Who holds brown equity? Economic development, divestment, and environmental outcomes

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Abstract

Using global equity-ownership data for 2002–2021 covering 3,559 firms and 111 investor countries, we show that investors in more developed countries hold less carbon-intensive portfolios. This income gradient appears within varying investor types and remains after accounting for return chasing and financial development, consistent with environmental concerns being more strongly reflected in richer-country portfolios. Greater ownership by poorer-country investors predicts higher subsequent emissions and ESG incidents. Exploiting waves of fossil-fuel divestment commitments, we construct a shift-share measure using firms' predetermined ownership. Rich-country divestment pressure shifts ownership toward poorer countries and worsens environmental performance, reduced-form effects consistent with an ownership channel.

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1 Introduction

A large literature studies how climate-conscious investors tilt away from carbon-intensive firms (Bolton and Kacperczyk, 2021; Gibson Brandon *et al.*, 2022; Heath *et al.*, 2023; Starks *et al.*, 2026). As the clientele literature implies (Heinkel *et al.*, 2001; Hong and Kacperczyk, 2009), what constrained investors refuse to hold ends up with the unconstrained. Prior work either compares investor types within one market or follows one investor type across markets.[1] As equity markets clear across both investor types and countries, studying one group in isolation misses where ownership settles. This matters because a firm's owners influence its environmental conduct (Dyck *et al.*, 2019; Chen *et al.*, 2020; Shive and Forster, 2020; Kahn *et al.*, 2023; Naaraayanan *et al.*, 2026). For carbon-intensive firms, the environmental consequences of divestment depend not only on who exits, but also on who replaces them.

Measuring ownership at the investor-country level nets out intra-market trades and closes the market across all observed investor countries. Figures 1 and 2 provide country-level evidence. Across 123 countries in 2017, the emissions intensity of national equity portfolios declines with GDP per capita, for both the overall portfolio and the foreign shares-only portfolio. Motivated by this, we examine how the level of investor-country economic development affects the ownership of more polluting firms.[2]

[Insert Figures 1 and 2 about here]

Using global ownership information for individual public firms over 2002–2021, we construct the share held by each investor country in each firm-year. We regress this share on the interaction of a firm's emissions intensity in revenue (*EIR*, computed as emissions over revenue) with investor-country log GDP per capita, including firm-year and investor-country-year fixed

[1] Hong and Kacperczyk (2009), for example, document domestic sorting in the ownership of sin stocks. Other work follows institutional investors across countries and relates their environmental behaviour to home-country norms and responsible-investment commitments (Dyck *et al.*, 2019; Gibson Brandon *et al.*, 2022).

[2] Economic development has previously been shown to affect the location of polluting activities, as such activities migrate from more developed economies toward less developed ones (Copeland and Taylor, 1994; Peters *et al.*, 2011), a pattern usually associated with the stricter environmental rules of richer countries (Babiker, 2005; Ben-David *et al.*, 2021).

effects. The estimated interaction term is negative, implying that richer-country investors avoid carbon-intensive firms more. Comparing investor countries at the 25th and 75th percentile of the income distribution, the richer country holds about 0.33 percentage point less of the ownership of a firm per one-standard-deviation increase in *EIR*.

We interpret the relatively green portfolios of investors in richer countries as reflecting a willingness to contribute more to the green transition. This is consistent with models of private provision of public goods, in which contributions tend to rise with income (Bergstrom *et al.*, 1986; Murdoch and Sandler, 1997). But we use environmental preferences in a broad sense. They can shape portfolios directly through nonpecuniary motives and indirectly through policy, institutional mandates, client demand, and transition-risk assessment. Consistent with this interpretation, narrower proxies of green preferences (rule of law, self-expression values, and fossil-fuel divestment commitments) each capture part of the pattern, but none subsumes economic development.

We address two endogeneity concerns. First, domestic ownership could drive the observed pattern. Stricter climate policy lowers the emissions of firms in rich countries, and rich-country investors predominantly own their domestic firms. Their portfolios could therefore appear greener. However, our main finding persists when we exclude domestic holdings. Second, international investment frictions could affect our estimates. Poorer-country investors might hold fewer clean foreign firms because those firms are less accessible, not because of their preferences. Yet poorer countries' tendency to invest in brown foreign firms strengthens, not weakens, when we restrict the estimation to relatively large foreign firms, where such frictions are least binding.

The richer-country avoidance of brown firms varies across investor types and firms. It is strongest among strategic and long-horizon investors, whose relatively persistent stakes may make carbon exposure especially salient. The long-horizon result is consistent with evidence that patient institutions tilt toward firms with stronger ESG profiles and promote CSR through monitoring (Kim *et al.*, 2019; Starks *et al.*, 2026). It is also sizable among delegated managers, who translate their clients' and home-country environmental norms into their portfolio decisions (Gibson Brandon *et al.*, 2022). It is weakest for stewards, such as pension and sovereign-wealth

funds, which may keep shares in order to engage with firms (McCahery *et al.*, 2016). Across firms, it is most pronounced for firms in brown industries and for large firms, which draw the most scrutiny (Azar *et al.*, 2021; Bolton and Kacperczyk, 2021). Moreover, it fades for MSCI World index constituents that experience passive investor demand that is less sensitive to environmental concerns. The gradient survives within each of our three investor types. It therefore cannot be explained merely by cross-country differences in investor-type composition. The country matters over and above the investor type.

Reverse causality is unlikely to explain the effect of economic development, since an investor country's ownership in any one firm is not going to affect its GDP per capita. The relation between ownership and *EIR* is more subtle. If richer-country ownership improves environmental performance, then persistent ownership could itself contribute to a pattern whereby richer countries invest relatively more in greener firms. However, we find that the tendency for rich countries to hold green stocks became much stronger with the entry into force of the Paris Agreement in 2016. The timing is consistent with a shift in investor demand rather than a relation produced only by persistent ownership.

Nevertheless, the international ownership pattern of brown firms potentially affects their environmental performance. Since home-country norms shape how owners act on their rights (Dyck *et al.*, 2019), we ask whether the relatively higher ownership of brown firms by poorer-country investors worsens their environmental performance. We answer this in two settings.

First, we relate a firm's ownership composition across investor-country income groups to its next-year emissions intensity and RepRisk incident intensity. We show that greater ownership by richer countries predicts lower next-year emissions and fewer RepRisk incidents, especially for firms in brown industries and large firms.

Second, to obtain plausibly exogenous variation, we exploit the waves of fossil-fuel divestment commitments. Concentrated in rich countries, these commitments make rich-country investors exit from targeted firms, whose shares others must absorb. We build a shift-share measure in the spirit of Greenstone *et al.* (2020), interacting firms' predetermined 2002–2005 cross-border ownership weights with the later accumulation of rich-country divestment commitments.

Relative to non-exposed firms, a one-standard-deviation increase in divestment-pressure exposure is followed by declines of 2.5 percentage points in the next year and 4.4 percentage points three years later in the rich-country share of foreign ownership. Non-exposed firms show no such move and no differential pre-trend. This is direct evidence that the shares rich-country investors divest are absorbed by foreign investors from poorer countries, a cross-border reallocation that a single-market or single-investor-type setting cannot capture.

In the divestment-pressure test, richer-country pressure shifts target firms' ownership toward poorer countries and worsens their subsequent environmental outcomes. Non-exposed firms with comparable shareholders do not deteriorate and, if anything, improve. Overall, we interpret these estimates as two reduced-form responses to the same pressure. Their joint occurrence, together with the predictive relation between ownership composition and later outcomes, is consistent with an ownership channel. Divestment pressure, however, may also reach firms through stock prices, managerial incentives, or the cost of capital (Gantchev *et al.*, 2022; Choi *et al.*, 2025; Hartzmark and Shue, 2026), and the present design cannot separate these channels.

The results of this paper speak to whether climate-minded investors should exit or engage. In a market setting, divestment does not retire ownership but transfers it, and its environmental effect depends on who absorbs the shares. When the buyer has weaker preferences and less governance capacity, the transfer can undo the intended gains.

Our results connect three strands of work. A theoretical literature shows how investors' nonpecuniary preferences shape equilibrium asset prices, holdings, financing, and corporate behavior (Heinkel *et al.*, 2001; Chowdhry *et al.*, 2019; Pástor *et al.*, 2021; Pedersen *et al.*, 2021; Hong *et al.*, 2023; Oehmke and Opp, 2025). Such preferences are well documented (Hong and Kacperczyk, 2009; Riedl and Smeets, 2017; Hartzmark and Sussman, 2019), and carbon and transition risk are priced and shape institutional behavior (Bolton and Kacperczyk, 2021, 2023; Pástor *et al.*, 2022). Much of this literature examines investor demand and asset prices, with little evidence on equilibrium ownership reallocation and its environmental consequences.

Our work is related to Duchin *et al.* (2025), who find that, using US data, investor pressure can lead firms to sell polluting assets to less scrutinized owners. Berg *et al.* (2026) show that firms under investor pressure sell their foreign-located polluting assets to buyers that attract

less scrutiny, moving the emissions out of sight rather than reducing them. These papers study the reallocation of polluting assets. We instead study the international reallocation of equity ownership, asking which investor countries absorb the shares and how their income matters. Another related literature studies carbon leakage through the international migration of polluting production (Babiker, 2005; Ben-David *et al.*, 2021) or the cross-border reallocation of lending to polluting firms (Benincasa *et al.*, 2022; Laeven and Popov, 2023).

Several papers have examined whether and how investor divestment affects firms. Selling can raise targeted firms' cost of capital or discipline managers through the threat of exit, but these effects depend on the responsiveness of capital and whether firms rely on external finance (Heinkel *et al.*, 2001; Davies and Van Wesep, 2018; Chowdhry *et al.*, 2019; Broccardo *et al.*, 2022; Edmans *et al.*, 2022; Hong *et al.*, 2023; Berk and van Binsbergen, 2025; Oehmke and Opp, 2025). Empirical evidence is mixed: selling pressure and carbon-firm devaluation can induce operational adjustment (Gantchev *et al.*, 2022; Rohleder *et al.*, 2022; Choi *et al.*, 2025), while responsible funds may select firms with stronger pre-existing environmental performance without changing their conduct (Heath *et al.*, 2023). A related literature shows that institutional and engaged owners can improve environmental performance through voice while retaining their shares (Dyck *et al.*, 2019; Kim *et al.*, 2019; Chen *et al.*, 2020; Shive and Forster, 2020; Azar *et al.*, 2021; Naaraayanan *et al.*, 2026), and that governance travels across borders with ownership (Aggarwal *et al.*, 2011). Our evidence links these literatures through two reduced-form responses to pressure from richer countries. Specifically, the pressure shifts targeted fossil-fuel firms' ownership toward poorer countries and worsens their subsequent environmental performance. Together with the broader predictive relation between ownership and outcomes, these responses are consistent with an ownership channel through which divestment affects firms' environmental conduct.

The remainder of the paper proceeds as follows. Section 2 describes the data. Section 3 sets out the empirical approach. Section 4 reports the international ownership allocation results, robustness, and heterogeneity across investors and firms. Section 5 examines the environmental implications, including the divestment pressure design. Section 6 concludes.

2 Data and variables

2.1 Ownership data

We consider the international ownership of the ordinary shares of public companies globally from 2002 to 2021 obtained from the London Stock Exchange Group's Refinitiv Workspace. We restrict ourselves to shares for which price information is available. Ownership data availability varies over time and across countries because of differences in reporting.

In our analysis, we only include firms with a single class of ordinary shares to be able to calculate ownership shares unambiguously.[3] We restrict ourselves to firms for which at least 75% of the ownership is known to ensure that the ownership information is representative of the firm's owners. The ownership threshold of 75% balances having comprehensive ownership data and having broad sets of investor and home countries in the sample.[4] We require that a firm has at least three consecutive years of ownership information, and we only include continuous ownership spans.[5] Firms that are subsidiaries of other firms in the sample are excluded.

Ownership share is calculated as the sum of the ownership shares of all investors with a reported address in a particular country, implying that we consider direct ownership. In practice, many investors channel their investments through an offshore financial center (OFC) to reduce their tax liability or to hide their identity, in which case the country of direct ownership differs from the country of ultimate ownership. For this reason, we exclude OFCs as investor countries in our main analysis. We identify the following countries as OFCs: the Bahamas, Barbados, Cyprus, Gibraltar, Hong Kong, Ireland, Luxembourg, Marshall Islands, Netherlands, Singapore, Switzerland, and the United Kingdom.[6]

A concern with this exclusion is that OFC holdings of brown firms may disproportionately represent unobserved ultimate ownership by investors from richer countries, leading us to

[3]Nearly all firms (96.9%) have issued only one class of ordinary shares.

[4]The Online Appendix elaborates on this and shows the robustness of our results, reporting estimates using higher minimum coverage levels.

[5]For a firm with multiple ownership spans of at least three years, we keep the longest one. If there are multiple ownership spans of equal length, we keep the most recent one.

[6]We use the list of conduit-OFCs from Garcia-Bernardo *et al.* (2017), see Table S4 (with Threshold 100).

understate rich-country ownership in polluting firms. Figure 3 plots OFC and non-OFC average ownership shares in brown firms using two firm weightings: equal weight (Panel A) and current-year market capitalization (Panel B). Under both weightings, the OFC share is low, fluctuating over the first few years and then staying relatively flat. This stability alleviates the concern that excluding OFCs qualitatively changes the rich–poor ownership pattern examined in this paper.

[Insert Figure 3 about here]

Our final firm-level sample has ownership information for 3,559 firms held by investors with addresses in 111 nations and special administrative regions. On average, we observe ownership from 20 investor countries per firm-year. *Ownership share* is winsorized at the 0.01 level, and the final regression sample consists of 298,803 observations (Table 1, Panel A). As an alternative ownership variable, we use *Holding value*, the value of an investor country's collective position in a firm divided by investor-country GDP.

[Insert Table 1 about here]

We construct investor-type-specific ownership by aggregating holdings within each investor country–firm–year. Using LSEG's classification, we group investors into three categories: *Delegated* investors that manage capital for external clients; *Stewards* such as pension funds whose primary channel of influence is voting and engagement; and *Strategic* investors that hold concentrated positions for ownership or control. We separately classify investors into high-, medium-, and low-turnover groups, corresponding to average holding periods below one year, one to two years, and above two years.[7]

We also construct ownership variables by GDP-per-capita quartile grouping (groups 1–4, bottom to top), expressed as fractions of total reported ownership so that they add up to one. Countries in the bottom and top quartiles own 3% and 82% of a firm's shares on average (Table 1, Panel C).

[7]The Online Appendix provides more details for category mapping and sample composition.

2.2 Fossil-fuel divestment commitments and targets

We obtain data on publicly announced institutional fossil-fuel divestment commitments from Stand.earth's Global Divestment Commitments Database. We assign each commitment to the country in which the committing institution is domiciled. Because the registry does not report commitment dates, we identify the commitment year from public announcements and archived versions of the registry. Of the 1,731 commitments in the registry, 1,576 (91.0%) have a verifiable commitment year and enter our country-year construction. We exclude the remaining 155 commitments.

For each investor country and year, we count the cumulative number of dated commitments through year-end and construct *Div. commitment* as log(1 + cumulative commitments). We interpret this variable as a proxy for the pressure within an investor country to incorporate environmental concerns into portfolio decisions. This pressure can arise from institutions' own preferences, public attention, or related policy and mandate pressures. It does not separately identify the underlying sources of this pressure, and it does not assume that all investors in a country have committed to divest.

