021).

<sup>8</sup>Many of our arguments related to institutional investors in general also apply to domestic investors. For example, it is reasonable to assume that domestic institutional investors will be subjected to greater pressure than foreign investors, both from a social and reputational standpoint. For example, using US industrial facility-level data, Kim, Wan et al. (2019) find that local institutional ownership is negatively related to toxic releases. At the same time, however, domestic institutional investors are less independent on firm managers compared with their foreign peers because they are more likely to have business ties with their investee firms, which makes it more difficult for them to take an active stance in promoting changes or opposing value-destroying managerial decisions (Davis & Kim, 2007). Therefore, we do not develop a separate hypothesis related to domestic institutional investors but include domestic institutional ownership as a control variable in all our regressions.

**Hypothesis 4.** Corporate environmental costs decrease with increasing foreign institutional ownership.

To better understand the impact of foreign institutional investors on corporate environmental costs, we examine the effect of foreign institutional investors across different countries. In particular, we test two propositions directly connected to Hypothesis 4. First, a substitution view argues that there is some form of substitutability between the quality of local corporate governance and the corporate governance activities of foreign institutional investors (Deng et al., 2018; Ferreira et al., 2010). For example, Fang et al. (2015) show that foreign institutional investors play a less important role in countries with strong regulatory and monitoring environments in connection with the international convergence of financial reporting practices. Döring et al. (2023) find that foreign institutional ownership, particularly from civil law countries, is positively correlated with the quality of firms' emissions disclosure.<sup>9</sup> This effect is most pronounced in firms from nonclimate-sensitized countries, where the gap between firms' environmental standards and investors' environmental targets is larger. On the basis of this notion, we argue that the effect of foreign institutional investors on corporate environmental costs will be stronger in firms located in less developed countries, which are more likely to suffer from weaker corporate governance practices, poor environmental regulation, and lack of external oversight.

Second, we divide total foreign institutional ownership according to investors' origin into foreign institutional investors from advanced (or high-income) versus developing (or low- and middle-income) economies. Earlier literature argues that investors from communities or countries with a better understanding of environmental risks can exert a stronger influence on firms' environmental policies (Dyck et al., 2019; Liang & Renneboog, 2017). We expect that investors from advanced economies have a stronger sensitivity to environmental dimensions and the related risks, and thus are better in forcing firms to reduce environmental costs. In other words, due to their higher experience in managing firms' environmental costs in their home countries, any cost effect should be driven by foreign institutional investors from advanced economies.

### 3 | SAMPLE AND VARIABLE CONSTRUCTION

#### 3.1 | Sample construction

We obtain financial data from Compustat Global over the period 2010–2018. Data on corporate environmental costs come from Freiberg et al. (2022). Their data include two aspects of a firm's operational activities: total emissions and water usage. In particular, they capture four emission variables—total greenhouse gas emissions (GHG total), nitrogen oxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>) and volatile organic compounds—and two water usage variables (water withdrawal and water discharge). Total GHG emissions include total scope 1 emissions (direct emissions) and total scope 2 emissions (indirect emissions). Firm-level emissions and water usage data are originally from Bloomberg and Thomson Reuters.

<sup>9</sup>For related studies on the quality of firms' emissions disclosure, see Barg et al. (2023a, 2023b).

We restrict our sample to firm-year observations with available data for environmental costs and institutional ownership. We further limit the sample to countries with at least 10 firm-year observations to mitigate the concern that our results may be distorted by small countries (e.g., the Cayman Islands and Bermuda).<sup>10</sup> Our final sample for the empirical analyses comprises 9397 firm-year observations over the 2010–2018 period.

### 3.2 | Environmental costs ratio

Corporate environmental costs capture a firm's environmental impact from business operations. They are computed as the sum of emissions volume and net water consumption, multiplied by monetary coefficients. The Environmental Priority Strategies database provides a publicly available methodology to transform the direct results of a firm's operations, or output such as emissions, into their impacts. These impacts are referred to as “safeguard subjects” (Steen & Palander, 2016), which relate to the multiple resources considered critical for human health and well-being. In addition, the database provides monetary coefficients that allow for a transformation of impacts into monetary values, for example, \$/kg emission.

Water monetary coefficients come from the Availability Water REMaining (AWARE) model (Lee et al., 2018). Local water scarcity varies significantly based on human needs and agricultural and industrial activities. Water monetary coefficients are the product of (1) the AWARE factors and (2) average water prices. AWARE factors are commonly used in the literature to measure the effect of water scarcity (see Freiberg et al., 2022, for more details). Average water price data come from the Waterfund data set. It captures the hidden economic costs of water, such as water production, delivery and wastewater treatment, which are often not fully reflected in the actual price firms pay for water (e.g., due to governmental regulations and subsidies).

Our test variable is the environmental costs ratio (EC), defined as corporate environmental costs scaled by operating income. Table 1 presents the mean environmental costs ratio by country, industry and year. Industries are defined based on the Fama–French 12-industry classification. On average, as shown in Panel A, firms from Indonesia exhibit the highest average environmental costs ratio, at 10.38, indicating that the environmental costs incurred by these firms significantly exceed the financial profits they generate. Generally, firms from emerging economies, such as Columbia, India, Russia and Thailand, exhibit high environmental costs ratios. Although the average ratios tend to be much lower in developed economies, there is also notable heterogeneity within this group of countries. For example, the average cost ratio in Japan (0.56) is only half of that in the United States (1.04). Panel B shows that financials (utilities) exhibit the lowest (highest) environmental costs, with ratios of 3% and 5.37%, respectively. The average environmental costs ratio increased slightly from 91% in 2010 to 106% in 2018 (Panel C).

<sup>10</sup>We find that our results remain qualitatively similar when we include all countries in the sample even if their number of observations is below this threshold.

**TABLE 1** Environmental costs by country, industry and year.

This table reports the mean corporate environmental costs ratio by country, industry (according to the Fama and French 12 industries classification) and year based on data from Freiberg et al. (2022). A firm's environmental costs are defined as the ratio of environmental costs to operating income and winsorized at the 1% level.

<i>Panel A: Environmental costs ratio by country</i>					
Country	N	Mean	Country	N	Mean
Australia	298	1.22	Malaysia	73	2.41
Austria	65	0.66	Mexico	84	0.89
Belgium	29	0.74	The Netherlands	130	0.36
Brazil	88	0.42	New Zealand	35	0.36
Canada	276	1.72	Norway	65	0.36
Chile	11	2.76	Philippines	38	1.16
China	105	1.86	Poland	27	3.46
Colombia	25	4.27	Portugal	40	0.77
Denmark	20	0.51	Russia	41	3.93
Finland	118	0.50	Saudi Arabia	10	1.45
France	392	0.59	Singapore	53	1.69
Germany	218	0.98	South Africa	295	1.46
Greece	28	8.86	Spain	128	1.57
Hong Kong	164	1.77	Sri Lanka	16	0.57
India	197	4.26	Sweden	182	0.26
Indonesia	19	10.38	Switzerland	189	0.62
Ireland	24	0.26	Taiwan	761	1.17
Israel	12	0.31	Thailand	70	4.72
Italy	79	1.58	Turkey	41	1.57
Japan	1871	0.56	The United Kingdom	1001	0.35
Korea	324	1.26	The United States	1755	1.04
<i>Panel B: Environmental costs ratio by industry</i>			<i>Panel C: Environmental costs ratio by year</i>		
Industry	N	Mean	Year	N	Mean
Consumer nondurables	803	0.67	2010	740	0.91
Consumer durables	428	0.24	2011	828	1.03
Manufacturing	1550	1.45	2012	950	1.10
Energy	327	1.20	2013	1033	1.13
Chemicals	735	1.34	2014	1049	1.05
Business equipment	1294	0.24	2015	1101	1.12

(Continues)

TABLE 1 (Continued)

<i>Panel B: Environmental costs ratio by industry</i>			<i>Panel C: Environmental costs ratio by year</i>		
Industry	N	Mean	Year	N	Mean
Telephone	488	0.21	2016	1201	1.05
Utilities	545	5.37	2017	1251	1.06
Wholesale	854	0.40	2018	1244	1.05
Health	458	0.24			
Finance	210	0.03			
Other	1699	1.13			

### 3.3 | Institutional ownership

Institutional investor ownership data come from the FactSet 13F (the United States) and international funds (non-US) databases. The variable *IO* captures total institutional ownership (in percent). To explore heterogeneity across investors with different investment horizons, we follow Döring et al. (2021) and split investors into long-term (*LTIO*) and short-term (*STIO*) investors based on churn rates (defined as the fraction of an investor's portfolio holdings bought or sold over a given year). We then classify institutional investors as long-term (short-term) if their average churn rate is in the bottom (top) tercile of all institutional investors in our sample. We further distinguish between foreign (*IO\_frgn*) and domestic (*IO\_dom*) investors. Finally, we disentangle foreign investors from advanced (*FIO\_adv\_econ*) and developing economies (*FIO\_dev\_econ*). On the basis of investment horizon (churn rate) and investor origin, we classify institutional investor ownership into four categories: long-term institutional ownership held by foreign investors (*LTIO\_frgn*), long-term institutional ownership held by domestic investors (*LTIO\_dom*), short-term institutional ownership held by foreign investors (*STIO\_frgn*) and short-term institutional ownership held by domestic investors (*STIO\_dom*).

### 3.4 | Summary statistics

Panel A of Table 2 shows summary statistics for environmental costs ratios, institutional ownership and control variables. The mean (median) environmental costs ratio is 2.18 (0.16), indicating strong skewness. We use the logarithm of the environmental costs ratio (*Ln EC*) in our analyses to attenuate this issue.<sup>11</sup>

Average institutional ownership (*IO*) is 27% in our sample. Long-term institutional ownership dominates short-term institutional ownership; the means of *LTIO* and *STIO* are 16% and 2%, respectively. Moreover, the means of domestic (*IO\_dom*) and foreign (*IO\_frgn*) institutional ownership are 17% and 10%, respectively. Foreign institutional ownership comes predominantly from advanced economies (*FIO\_adv\_econ*).

<sup>11</sup>We only retain observations with positive operating income. In robustness tests, we further consider alternative measures of environmental costs, using alternative assumptions and a different data set (see Section 4.3.3). Moreover, in unreported results, we scale environmental costs by sales. All our results remain qualitatively unchanged.

**TABLE 2** Descriptive statistics and subsample analyses.

Panel A reports summary statistics (number of observations, mean, standard deviation, minimum, median and maximum) of the variables used in our regression analysis. Panel B reports the means of *Ln EC*, Freiberg et al.'s (2022) measure of corporate environmental costs calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details) for subgroups of firms based on their ownership characteristics. Medians of the ownership categories are used to define the high and low institutional ownership subsamples: institutional ownership (*IO*), long-term institutional ownership (*LTIO*), short-term institutional ownership (*STIO*), foreign institutional ownership (*IO\_frgn*) and domestic institutional ownership (*IO\_dom*), long-term foreign institutional ownership (*LTIO\_frgn*), long-term domestic institutional ownership (*LTIO\_dom*), short-term foreign institutional ownership (*STIO\_frgn*) and short-term domestic institutional ownership (*STIO\_dom*). The *p* values refer to statistical tests for differences in means. The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1.

<b>Panel A: Descriptive statistics</b>						
	<b><i>N</i></b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Median</b>	<b>Max</b>
<i>EC</i>	9397	2.18	32.20	0.00	0.16	2606.85
<i>Ln EC</i>	9397	−1.53	1.70	−9.05	−1.80	7.87
<i>Ln EC_discount</i>	9391	−2.24	1.61	−5.29	−2.60	6.85
<i>Ln EC_adj</i>	9397	−1.56	1.70	−6.18	−1.83	7.87
<i>Ln EC_Trucost</i>	8423	−2.81	1.52	−4.60	−3.06	4.51
<i>IO</i>	9397	0.27	0.26	0.00	0.16	1.00
<i>LTIO</i>	9397	0.16	0.17	0.00	0.09	0.81
<i>STIO</i>	9397	0.02	0.03	0.00	0.01	0.52
<i>IO_dom</i>	9397	0.17	0.25	0.00	0.04	0.98
<i>IO_frgn</i>	9397	0.10	0.08	0.00	0.08	0.83
<i>LTIO_frgn</i>	8129	0.05	0.04	0.00	0.04	0.50
<i>LTIO_dom</i>	8129	0.10	0.17	0.00	0.02	0.76
<i>STIO_frgn</i>	8129	0.01	0.01	0.00	0.00	0.31
<i>STIO_dom</i>	8129	0.02	0.03	0.00	0.00	0.39
<i>FIO_adv_econ</i>	8129	0.10	0.08	0.00	0.08	0.86
<i>FIO_dev_econ</i>	8129	0.00	0.00	0.00	0.00	0.17
<i>BRICS</i>	9397	0.08	0.27	0.00	0.00	1.00
<i>G7</i>	9397	0.60	0.49	0.00	1.00	1.00
<i>Nonhigh income</i>	9397	0.11	0.32	0.00	0.00	1.00
<i>Ln MTB</i>	9270	0.39	0.47	−0.96	0.28	4.37
<i>COE</i>	8949	0.11	0.05	0.02	0.10	0.92
<i>KMPEG</i>	8674	0.13	0.10	0.00	0.11	1.00
<i>KOJN</i>	7539	0.12	0.05	0.02	0.11	0.73
<i>KCT</i>	8150	0.10	0.05	0.00	0.09	0.91

(Continues)

TABLE 2 (Continued)

<b>Panel A: Descriptive statistics</b>						
	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Median</b>	<b>Max</b>
<i>KGLS</i>	8835	0.09	0.04	0.00	0.08	0.92
<i>Size</i>	9397	8.76	1.59	3.98	8.71	14.76
<i>Capital expenditures</i>	9397	0.05	0.04	0.00	0.04	0.39
<i>Dividends</i>	9397	0.03	0.04	0.00	0.02	0.73
<i>Leverage</i>	9397	0.24	0.16	0.00	0.23	2.38
<i>ROA</i>	9397	0.13	0.10	−0.33	0.12	2.83
<i>R&amp;D</i>	9397	0.02	0.03	−0.02	0.00	0.41
<i>LnGDPpercap</i>	9397	10.43	0.75	7.00	10.65	11.62
<i>BETA</i>	8912	0.80	1.11	−9.88	0.77	14.81
<i>Dispersion</i>	8776	0.00	0.03	0.00	0.00	2.62
<i>Forecast_bias</i>	8230	0.00	0.30	−25.62	0.00	1.83
<i>Inflation</i>	8721	0.02	0.02	0.00	0.02	0.33
<b>Panel B: Subsample analyses</b>						
	<b>Low</b>		<b>High</b>		<b>Difference</b>	<b>p value</b>
	<b>N</b>	<b>Mean(Ln EC)</b>	<b>N</b>	<b>Mean(Ln EC)</b>		
<i>IO</i>	4699	−1.21	4698	−1.84	0.64	0.000
<i>LTIO</i>	4699	−1.23	4698	−1.82	0.59	0.000
<i>STIO</i>	4699	−1.32	4698	−1.73	0.41	0.000
<i>IO_frgn</i>	4699	−1.25	4698	−1.80	0.56	0.000
<i>IO_dom</i>	4699	−1.26	4698	−1.80	0.54	0.000
<i>LTIO_frgn</i>	4065	−2.07	4058	−2.43	0.35	0.000
<i>LTIO_dom</i>	4062	−1.98	4061	−2.52	0.55	0.000
<i>STIO_frgn</i>	4062	−2.04	4061	−2.46	0.41	0.000
<i>STIO_dom</i>	4063	−2.08	4060	−2.42	0.34	0.000

Panel B of Table 2 provides the means of *Ln EC* for different subgroups based on ownership characteristics, using the median of each category to categorize the high and low institutional ownership subsamples. We also report differences in means between the low and high ownership subgroups. As expected and providing preliminary support for our main hypothesis, average environmental costs ratios are lower when institutional investor ownership is high. Similar results hold for the other more granular institutional ownership classifications (*LTIO*, *STIO*, *IO\_frgn*, *IO\_dom*, *LTIO\_frgn*, *LTIO\_dom*, *STIO\_frgn* and *STIO\_dom*). For example, based on the average *EC* values, corporate environmental costs are higher in the low-*LTIO* subsample than in the high-*LTIO* subsample (with logarithmic values of −1.23 and −1.82, respectively).