Observable commitments are strongly concentrated in richer investor countries. By 2021, among the 921 country-attributed commitments recorded for investor countries represented in our ownership sample, 863 (93.7%) originate from countries in the upper two GDP-per-capita quartiles. Thus, restricting our later analysis to rich-country commitments does not materially narrow the observable divestment pressure captured in our sample.

To identify firms targeted by fossil-fuel divestment campaigns, we use Urgewald's Global Oil and Gas Exit List (GOGEL), the Global Coal Exit List (GCEL), and the Metallurgical Coal Exit List (MCEL). We construct a time-invariant classification because firms' underlying fossil-fuel activities are expected to be persistent over our sample period. We match firms in our sample to the Urgewald data using Refinitiv organization identifiers, equity ISINs, and normalized firm names and countries. Using fossil-fuel revenue and power shares, coal production, coal-power capacity, and related Urgewald indicators, we classify firms into four tiers of divestment-targeting risk: Heavy, Moderate, Low, and No risk.[8] Table 2 summarizes

[8]The Online Appendix provides details on the matching procedure, tier-assignment criteria, and fallback clas-

the classification criteria and the distribution of firms across tiers. It also reports how many firms in each tier enter the divestment-pressure sample, which requires sufficient 2002–2005 bilateral ownership shares and at least one post-2008 observation. The tier shares are similar across the two samples, indicating that conditioning on pre-divestment ownership data broadly preserves the representation of each tier. In the divestment-pressure analysis, *FF-exposed* firms are those classified as Heavy or Moderate, while *non-FF* firms are those classified as No risk.[9]

[Insert Tables 2 and 3 about here]

2.3 Emission and incident data

We obtain emissions data by combining firms' self-reported disclosures from the Carbon Disclosure Project (CDP) with reported and estimated data from Refinitiv Workspace. We use a firm's sum of Scope 1 and 2 emissions relative to its revenues, denoted *Emissions intensity in revenue (EIR)*, as the main carbon intensity variable. This emissions intensity measures emissions relative to the total value of production.[10] The mean of *EIR* is 0.41 tonnes of CO_2 equivalent per thousand USD of revenue (Table 1, Panel A).

In an additional test, we distinguish between brown and non-brown industries using industry groups within the 10 sectors of the Refinitiv Business Classification (TRBC). We identify brown industries as the industries with consistently high yearly median emission measures.[11]

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sification of firms without a unique Urgewald match. In May 2026, we used Claude Opus 4.8 (Anthropic), accessed through Claude Code, to generate candidate classifications based on firm names, countries of incorporation, and available business descriptions. We reviewed all candidate classifications and made the final decisions.

[9]We exclude Low-risk firms because their peripheral fossil-fuel exposure makes them unlikely to be direct divestment targets, while including them with No-risk firms would introduce partially exposed firms into the comparison group. Because Low-tier firms account for only 2.5% of the environmental-outcome firm sample and 2.1% of the divestment-pressure sample, this exclusion has little effect on sample size.

[10]This captures all the productive inputs. In contrast, emissions intensity in terms of assets measures emissions relative to capital inputs as proxied by assets. Table A3 in Appendix A reports robustness to alternative emissions variables.

[11]The brown industries are Oil and Gas, Metals and Mining, Construction Materials, Paper and Forest Products, Freight and Logistics Services, Passenger Transportation Services, Electric Utilities and IPPs, Natural Gas Utilities,

We supplement our firm-level sample with environmental, social, and governance (ESG) incident data collected by RepRisk. Incidents refer to documented ESG controversies, events, or violations associated with specific companies, capturing the extent of ESG pressures or shocks to their reputation (Duchin *et al.*, 2025). We calculate total and environmental incident intensities as the log of the ratio of a firm's relevant incident count to its total assets, reflecting that larger firms are likely to experience more incidents. Summary statistics for the incident intensity variables are provided in Panel C of Table 1 and Table 3. Table A1 of Appendix A details all variables and their sources.

3 Empirical approach

3.1 Collective portfolios and economic development

Our main hypothesis is that the propensity of investors in a country to own shares of carbon-intensive firms declines with its economic development. In the case of equity investments in individual firms, we estimate the following specification,

$$\begin{aligned} \textit{Ownership share}_{fct} = \alpha + \beta\, EIR_{ft} \times \textit{Log GDP per capita}_{ct} + \mu\, EIR_{ft} \times \textit{Market Cap.}_{ct} \\ + \theta\, Return_{ft} \times \textit{Log GDP per capita}_{ct} + Foreign_{fc} + \gamma_{ft} + \delta_{ct} + \varepsilon_{fct}, \end{aligned} \tag{1}$$

where $\textit{Ownership share}_{fct}$ is the total ownership share of firm f held by investors in country c at time t, and EIR_{ft} denotes the emissions relative to revenues of firm f in year t.

We focus on ownership share, which represents a quantity outcome in general equilibrium. For this ownership share specification, a concern is that firms' emission intensities may be systematically correlated with returns (Bolton and Kacperczyk, 2021, 2023; Pástor *et al.*, 2021). This issue is especially relevant here. Prior evidence suggests that carbon-related return patterns vary systematically across markets and with economic development (Bolton and Kacperczyk,

Multiline Utilities, Chemicals, Containers and Packaging, Consumer Goods Conglomerates, Healthcare Providers and Services, Food and Tobacco, and Homebuilding and Construction Supplies. See the Online Appendix for construction details.

2023; Zhang, 2025). Cross-country differences in ownership of high-emission firms could therefore reflect return-driven portfolio sorting. If richer-country investors are best placed to harvest the carbon premium, this pecuniary force works against the carbon-sensitive sorting that we hypothesize. We therefore include $Return_{ft} \times Log\ GDP\ per\ capita_{ct}$ to separate this return-seeking channel from the decarbonization channel. Relatedly, economic development is correlated with financial development, which may independently shape firms' environmental performance and how investors value it (Breuer *et al.*, 2018; De Haas and Popov, 2023). We include $EIR_{ft} \times Market\ Cap._{ct}$ to control for the role of investor-country financial development.[12] Separating financial development from economic development helps to isolate the carbon-sensitive portfolio allocation associated with the broader investor-country environment.

We include a $Foreign$ dummy to distinguish between domestic and foreign portfolio choices. We also include time-varying firm fixed effects (γ_{ft}) to control for firm characteristics including perceived financial risk and return, actual stock price fluctuations, and the firm's carbon intensity. In addition, we include time-varying investor-country fixed effects (δ_{ct}), which control for time-varying investor-country characteristics, including overall portfolio size.[13] Standard errors are clustered at the firm level.

The key parameter β measures how the carbon gradient of investment $\left(\frac{\partial\ Ownership\ share_{fct}}{\partial\ EIR_{ft}}\right)$ varies with economic development as proxied by $Log\ GDP\ per\ capita_{ct}$.[14] With firm-year and

[12] Appendix Table A2 reports the variable selection exercise behind this choice. We consider additional investor-country controls for financial development, resource exposure and commodity trade, and climate risk exposure. Resource exposure and commodity trade may shape national ties to brown industries, while climate risk may affect demand for green portfolios. The relation between EIR_{ft} and $Log\ GDP\ per\ capita_{ct}$ remains negative and economically strong across these specifications, while most added controls are not significant. The exception is indices of financial development. We retain stock-market capitalization rather than bank assets because it materially affects the key estimated coefficient while being less strongly correlated with GDP per capita.

[13] Investor-country × home-country fixed effects absorb persistent bilateral investment propensities and change the estimand from the aggregate cross-country allocation gradient to relative allocation across firms within the same investor–home pairs. We report this complementary specification in Section 4.3 to assess whether persistent bilateral matching accounts for the baseline result.

[14] As a descriptive diagnostic, the unconditional correlation between *EIR* and *Log GDP per capita* in our firm-level sample is neither numerically nor statistically different from 0.

investor-country-year fixed effects, β is identified by comparing the ownership–EIR gradient across investor countries with different levels of economic development. A more negative estimated value of β implies that the carbon sensitivity of investment increases with economic development, meaning that investors in richer countries have a weaker tendency to hold carbon-intensive firms.

Our interpretation of β is deliberately reduced-form. We do not interpret GDP per capita as identifying the causal effect of income or a purely nonpecuniary preference parameter. Rather, economic development summarizes the broader investor-country environment through which environmental concerns enter portfolio allocation, including social preferences, regulation, institutional mandates, client demand, and beliefs about carbon-transition risk. These policy and institutional channels are therefore part of the economic-development gradient we study, rather than competing explanations that the specification seeks to eliminate.

A simple reverse-causality interpretation is unlikely: an individual investor country's ownership share in a given firm-year cannot reasonably determine either the firm's emissions intensity or the investor country's level of economic development. However, two endogeneity concerns remain.

First, domestic ownership pairs create a possible confounding link because the investor country is also the firm's home country. If countries hold disproportionately large stakes in their own firms, and firms in poorer countries are more carbon-intensive, the negative interaction could partly reflect poorer countries' domestic ownership of their own brown firms rather than richer countries' lower ownership of carbon-intensive firms. We address this concern through a foreign-holdings specification that removes domestic ownership pairs and includes the variable *Distance* to account for bilateral information costs in cross-border portfolio choice.

Second, investor countries may differ in the set of firms they can effectively access. If poorer-country investors are less likely to hold low-EIR firms because those firms are concentrated in markets or segments with greater access, information, or investability barriers, the estimated interaction could partly reflect these frictions rather than carbon-sensitive portfolio allocation. To address this concern, we re-estimate the foreign holdings specification for large firms that are more visible, widely held, and more likely to have reliable ownership, emissions, and trading

information. Finally, we extend the benchmark specification in several ways to examine investor heterogeneity and sector- and firm-level heterogeneity.

3.2 Ownership allocation and corporate environmental outcomes

Our baseline estimates imply that richer-country investors' stronger avoidance of carbon-intensive firms shifts their ownership toward poorer-country investors. We examine the environmental implications of this reallocation through two complementary tests. We begin by relating realized ownership composition to subsequent environmental outcomes across the broad firm sample in Subsection 3.2.1. Subsection 3.2.2 then uses fossil-fuel divestment pressure to estimate separate reduced-form effects on international ownership reallocation and environmental performance.

3.2.1 Ownership composition and subsequent environmental outcomes

We relate a firm's ownership distribution across investor-country income groups to its subsequent emissions intensity and ESG incident counts by estimating the following specification:

$$Y_{f,t+1} = \alpha + \beta_1 \, Ownership_{ft}^{2q} + \beta_2 \, Ownership_{ft}^{3q} + \beta_3 \, Ownership_{ft}^{4q} + \gamma_f + \delta_t + \Theta X_{ft} + \varepsilon_{f,t+1}, \quad (2)$$

where $Y_{f,t+1}$ denotes one of two firm-level outcomes measured in year $t+1$: $\log(EIR)_{f,t+1}$, the log emissions intensity of firm f, or $\log(\textit{incident intensity})_{f,t+1}$, computed as the log of the total count of incidents divided by assets. $Ownership_{ft}^{2q}$, $Ownership_{ft}^{3q}$ and $Ownership_{ft}^{4q}$ are the adjusted ownership fractions of country groups 2 to 4 (representing countries in the second to fourth quartiles of the distribution of GDP per capita). The ownership fraction for countries in group 1, i.e., in the bottom quartile of the distribution of GDP per capita, is omitted from the regression. The controls X_{ft} include a firm's size measured by the log of assets, leverage measured by total liabilities divided by total assets, return on assets, and Tobin's Q. Firm and year fixed effects are included, absorbing time-invariant firm-specific characteristics as well as year-specific shocks.

Negative estimates of β_1, β_2 and β_3 would indicate that, relative to ownership by investors in the poorest country group, larger ownership shares by investors from richer country groups

are associated with lower subsequent emission or incident intensity. This pattern would be consistent with investors in richer countries monitoring and pressing portfolio firms toward greener practices. It would also suggest that reallocating brown-firm ownership toward poorer-country investors could increase pollution and ESG-related incidents. We acknowledge two limitations. First, using next year's outcomes reduces but does not eliminate reverse-causality concerns. Richer-country investors may select firms that already plan to improve environmentally. The divestment-pressure setting in Section 3.2.2 can provide complementary evidence from predetermined exposure that does not rely on contemporaneous ownership selection. Second, because the ownership variables include domestic shares, the estimated associations could partly reflect home-country confounding factors that do not always relate to the international ownership composition. The divestment-pressure test addresses this domestic confounding link by focusing on the foreign shareholder base.

3.2.2 Fossil-fuel divestment pressure and environmental outcomes

We exploit country-specific fossil-fuel divestment pressure in an interacted shift-share design that combines firms' pre-campaign ownership shares with subsequent country-level divestment commitments. Comparing firms with substantial fossil-fuel exposure (FF-exposed) and firms with no identified fossil-fuel exposure (non-FF), we estimate how the same pressure affects both the ownership of fossil-fuel firms and their subsequent environmental performance. By focusing on the foreign shareholder base throughout, this test also removes the domestic confounding factor present in Section 3.2.1, where ownership variables include positions held by investors from the firm's home country. The setting is necessarily narrower than our broad comparison across firms with different emissions intensities because the observed commitments mainly target fossil-fuel holdings. This focus does not imply that environmentally motivated portfolio reallocation is confined to these firms, since the preferences behind the commitments may also shape holdings outside the fossil-fuel sector.[15]

[15]Some portfolio decarbonization commitments extend beyond fossil-fuel holdings. The Portfolio Decarbonization Coalition (PDC), for example, mobilizes institutional investors to decarbonize their portfolios through approaches ranging from engagement to divestment.

To measure how much divestment pressure a firm's shareholder base faces, we construct a firm-level shift-share ("Bartik") exposure measure similar to the credit-supply shift-share design of Greenstone *et al.* (2020). Countries in the upper half of the investor-country GDP-per-capita distribution account for 93.7% of dated divestment commitments. Including the few commitments from relatively poorer countries has little effect on the measure but makes its interpretation less clear. We therefore construct the exposure measure using commitments from richer investor countries only.[16]

$$\textit{Divestment pressure}_{f,t} = \sum_{c \in \textit{Richer countries}} w_{f,c}^{2002\text{–}2005} \cdot \textit{Div. commitment}_{c,t}, \tag{3}$$

where f indexes firms, c indexes investor countries, and t indexes year. Here, as pre-period exposure shares, we use firm f's average bilateral ownership share by country c across its earliest (up to) three observations during the 2002–2005 pre-treatment window, denoted $w_{f,c}^{2002\text{–}2005}$. The country-year-specific variable *Div. commitment* is computed based on the cumulative commitments by institutions domiciled in richer country c through year-end t. Due to the lasting nature of the divestment commitments, the shift component is the cumulative stock of divestment pressure rather than a per-period shock. We follow the exposure-share interpretation of Goldsmith-Pinkham *et al.* (2020), under which identification comes from the shares. Conditional on the fixed effects, identification therefore requires firms' 2002–2005 cross-border ownership weights to be uncorrelated with their subsequent unobserved ownership and environmental-outcome shocks.