## 4 | EMPIRICAL RESULTS

### 4.1 | Baseline regression analysis

We begin our analysis of the relation between corporate environmental costs and institutional investor ownership by estimating the following baseline regression model:

$$\ln EC = \alpha + \beta \times IO + Controls + FE + \varepsilon. \quad (1)$$

Subscripts are omitted for parsimony. We estimate Equation (1) using ordinary least squares panel regressions, controlling for year, industry and country fixed effects. We cluster standard errors at the firm level.

Our models control for a wide range of firm and country characteristics that may potentially affect a firm's environmental costs. The control variables are: the natural logarithm of total assets in USD million (*Size*), capital expenditures to total assets (*Capital expenditures*), dividends to total assets (*Dividends*), total debt to total assets (*Leverage*), operating income to total assets (*ROA*), research and development expenses to total assets (*R&D*) and the natural logarithm of GDP per capita in USD (*LnGDPpercap*). Definitions of all variables are presented in Appendix Table A1. We obtain firm-level control variables from Compustat Global and country-/area-level variables from the World Development Indicators (WDI).

Table 3 presents the results of estimating the baseline regression model in Equation (1). In columns (1) and (2), we regress the natural logarithm of corporate environmental costs (*Ln EC*) on the percentage of institutional investor ownership (*IO*) without and with control variables, respectively. To analyze the heterogeneous effects of institutional investors with different investment horizons, we replace *IO* with long-term (*LTIO*) and short-term (*STIO*) ownership in columns (3) and (4), respectively.

Corroborating Hypothesis 1b, and contradicting Friedman's (1970) pure (normative) shareholder theory, results in columns (1) and (2) indicate a negative and statistically significant relation between corporate environmental costs and institutional investor ownership. For example, in column (2), the negative estimate on *IO* (−0.552) suggests that a one-standard-deviation increase in *IO* (26%) roughly implies a 14.35% ( $=0.26 \times 0.552 \times 100$ ) decrease in the environmental costs ratio.

In line with Hypothesis 2, the estimated coefficient of *LTIO* in column (3) is significantly negative, indicating that corporate environmental costs are negatively related long-term institutional ownership. In contrast, we find no significant association between corporate environmental costs and short-term institutional ownership (*STIO*) in column (4), most likely because the negative (Hypothesis 3a) and positive (Hypothesis 3b) effects offset each other. In column (5), we simultaneously include *LTIO* and *STIO* in the model. As expected, the coefficient of *LTIO* is negative and statistically significant, while that of *STIO* is not; the *t* value of a test for difference in the coefficient estimates is 87.26 (reported at the bottom of the table). These results indicate that the negative effect of institutional ownership on firms' environmental costs is driven by the group of long-term institutional investors.

Next, to analyze the effect of investor origin on corporate environmental costs, we replace institutional investor ownership (*IO*) with foreign (*IO\_frgn*) and domestic (*IO\_dom*) institutional ownership in columns (6) and (7), respectively. Consistent with Hypothesis 4, there is a negative and statistically significant relation between corporate environmental costs and *IO\_frgn*, while there is no significant relation between corporate environmental costs and

TABLE 3 Environmental cost and institutional ownership.

This table presents the results from estimating the effect of institutional ownership on corporate environmental costs. The dependent variable, *Ln EC*, is Freilberg et al.'s (2022) measure of corporate environmental costs, calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details). Total institutional investor ownership (*IO*) is decomposed into eight subgroups: long-term institutional ownership (*LTIO*); short-term institutional ownership (*STIO*), foreign institutional ownership (*IO\_fgn*), domestic institutional ownership (*IO\_dom*), long-term institutional ownership held by foreign investors (*LTIO\_fgn*), long-term institutional ownership held by domestic investors (*LTIO\_dom*), short-term institutional ownership held by foreign investors (*STIO\_fgn*) and short-term institutional ownership held by domestic investors (*STIO\_dom*). The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported in parentheses. The bottom part of the table shows the *t* values of tests for differences in estimated coefficients. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% level, respectively.

[illegible]

TABLE 3 (Continued)

TABLE 3 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable = <i>Ln EC</i>								
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	9391	9391	9391	9391	9391	9391	9391	8123
$R^2$	0.446	0.494	0.493	0.495	0.498	0.493	0.498	0.498
Test for difference in coefficients:								
$Coeff.LTIO = Coeff.STIO$		4.17**		87.26***				
$Coeff.IO\_frgn = Coeff.IO\_dom$				16.35***				
$Coeff.LTIO\_frgn = Coeff.STIO\_frgn$				25.34***				
$Coeff.LTIO\_frgn = Coeff.LTIO\_dom$				97.39***				
				23.02***				

*IO\_dom*. These results remain when we include *IO\_frgn* and *IO\_dom* in the model simultaneously in column (8).

Finally, having confirmed Hypotheses 3 and 4, we analyze the combined effect of investment horizon and investor origin. The model in column (9) splits long-term and short-term institutional ownership into four subgroups: (1) long-term institutional ownership held by foreign investors (*LTIO\_frgn*), (2) long-term institutional ownership held by domestic investors (*LTIO\_dom*), (3) short-term institutional ownership held by foreign investors (*STIO\_frgn*) and (4) short-term institutional ownership held by domestic investors (*STIO\_dom*). Our results show that the relation between corporate environmental costs and institutional investors is driven primarily by the subgroup of long-term institutional investors from foreign countries; only *LTIO\_frgn* exhibits a negative and statistically significant impact on corporate environmental costs. A test for difference between the estimated coefficients of *LTIO\_frgn* and *LTIO\_dom* reveals that the difference is statistically significant (with  $t = 23.02$ ).

Overall, these findings suggest that corporate environmental costs are negatively related to institutional ownership. As expected, this effect is driven by long-term foreign institutional investors. In contrast, there are generally no cost-reducing effects from short-term institutional investors. Our results corroborate Broccardo et al.'s (2022) theoretical analysis. Their model predicts that, in a competitive world, investor “exits” are less effective than engagement (“voice”) at pushing firms to act in a socially responsible manner.

## 4.2 | Heterogeneity analysis<sup>12</sup>

Given the negative relationship between corporate environmental costs and foreign institutional ownership, an open question is whether this effect is identical in different countries. First, the literature shows evidence of some degree of substitutability between the quality of local corporate governance and the governance activities of institutional investors (Deng et al., 2018; Ferreira et al., 2010). Accordingly, we hypothesize that the effect of foreign institutional investors on corporate environmental costs will be stronger in firms located in low-income or middle-income countries, such as the BRICS countries (the largest middle-income countries), which suffer from relatively poor environmental regulation and lack of external oversight. In contrast, we expect the impact of foreign institutional investors on corporate environmental costs to be less pronounced in firms located in high-income countries, such as the G7 countries, which are more environmentally sensitized and have more sophisticated regulatory systems in place.

Second, we divide foreign institutional ownership into investors from advanced and developing economies. We propose that institutional investors from advanced economies better understand environmental issues and know more about the related risks (El Ghoul et al., 2017; Liang & Renneboog, 2017). Therefore, this group of foreign institutional investors should be in a better position to promote the necessary reductions in corporate environmental costs.

Table 4 presents the results of the interactions between foreign institutional ownership and the origin of firms and institutional investors. Data on countries' income levels are from the World Bank WDI data set. As expected, foreign institutional ownership has a particularly strong negative effect on corporate environmental costs in the BRICS countries (column 1), as

<sup>12</sup>We thank anonymous reviewers for suggesting this analysis.

**TABLE 4** Cross-country variation in the effect of foreign institutional ownership.

This table reports the results from estimating the cross-country variation in the effect of foreign institutional ownership on corporate environmental costs. The dependent variable, *Ln EC*, is Freiberg et al.'s (2022) measure of corporate environmental costs, calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details). Foreign institutional ownership (*IO\_frgn*) is decomposed into two subgroups: foreign institutional ownership from advanced economies (*FIO\_adv\_econ*) and foreign institutional ownership from developing economies (*FIO\_dev\_econ*). To explore the effects of foreign institutional ownership in different countries, we create two dummy variables, which equal one if a firm is located in BRICS countries or G7 countries. We use the World Bank classification standard to create a dummy variable for nonhigh-income countries (*Nonhigh income*) that equals to one if a firm is located in low- or middle-income country. The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported in parentheses. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Dependent variable = <i>Ln EC</i></b>						
<i>IO_frgn</i>	−1.715*** (0.395)		−2.385*** (0.534)		−1.713*** (0.414)	
<i>BRICS × IO_frgn</i>	−3.354** (1.550)					
<i>BRICS × FIO_adv_econ</i>		−4.267*** (1.645)				
<i>BRICS × FIO_dev_econ</i>		−19.432 (22.107)				
<i>G7 × IO_frgn</i>			0.867 (0.721)			
<i>G7 × FIO_adv_econ</i>				1.828** (0.822)		
<i>G7 × FIO_dev_econ</i>				−3.257 (8.527)		
<i>Nonhigh income</i>					0.556** (0.257)	0.613** (0.251)
<i>Nonhigh income × IO_frgn</i>					−1.584 (0.984)	
<i>Nonhigh income × FIO_adv_econ</i>						−1.890* (1.038)
<i>Nonhigh income × FIO_dev_econ</i>						−6.788 (7.012)
<i>FIO_adv_econ</i>		−1.538*** (0.475)		−2.882*** (0.607)		−1.529*** (0.499)

TABLE 4 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable = $\ln EC$					
<i>FIO_dev_econ</i>		6.625 (4.325)		8.496 (6.417)		7.173 (4.905)
<i>IO_dom</i>	0.214 (0.328)	0.264 (0.348)	0.223 (0.328)	0.280 (0.347)	0.215 (0.329)	0.266 (0.348)
<i>Size</i>	0.006 (0.024)	0.003 (0.025)	0.006 (0.024)	0.003 (0.025)	0.006 (0.024)	0.003 (0.025)
<i>Capital expenditures</i>	7.310*** (0.948)	7.015*** (0.975)	7.353*** (0.944)	7.066*** (0.968)	7.287*** (0.950)	6.984*** (0.979)
<i>Dividends</i>	-1.277 (0.920)	-0.938 (0.950)	-1.246 (0.916)	-0.886 (0.943)	-1.240 (0.917)	-0.894 (0.948)
<i>Leverage</i>	0.189 (0.178)	0.251 (0.186)	0.196 (0.178)	0.262 (0.187)	0.195 (0.178)	0.260 (0.186)
<i>ROA</i>	-2.396** (1.114)	-2.475** (1.095)	-2.394** (1.112)	-2.463** (1.087)	-2.402** (1.114)	-2.483** (1.095)
<i>R&amp;D</i>	-5.260*** (1.942)	-5.098** (1.988)	-5.219*** (1.921)	-5.040*** (1.949)	-5.236*** (1.939)	-5.072** (1.986)
<i>LnGDPpercap</i>	-0.295*** (0.101)	-0.316*** (0.107)	-0.286*** (0.101)	-0.316*** (0.109)	-0.284*** (0.101)	-0.291*** (0.111)
<i>Constant</i>	1.667 (1.094)	1.866 (1.162)	1.573 (1.101)	1.857 (1.183)	1.492 (1.103)	1.543 (1.206)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
<i>Observations</i>	9391	8123	9391	8123	9391	8123
$R^2$	0.499	0.500	0.498	0.500	0.499	0.499

indicated by the significantly negative coefficient of  $BRICS \times IO\_frgn$ . Also consistent with our proposition, column (2) indicates that the impact of foreign institutional ownership in these countries is driven by investors from advanced economies. While the estimate on  $BRICS \times FIO\_adv\_econ$  is significantly negative, foreign institutional investors from developing countries have no discernable effect on corporate environmental costs.

Columns (3) and (4) analyze the impact of foreign institutional investors on corporate environmental costs in firms located in G7 countries. Although the interaction coefficient of interest in column (3),  $G7 \times IO\_frgn$ , is positive, it is statistically insignificant, indicating that



the effect of foreign institutional investors on corporate environmental costs is not different in G7 countries compared with non-G7 countries. Most importantly, the estimated coefficient of *FIO\_adv\_econ* in column (4) is negative and statistically significant at the 1% level, that is, foreign institutional investors from advanced economies seem more experienced and assist firms in reducing environmental costs. This negative effect of foreign institutional investors from advanced economies is less pronounced in G7 countries, as indicated by a positive and statistically significant coefficient of the interaction term  $G7 \times FIO\_adv\_econ$ , most likely because firms from these countries are more environmentally sensitized and have experience in managing their environmental costs.

Finally, in columns (5) and (6), we explore the impact of foreign institutional investors in nonhigh-income countries by creating a dummy variable, denoted as *Nonhigh income*, which equals 1 if a firm is located in a low- or middle-income country, and 0 otherwise. The estimated coefficient of *Nonhigh income* is positive and statistically significant, confirming that firms from nonhigh-income countries generate higher corporate environmental costs. As expected, the estimated coefficients of *IO\_frgn* (column 5) and *FIO\_adv\_econ* (column 6) are negative and statistically significant at the 1% level. In column (5), there is no difference in the impact of foreign institutional investors in high-income countries compared with other countries; the estimated coefficient of  $Nonhigh\ income \times IO\_frgn$  remains insignificant. However, column (6) reveals that the impact of foreign institutional investors from advanced economies on corporate environmental costs is strongest in nonhigh-income countries, as indicated by the negative coefficient of the interaction term  $Nonhigh\ income \times FIO\_adv\_econ$  (statistically significant at the 10% level).

Overall, our findings in Table 4 are consistent with substitution arguments. The impact of foreign institutional investors on corporate environmental costs is more pronounced in emerging countries (BRICS), that is, countries that are more likely to suffer from weaker corporate governance, poor environmental regulation, and lack of external oversight. At the same time, this effect is primarily driven by foreign institutional investors from advanced economies, where both the public perception and the regulatory framework have a strong focus on environmental issues. Through their higher climate-sensitivity and superior monitoring abilities, this group of investors transfers the higher norms and standards from their home countries to their investee firms.

## 4.3 | Robustness checks

### 4.3.1 | Heckman selection correction

Our results may suffer from sample selection bias. Ideally, we would create a representative sample by randomly selecting firms. However, some firms, for example, those in utilities or energy industries, are more likely to be asked to report their environmental data. These firms may exhibit lower institutional ownership and higher environmental costs. As a result, this selection process may lead to a biased sample without proper randomization.

To mitigate concerns about selection bias, we implement a Heckman selection correction procedure in all our model specifications. In a first-stage regression, we estimate a probit regression to predict the likelihood of a firm being included in our sample. We use the entire Compustat Global database from 2010 to 2018 as our sample in this first stage. We create a dummy variable (*Sample\_dummy*) that equals 1 if a firm-year observation is included in our environmental cost data set, and 0 otherwise. In the second-stage regression, we rerun the baseline regression and use the inverse Mills ratio (*Lambda*) as an additional control variable.

Lennox et al. (2012) emphasize that identifying selection bias requires at least one exclusion restriction in the first-stage model. In particular, we refer to variables included in the first-stage but not the second-stage model as exclusion restrictions. These variables should not directly impact the dependent variable (corporate environmental costs) in the second-stage model, and any association between environmental costs and these variables is only indirect through the likelihood ratio obtained from the first-stage estimation. Following Bose et al. (2020), we use the industry-country share of firms that have environmental costs data as an explanatory variable. This variable, labeled *Ind\_ctr\_share*, is an appropriate exclusion restriction because the industry-country-wide fraction of firms that provide environmental costs data increases the likelihood of a firm disclosing its own data. At the same time, it is unlikely that the industry-country wide fraction of firms that provide environmental cost data influences a particular firm's level of environmental costs because there are many firms in the industry of a given county. Therefore, our instrument should satisfy the exclusion restriction, and we include it in the first-stage regression along with the other explanatory variables.

Columns (1), (3), (5) and (7) of Table 5 show the first-stage regression results of the different model specifications. As expected, the estimated coefficients of *Ind\_ctr\_share* are positive and statistically significant in all models. In the second-stage regression, in addition to all other control variables, we include the inverse Mills ratio predicted in the first-stage regression. The second-stage regressions in columns (2), (4), (6) and (8) confirm our baseline results in Table 3, that is, all institutional investor variables are negatively and statistically significantly related to corporate environmental costs. In addition, the estimated coefficient of *Lambda*, reflecting the likelihood of being selected in our sample, is statistically insignificant in all second-stage regressions. This indicates that selection bias should not be a major problem.