We estimate separate reduced-form effects of divestment pressure on ownership composition and environmental outcomes. We do not use pressure as an instrument for realized ownership changes. Such an interpretation would require pressure to affect environmental outcomes only through measured year-end ownership, whereas it may also affect firm behavior through stock-price pressure and managerial incentives (Gantchev *et al.*, 2022; Choi *et al.*, 2025). First, we examine whether divestment pressure changes the composition of fossil-fuel-exposed firms' foreign shareholder bases. We use two measures of ownership reallocation. One is the fraction

[16] We classify richer investor countries once, based on each investor country's average GDP per capita over the sample period, and use the same country group in all years.

of foreign ownership held by rich investor countries. The other is the ownership-weighted average log GDP per capita of foreign owners.[17] For horizons $h = 1, 2, 3$, we estimate

$$OC_{f,t+h} = \alpha + \beta_1 Divestment\,pressure_{f,t} + \beta_2 Divestment\,pressure_{f,t} \times FF\text{-}exposed_f + \beta_3 Divestment\,pressure_{f,t} \times EIR_{f,t} + \rho\, OC_{f,t-1} + \Theta X^O_{ft} + \gamma_f + \delta_{C,t} + \eta_{FF,t} + \varepsilon_{f,t+h}, \tag{4}$$

where $OC_{f,t+h}$ denotes one of the two ownership-composition outcomes measured at $t+h$. Each specification includes the corresponding lagged outcome $OC_{f,t-1}$, so the estimates compare subsequent ownership composition among firms with similar pre-existing ownership composition. The control vector X^O_{ft} contains firm size, leverage, Tobin's Q, return on assets, stock return, *EIR*, and an indicator for MSCI World index inclusion. Firm fixed effects γ_f absorb time-invariant firm characteristics. Firm country × year fixed effects $\delta_{C,t}$ absorb country-level shocks in the firm's location country. We also include FF-exposed × year fixed effects $\eta_{FF,t}$ to absorb common year-specific changes in the ownership composition of FF-exposed firms, such as those associated with commodity-price fluctuations or broad shifts in policy and market sentiment toward fossil fuels. The coefficient of interest is β_2, which tests whether FF-exposed firms facing greater divestment-pressure exposure through their pre-treatment shareholder base subsequently have a lower rich-country presence among foreign owners. Specifically, β_2 captures differential subsequent ownership composition beyond common sector-wide changes and the firm's own lagged ownership composition. We additionally interact divestment pressure with *EIR* to control for the possibility that some divestment pressure spills over to carbon-intensive firms regardless of their fossil-fuel exposure. Standard errors are clustered at the firm's location country level, accounting for potential correlation in ownership composition across firms within a given country.

In the second step, we estimate the reduced-form effect of divestment pressure on subsequent environmental outcomes, separately for FF-exposed and non-FF firms.

$$Y_{f,t+h} = \alpha + \beta\, Divestment\,pressure_{f,t} + \gamma_f + \delta_{C,t} + \Theta X^E_{ft} + \varepsilon_{f,t+h}, \tag{5}$$

[17] The outcome is required to have a foreign shareholder base of at least five percentage points at both $t-1$ and $t+h$ to mitigate the accessibility concern. Moreover, to avoid mechanical effects from time-varying country reclassification, we again use a fixed rich-country classification.

The dependent variable $Y_{f,t+h}$ is *Log EIR*, *Log total incident intensity*, or *Log environmental incident intensity*. Each is measured in year $t+h$, for $h = 1, 2, 3$. The control vector X^E_{ft} contains lagged firm size, leverage, Tobin's Q, return on assets, the MSCI World index indicator, lagged annual log price return, and lagged ownership shares held by investor-country quartiles Q2, Q3, and Q4, expressed in percentage points, with Q1 omitted. These ownership shares may affect environmental outcomes independently of ownership-weighted divestment pressure, as specification (2) shows. The coefficient β captures the reduced-form environmental response to divestment pressure. For FF-exposed firms, the observed commitments directly target holdings in their stocks. A positive β indicates that the pressure worsens their subsequent environmental outcomes through one or more channels, which may include but are not limited to measured year-end ownership changes. For non-FF firms, the same exposure is not based on direct fossil-fuel targeting and may capture broader portfolio-reallocation or spillover effects, so we report these estimates as a comparison rather than as a strict placebo. In both specifications, the estimation sample begins in 2008, the first year with an observed divestment commitment, and standard errors are clustered at the firm's location country level.

4 International ownership allocation of carbon-intensive firms

4.1 Economic development and carbon-sensitive ownership

We report our basic estimation results based on specification (1) in Table 4. Column 1 shows baseline estimates for 2002–2021 using investor-country ownership shares in each firm as the dependent variable. With firm-year and investor-country-year fixed effects, the interaction *EIR* × *Log GDP per capita* captures whether firms with higher carbon intensity have a different distribution of ownership across richer and poorer investor countries. The estimated coefficient is −4.47 (significant at 5%), indicating that, relative to investors from poorer countries, investors from richer countries account for smaller ownership shares in firms with higher carbon intensity. For a given year, comparing investor countries at the 25th and 75th percentiles of GDP per capita, the relatively richer country on average holds about 33.26

basis points less ownership for a one-standard-deviation increase in the portfolio firm's *EIR*.[18] Economically, this level of 33.26 basis points is 6.3% of the mean ownership share (523.94 basis points) but five times the median position (6.64 basis points).[19] The median is the more informative benchmark, since it corresponds to a typical investor-country position.

[Insert Table 4 about here]

The baseline estimate is conditional on two financial channels that may otherwise confound the interpretation. First, because carbon intensity may be correlated with returns and associated risks that differ across markets (Bolton and Kacperczyk, 2021, 2023; Zhang, 2025), we include *Return* × *Log GDP per capita*. This control separates carbon-sensitive ownership allocation from ownership sorting associated with realized firm returns. The estimated coefficient is 0.642 (significant at 1%), indicating that, relative to poorer-country investors, richer-country investors hold larger ownership shares in higher-return firms. Richer-country investors do chase returns, which, given the carbon premium documented by Bolton and Kacperczyk (2021, 2023), would on its own tilt them toward carbon-intensive firms. Yet the carbon gradient estimated conditional on this return sorting remains negative.

Second, we include *EIR* × *Market cap.* to separate the economic-development gradient from differences in investor-country financial-market development. The estimated coefficient is −5.79 (significant at 5%), indicating that countries with deeper stock markets tilt relatively more toward greener firms.

The result is also robust to alternative measures of holdings in columns 2 and 3, in which we rescale ownership shares by coverage and measure holdings in value terms. Thus, the baseline relation is not specific to the ownership-share measure. As ownership shares abstract from share prices, we retain *Ownership share* as the dependent variable in our subsequent firm-level analysis.

Columns 4–8 address sample and data restrictions. Because part of a firm's ownership may

[18] This can be calculated as follows: $33.26 = 4.47 \times 4.616 \times 1.612$. The value 1.612 is the average 25th-to-75th percentile difference in *Log GDP per capita* when investor countries are ranked within each year.

[19] The two benchmarks diverge because domestic positions, though only 5.9% of the observations, account for 80% of the mean.

be unobserved, the estimated gradient could reflect selective reporting if rich-country holdings are disproportionately missing for high-EIR firms. Columns 4 and 5 therefore split the sample by the ownership coverage of their headquarters country. The interaction *EIR* × *Log GDP per capita* is negative in both groups. It is significant in high-coverage countries (column 4) and larger but imprecisely estimated in low-coverage countries (column 5). The high-coverage estimate shows that the result is not driven by selective missing holdings in low-coverage markets.

A further concern is that firms headquartered in countries with high national fossil-fuel dependence may have fundamentally different ownership patterns. In columns 6 and 7, we therefore split the sample by whether the firm's headquarters country is a "petro-state".[20] The estimate is insignificant for petro-state firms and remains negative and significant for firms from the other countries. In column 8, we start from the non-petro-state firm sample and additionally exclude petro-state investor countries. The estimate remains negative and significant.

Finally, columns 9 and 10 examine whether carbon-sensitive ownership allocation shifts after the Paris Agreement by extending specification (1) with *EIR* × *Log GDP per capita* × *PostPA*. In the full sample in column 9, the triple interaction is negative and larger in magnitude (-8.48), but insignificant. To alleviate the selection concern that more firms, and potentially greener firms, are observed in the post-Paris period than in the pre-Paris period, we re-estimate the triple interaction in a balanced-window sample that requires firms to be present at least once in both the pre- and post-Paris windows. The corresponding estimate is -17.92 in this sample, significant at 10%. The negative estimates point to a stronger carbon-sensitive ownership pattern after the Paris Agreement, suggesting that environmental concerns became more strongly expressed through portfolio choices. We do not isolate nonpecuniary preferences or claim the causal effect of the Paris Agreement, as the timing is also associated with changes in policy, disclosure, institutional mandates, and transition-risk assessment. The estimates in column 10 imply that, in the post-Paris period, the same 25th-to-75th percentile comparison

[20] We classify countries as petro-state if average oil, natural gas, and coal rents account for at least 7% of GDP over 2000–2021, where rents follow the World Bank definition, i.e., the value of resource production at world prices net of extraction cost. The countries in this group represented in our sample are Bahrain, Egypt, Kazakhstan, Kuwait, Norway, Oman, Qatar, Russia, Saudi Arabia, and the United Arab Emirates.

across investor countries is associated with an ownership differential of −160.0 basis points for a one-standard-deviation increase in the portfolio firm's *EIR*.[21] This effect is 30.5% of the mean ownership share but roughly 24 times the median position.

4.2 Economic development versus alternative measures of preferences

Our focus on the negative interaction between *EIR* and *Log GDP per capita* is motivated by the theory of the private provision of public goods (Bergstrom *et al.*, 1986). We view greener equity allocation as a form of private contribution to an environmental public good, and argue that countries at higher levels of economic development may collectively be more willing to support such an allocation. We therefore interpret economic development as reflecting a broader preference toward a low-carbon transition, including nonpecuniary motives as well as the policy, institutional, and market channels through which environmental concerns enter portfolio decisions.

A natural alternative is to use more conventional country-level proxies for the preferences that may underlie the economic-development gradient. Table 5 considers three such measures.[22] *Rule of law* captures an institutional dimension of the country environment, following La Porta *et al.* (1998), who use it as their measure of the quality of legal enforcement. Prior work shows that country legal institutions shape corporate social responsibility (Liang and Renneboog, 2017) and that investor protection changes how CSR is reflected in firms' cost of equity (Breuer *et al.*, 2018). *Self-expression* captures a cultural-values dimension related to non-financial preferences, in line with evidence that investor-country social norms matter for institutional ownership (Hong and Kacperczyk, 2009; Dyck *et al.*, 2019). *Div. commitment* captures investor-country exposure to the use of divestment as an environmental-finance tool and is more directly linked to the ownership pattern we study.

[Insert Table 5 about here]

[21] This can be calculated as follows: $-160.0 = (-3.58 - 17.92) \times 1.612 \times 4.616$.

[22] This test is distinct from the control-selection exercise in Appendix Table A2, which considers additional country characteristics that could affect ownership sorting through channels not captured by economic development.

Panel A shows that these alternatives are closely related to GDP per capita, especially *Rule of law* and *Self-expression*, which have correlations with *Log GDP per capita* of 0.78 and 0.76.[23] These two measures are also highly correlated with each other, at 0.79. *Div. commitment* is positively correlated with *Log GDP per capita*, with a full-sample correlation of 0.16. This lower full-sample correlation mainly reflects the recent emergence of divestment campaigns and the resulting mass of earlier zero-commitment country-years. Among country-years with at least one commitment, the correlation between *Div. commitment* and *Log GDP per capita* rises to 0.48.

Panel B examines whether these alternative measures can account for the economic-development gradient. We add each alternative measure to the baseline specification in column 1 and report the resulting joint specifications in columns 2, 3, and 4. We also estimate a corresponding replacement specification that uses the alternative measure in place of *Log GDP per capita*, and report these results next to the joint specifications in columns 2′, 3′, and 4′.

We find that the alternatives can capture pieces of the same ownership-sorting pattern in isolation, but none provides an independent negative gradient once GDP per capita is included. Specifically, the replacement specifications show that *Rule of law* and *Div. commitment* each generate a negative ownership gradient similar to the baseline GDP-per-capita gradient, although their coefficients are significant only at the 10% level. *Self-expression* does not generate a significant negative gradient. In the joint specifications, the GDP-per-capita interaction remains negative and statistically significant in all three columns. By contrast, *Rule of law* and *Div. commitment* lose significance when included with GDP per capita, while *Self-expression* reverses sign and becomes positive. One possible reason for this weaker result is that self-expression is a broad cultural measure rather than a preference measured close to financial decision-makers.

These results indicate that the alternative measures capture part of the ownership sorting associated with economic development, but do not subsume it. This pattern is consistent with our argument that GDP per capita captures a broader country-level preference environment than any

[23]This is consistent with La Porta *et al.* (1998), who report that per capita income explains most of the cross-country variation in rule-of-law scores.

one of these alternatives. The alternatives help locate possible components of this environment, including institutional conditions, cultural values, and climate-finance preferences expressed through divestment, but each captures only a particular component. In richer economies, carbon-related preferences may be expressed directly through nonpecuniary portfolio choices and indirectly through regulation, mandates, client demand, and forward-looking assessments of carbon risk. Interpreting economic development as a summary measure of this broader preference environment therefore matches our focus on the general-equilibrium ownership outcome, which reflects the net result of these various channels in the allocation of firm ownership across investor countries.

4.3 Robustness and extensions

We next examine the robustness of the baseline pattern and then extend the analysis to examine heterogeneity across investors and across firms. In particular, we first address two endogeneity concerns for the baseline estimates, namely the domestic ownership confounding factor and selection into the ownership choice set, as outlined in Section 3.1. We report the results in Table 6.

[Insert Table 6 about here]

Columns 1 and 2 restrict the sample to foreign investor–firm pairs and control for bilateral distance that proxies for cross-border information frictions. The coefficient on $EIR \times Log\ GDP\ per\ capita$ remains negative and significant after removing the domestic holdings, supporting our baseline result. Moreover, this estimated coefficient becomes more negative from -3.11 in the full foreign sample to -7.76 in the post-Paris period. The stronger post-Paris estimate indicates that the carbon-income ownership gradient is more pronounced after the Paris Agreement, consistent with carbon-related considerations becoming more salient in cross-border portfolio allocation.

Columns 3 and 4 further restrict the foreign-holdings sample to large firms, addressing accessibility and investability concerns. The estimated coefficient is more negative in both the full sample and the post-Paris period, with a smaller increase in effect size between the two

columns. This pattern alleviates the concern that the baseline result is created by access bias, whereby poorer-country investors are less likely to hold low-EIR foreign firms because those firms are harder for them to access. Indeed, limiting the comparison to more visible and broadly investable firms strengthens the gradient, suggesting that better access may make poorer-country investors' relative ownership of browner firms even more pronounced.

Appendix Table A4 re-estimates the specifications with investor-country × home-country and investor-country × home-country × year fixed effects, holding each investor–home relationship fixed. The income gradient remains negative, −2.65 (significant at 5%) and −2.64 (significant at 10%) for the benchmark sample, so it also exists within investor-country × home-country pairs. However, we use these specifications as robustness tests only, as the demanding fixed effects remove the across-market component of the sorting we study. If richer countries hold less brown equity partly by investing less in carbon-intensive economies as a whole, these estimates retain only the within-market tilt.