#### 4.3.2 | Alternative fixed effects

Another potential concern is the omitted variables problem. Our estimates will be biased if some firm-level variables that affect institutional ownership and corporate environmental costs are omitted. One way to deal with the problem of potentially omitted variables is to use firm and year fixed effects panel regressions. We note that all our regressions already include year fixed effects. However, Zhou (2001) argues that firm fixed effects should not be included when the independent variable of interest substantially varies between firms, but changes slowly within firms. In this case, firm fixed effects estimators may fail to detect any effect of institutional ownership.

Following Berger et al. (2017), we implement two tests to analyze whether this bias affects our analysis. First, we examine how our main independent variable varies across firms. We then compare it to the variation within a firm, that is, we compare within and between variations in institutional ownership (*IO*). For the within variation, we compute the standard deviation of institutional investor ownership by firm across years, and then take the average across firms. For the between variation, we calculate the standard deviation of institutional ownership by year across firms, and then take the average across years. Firm fixed effects should not be used if the between variation is much larger than the within variation. In unreported results, we find that the between variation is about seven times higher than the within variation in our analysis, suggesting that firm fixed effects are inappropriate in our setup.

Second, we measure how slowly institutional ownership varies within a firm. As expected, the serial correlation of our most elementary institutional investor ownership (*IO*) variable is 0.965, that is, ownership is generally highly sticky. Again, this indicates that firm fixed effects are not suitable in our setting.

TABLE 5 Heckman selection correction.

This table presents the results of the Heckman selection correction analysis. The first stage is a probit regression of *Sample\_dummy*, a dummy dependent variable indicating whether a firm-year observation is contained in our main sample, on our control variables and the industry-country share of firms that have environmental costs data (*Ind\_pty\_share*). In the second stage, the dependent variable, *Ln EC*, is Freiberg et al.'s (2022) measure of corporate environmental costs, calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details). We include Lambda, the inverse Mills ratio predicted from the first stage to control for the selection bias. The main independent variables are institutional ownership (*IO*), long-term institutional ownership (*LTIO*), short-term institutional ownership (*STIO*), foreign institutional ownership held by domestic investors (*LTIO\_dom*), long-term institutional ownership held by foreign investors (*LTIO\_frgn*), long-term institutional ownership held by domestic investors (*LTIO\_dom*), short-term institutional ownership held by foreign investors (*STIO\_frgn*) and short-term institutional ownership held by domestic investors (*STIO\_dom*). The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported in parentheses. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% level, respectively.

Dependent variable	First stage <i>Sample_dummy</i> (1)	Second stage <i>Ln EC</i> (2)	First stage <i>Sample_dummy</i> (3)	Second stage <i>Ln EC</i> (4)	First stage <i>Sample_dummy</i> (5)	Second stage <i>Ln EC</i> (6)	First stage <i>Sample_dummy</i> (7)	Second stage <i>Ln EC</i> (8)
<i>IO</i>	1.010*** (0.123)	−0.587** (0.253)						
<i>LTIO</i>			1.457*** (0.172)	−1.149*** (0.348)				
<i>STIO</i>			0.187 (0.345)	1.396 (1.111)				
<i>IO_frgn</i>					1.916*** (0.179)	−1.944*** (0.413)		
<i>IO_dom</i>					0.502*** (0.141)	0.203 (0.330)		

TABLE 5 (Continued)

Dependent variable	First stage <i>Sample_dummy</i> (1)	Second stage <i>Ln EC</i> (2)	First stage <i>Sample_dummy</i> (3)	Second stage <i>Ln EC</i> (4)	First stage <i>Sample_dummy</i> (5)	Second stage <i>Ln EC</i> (6)	First stage <i>Sample_dummy</i> (7)	Second stage <i>Ln EC</i> (8)
<i>LTIO_frgn</i>							2.939*** (0.294)	−2.362*** (0.740)
<i>LTIO_dom</i>							0.964*** (0.199)	−0.514 (0.425)
<i>STIO_frgn</i>							1.398* (0.765)	−1.442 (1.904)
<i>STIO_dom</i>							−0.572 (0.420)	2.232 (1.560)
<i>Ind_ctr_y_share</i>	4.288*** (0.273)		4.311*** (0.272)		4.341*** (0.272)		4.427*** (0.280)	
<i>Lambda</i>		0.139 (0.284)		0.129 (0.282)		0.118 (0.280)		0.157 (0.285)
<i>Size</i>	0.521*** (0.011)	−0.034 (0.052)	0.511*** (0.011)	−0.020 (0.051)	0.507*** (0.011)	−0.011 (0.051)	0.506*** (0.012)	−0.016 (0.051)
<i>Capital expenditures</i>	−0.965*** (0.157)	7.300*** (0.968)	−0.953*** (0.155)	7.272*** (0.966)	−0.918*** (0.153)	7.377*** (0.960)	−0.912*** (0.155)	7.033*** (0.991)
<i>Dividends</i>	0.239*** (0.030)	−1.475 (0.947)	0.236*** (0.029)	−1.333 (0.926)	0.226*** (0.029)	−1.261 (0.924)	0.217*** (0.029)	−0.982 (0.953)

(Continues)

TABLE 5 (Continued)

Dependent variable	First stage Sample_dummy (1)	Second stage Ln EC (2)	First stage Sample_dummy (3)	Second stage Ln EC (4)	First stage Sample_dummy (5)	Second stage Ln EC (6)	First stage Sample_dummy (7)	Second stage Ln EC (8)
Leverage	-0.247*** (0.095)	0.232 (0.178)	-0.232** (0.095)	0.207 (0.178)	-0.223** (0.095)	0.203 (0.177)	-0.217** (0.100)	0.254 (0.187)
ROA	0.792*** (0.114)	-2.485** (1.165)	0.781*** (0.112)	-2.474** (1.157)	0.752*** (0.111)	-2.434** (1.133)	0.746*** (0.113)	-2.531** (1.125)
R&D	1.398*** (0.184)	-5.292*** (1.981)	1.374*** (0.181)	-5.237*** (1.979)	1.305*** (0.182)	-5.287*** (1.951)	1.332*** (0.174)	-5.120** (2.005)
LnGDPpercap	0.203*** (0.062)	-0.278*** (0.104)	0.203*** (0.061)	-0.270*** (0.104)	0.176*** (0.062)	-0.294*** (0.102)	0.125* (0.067)	-0.294*** (0.106)
Constant	-8.306*** (0.830)	1.808 (1.226)	-8.200*** (0.818)	1.594 (1.216)	-7.968*** (0.821)	1.776 (1.195)	-7.510*** (0.879)	1.796 (1.226)
Industry dummy variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummy variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummy variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Observations	125,807	9391	125,807	9391	125,807	9391	107,602	8123
Pseudo- $R^2/R^2$	0.415	0.494	0.415	0.495	0.418	0.498	0.419	0.498

### 4.3.3 | Alternative environmental cost measures

We implement robustness tests using three alternative measures of corporate environmental costs. First, our baseline model assumes a 0% discount rate when calculating environmental costs (see Freiberg et al., 2022, for the details). An alternative scenario may be that environmental costs affect resource distribution between generations, making it necessary to discount environmental impacts. Another possibility is that the monetized impacts are clustered and more heavily weighted at the end of the time horizon. Therefore, it is necessary to run sensitivity tests assuming that the discount rate is positive. We emphasize that the discount rate does not pertain to the wealth creation process, but rather captures the intergenerational distribution of resources and any accumulated negative environmental impacts.

To address these concerns, we assume a 3% discount rate to calculate environmental costs. For the sake of conservatism, this number represents the global long-term economic growth rate during the 1913–2012 period (Piketty, 2014). Discounted environmental costs, labeled *EC\_discount*, are obtained from Freiberg et al. (2022). Columns (1)–(4) of Panel A in Table 6 confirm that our results are very similar under alternative assumptions for the discount rate.

Second, if data on certain types of emission releases are missing, we assume that the firm's emissions volume equals the industry's average emissions volume within a country. Our estimates may be biased if a firm's actual emissions volume deviates strongly from the country-industry level average. To address this concern, we construct another environmental cost variable, labeled *EC\_adj*, which assumes firms without certain emissions release data have no releases on that emission type. Columns (5)–(8) of Panel A in Table 6 confirm that our results remain robust.

Third, as another robustness check, we re-examine our main results by using environmental costs data from Trucost (*EC\_Trucost*) in columns (1)–(4) of Panel B in Table 6. While the estimated coefficient of *IO* is negative but insignificant (column 1), we find negative and statistically significant coefficients of *LTIO*, *IO\_frgn* and *LTIO\_frgn* (columns 2–4). Again, the cost effect is driven primarily by the subgroup of long-term foreign institutional investors.

### 4.3.4 | Non-US sample and WLS regression

In our sample, the United States accounts for a large fraction of firm-year observations (18.7%). We use two tests to ensure that observations from large countries do not distort our results. First, we exclude observations from the United States. Columns (1)–(4) of Table 7 show the results. The estimated coefficients of *IO*, *LTIO*, *IO\_frgn* and *LTIO\_frgn* are negative and statistically significant. Second, we run WLS regressions, assigning each country a weight equal to the reciprocal of the number of observations. Our results in columns (5)–(8) of Table 7 remain unchanged. Finally, since Japan also accounts for a large fraction of firm-year observations, we re-estimate our baseline model using a non-Japan sample. Again, our results (not reported) remain qualitatively the same.

## 5 | VALUATION AND COST OF EQUITY IMPLICATIONS

Finally, we directly test the financial benefits of low environmental costs. In particular, we measure the material effects of corporate environmental costs on firm valuation and firms' cost of equity. Our proxy for firm valuation is the logarithm of the market-to-book ratio of assets (*Ln MTB*). Following Hail and Leuz (2006) and El Ghoul et al. (2018), we measure the cost of

TABLE 6 Alternative measures of environmental cost.

This table presents the results from regressing alternative measures of environmental costs on institutional ownerships. In Panel A, *Ln EC\_discount* is the natural logarithm of a firm's environmental costs scaled by operating income, assuming a 3% discount rate. *Ln EC\_adj* is the natural logarithm of the firm's environmental costs scaled by operating income, assuming that firms without reported toxic release data have no toxic releases. In Panel B, *Ln EC\_Trucost* is the natural logarithm of the firm's environmental cost scaled by operating income, based on the Trucost data set. The main independent variables include: total institutional ownership (*IO*), long-term institutional ownership (*LTI*), short-term institutional ownership (*STI*), foreign institutional ownership held by domestic investors (*LTIIO\_dom*), short-term long-term institutional ownership held by foreign investors (*LTIIO\_frgrn*), long-term institutional ownership held by domestic investors (*LTIIO\_dom*), short-term institutional ownership held by foreign investors (*STIIO\_frgrn*) and short-term institutional ownership held by domestic investors (*STIIO\_dom*). The sample covers firms from 42 countries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported between parentheses. \*\*\*, \*\*, \* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Discounted environmental cost and adjusted environmental cost								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable = Ln EC_discount			Dependent variable = Ln EC_adj				
IO	−0.485** (0.226)				−0.553** (0.247)			
LTIO		−1.006*** (0.305)				−1.105*** (0.336)		
STIO		1.450 (1.043)				1.436 (1.121)		
IO_frgrn			−1.672*** (0.361)				−1.897*** (0.391)	
IO_dom			0.199 (0.301)				0.224 (0.330)	
LTIO_frgrn				−2.020*** (0.680)				−2.257*** (0.699)



TABLE 6 (Continued)

Panel A: Discounted environmental cost and adjusted environmental cost							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent variable = <i>Ln EC_discount</i>			Dependent variable = <i>Ln EC_adj</i>			
<i>LTIO_dom</i>				−0.502 (0.385)			−0.474 (0.419)
<i>STIO_frgn</i>				−0.834 (1.624)			−1.438 (1.859)
<i>STIO_dom</i>				2.105 (1.474)			2.267 (1.571)
<i>Size</i>	−0.009 (0.022)	0.002 (0.022)	0.008 (0.022)	0.009 (0.023)	−0.012 (0.024)	0.000 (0.023)	0.007 (0.024)
<i>Capital expenditures</i>	6.264*** (0.888)	6.236*** (0.886)	6.338*** (0.881)	6.009*** (0.911)	7.344*** (0.954)	7.319*** (0.952)	7.428*** (0.946)
<i>Dividends</i>	−1.066 (0.918)	−0.936 (0.897)	−0.878 (0.896)	−0.621 (0.926)	−1.483 (0.942)	−1.340 (0.920)	−1.269 (0.919)
<i>Leverage</i>	0.143 (0.166)	0.119 (0.166)	0.119 (0.165)	0.160 (0.174)	0.238 (0.179)	0.213 (0.180)	0.210 (0.179)
<i>ROA</i>	−2.185** (1.079)	−2.175** (1.070)	−2.145** (1.050)	−2.230** (1.044)	−2.412** (1.137)	−2.403** (1.128)	−2.366** (1.104)
<i>R&amp;D</i>	−4.239** (1.754)	−4.194** (1.752)	−4.247** (1.732)	−4.036** (1.774)	−5.202*** (1.956)	−5.151*** (1.956)	−5.211*** (1.929)
<i>LnGDPpercap</i>	−0.211** (0.098)	−0.204** (0.098)	−0.227** (0.097)	−0.223** (0.102)	−0.273*** (0.103)	−0.265** (0.103)	−0.291*** (0.102)

(Continues)

TABLE 6 (Continued)

Panel A: Discounted environmental cost and adjusted environmental cost							
	(1)	(2)	(3)	(4)	(5)	(6)	(8)
	Dependent variable = <i>Ln EC_discount</i>				Dependent variable = <i>Ln EC_adj</i>		
<i>Constant</i>	0.201 (1.070)	0.023 (1.065)	0.217 (1.056)	0.158 (1.100)	1.554 (1.126)	1.358 (1.121)	1.552 (1.157)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm
<i>Observations</i>	9385	9385	9385	8117	9391	9391	8123
<i>R</i> <sup>2</sup>	0.495	0.496	0.499	0.498	0.490	0.491	0.494
Panel B: Alternative data on environmental cost							
	(1)	(2)		(3)		(4)	
	Dependent variable = <i>Ln EC_Trucost</i>						
<i>IO</i>	−0.299 (0.190)						
<i>LTIO</i>		−0.534** (0.258)					
<i>STIO</i>		1.015 (0.665)					
<i>IO_firgn</i>						−0.991*** (0.257)	

TABLE 6 (Continued)

Panel B: Alternative data on environmental cost			
	(1)	(2)	(3)
Dependent variable = Ln EC_Trucost			
IO_dom			
			0.113 (0.258)
LTIO_frgn			−1.702*** (0.412)
LTIO_dom			0.071 (0.346)
STIO_frgn			1.420 (1.081)
STIO_dom			1.230 (0.940)
Size	0.009 (0.017)	0.017 (0.017)	0.018 (0.017)
Capital expenditures	1.768*** (0.604)	1.740*** (0.603)	1.791*** (0.598)
			1.727*** (0.630)
Dividends	−0.670 (0.505)	−0.590 (0.495)	−0.567 (0.500)
Leverage	−0.383*** (0.123)	−0.395*** (0.123)	−0.397*** (0.123)
ROA	−1.892*** (0.717)	−1.883*** (0.712)	−1.866*** (0.698)
			−1.956*** (0.711)

(Continues)

TABLE 6 (Continued)

Panel B: Alternative data on environmental cost			
	(1)	(2)	(3)
Dependent variable = <i>Ln EC_Trucost</i>			
<i>R&amp;D</i>	−2.524*** (0.802)	−2.483*** (0.802)	−2.526*** (0.805)
<i>LnGDPpercap</i>	−0.028 (0.063)	−0.022 (0.064)	−0.042 (0.062)
<i>Constant</i>	−2.201*** (0.703)	−2.359*** (0.702)	−2.144*** (0.689)
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Cluster	Firm	Firm	Firm
Observations	8417	8417	8417
<i>R</i> <sup>2</sup>	0.751	0.751	0.752
			0.754