We next examine where the negative relation between firm carbon intensity and richer-country ownership is most pronounced across investors and firms. Panel A of Table 7 examines whether the carbon–ownership gradient differs across investor types in columns 1–3 and alternatively by portfolio turnover in columns 4–6. Prior work provides grounds to expect variation across investor categories. Home-country environmental values shape institutional investors' portfolio and governance decisions (Dyck *et al.*, 2019), and the home location of responsible investors predicts whether responsible investment commitments translate into greener portfolio holdings (Gibson Brandon *et al.*, 2022).

[Insert Table 7 about here]

As described in Section 2, we classify investors as delegated investors, stewards, or strategic investors. We aggregate each investor country's holdings in a firm-year separately for each investor-type category. If a country holds a firm but not through all three types, we assign zero to the absent types rather than omitting those observations, since the absence of a type's holding is itself informative about how that type allocates across firms. Our investor-type heterogeneity test uses the sample of large foreign-held firms to mitigate the concerns related to coverage and

selection.[24]

The estimated coefficients on *EIR* × *Log GDP per capita* are negative and significant for all three investor types. These results indicate that the income gradient in carbon-intensive ownership varies in magnitude but is not confined to a single mandate type.

The magnitude difference across types is informative. The larger coefficient for strategic investors is consistent with concentrated, long-term positions creating stronger sensitivity to carbon risk in foreign target firms. The significant coefficient for delegated investors is consistent with evidence that investment managers, who allocate capital on behalf of clients, implement their home-country environmental norms through portfolio choices (Gibson Brandon *et al.*, 2022). The smaller coefficient for stewards is expected: institutions such as pension funds and sovereign wealth funds are more likely than other investor types to use engagement and voting to induce brown firms to become greener (McCahery *et al.*, 2016; Dyck *et al.*, 2019; Broccardo *et al.*, 2022), which requires continued ownership of such firms.

Columns 4–6 split the sample by portfolio turnover. The estimated coefficients on *EIR* × *Log GDP per capita* are negative and significant across all three turnover groups, with magnitude increasing monotonically from high- to low-turnover investors. This increasing gradient is consistent with evidence that long-horizon investors tilt their portfolios more strongly toward firms with stronger environmental profiles (Starks *et al.*, 2026).

Panel B turns to firm-level heterogeneity, removing the large foreign firm restriction. Columns 1–3 split the sample by industry, estimating the baseline specification separately for brown and non-brown firms. Column 2 further excludes upstream fossil-fuel energy firms from the set of brown firms to test whether the gradient persists across other brown firms. Columns 4–6 augment the baseline with triple interactions of *EIR* × *Log GDP per capita* with firm size and MSCI World index inclusion.

The estimated coefficient on *EIR* × *Log GDP per capita* is negative and significant for brown industries. The result is not limited to upstream fossil-fuel energy firms, as it remains when

[24] Splitting by investor type in the full sample risks conflating genuine cross-type differences in carbon preferences with the domestic-investment or disclosure patterns. For example, strategic investors may hold positions in their home country more than other types of investors.

these are excluded. The estimate for non-brown industries is negative but insignificant. This is consistent with evidence that investors pay particular attention to carbon risk in high-emission sectors (Bolton and Kacperczyk, 2021, 2023). In columns 4–6, the triple interaction with firm size is negative, indicating a stronger gradient for larger firms that attract greater investor scrutiny (Azar *et al.*, 2021). The triple interaction with MSCI World index inclusion is positive and significant, indicating a weaker gradient for index constituents. This result suggests that index inclusion may generate passive demand that is unresponsive to carbon intensity, shifting the equilibrium ownership composition. Both patterns remain when the two interactions are included together.

5 Environmental implications of international ownership allocation

Section 4 documents that investors from richer countries hold smaller shares of more carbon-intensive firms. As environmental preferences continue to shape this sorting, the general-equilibrium implication is that ownership of carbon-intensive firms may increasingly be concentrated among investors from poorer countries.

A growing literature suggests that shareholders can influence firm environmental outcomes (Dyck *et al.*, 2019; Kim *et al.*, 2019; Chen *et al.*, 2020), raising the question of whether the cross-country ownership sorting we document carries implications for firms' environmental performance. We first examine whether ownership by richer-country investors predicts subsequent emissions and ESG outcomes. Since observed ownership may reflect selection, we then exploit predetermined exposure to divestment pressure and ask whether the same pressure both reallocates ownership and worsens environmental performance. Together, these results allow us to assess ownership as a possible channel without treating it as identified.

5.1 Ownership composition and subsequent environmental outcomes

We relate firms' subsequent environmental outcomes to their ownership composition across investor-country income groups. This exercise connects to studies linking shareholder monitor-

ing and engagement to firms' environmental and social policies (Dyck *et al.*, 2019; Kim *et al.*, 2019; Chen *et al.*, 2020), and to the exit-versus-voice literature emphasizing that divestment may remove investors who could otherwise press firms to improve (Broccardo *et al.*, 2022; Edmans *et al.*, 2022). The estimates in Table 8 should nevertheless be read as associations: country group 1 is omitted, so negative coefficients on groups 2–4 indicate lower subsequent environmental intensity when a larger share of ownership is held by investors from richer country groups rather than from the poorest group.

[Insert Table 8 about here]

Panel A uses next-year *Log EIR* as the dependent variable. In the all-firm sample, ownership by each richer country group is associated with lower subsequent emissions intensity (column 1). The association is stronger for firms in brown industries (column 2) and for firms above the median size (column 4). Moreover, in the large-firm regression the coefficients increase in magnitude from country group 2 to group 4 (-1.480, -1.652, -1.806), suggesting that the strength of the association rises with investor-country economic development. Taking country group 4 as an example, its coefficient implies that a large firm with a one-percentage-point higher richest-country ownership share experiences an approximately 1.8% lower next-year emissions intensity. For non-brown firms and smaller firms, the estimates are weaker and imprecise.

Panel B reports analogous estimates for total ESG incident intensity. The coefficients are negative across all richer-country groups, and they increase monotonically from group 2 to group 4 in both the all-firm sample and the large-firm subsample, reinforcing the pattern in Panel A. Taking country group 4 as an example, its coefficient implies an approximately 1.7% lower next-year incident intensity for a large firm with a one-percentage-point higher richest-country ownership share. The regressions for the firms within both brown and non-brown industries show similar results.

Overall, Table 8 shows that greater ownership by richer-country investors is associated with better subsequent environmental outcomes, especially among brown and large firms. It should be noted that these are the same subgroups for which we show that the carbon-income ownership gradient is strongest. Our results in this subsection are in line with the view that shareholder composition is relevant for firms' environmental paths. Richer-country investors may, however,

favor firms already on improving environmental trajectories. We acknowledge that leading outcomes by one year does not fully resolve this selection concern. A second concern is that the ownership variables include domestic shares, so the association may partly reflect home-country confounding factors rather than the impact of the broader ownership composition. Subsection 5.2 therefore turns to predetermined exposure to divestment pressure and foreign shareholder holdings.

5.2 Divestment pressure, ownership reallocation, and environmental outcomes

To move beyond the predictive ownership evidence, we exploit cross-sectional variation in firms' exposure to rich-country fossil-fuel divestment campaigns. We first ask whether greater pressure shifts FF-exposed firms' foreign investor base away from richer countries. We then ask whether the same pressure worsens their subsequent environmental performance. Under the stated exogeneity assumption, the interacted shift-share design identifies both as reduced-form effects of divestment pressure. We do not use the ownership response as an instrument for environmental performance, so the design does not identify ownership reallocation as the channel. The pressure variable uses pre-treatment bilateral ownership weights and is therefore predetermined with respect to subsequent outcomes.

[Insert Tables 9 and 10 about here]

The first test compares how FF-exposed and non-FF firms' foreign shareholder composition responds to a shift-share measure of richer-country divestment pressure. Columns 1–3 of Table 9 report results for the rich-country fraction of foreign ownership. The estimated coefficient on *Divestment pressure* $\times$ *FF-exposed* is -1.290 (significant at 5%) in the first year ($h = 1$), -1.715 (significant at 5%) in the second year ($h = 2$), and -2.264 (significant at 1%) in the third year ($h = 3$). A one-standard-deviation increase in divestment pressure reduces this fraction by 2.5 percentage points in the next year ($h = 1$) and by 4.4 percentage points in the third year ($h = 3$). The effect amounts to 15%–25% of the variable's standard deviation.

These results are robust to using the alternative outcome measure of ownership-weighted

average log GDP per capita of foreign owners in columns 4–6. The estimated coefficient is −0.025 (significant at 5%) in the first year ($h = 1$) and −0.043 and −0.042 (significant at 1%) in the second and third years ($h = 2$ and $h = 3$), consistent with the rich-country fraction result and of similar economic magnitude (15%–25% of a standard deviation).

The uninteracted *Divestment pressure* variable, which captures any effect on non-FF firms, receives coefficients that are indistinguishable from zero throughout, confirming that the reallocation is specific to fossil-fuel-exposed firms. Furthermore, the estimated coefficient on *Divestment pressure* × *EIR* shows no clear pattern. As a pre-trend check, we regress the 2003–2007 pre-period change in rich-country ownership on future Bartik exposure interacted with FF-exposed. The estimated coefficient is statistically indistinguishable from zero, confirming no differential pre-existing trend in rich-country ownership for more-exposed firms. Overall, Table 9 shows that FF-exposed firms with greater exposure to rich-country divestment pressure undergo a shift in their foreign shareholder base away from richer-country investors, consistent with a general-equilibrium reallocation toward poorer-country investors.

The identifying variation is concentrated. The US and UK carry 83.7% and 10.0% of the Rotemberg weight (Goldsmith-Pinkham *et al.*, 2020). Appendix Table A5 reports targeted tests. The reallocation stays negative and at least marginally significant when the dominant US component is dropped. It also holds when we use only pressure from outside the firm's home country, and when we absorb common rich-country exposure trends. The estimates are nearly unchanged when Low-risk firms are retained, or when the contemporaneous EIR interaction is replaced with lagged EIR. The result is thus not driven by the dominant US shift, domestic-source pressure, or a common rich-country trend.

Models of green and sustainable investing show how investor demand can pressure firms to become greener (Heinkel *et al.*, 2001; Pástor *et al.*, 2021). But ownership identity matters for firm outcomes as well. Investors' home-country norms can shape how they govern portfolio firms, including on environmental matters (Dyck *et al.*, 2019). When divestment reallocates ownership from richer- to poorer-country investors, the divested firms could lose effective environmental governance. The environmental specification estimates the net reduced-form effect of pressure rather than the contribution of any single channel. Given the predictive

evidence in Subsection 5.1, we expect the net effect on FF-exposed firms to be adverse. As non-FF firms are not targeted by divestment, we expect them to be overall unaffected. However, there is also a possibility that non-FF firms may benefit from a general-equilibrium reallocation of richer-country capital.

Table 10 reports three environmental outcomes. Columns 1–3 cover FF-exposed firms, and columns 4–6 cover non-FF firms. The outcomes are *Log EIR*, *Log total incident intensity*, and *Log environmental incident intensity*. Panel A shows that for FF-exposed firms the estimated coefficient on *Divestment pressure* for *Log EIR* is positive and increases across horizons, from 0.332 in the first year ($h = 1$) to 0.478 and 0.541 in the second and third years. The estimate becomes significant at 1% from the second year following the strengthening of divestment pressure. For non-FF firms, the coefficient is small and statistically insignificant at all horizons, in line with our expectation that they are not targeted and so remain unaffected.

Panel B and Panel C consider the incident intensities. For FF-exposed firms, Panel B shows positive coefficients across all horizons. In the second year, the coefficient is statistically significant (0.609, at 1%). The non-FF coefficient is negative and significant at all horizons.

Focusing on environmental incidents specifically, Panel C reports a positive coefficient of 0.733 (significant at 1%) for FF-exposed firms in the first year ($h = 1$). It remains at 0.722 (significant at 1%) in the second year and 0.421 (significant at 5%) in the third year. For non-FF firms, the coefficient is negative and significant at all horizons. These reduced-form estimates indicate worsening environmental conditions at targeted firms and potential improvement among non-FF firms. They do not establish that ownership reallocation causes either response.

As a complementary check, we re-estimate the environmental-outcome regression for FF-exposed firms and, for comparison, non-FF firms, with the outcome measured at horizons $h = -3$ to $+3$ around the pressure year. We plot the divestment-pressure coefficients at each horizon, which provides an event-study view of the timing of the estimated responses.[25] The positive emissions response becomes significant from the second year. The environmental-

[25] See Appendix Figure A1. For FF-exposed firms, the pre-period coefficients ($h < 0$) show no differential pre-trend in emissions intensity, whereas both incident outcomes show significant pre-period coefficients (negative for total incidents, which works against the positive response, and positive for environmental incidents). For emissions intensity, the post-pressure contrast between FF-exposed and non-FF firms is clear.

incident response is positive immediately and persists through the third year. This outcome, however, also shows significant positive coefficients before the pressure year. Because pressure is cumulative, these may reflect earlier pressure rather than selection, but we cannot separate the two and therefore interpret this response more cautiously than the emissions result.

Together, Tables 9 and 10 show that divestment pressure both reallocates fossil-fuel firms' foreign ownership away from richer countries and worsens their environmental outcomes. Although the design cannot isolate ownership reallocation as the mechanism connecting these two reduced-form effects, the evidence points consistently toward that channel. Both responses occur among targeted FF-exposed firms following the same predetermined pressure, whereas non-FF firms show the opposite environmental pattern. Given the earlier finding that poorer-country ownership predicts worse subsequent environmental performance, this alignment provides suggestive evidence that ownership reallocation is part of how divestment pressure affects environmental performance. Equity prices provide another important channel because the main goal of divestment is to raise targeted firms' cost of capital (Heinkel *et al.*, 2001; Berk and van Binsbergen, 2025). Because divestment pressure can affect prices and ownership simultaneously, however, our variation cannot isolate changes in ownership while holding the cost of capital fixed. This also implies that identifying the effects of divestment through the price channel may also require accounting for the accompanying reallocation of ownership.

6 Conclusion

We show that equity portfolios become greener with economic development. That is, richer countries hold relatively greener equity portfolios. The pattern is consistent with environmental quality as a normal public good, to which richer agents contribute more as incomes rise (Murdoch and Sandler, 1997). In our setting, that contribution takes the form of greener portfolio choices. Our finding is robust to cross-country differences in return-sorting, and it holds for the subsample of foreign holdings, where domestic investment bias is not a concern. Our findings are stronger for firms that are more accessible to foreign investors. This pattern is present across investor types. It is particularly strong among delegated investors, whose

portfolios reflect client preferences, and among strategic investors, whose holdings reflect real business or control interests. This pattern is also more pronounced among long-horizon investors.

Sorting matters because ownership patterns shape corporate environmental behavior. Firms' sustainability performance is positively related to the ownership held by richer-country investors. This is consistent with poorer-country investors being less able or willing to push portfolio firms toward greener practices.

Exploiting rich-country divestment campaigns, we find that the divestment pressure shifts fossil-fuel-exposed firms' ownership toward poorer countries and worsens their subsequent environmental performance. Non-exposed firms show no deterioration and, if anything, improve. Overall, the aligned ownership and environmental responses are consistent with environmental governance weakening after richer-country investors exit. The ownership channel remains suggestive, however, because the design cannot isolate it from other effects of divestment pressure.

Our findings speak to whether climate-minded investors in richer countries should pursue their goals through exit or voice. The conventional case for divestment holds that selling pressure forces firms to reform. In an integrated equity market, exit does not remove ownership but transfers it. We show robustly that divestment pressure can transfer ownership toward poorer-country investors. The accompanying reduced-form environmental response suggests that exit may weaken environmental governance, although the design cannot isolate ownership reallocation from other channels. This distinction strengthens the case for studying exit and voice jointly rather than assuming that a change in ownership composition mechanically changes firm behavior.

Because emissions are a global externality, any environmental deterioration associated with this reallocation could have consequences beyond the affected firms and their owners. Prior evidence shows that higher temperatures reduce growth more strongly in poorer countries and have already widened global income inequality (Dell *et al.*, 2012; Burke *et al.*, 2015; Diffenbaugh and Burke, 2019). This greater vulnerability, combined with the potentially more limited climate discipline of poorer-country investors, suggests that public policy and institutional safeguards may remain especially important in poorer countries.

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Table 1: Summary statistics.

This table presents descriptive statistics for the variables used in the regression analyses. Panel A reports variables used in Tables 4–6. Unless otherwise indicated, summary statistics are reported for the estimation sample in column 1 of Table 4. *Self-expression* is reported for its available sample in Table 5, and the two foreign-ownership rows are reported for the estimation sample in column 1 of Table 6. *Ownership share* is measured in basis points (bps). *Ownership share, scaled* divides this share by firm-year reported ownership coverage. *Holding value* is the value of the position scaled by investor-country GDP. The Paris Agreement indicator equals one in 2016–2021. Panel B reports the additional variables used in Table 7. *Ownership shares by investor group* are constructed by aggregating holdings within the corresponding investor group and treating missing group ownership within observed firm-year investor-country cells as zero. These statistics are reported for the large foreign-firm sample used in Panel A of Table 7. *Firm size* is log total assets, and *MSCI World* is an index-membership indicator, reported for the full bilateral samples used in the continuous-interaction columns of that table. Panel C reports the variables used in Table 8. *Ownership by country group* is the share of a firm's reported ownership held by investors from each quartile of the investor-country GDP-per-capita distribution, normalized so that the group shares sum to one in each firm-year. *Log EIR* and *Log incident intensity* are measured with a one-year lead. See Table A1 for variable definitions.

Variable	N	Mean	Median	SD	Min	Max
Panel A: Baseline variables, used in Tables 4–6						
Ownership share, bps	298,803	523.94	6.64	1,828.46	0.02	8,676.79
Ownership share, scaled, bps	298,803	589.43	7.52	2,044.54	0.02	10,000
Holding value, USD per million GDP	298,803	124.28	3.88	549.67	0.00	4,891.05
EIR, ton CO2e per thousand USD	298,803	0.413	0.036	4.616	0	725.433
Log GDP per capita	298,803	3.590	3.791	0.700	−0.771	4.755
Market cap., fraction of GDP	298,803	0.959	0.861	0.549	0.001	3.227
Return, percentage points	298,803	6.438	9.097	37.634	−122.854	108.705
PostPA	298,803	0.553	1	0.497	0	1
Rule of law	298,803	1.325	1.530	0.657	−1.139	2.125
Self-expression	275,756	1.460	1.458	1.065	−1.513	3.113
Div. commitment	298,803	1.477	0.693	1.730	0	6.080
Ownership share, bps (foreign)	281,078	79.77	5.32	306.62	0.01	2,461.41
Log distance (foreign)	281,078	8.542	8.752	0.978	1.806	9.885
Panel B: Additional variables, used in Table 7						
Ownership share by delegated investors, bps	139,877	56.03	2.34	416.24	0	7,534.70
Ownership share by stewards, bps	135,925	9.03	0	34.36	0	433.82
Ownership share by strategic investors, bps	138,970	24.49	0	325.12	0	5,832.74
Ownership share by high-turnover investors, bps	139,016	4.33	0	35.54	0	727.45
Ownership share by medium-turnover investors, bps	139,007	14.16	0.48	97.19	0	1,964.02
Ownership share by low-turnover investors, bps	139,063	70.72	0.93	478.31	0	7,013.37
Firm size	294,803	8.620	8.609	1.472	1.339	13.838
MSCI World	213,256	0.260	0	0.439	0	1
Panel C: Firm-level variables, used in Table 8						
Ownership by country group 1, fraction	19,183	0.03	0	0.16	0	1
Ownership by country group 2, fraction	19,183	0.08	0.000	0.25	0	1
Ownership by country group 3, fraction	19,183	0.07	0.000	0.22	0	1
Ownership by country group 4, fraction	19,183	0.82	0.999	0.34	0	1
Log EIR	16,243	3.68	3.603	3.56	−69.08	19.39
Log incident intensity	6,656	−1.143	−1.125	1.287	−6.607	3.811

Table 2: Fossil-fuel firm divestment and eligible targets.

This table reports the time-invariant fossil-fuel(FF) tier assignment used in the divestment-pressure tests. We classify the firms using Urgewald's Global Oil and Gas Exit List (GOGEL), historical GOGEL files, Global Coal Exit List (GCEL), and Metallurgical Coal Exit List (MCEL). In the first column, we summarize the tier distribution of our firm universe, as in the Table 8 sample. The second column reports the tier distribution after the shift-share eligibility restriction, which requires valid 2002–2005 pre-treatment bilateral ownership weights and at least one post-2008 observation. Heavy and Moderate firms constitute the FF-exposed group in Tables 9–10. No-risk firms form the non-FF comparison group in Table 10. Low-risk firms are excluded from that comparison because their fossil-fuel links are peripheral.

Tier and definition	Firm universe (Table 8 sample)	Shift-share eligible
Heavy risk: firms with a business centered on fossil fuels. *Fossil-fuel or coal revenue share* $\geq$ 50%*, fossil-fuel or coal power share* $\geq$ 50% *for power or oil-and-gas firms, or coal production* $\geq$ 30 *Mt/yr.*	202 (7.0%)	66 (6.2%)
Moderate risk: firms with material fossil-fuel exposure. *Fossil-fuel or coal revenue share between 10% and 50%, fossil-fuel or coal power share* $\geq$ 10%*, own coal mining, coal-power capacity* $\geq$ 500 *MW, or fossil-fuel expansion exposure.*	64 (2.2%)	23 (2.2%)
Low risk: firms with peripheral fossil-fuel links. *Fossil-fuel revenue share below 10%, finance or holding-company exposure, services-only links, or weakly documented fossil-fuel exposure.*	71 (2.5%)	22 (2.1%)
No risk: firms without identified fossil-fuel exposure. *Firms not classified as Heavy, Moderate, or Low under the Urgewald matching and hand-curated review.*	2,558 (88.4%)	950 (89.5%)
Total	2,895 (100%)	1,061 (100%)

Table 3: Summary statistics for divestment-pressure tests.

This table presents descriptive statistics for the variables used in Tables 9–10. Panel A reports the divestment-pressure regressors and the ownership-composition outcomes used in Table 9. For the divestment-pressure regressors, we report summary statistics using the $h = 1$ estimation sample. The ownership-composition outcomes are measured in levels at $t + h$ and are reported for all horizons $h = 1, 2, 3$. Rich investor countries are the upper half of investor countries by sample-period mean GDP per capita, fixed over time. Panel B reports Table 10 outcomes on the corresponding horizon-specific estimation samples, pooling the displayed FF-exposed and non-FF samples. See Table A1 for variable definitions.

Variable	N	Mean	Median	SD	Min	Max
Panel A: Variables used in Table 9						
Divestment pressure	3,000	2.644	2.887	1.959	0	6.160
FF-exposed	3,000	0.097	0	0.296	0	1
EIR	3,000	0.338	0.031	1.774	0	40.717
Rich-country share of foreign ownership$_{t+1}$	3,000	95.806	99.843	16.643	0.006	100.000
Rich-country share of foreign ownership$_{t+2}$	2,468	95.592	99.818	17.092	0.006	100.000
Rich-country share of foreign ownership$_{t+3}$	2,013	95.408	99.808	17.552	0.006	100.000
Avg. log GDPpc of foreign owners$_{t+1}$	3,000	3.889	3.941	0.335	1.956	4.589
Avg. log GDPpc of foreign owners$_{t+2}$	2,468	3.887	3.940	0.342	1.956	4.589
Avg. log GDPpc of foreign owners$_{t+3}$	2,013	3.885	3.937	0.350	2.176	4.589
Panel B: Variables used in Table 10						
Log EIR$_{t+1}$	6,210	3.479	3.450	4.064	−69.078	19.394
Log EIR$_{t+2}$	5,196	3.468	3.438	4.008	−69.078	19.394
Log EIR$_{t+3}$	4,300	3.455	3.428	4.026	−69.078	19.394
Log incident intensity$_{t+1}$	3,036	−1.295	−1.244	1.258	−6.607	3.258
Log incident intensity$_{t+2}$	2,711	−1.313	−1.253	1.252	−6.607	3.258
Log incident intensity$_{t+3}$	2,379	−1.337	−1.270	1.247	−6.607	3.258
Log environmental incident intensity$_{t+1}$	1,463	−1.836	−1.826	1.263	−6.805	3.033
Log environmental incident intensity$_{t+2}$	1,316	−1.852	−1.822	1.236	−6.805	2.566
Log environmental incident intensity$_{t+3}$	1,176	−1.883	−1.854	1.226	−6.805	2.566

Table 4: Ownership share and holding value with firm-level data.

This table reports OLS estimates of *Ownership share* on *EIR* interacted with investor-country characteristics. The dependent variable is *Ownership share* (bps) except in column 2, where it is *Ownership share, scaled* (*Ownership share* divided by firm-year coverage), and column 3, where it is *Holding value* (position value scaled by investor-country GDP). *EIR* is emissions divided by revenue. *Log GDP per capita* is the log of investor-country per-capita GDP in thousands of U.S. dollars. *Market cap* is investor-country stock-market capitalization as a fraction of GDP. *Return* is the firm's lagged annual log price return. The *Foreign* dummy is included but omitted from the table. Columns 4–5 split firms by ownership coverage in the firm's headquarters country, measured before emissions data enter the sample and split at the cross-country median. Columns 6–7 split firms by whether their headquarters country is a petrostate. Column 8 additionally excludes petrostate investor countries. Columns 9–10 augment column 1 with the interaction between *EIR*, *Log GDP per capita*, and the post-Paris indicator. Column 10 uses a balanced-window subsample of firms present in both 2010–2014 and 2016–2021. All columns include firm-year and investor-country-year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6	7	8	9	10
				Split by firm's headquarters country					*Post-Paris shift*	
	Own. share	*Own., scaled*	*Holding value*	*Coverage* *High*	*Low*	*Petrostate* *Yes*	*No*	*Own. share*	*PostPA interaction*	*Balanced*
EIR × Log GDP per capita	−4.47**	−5.52***	−2.79**	−3.41**	−5.32	74.04	−4.94**	−5.34**	−3.73***	−3.58**
	(1.79)	(2.03)	(1.15)	(1.70)	(3.42)	(47.34)	(1.98)	(2.11)	(1.41)	(1.44)
EIR × Log GDP per capita × PostPA									−8.48	−17.92*
									(7.38)	(9.33)
EIR × Market cap.	−5.79**	−6.85**	−2.66***	−6.55**	−5.40	−56.06	−5.99**	−5.84**	−5.10**	−4.72**
	(2.32)	(2.67)	(0.93)	(2.75)	(3.93)	(32.22)	(2.42)	(2.38)	(2.06)	(2.12)
Return × Log GDP per capita	0.642***	0.744***	0.404***	0.486***	1.371***	3.475*	0.650***	0.732***	0.637***	0.675***
	(0.106)	(0.123)	(0.082)	(0.102)	(0.322)	(1.754)	(0.106)	(0.117)	(0.105)	(0.153)
N	298,803	298,803	298,803	251,791	47,012	3,985	294,818	274,009	298,803	163,703
Adjusted R^2	0.855	0.854	0.343	0.898	0.627	0.697	0.858	0.859	0.855	0.847

Table 5: Economic development and proxies for collective preferences in carbon-sensitive ownership.

This table reports OLS estimates of *Ownership share* on *EIR* interacted with investor-country characteristics, augmented with additional investor-country controls. Panel A reports Pearson correlations at the investor-country-year level (n = 1,222). Parentheses in the *Div. commitment* column give the correlation restricted to country-years with at least one commitment (n = 221). Panel B reports coefficient estimates. The dependent variable is the ownership share (basis points) of a given firm held by investors domiciled in a given country in a given year. Column 1 presents the baseline, which interacts *EIR* with *Log GDP per capita* and *market cap.* and additionally includes the *Foreign* dummy and *Return×Log GDP per capita*. Columns 2, 3, and 4 augment the baseline by adding one further *EIR* interaction with, respectively, *Rule of law*, *Self-expression*, and *Div. commitment*. Columns 2′, 3′, and 4′ repeat the preceding column on the same sample but omit *EIR×Log GDP per capita*. *Rule of law* is the World Bank Worldwide Governance Indicators estimate. *Self-expression* is the country-period mean of the self-expression values index from the World Values Survey, with pre- and post-Paris periods captured by different waves. *Div. commitment* is the log of one plus cumulative commitments for the investor country-year. Each regression includes firm-year and investor-country-year fixed effects, as well as a foreign dummy. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. For correlations, * denotes significance at the 5% level.

Panel A: Pairwise correlations

	Rule of law	*Self-expression*	*Div. commitment*
Log GDP per capita	0.78*	0.76*	0.16* (0.48*)
Rule of law		0.79*	0.24* (0.44*)
Self-expression			0.35* (0.48*)

Panel B: Ownership regressions

	1	2	2′	3	3′	4	4′
	Baseline	*Rule of law*		*Self-expression*		*Div. commitment*	
EIR × Log GDP per capita	−4.47**	−4.79**		−7.53**		−3.60**	
	(1.79)	(2.00)		(3.02)		(1.49)	
EIR × Rule of law		0.523	−3.717*				
		(2.438)	(2.044)				
EIR × Self-expression				3.270**	−0.999		
				(1.301)	(0.704)		
EIR × Div. commitment						−3.04	−3.79*
						(1.97)	(2.10)
EIR × Market cap.	−5.79**	−5.78**	−3.98**	−6.64***	−2.39	−4.27**	−1.04
	(2.32)	(2.34)	(1.97)	(2.51)	(1.77)	(1.72)	(0.90)
Return × Log GDP per capita	0.642***	0.642***	0.647***	0.688***	0.697***	0.639***	0.648***
	(0.106)	(0.106)	(0.106)	(0.120)	(0.120)	(0.106)	(0.106)
N	298,803	298,803	298,803	275,756	275,756	298,803	298,803
Adjusted R^2	0.855	0.855	0.855	0.866	0.866	0.855	0.855

Table 6: Cross-border ownership: pre- vs. post-Paris gradient, by firm subsample.