**TABLE 7** Non-US sample and weighted least squares regression.

This table examines the effects of institutional ownership on environmental costs using a non-US sample and weighted least square (WLS) regressions. The weights used in WLS are calculated based on a total number of observations in each country. The dependent variable, *Ln EC*, is Freiberg et al.'s (2022) measure of corporate environmental costs, calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details). The main independent variables include: institutional ownership (*IO*), long-term institutional ownership (*LTIO*), short-term institutional ownership (*STIO*), foreign institutional ownership (*IO\_frgn*), domestic institutional ownership (*IO\_dom*), long-term institutional ownership held by foreign investors (*LTIO\_frgn*), long-term institutional ownership held by domestic investors (*LTIO\_dom*), short-term institutional ownership held by foreign investors (*STIO\_frgn*) and short-term institutional ownership held by domestic investors (*STIO\_dom*). The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported between parentheses. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

	Exclude US				WLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Dependent variable = <i>Ln EC</i></b>								
<i>IO</i>	−0.889** (0.351)				−1.233*** (0.382)			
<i>LTIO</i>		−1.173** (0.507)				−1.921*** (0.590)		
<i>STIO</i>		−0.708 (1.692)				0.830 (1.553)		
<i>IO_frgn</i>			−1.750*** (0.421)				−1.800*** (0.531)	
<i>IO_dom</i>			0.338 (0.599)				0.003 (0.433)	
<i>LTIO_frgn</i>				−2.477*** (0.700)				−2.351** (0.928)
<i>LTIO_dom</i>				0.506 (0.840)				−0.386 (0.519)
<i>STIO_frgn</i>				−1.621 (2.041)				−3.124 (2.061)
<i>STIO_dom</i>				−0.291 (2.495)				1.564 (1.571)
<i>Size</i>	0.017 (0.027)	0.025 (0.027)	0.036 (0.028)	0.036 (0.028)	0.002 (0.036)	0.016 (0.036)	0.012 (0.037)	0.019 (0.037)
<i>Capital expenditures</i>	6.513*** (0.979)	6.567*** (0.980)	6.623*** (0.973)	6.459*** (1.002)	5.987*** (1.200)	6.047*** (1.203)	6.049*** (1.205)	5.522*** (1.301)
<i>Dividends</i>	−1.897* (1.133)	−1.809 (1.133)	−1.743 (1.126)	−1.314 (1.170)	−1.024 (2.262)	−0.883 (2.259)	−0.940 (2.255)	0.340 (2.085)

(Continues)

TABLE 7 (Continued)

	Exclude US				WLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Dependent variable = <math>\ln EC</math></b>								
<i>Leverage</i>	0.213 (0.203)	0.220 (0.204)	0.207 (0.202)	0.245 (0.211)	−0.165 (0.297)	−0.172 (0.298)	−0.159 (0.297)	−0.126 (0.306)
<i>ROA</i>	−2.072* (1.167)	−2.086* (1.179)	−2.020* (1.146)	−2.177* (1.144)	−3.451*** (0.844)	−3.486*** (0.854)	−3.395*** (0.840)	−3.615*** (0.803)
<i>R&amp;D</i>	−4.264* (2.280)	−4.258* (2.295)	−4.131* (2.240)	−4.060* (2.267)	−6.662** (2.682)	−6.635** (2.703)	−6.437** (2.638)	−6.145** (2.812)
<i>LnGDPpercap</i>	−0.277** (0.108)	−0.270** (0.108)	−0.283*** (0.107)	−0.294*** (0.113)	−0.229 (0.142)	−0.204 (0.143)	−0.233* (0.141)	−0.237 (0.159)
<i>Constant</i>	1.384 (1.173)	1.204 (1.171)	1.285 (1.157)	1.380 (1.212)	1.626 (1.502)	1.210 (1.495)	1.562 (1.490)	1.511 (1.645)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
<i>Observations</i>	7636	7636	7636	6584	9391	9391	9391	8123
$R^2$	0.468	0.467	0.471	0.471	0.562	0.561	0.563	0.573

equity (*COE*) based on analysts' earnings forecasts and stock prices. In particular, our *COE* measure is estimated by taking the average of the implied cost of equity estimates across the four valuation models from Claus and Thomas (2001; Kct), Gebhardt et al. (2001; Kgl), Easton (2004; Kmpeg) and Ohlson and Juettner-Nauroth (2005; Kojn). We also use these four proxies for the implied cost of equity separately to test whether the results are sensitive to any measurement approach.

Our valuation regressions include all control variables already used in the analysis above. Moreover, we incorporate an additional set of control variables used in prior cost of equity research (Attig et al., 2013; Hail & Leuz, 2006). These variables include stock return beta (measured over the past 60 months; *BETA*), dispersion of analyst forecasts (*Dispersion*), earning forecast bias (*Forecast\_bias*) and realized inflation rate (*Inflation*). All variables are described in detail in Appendix Table A1.

Table 8 reports the results. Controlling for a large set of firm- and country-level characteristics, we find that corporate environmental costs are negatively related to *Ln MTB* (column 1), and positively related to *COE* (column 2). The effects are statistically significant

**TABLE 8** Implications for valuation and cost of equity.

This table presents the results from estimating the effect of corporate environmental costs in the market-to-book ratio and the cost of equity (*COE*). *Ln MTB* is the natural logarithm of the market-to-book ratio of assets. *COE* is the average cost of equity obtained from four models developed by Ohlson and Juettner-Nauroth (2005), Easton (2004), Claus and Thomas (2001) and Gebhardt et al. (2001) and labeled as *KOJN*, *KMPEG*, *KCT* and *KGLS*, respectively. *Ln EC* is Freiberg et al.'s (2022) measure of corporate environmental costs, calculated based on total emissions and the corresponding monetary coefficients (see Section 3.2 for details). The sample covers firms from 42 countries from 12 industries over the period 2010–2018. All variables are defined in Appendix Table A1. Standard errors clustered at the firm level are reported between parentheses. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% level, respectively.

Dependent variable	(1) <i>Ln MTB</i>	(2) <i>COE</i>	(3) <i>KMPEG</i>	(4) <i>KOJN</i>	(5) <i>KCT</i>	(6) <i>KGLS</i>
<i>Ln EC</i>	−0.061*** (0.009)	0.005*** (0.001)	0.008*** (0.001)	0.006*** (0.001)	0.003*** (0.001)	0.004*** (0.001)
<i>BETA</i>	−0.019*** (0.004)	0.003*** (0.001)	0.005*** (0.001)	0.003*** (0.001)	0.002*** (0.001)	0.002*** (0.000)
<i>Capital expenditures</i>	−0.340 (0.441)	0.050* (0.028)	0.110** (0.050)	0.057** (0.027)	0.044* (0.023)	−0.015 (0.026)
<i>Dispersion</i>	−0.859 (0.797)	0.718*** (0.241)	1.487*** (0.519)	0.840*** (0.275)	0.698* (0.366)	0.339*** (0.083)
<i>Dividends</i>	2.060*** (0.382)	−0.059** (0.023)	−0.010 (0.037)	−0.033 (0.021)	−0.041* (0.021)	−0.157*** (0.032)
<i>Leverage</i>	−0.028 (0.048)	0.022*** (0.006)	0.031*** (0.009)	0.030*** (0.006)	0.028*** (0.006)	−0.010 (0.007)
<i>Forecast_bias</i>	−0.178*** (0.045)	0.083** (0.040)	0.123* (0.069)	0.045** (0.021)	0.057** (0.027)	0.030*** (0.011)
<i>ROA</i>	1.753*** (0.614)	−0.026 (0.023)	−0.056 (0.035)	−0.036 (0.026)	−0.013 (0.013)	0.008 (0.022)
<i>Size</i>	−0.046*** (0.007)	0.001 (0.001)	0.001 (0.001)	−0.002*** (0.001)	−0.000 (0.001)	0.003*** (0.001)
<i>Inflation</i>	−0.499* (0.256)	0.028 (0.047)	0.198** (0.079)	−0.174* (0.099)	0.156 (0.120)	0.051 (0.035)
<i>R&amp;D</i>	1.681*** (0.396)	0.002 (0.025)	0.074 (0.054)	0.054 (0.038)	−0.008 (0.027)	−0.117*** (0.024)
<i>LnGDPpercap</i>	0.021 (0.055)	0.004 (0.004)	0.010 (0.008)	0.007* (0.004)	0.000 (0.005)	−0.007 (0.005)
<i>Constant</i>	0.235 (0.589)	0.065 (0.045)	0.013 (0.086)	0.056 (0.044)	0.088 (0.054)	0.140*** (0.049)

(Continues)



TABLE 8 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Dependent variable</b>	<b><i>Ln MTB</i></b>	<b><i>COE</i></b>	<b><i>KMPEG</i></b>	<b><i>KOJN</i></b>	<b><i>KCT</i></b>	<b><i>KGLS</i></b>
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
<i>Observations</i>	6048	6061	5886	5285	5680	5986
$R^2$	0.627	0.219	0.144	0.287	0.222	0.281

and economically large. For example, on average, a 1% increase in the environmental costs ratio is associated with a six-basis point decrease in the market-to-book ratio.