This table reports OLS estimates of *Ownership share* on *EIR* interacted with investor-country characteristics, restricting to foreign investor-firm pairs. The dependent variable is the ownership share (basis points) of a given firm held by investors domiciled in a given country in a given year, winsorized at 1% and 99%. Foreign pairs are those in which the investor country differs from the firm's headquarters country. All columns include, as controls, *EIR*×*Log GDP per capita*, *EIR*×*Market cap.*, *Return*×*Log GDP per capita*, and the log bilateral distance between investor and host country. Columns 1–2 use the full foreign-pair sample. Columns 3–4 further restrict to *Large firms*, defined at the firm level as firms whose mean firm size across observed years is at or above the median of firm-level means in the analysis sample. Within each sample cut, odd columns pool all years (2002–2021) and even columns restrict to the post-Paris years (2016–2021). Each regression includes firm-year and investor-country-year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4
	Full foreign		*Large firms*	
	All	*Post-PA*	*All*	*Post-PA*
EIR × Log GDP per capita	−3.11*	−7.76***	−6.73**	−9.83***
	(1.67)	(2.84)	(2.99)	(2.95)
EIR × Market cap.	−3.60*	−9.53***	−5.35*	−10.47***
	(1.95)	(2.52)	(3.00)	(2.24)
Return × Log GDP per capita	0.153***	0.127**	0.182***	0.203***
	(0.039)	(0.054)	(0.041)	(0.064)
Log distance	−41.19***	−41.07***	−44.35***	−43.79***
	(3.16)	(3.13)	(4.18)	(4.17)
N	281,078	154,586	200,218	98,493
Adjusted R^2	0.359	0.344	0.335	0.318

Table 7: Investor and firm heterogeneity.

This table reports OLS estimates of *Ownership share* across heterogeneity cuts in investor type, portfolio turnover, and firm characteristics. Panel A splits investors by investor type, restricting to large foreign firms. All regressions control for *EIR×Market cap.* and *Return×Log GDP per capita*. Panel B additionally includes the *Foreign* dummy. Panel B columns 1–3 split firms by industry, where *Brown* comprises TRBC energy, materials, utilities, and heavy industrials. The [a] specification drops upstream fossil-fuel energy firms (TRBC sector 5010) from the brown subsample. Column 4 interacts *EIR×Log GDP per capita* with *Firm size* (mean-centered log total assets, i.e., log assets minus its sample mean), full 2002–2021 sample. Columns 5–6 interact with a firm-year *MSCI World* indicator and restrict the sample to 2013–2021. Each regression includes firm-year and investor-country-year fixed effects. The petrostate-headquartered firms are excluded. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Investor heterogeneity (large foreign firms)

	1	2	3	4	5	6
	By investor type			*By portfolio turnover*		
	Delegated	*Stewards*	*Strategic*	*High*	*Medium*	*Low*
EIR × Log GDP per capita	−8.97***	−0.90***	−14.14*	−0.53***	−1.61***	−22.98***
	(1.98)	(0.26)	(7.63)	(0.12)	(0.31)	(7.47)
N	139,877	135,925	138,970	139,016	139,007	139,063
Adj. R^2	0.300	0.402	0.049	0.187	0.250	0.177

Panel B: Firm heterogeneity

	1	2	3	4	5	6
	By industry			*Continuous interactions*		
	Brown	*Brown*[a]	*Non-brown*	*Size* ×	*MSCI* ×	*Both* ×
EIR × Log GDP per capita	−2.98**	−3.08*	−11.92	−7.75**	−18.00**	−18.83***
	(1.26)	(1.78)	(8.28)	(3.85)	(7.86)	(6.82)
EIR × Log GDP per capita × Firm size				−2.76*		−9.24***
				(1.50)		(3.01)
EIR × Log GDP per capita × MSCI World					26.12***	37.84***
					(8.43)	(7.72)
N	60,809	48,663	234,009	294,803	213,271	213,256
Adj. R^2	0.828	0.824	0.869	0.858	0.851	0.852

Table 8: Emission and incident intensity and international ownership by income levels.

This table reports OLS estimates of next-year emission and incident outcomes on the income-group composition of firm ownership. Panel A reports regressions where the dependent variable is *Log EIR*, the log of Scope 1 plus Scope 2 GHG emissions divided by revenue, with a one-year lead. Panel B reports regressions where the dependent variable is *Log incident intensity*, computed as log(count/assets) using all incidents, with a one-year lead. Countries are divided into four quartile groups based on each year's GDP per capita distribution. Ownership variables are fractional shares adjusted so the four groups sum to one, and country group 1 (poorest) is omitted. Controls are log assets, leverage, ROA, and Tobin's Q. All regressions include firm and year fixed effects. Columns 2–3 split the sample into brown and non-brown industries. Columns 4–5 split the sample above and below the log-assets median of 8.67. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5
	All firms	*Firms in brown industries*	*Firms in non-brown industries*	*Firms of size above the median*	*Firms of size below the median*
Panel A: Dependent variable: Log EIR$_{t+1}$					
Ownership by country group 2	-0.726**	-1.160*	-0.545	-1.480**	0.242
	(0.366)	(0.617)	(0.419)	(0.604)	(0.671)
Ownership by country group 3	-0.764*	-1.508**	-0.338	-1.652**	0.523
	(0.393)	(0.648)	(0.464)	(0.641)	(0.700)
Ownership by country group 4	-0.697*	-1.606**	-0.185	-1.806***	0.806
	(0.415)	(0.675)	(0.500)	(0.648)	(0.737)
N	16,243	3,609	12,634	8,412	7,831
Adjusted R^2	0.687	0.809	0.631	0.683	0.741
Panel B: Dependent variable: Log incident intensity$_{t+1}$					
Ownership by country group 2	-0.517***	-0.820***	-0.311**	-1.289***	-0.198
	(0.186)	(0.285)	(0.155)	(0.270)	(0.147)
Ownership by country group 3	-0.802***	-1.116***	-0.622***	-1.580***	-0.260
	(0.226)	(0.339)	(0.237)	(0.299)	(0.343)
Ownership by country group 4	-0.923***	-1.047***	-0.867***	-1.688***	-0.599
	(0.258)	(0.395)	(0.277)	(0.327)	(0.447)
N	6,656	2,071	4,585	4,849	1,807
Adjusted R^2	0.776	0.676	0.803	0.734	0.644

Table 9: Ownership reallocation under divestment pressure.

This table reports OLS estimates of ownership-composition outcomes on firm-level *Divestment pressure*. The estimation sample is restricted to years since 2008, the year of the first divestment commitment in the Stand.earth database, and excludes Low-risk firms from the comparison sample. The dependent variables are levels measured at $t + h$, and each specification controls for the corresponding lagged dependent variable at $t - 1$. Columns 1–3 use the share of firm f's foreign ownership held by rich investor countries. Columns 4–6 use the ownership-weighted average log GDP per capita of firm f's foreign owners. Rich investor countries are the upper half of investor countries by sample-period mean GDP per capita, fixed over time. Each dependent variable requires the foreign shareholder base to be at least 5 percentage points at both $t - 1$ and $t + h$. *Divestment pressure* is a shift-share measure, where cumulative divestment commitments from richer investor countries are weighted by firm f's 2002–2005 bilateral ownership shares before transformation. FF-exposed firms are those classified as Heavy- or Moderate-risk. Unreported controls are lagged firm size, leverage, Tobin's Q, ROA, current EIR, MSCI-World indicator, and lagged log price return (winsorized). Firm, home-country×year, and FF-exposed×year fixed effects are included. Standard errors are clustered at the firm home-country level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6
	Rich-country share of foreign ownership			*Avg. log GDPpc of foreign owners*		
	t+1	t+2	t+3	t+1	t+2	t+3
Divestment pressure × FF-exposed	−1.290**	−1.715**	−2.264***	−0.025**	−0.043***	−0.042***
	(0.577)	(0.841)	(0.576)	(0.012)	(0.013)	(0.015)
Divestment pressure	+0.275	+0.044	−0.116	+0.013	+0.009	+0.003
	(0.327)	(0.411)	(0.607)	(0.008)	(0.009)	(0.011)
Divestment pressure × EIR	−0.007	−0.012	+0.010	−0.001	−0.001*	+0.001**
	(0.015)	(0.021)	(0.017)	(0.001)	(0.001)	(0.000)
N	3,000	2,468	2,013	3,000	2,468	2,013
Home-country clusters	39	38	36	39	38	36

Table 10: Rich-country divestment pressure and fossil-fuel firms' subsequent emissions and incidents.

This table reports OLS estimates of firm-level environmental outcomes on firm-specific *Divestment pressure*. Coefficients are from separate regressions of firm f's environmental outcome at year $t+h$ on firm-specific divestment pressure. The estimation sample is restricted to years since 2008, the year of the first divestment commitment in the Stand.earth database. Columns 1–3 restrict the sample to FF-exposed firms (Heavy- and Moderate-risk). Columns 4–6 restrict it to non-FF firms (No risk). The three panels use log emissions intensity (Panel A), log total incident intensity (Panel B), and log environmental incident intensity (Panel C) as the dependent variable. *Divestment pressure* is a shift-share measure, where cumulative divestment commitments from rich investor countries are weighted by firm f's 2002–2005 bilateral ownership shares before transformation. Rich investor countries are the upper half of investor countries by sample-period mean GDP per capita, fixed over time. Unreported controls are lagged firm size, leverage, Tobin's Q, ROA, MSCI-World indicator, lagged log price return (winsorized), and lagged ownership shares held by investor-country income groups 2–4. All regressions include firm and home-country×year fixed effects. Standard errors are clustered at the firm home-country level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6
	FF-exposed firms			*Non-FF firms*		
	h=1	h=2	h=3	h=1	h=2	h=3
Panel A: Dependent variable: Log $EIR_{i,t+h}$						
Divestment pressure	+0.332	+0.478***	+0.541***	−0.055	+0.090	+0.065
	(0.269)	(0.128)	(0.113)	(0.067)	(0.109)	(0.097)
N	622	535	453	5,588	4,661	3,847
Adjusted R^2	0.848	0.875	0.872	0.778	0.840	0.883
Panel B: Dependent variable: Log incident intensity$_{i,t+h}$						
Divestment pressure	+0.379	+0.609***	+0.240	−0.251***	−0.209***	−0.135**
	(0.245)	(0.163)	(0.226)	(0.054)	(0.056)	(0.051)
N	445	395	344	2,591	2,316	2,035
Adjusted R^2	0.640	0.626	0.625	0.767	0.763	0.759
Panel C: Dependent variable: Log env. incident intensity$_{i,t+h}$						
Divestment pressure	+0.733***	+0.722***	+0.421**	−0.263***	−0.255***	−0.241***
	(0.051)	(0.111)	(0.171)	(0.056)	(0.046)	(0.059)
N	393	349	306	1,070	967	870
Adjusted R^2	0.625	0.619	0.630	0.819	0.802	0.804

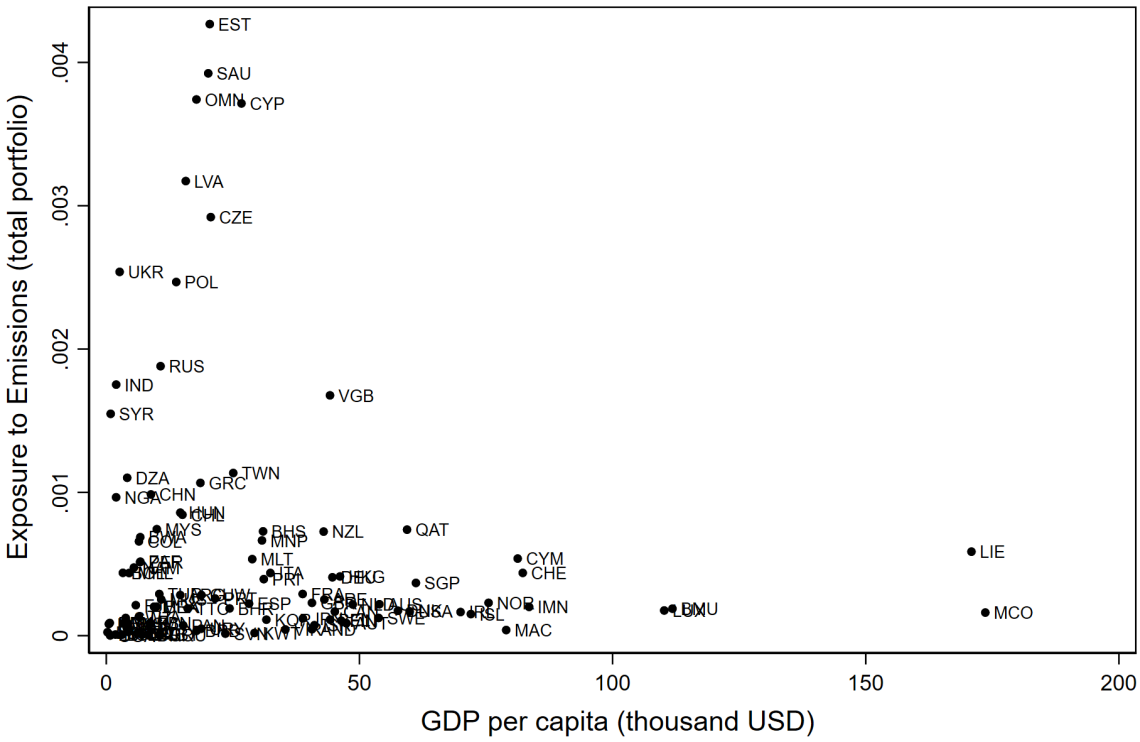


Figure 1: Full portfolio exposure to emissions scaled by revenues and GDP per capita in 2017. This figure plots the national portfolio exposure to emissions relative to revenues against GDP per capita for countries included in the firm-level sample for the year 2017. This exposure is computed using information for all firms in the firm-level sample as follows,

$$\frac{\sum_{i \in Full\ Portfolio_t} w_{it} \times Emissions_{it}}{\sum_{i \in Full\ Portfolio_t} w_{it} \times Total\ revenue_{it}}$$

where i is a firm index, t is the year 2017, and w_{it} represents the percentage ownership held by a country in firm i at the end of 2017. Emissions are the sum of Scope 1 and Scope 2 emissions.

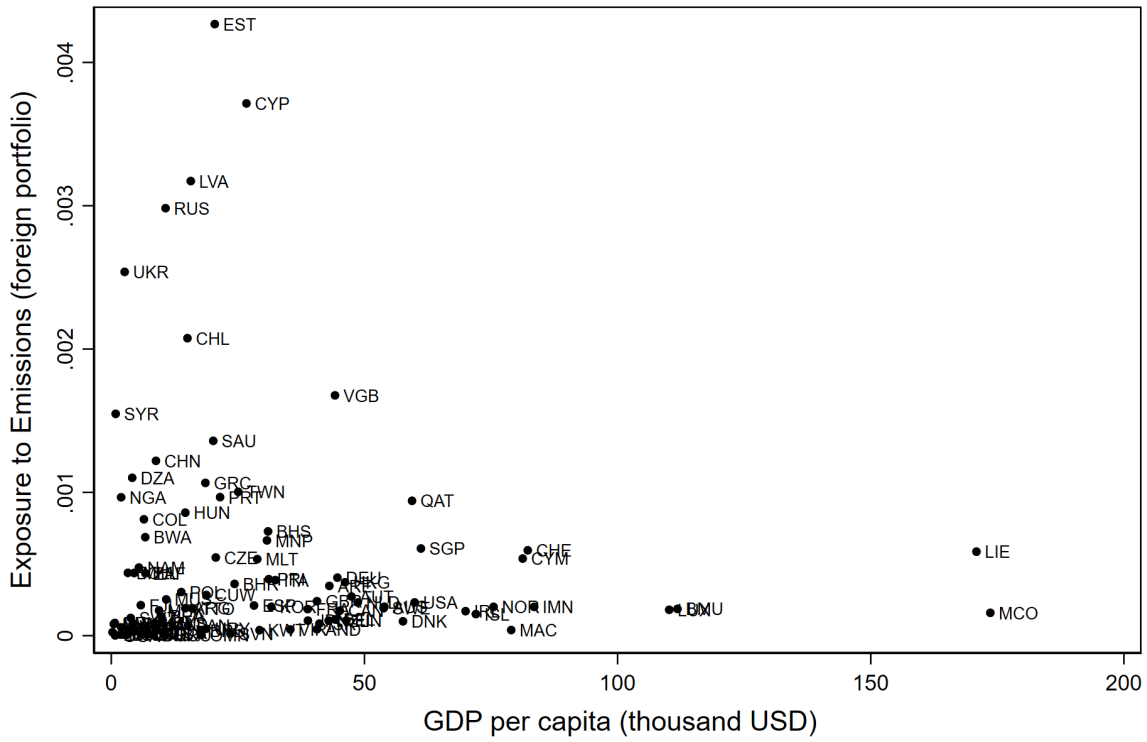


Figure 2: Foreign portfolio exposure to emissions relative to revenues and GDP per capita in 2017. This figure plots the national foreign portfolio exposure to emissions relative to revenues against GDP per capita for countries included in the firm-level sample for the year 2017. This exposure is computed using information for all foreign firms in the firm-level sample as follows,

$$\frac{\sum_{i \in Foreign\ Portfolio_t} w_{it} \times Emissions_{it}}{\sum_{i \in Foreign\ Portfolio_t} w_{it} \times Total\ revenue_{it}}$$

where i is a firm index, t is the year 2017, and w_{it} represents the percentage ownership held by a country in firm i at the end of 2017. Emissions are the sum of Scope 1 and Scope 2 emissions.

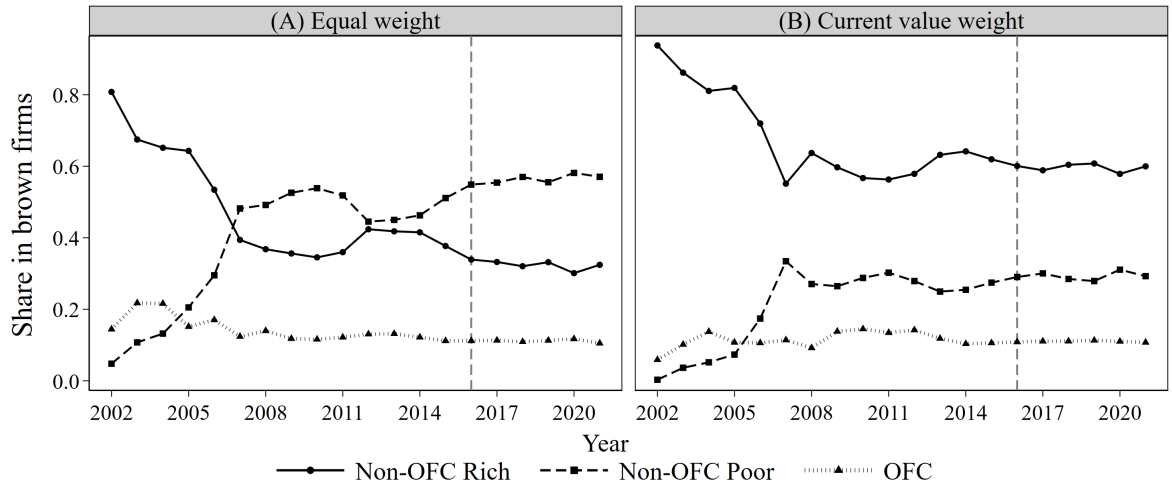


Figure 3: Country group's average share in brown firms, 2002–2021.

This figure plots each country group's average share in brown firms over 2002–2021 under two firm weightings. For each year, we average across *Brown* firms each country group's within-firm ownership share. For firm i we compute the share of its ownership held by group g, $s_{igt} = \left(\sum_{c \in g} w_{ict}\right) / \left(\sum_{c} w_{ict}\right)$, where w_{ict} is country c's ownership stake in firm i at year-end t (basis points). For group g in year t,

$$\textit{Share in brown firms}_{gt} \;=\; \frac{\sum_{i \in Brown} \omega_{it}\, s_{igt}}{\sum_{i \in Brown} \omega_{it}},$$

with firm weights ω_{it}. The three shares sum to one each year. **Panel (A)** weights firms equally ($\omega_{it} = 1$) to isolate the ownership quantities. **Panel (B)** weights firms by their contemporaneous (current-year) market capitalization, winsorized at the 99th percentile. The sample is the broad ownership universe (firms with at least 75% ownership coverage), not conditioned on emissions data. Shares use firm-years held by at least one Rich-country and one Poor-country investor, for firms with continuous coverage present in at least three such years. Non-OFC countries are fix-classified to be rich or poor at the cross-country median of their sample-average GDP per capita. Ownership-data coverage expands over the sample period. The number of qualifying firms grows over time, from 16 in 2002 to about 280 by 2008 and over 430 by 2010, which cautions the interpretation of the first few years. The vertical dashed line marks the Paris Agreement entry into force in 2016.

Appendix A: Additional tables and figures

Table A1 Variable definitions and data sources.

Variable	Description	Data Source
Ownership share	A country's collective ownership share of a stock, aggregated from the investor–firm–year holding data, winsorized at the 1st and 99th percentiles, and expressed in basis points.	Refinitiv Workspace API.
Ownership share, scaled	Coverage-rescaled ownership share, computed as the bilateral ownership share divided by aggregate reported ownership in the firm-year and expressed in basis points.	Refinitiv Workspace API.
Holding value	Value of a country's ownership position in a stock, divided by investor-country GDP and winsorized at the 1st and 99th percentiles.	Holding data: Refinitiv Workspace API. GDP: World Bank, UN database, and official national sources.
EIR, Log EIR	EIR is Scope 1 plus Scope 2 GHG emissions divided by revenue (tons of CO2e per thousand USD). Log EIR is its logarithm.	GHG emissions: CDP and Refinitiv Workspace API. Revenues: Refinitiv Workspace API, Compustat Global, and Compustat North America.
Log GDP per capita	Log of GDP per capita in thousands of U.S. dollars for the investor country.	World Bank, UN database, and official national sources.
Market cap.	Stock market capitalization of domestic listed companies as a fraction of GDP.	World Bank.
Return	Lagged annual log price change, expressed in percentage points and winsorized at the 1st and 99th percentiles.	Refinitiv Workspace API, Compustat Global, and Compustat North America.
Foreign	Indicator equal to one if the firm is headquartered in a foreign country relative to a given investor country.	Refinitiv Workspace API.
Log distance	Log of the bilateral great-circle distance (kilometers) between the investor-country capital and the firm headquarters country capital.	CEPII GeoDist database.
Rule of law	WGI Rule of Law estimate, capturing perceptions of the extent to which agents respect and follow the rules of society.	World Bank Worldwide Governance Indicators.
Self-expression	Inglehart–Welzel self-expression values index from the World Values Survey, capturing post-materialist values such as tolerance, civil liberties, and environmental concern.	World Values Survey.
Div. commitment	Natural log of one plus the cumulative count of publicly announced institutional divestment commitments from a given investor country through the year of observation.	Stand.earth Global Fossil Fuel Divestment Commitments Database.
PostPA	Paris Agreement indicator equal to one from 2016 onward.	
Firm size	The logarithm of firm assets.	Refinitiv Workspace API, Compustat Global, Compustat North America.
Leverage	Total liabilities divided by total assets.	Refinitiv Workspace API, Compustat Global, Compustat North America.
Tobin's Q	Market value of assets divided by book value of assets.	Refinitiv Workspace API, Compustat Global, Compustat North America.
ROA	Return on assets, computed as net income divided by total assets.	Refinitiv Workspace API, Compustat Global, Compustat North America.
MSCI World	Indicator equal to one if the firm is a constituent of the MSCI World index in a given year. Yearly constituent lists are reconstructed backward from a 2022 base snapshot using annual constituent additions and deletions derived from iShares MSCI World ETF (URTH) holdings.	SEC EDGAR N-PORT and N-QUANT filings (iShares MSCI World ETF, 2013–present) and Refinitiv (2022 base snapshot).
Ownership share by investor type	Collective ownership share of a stock by investor-type group, expressed in basis points. Delegated investors include investment advisors, asset managers, hedge funds, banks and trusts, private equity, and venture capital. Stewards include pension funds, insurance companies, sovereign wealth funds, foundations, and endowments. Strategic investors include corporations, holding companies, individuals, insiders, and governments.	Refinitiv Workspace API.
Ownership share by investors with high / medium / low turnover	Collective ownership share of a stock by the Refinitiv-provided investor turnover category. High turnover is below one year, medium turnover is one to two years, and low turnover is above two years. The share is expressed in basis points.	Refinitiv Workspace API.

Continued on next page

Table A1 (continued) Variable definitions and data sources.

Variable	Description	Data Source
Ownership by country group (1–4)	Total ownership share held by investors from countries grouped into GDP per capita quartiles, divided by total reported ownership in the firm-year and expressed as a fraction.	Refinitiv Workspace API.
Rich-country share of foreign ownership	Share of firm f's foreign ownership held by rich investor countries, expressed in percentage points and excluding OFC investor countries. Rich investor countries are the constant upper half of investor countries by sample-period mean GDP per capita.	Refinitiv Workspace API. GDP per capita is from the World Bank, UN database, and official national sources.
Avg. log GDPpc of foreign owners	Ownership-weighted average log GDP per capita of firm f's non-OFC foreign owners.	Refinitiv Workspace API. GDP per capita is from the World Bank, UN database, and official national sources.
FF-exposed	Indicator equal to one if the firm is classified as Heavy or Moderate in the fossil-fuel tier assignment.	Urgewald GOGEL, GCEL, and MCEL workbooks, Refinitiv identifiers, and author-reviewed candidate classifications from Claude Opus.
Divestment pressure	Firm-specific shift-share exposure to fossil-fuel divestment pressure from richer investor countries. The measure weights each rich investor country's log cumulative divestment commitments by firm f's fixed 2002–2005 bilateral ownership share. Rich investor countries are the constant upper half of investor countries by sample-period mean GDP per capita.	Ownership weights: Refinitiv Workspace API. Divestment commitments: Stand.earth Global Fossil Fuel Divestment Commitments Database.
Log incident intensity, Log env. incident intensity	Log total incident intensity is computed as $\log(\text{count}/\text{assets})$. Log env. incident intensity uses environmental incident counts.	Incident counts: RepRisk. Assets: Refinitiv Workspace API, Compustat Global, Compustat North America.
FF rents	Sum of oil, natural gas, and coal rents as a percentage of GDP in the investor country-year. Following the World Bank definition, a resource rent is the value of production valued at world prices net of the cost of extraction, not the gross value of production.	World Bank.
CTOT index	IMF Gruss–Kebhaj commodity terms-of-trade index, measured as a weighted average of individual commodities' world-price changes, with each commodity weighted by the country's trade in that commodity (exports plus imports) relative to GDP. The weights are fixed over time (averaged over a base period) so that movements in the index reflect commodity price changes rather than changes in the country's trade volumes or composition.	IMF Commodity Terms of Trade database (Gruss and Kebhaj).
Heat index 35	Total days per year when the daily mean Heat index rose above 35°C.	World Bank.
Flood exposure	Additional share of the population projected to be exposed to annual coastal floods due to sea-level rise, using the maximum projection through 2050.	World Bank.

Table A2: Variable selection: ownership share with alternative added controls to the baseline.

This table reports OLS estimates where the dependent variable is *Ownership share* (basis points). *EIR* is carbon emissions divided by revenue. The table tests, one at a time, whether candidate investor-country controls belong in the ownership specification. Column 1 is a minimal specification with only *EIR*×*Log GDP per capita*. Columns 2–7 each add *EIR* interacted with one country-level variable and examine whether the added control materially changes the *EIR*×*Log GDP per capita* coefficient. The six candidates form three groups. The financial-development variables are *Bank assets*, defined as domestic bank assets divided by GDP, and *Market cap.*, defined as stock market capitalization divided by GDP. The resource and commodity-trade variables are *FF rents* and the *CTOT index*. *FF rents* is the sum of oil, natural gas, and coal rents divided by GDP. The *CTOT index* is the IMF Gruss–Kebhaj commodity terms-of-trade index. It is a weighted average of world commodity price changes, with each commodity weighted by the country's trade in it relative to GDP. The climate-risk variables are *Heat index 35*, defined as days per year when the daily mean heat index exceeds 35°C, and *Flood exposure*. The latter is the additional share of the population projected to face annual coastal floods under sea-level-rise projections through 2050. The *Corr with Log GDP per capita* row reports the pairwise country-year correlation of each candidate with *Log GDP per capita* as descriptive context. *Return* is the firm's lagged annual log price return, winsorized at 1%/99%. The *Foreign* dummy is included in every regression but omitted from the table. All regressions include firm-year and investor-country-year fixed effects. Only *Bank assets* and *Market cap.* materially shift the *EIR*×*Log GDP per capita* coefficient. As the two variables are related and *Bank assets* are highly correlated with *Log GDP per capita*, we eventually retain only the interaction with *Market cap.* for regressions. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6	7
		Financial development		*Resources and commodity trade*		*Climate risk exposure*	
EIR × Log GDP per capita	−2.39**	−4.18**	−4.47**	−2.40**	−2.31**	−2.80**	−2.55**
	(1.12)	(1.76)	(1.79)	(1.12)	(1.14)	(1.36)	(1.13)
EIR × Bank assets		0.104*					
		(0.059)					
EIR × Market cap.			−5.79**				
			(2.32)				
EIR × FF rents				−0.021			
				(0.145)			
EIR × CTOT index					1.695		
					(1.391)		
EIR × Heat index 35						−0.052	
						(0.085)	
EIR × Flood exposure							1.201
							(0.924)
Return × Log GDP per capita	0.595***	0.556***	0.642***	0.686***	0.601***	0.598***	0.649***
	(0.097)	(0.106)	(0.106)	(0.112)	(0.107)	(0.103)	(0.106)
Corr with Log GDP per capita	—	0.49	0.17	0.08	−0.06	0.02	−0.16
N	311,368	269,237	298,803	266,131	290,167	268,694	290,204
Adjusted R^2	0.849	0.865	0.855	0.854	0.862	0.862	0.853

Table A3: Alternative emissions variables.