Columns (3)–(6) report the regression results using the different costs of equity measures separately. As expected, all models lead to the same conclusion. In particular, a higher level of corporate environmental costs is associated with a higher cost of equity. This relation is consistent with the central idea from asset pricing models that find evidence for the existence of a “greenium” (Pástor et al., 2021, 2022).

## 6 | CONCLUSION

Knowing and measuring a firm's environmental costs is a fundamental part of the trajectory toward “net zero.” In this paper, we examine the role of institutional investors, particularly their investment horizon and origin, in influencing the monetized environmental impact generated by their investee firms. We provide evidence that institutional ownership has a significantly negative impact on corporate environmental costs. Importantly, this cost effect is driven by long-term foreign institutional ownership, while we find no such effects for short-term and domestic ownership. Our results are consistent with Krueger et al.'s (2020) finding that long-term institutional investors are more concerned about environmental issues and climate-related risks than short-term investors. They further support a growing literature arguing that foreign institutional investors are in a privileged position to serve as credible signals or endorsements (Aggarwal et al., 2011; Brockman et al., 2023; Cumming et al., 2017), for example, playing an active role in reducing a firm's negative environmental impact.

Additional analysis reveals that foreign institutional ownership's impact on corporate environmental costs is strongest in emerging economies, that is, countries more likely to suffer from weak corporate governance practices and defective environmental regulation. In addition, this effect is driven by foreign institutional investors from advanced economies, that is, a subgroup of highly climate-sensitized institutional investors. Overall, our empirical results suggest that foreign institutional investors from advanced economies transmit higher standards from their home countries, where both the public perception and the regulatory framework have a stronger focus on environmental dimensions, to their investee firms.

We further provide evidence that environmental costs have a material effect reflected in market prices and firms' cost of equity. Consistent with asset pricing equilibrium models

(Pástor et al., 2021, 2022), environmental costs affect firm valuation negatively and the cost of equity positively. Therefore, our results suggest that institutional investors, particularly those with a long investment horizon and foreign origin, should have incentives to monitor and even actively intervene in corporate policies that affect environmental costs. In this sense, our results are compatible with the argument that engagement is a more effective approach for reducing environmental damage and addressing climate-related risks than divestment (Berk & Van Binsbergen, 2022; Broccardo et al., 2022; Krueger et al., 2020).

## DATA AVAILABILITY STATEMENT

Research data are not shared.

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APPENDIX

See Table A1.

TABLE A1 Variable definitions.

Variables	Description	Source
EC	Firm's environmental costs scaled by operating income. The environmental costs are calculated based on total emissions volume and monetary coefficient. The total emissions are the total scope 1 (direct emissions) and scope 2 emissions (indirect emissions).	Freiberg et al. (2022)
Ln EC	Natural logarithm of EC.	As above
Ln EC_discount	Natural logarithm of the firm's environmental costs scaled by operating income, assuming a 3% discount rate. The environmental costs are calculated based on total emissions volume and monetary coefficient. The total emissions are the total scope 1 (direct emissions) and scope 2 emissions (indirect emissions).	As above
Ln EC_adj	Natural logarithm of the firm's environmental costs scaled by operating income, assuming that firms without toxic release data have no toxic release. The environmental costs are calculated based on total emissions volume and monetary coefficient. The total emissions are the total scope 1 (direct emissions) and scope 2 emissions (indirect emissions).	As above
Ln EC_Trucost	The natural logarithm of the firm's direct and indirect environmental costs scaled by	Authors' calculations based on Trucost data

(Continues)



TABLE A1 (Continued)

Variables	Description	Source
	operating income. The environmental costs are calculated based on the volume of greenhouse emissions, waste and water usage. The total greenhouse emissions are the total scope 1 (direct emissions) and scope 2 emissions (indirect emissions).	
<i>IO</i>	Institutional ownership.	Authors' calculations based on FactSet data
<i>LTIO</i>	Long-term institutional ownership (based on Döring et al., 2021).	As above
<i>STIO</i>	Short-term institutional ownership (based on Döring et al., 2021).	As above
<i>IO_frgn</i>	Foreign institutional ownership.	As above
<i>IO_dom</i>	Domestic institutional ownership.	As above
<i>LTIO_frgn</i>	Long-term foreign institutional ownership (based on Döring et al., 2021).	As above
<i>STIO_frgn</i>	Short-term foreign institutional ownership (based on Döring et al., 2021).	As above
<i>LTIO_dom</i>	Long-term domestic institutional ownership (based on Döring et al., 2021).	As above
<i>STIO_dom</i>	Short-term domestic institutional ownership (based on Döring et al., 2021).	As above
<i>FIO_adv_econ</i>	Foreign institutional ownership from advanced economies.	As above
<i>FIO_dev_econ</i>	Foreign institutional ownership from developing economies.	As above
<i>BRICS</i>	Dummy variable that equals to one if a firm is located in BRICS countries. BRICS stands for Brazil, Russia, India, China and South Africa.	Authors' calculations
<i>G7</i>	Dummy variable that equals to one if a firm is located in G7 countries. The G7 countries include Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.	Authors' calculations
<i>Nonhigh income</i>	A dummy variable that equals to one if a firm is located in a low- or middle-income country.	Authors' calculations based on World Development Indicators
<i>Ln MTB</i>	Natural logarithm of the market-to-book ratio of assets.	Authors' calculations based on Compustat data
<i>COE</i>	Average of <i>KMPEG</i> , <i>KOJN</i> , <i>KCT</i> and <i>KGLS</i> .	Authors' calculations based on I/B/E/S and Compustat data

TABLE A1 (Continued)

Variables	Description	Source
<i>KMPEG</i>	Implied cost of equity derived from the Easton (2004) model measured 10 months after the fiscal year end.	As above
<i>KOJN</i>	Implied cost of equity derived from the Ohlson and Juettner-Nauroth (2005) model measured 10 months after the fiscal year end.	As above
<i>KCT</i>	Implied cost of equity derived from the Claus and Thomas (2001) model measured 10 months after the fiscal year end.	As above
<i>KGLS</i>	Implied cost of equity derived from the Gebhardt et al. (2001) model measured 10 months after the fiscal year end.	As above
<i>Size</i>	Natural logarithm of total assets in \$ million.	Authors' calculations based on Compustat data
<i>Capital expenditures</i>	Ratio of capital expenditures to total assets.	As above
<i>Dividends</i>	Ratio of cash dividends to total assets.	As above
<i>Leverage</i>	Ratio of total debt to total assets.	Authors' calculations based on Compustat data
<i>ROA</i>	Ratio of operating income to total assets.	As above
<i>R&amp;D</i>	Ratio of research and development expenses to total assets. Missing research and development expenses are set to zero.	As above
<i>LnGDPpercap</i>	Natural logarithm of GDP per capita.	World Development Indicators
<i>BETA</i>	Stock return beta measured over the previous 60 months.	As above
<i>Dispersion</i>	Dispersion of analyst forecasts defined as the coefficient of variation of 1-year-ahead analyst forecasts of earnings per share measured 10 months after the fiscal year end.	Authors' calculations based on I/B/E/S data
<i>Forecast_bias</i>	1-year-ahead consensus earnings forecast minus realized earnings, divided by lagged assets per share.	As above
<i>Inflation</i>	Realized inflation rate over the next year.	World Development Indicators