This table reports OLS estimates on foreign investor-firm pairs, where the dependent variable is *Ownership share*, winsorized at 1% and 99%. Columns 1–5 use all years. Column 1 uses emissions divided by assets. Column 2 uses total emissions. Columns 3–5 use the log versions of emissions relative to revenue, emissions relative to assets, and total emissions. Each column also includes the emissions variable interacted with *Market cap.*, *Return×Log GDP per capita*, and a separate distance measure given the focus on foreign pairs. All regressions include firm-year and investor-country-year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Ownership share

	1	2	3	4	5
	Ownership share				
Emissions variable × Log GDP per capita	−13.08*	−1.575***	−9.718***	−7.354***	−5.286***
	(6.802)	(0.349)	(1.536)	(1.396)	(1.181)
Emissions variable	Emissions divided by assets (EIA)	Total emissions (Emis)	Log EIR	Log EIA	Log Emis
N	281,064	281,078	280,476	280,462	280,476
Adjusted R^2	0.360	0.360	0.361	0.361	0.360

Table A4: Bilateral fixed-effects robustness.

This table reports OLS estimates of *Ownership share* (basis points) on *EIR×Log GDP per capita* under alternative bilateral fixed effects. The dependent variable is winsorized at the 1st and 99th percentiles. Columns 1–2 re-estimate the benchmark specification in column 1 of Table 4. Columns 3–4 use the same sample and add *EIR×Log GDP per capita×PostPA*. Columns 5–6 use the full foreign-pair sample in column 1 of Table 6, with winsorization applied within that sample. The Pair specifications include firm-year, investor-country-year, and investor-country×firm-country fixed effects. The Pair-year specifications include firm-year and investor-country×firm-country×year fixed effects. Investor-country-year fixed effects are nested in the latter. All columns control for *EIR×Market cap.* and *Return×Log GDP per capita*. The *Foreign* indicator in columns 1–4 and bilateral distance in columns 5–6 are absorbed by the bilateral fixed effects. All regressions exclude subsidiaries and offshore financial centers. Standard errors are clustered at the firm level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6
	Benchmark		*Pooled PA interaction*		*Full foreign*	
	Pair	*Pair-year*	*Pair*	*Pair-year*	*Pair*	*Pair-year*
EIR × Log GDP per capita	−2.649**	−2.637*	−2.184**	−2.265*	−1.143	−1.441*
	(1.281)	(1.493)	(0.924)	(1.190)	(0.969)	(0.770)
EIR × Log GDP per capita × Post-PA			−5.638	−3.941		
			(6.576)	(7.048)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Investor-country-year FE	Yes	Nested	Yes	Nested	Yes	Nested
Investor–host FE	Yes	—	Yes	—	Yes	—
Investor–host–year FE	—	Yes	—	Yes	—	Yes
N	298,803	298,803	298,803	298,803	281,078	281,078
Adjusted R^2	0.901	0.905	0.901	0.905	0.551	0.543

Table A5: Shift-share robustness of ownership reallocation.

This table reports OLS estimates for the rich-country share of foreign ownership in columns 1–3 of Table 9. The dependent variable is measured at $t + h$, and the reported coefficient is on *Divestment pressure×FF-exposed*. The Baseline row reproduces Table 9. *Drop US from pressure* excludes the US component of the shift-share measure. *Foreign pressure only* excludes the component originating in the firm's home country. *Common rich-country trend* adds year-specific slopes on the firm's predetermined 2002–2005 ownership exposure to rich investor countries. *Include Low-risk firms* retains Low-risk firms in the comparison group. *Lagged EIR* replaces current EIR with lagged EIR both as a control and in its interaction with divestment pressure. All other controls, sample restrictions, and fixed effects are as in Table 9. Removing a source-country component changes the scale of divestment pressure, so the magnitudes of those coefficients are not directly comparable with the Baseline. Standard errors are clustered at the firm home-country level and reported in parentheses. N reports the number of observations before singletons are dropped. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	$t+1$	$t+2$	$t+3$
Baseline	−1.290**	−1.715**	−2.264***
	(0.577)	(0.841)	(0.576)
Drop US from pressure	−0.555*	−0.779*	−1.498
	(0.320)	(0.403)	(0.943)
Foreign pressure only	−0.441*	−0.528*	−1.085*
	(0.236)	(0.307)	(0.582)
Common rich-country trend	−1.972***	−2.606***	−3.104***
	(0.455)	(0.652)	(0.873)
Include Low-risk firms	−1.183**	−1.654**	−2.066***
	(0.529)	(0.738)	(0.543)
Lagged EIR	−1.321**	−1.779**	−2.278***
	(0.556)	(0.800)	(0.588)
N (Baseline)	3,000	2,468	2,013
N (incl. Low-risk)	3,057	2,517	2,054
Home-country clusters (Baseline)	39	38	36

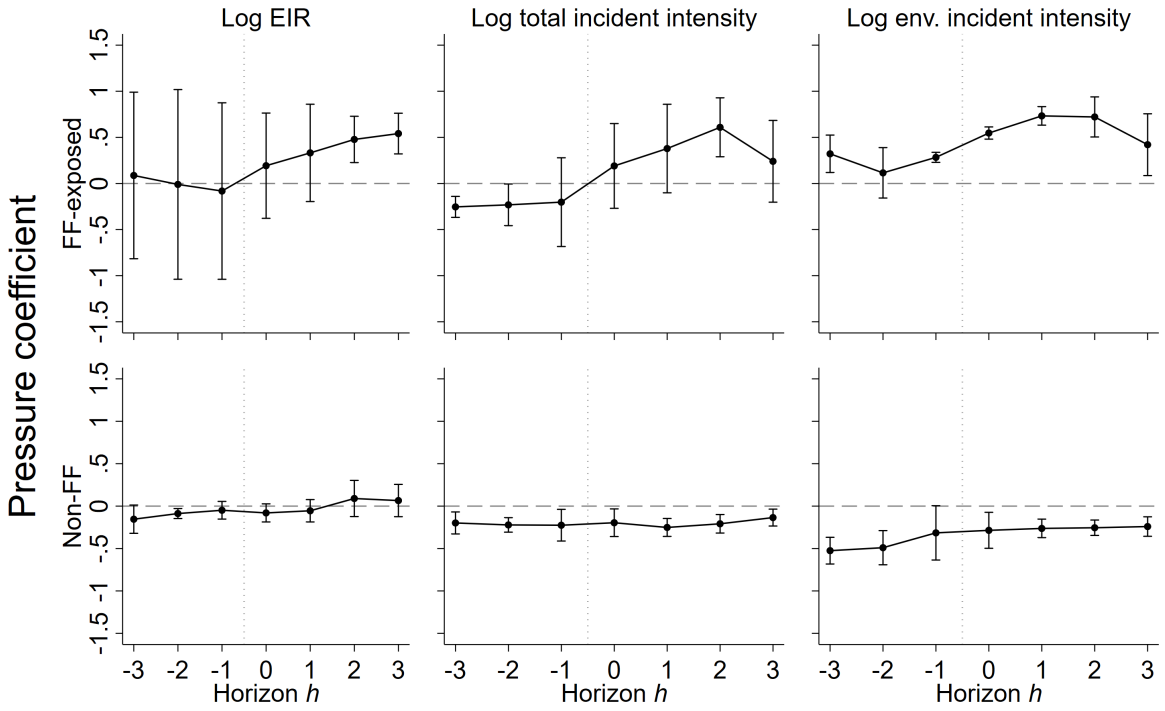


Figure A1: Event-study estimates of environmental outcomes around rich-country divestment pressure.

This figure plots dynamic estimates from the environmental-outcome specifications in Table 10. The columns report *Log EIR*, *Log total incident intensity*, and *Log environmental incident intensity*. The top row uses FF-exposed firms, and the bottom row uses non-FF firms as a comparison. For each sample and outcome, we estimate separately

$$Y_{f,t+h} = \beta_h \, \textit{Divestment pressure}_{f,t} + \Theta_h X^E_{ft} + \gamma_f + \delta_{C,t} + \varepsilon_{f,t+h}, \qquad h = -3, \ldots, 3,$$

and plot $\widehat{\beta}_h$. Divestment pressure is the shift-share measure that weights cumulative rich-country divestment commitments by firms' predetermined 2002–2005 bilateral ownership shares. Horizon $h = 0$ is the pressure year itself. Negative horizons relate current pressure to outcomes observed before year t and show whether similar patterns precede the subsequent associations. Horizons $h = 1, 2, 3$ reproduce the corresponding estimates in Table 10. All regressions use the same controls, sample restrictions, firm fixed effects, and firm home-country×year fixed effects as that table. Standard errors are clustered at the firm home-country level. The vertical bars represent 95% confidence intervals.

Online Appendix for "Who holds brown equity? Economic development, divestment, and environmental outcomes"

For online publication only – not intended for print

This Online Appendix contains supplementary material referenced in the main paper. Section OA.1 examines the ownership coverage threshold and sample construction. Section OA.2 provides details on the investor classifications, commitment dates, and fossil-fuel tier assignment used in the divestment pressure tests. Section OA.3 documents the classification of brown and non-brown industries. Section OA.4 reports additional figures.

OA.1 Ownership coverage threshold and sample construction

In our main analysis, we apply a minimum ownership coverage threshold of 75% for a firm to be included in the sample. We re-estimate our benchmark regressions for alternative, more restricted samples that result from requiring more complete ownership information, considering thresholds up to 90%. Figure OA1 shows how five sample characteristics vary with the threshold. The number of distinct investor countries declines, making the sample less suited to investigate the role of investor-country economic development in portfolio decarbonization. The number of host countries also declines, and the sample becomes increasingly dominated by U.S. firms. The mean observation year and investor-country GDP per capita increase, while mean EIR declines, indicating that more complete ownership information is available disproportionately for later observations, richer investors, and greener firms.

Table OA1 reports the benchmark estimates using the alternative samples. The estimates of *EIR* $\times$ *Log GDP per capita* remain negative as the coverage threshold increases and remain significant in the foreign-holdings specifications at each threshold. The estimates for all investor–firm pairs increase in magnitude but lose statistical significance at the more restrictive

thresholds. Overall, this evidence provides qualified support for our main finding that richer-country investors hold lower ownership shares in brown firms, while also showing that more stringent coverage requirements materially change the sample and make it less representative.

Table OA2 reports annual ownership-data availability and the resulting firm-level sample counts.

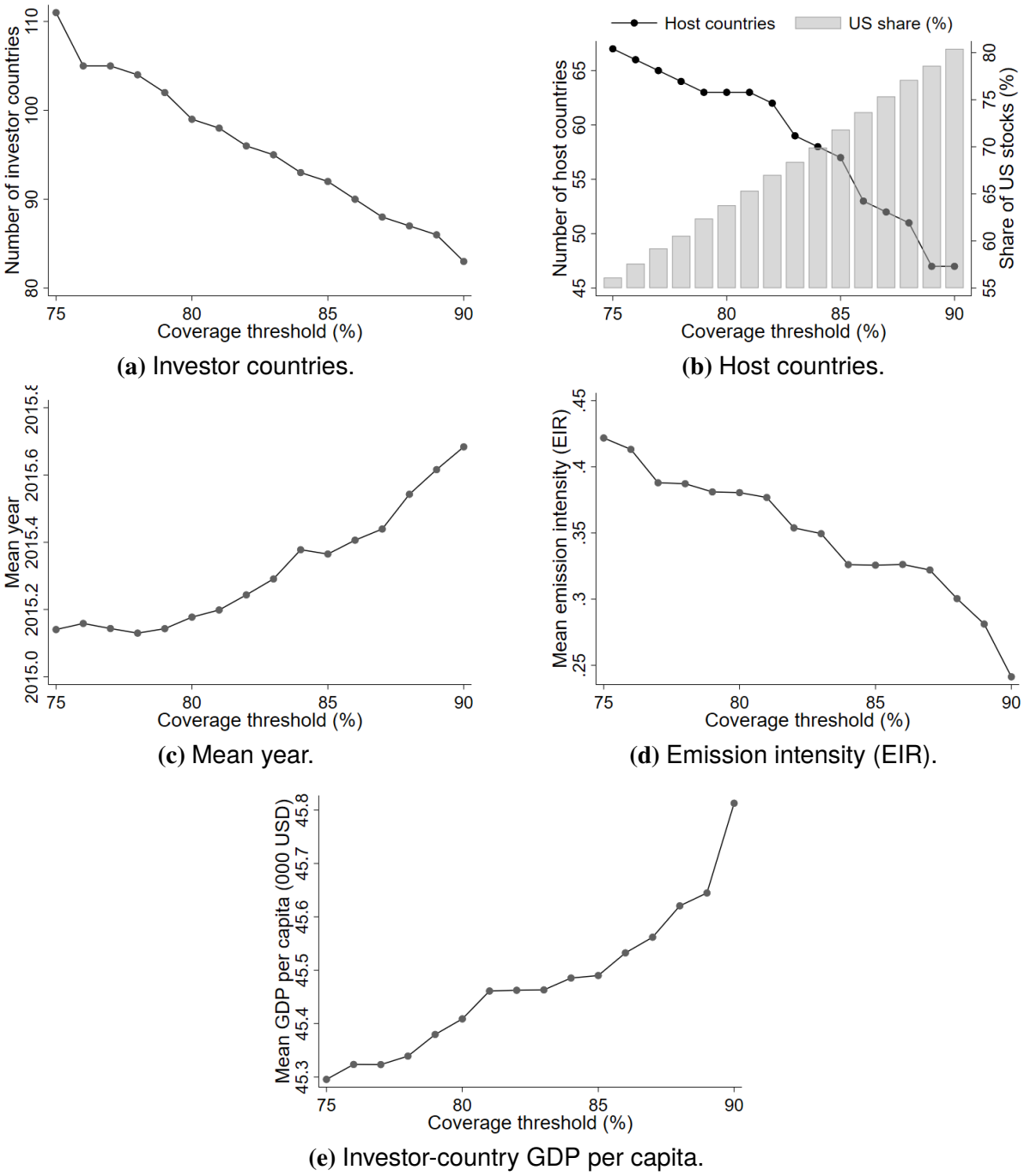


Figure OA1: Sample characteristics and coverage threshold.

This figure shows how each sample characteristic varies as the minimum ownership coverage threshold increases from 75% to 90%. (a) Number of distinct investor countries. (b) Number of distinct host countries (left y-axis) and share of observations associated with U.S. stocks (right y-axis). (c) Mean year of observations. (d) Mean emission intensity relative to revenue (EIR). (e) Mean GDP per capita of investor countries, measured in thousands of constant 2021 international dollars based on purchasing power parity. An alternative plot using current U.S. dollars shows an almost identical trend.

Table OA1: Estimation of benchmark specifications with alternative coverage thresholds.

This table reports OLS estimates where the dependent variable is *Ownership share*. Odd-numbered columns use all investor–firm pairs and include the *Foreign* dummy. Even-numbered columns restrict the sample to foreign pairs and include distance. Columns 1–2 use a coverage threshold of 75%, columns 3–4 use 80%, columns 5–6 use 85%, and columns 7–10 use 90%. Columns 9–10 additionally exclude U.S.-headquartered firms. All columns include *EIR×Market cap.* and *Return×Log GDP per capita*. All regressions include firm-year and investor-country-year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4	5	6	7	8	9	10
	Ownership share		Ownership share		Ownership share		Ownership share		Ownership share	
	All	Foreign	All	Foreign	All	Foreign	All	Foreign	All	Foreign
EIR × Log GDP per capita	−4.477**	−3.105*	−3.955*	−4.930**	−6.099	−4.835**	−17.31	−5.330*	−27.38	−31.80**
	(1.808)	(1.671)	(2.032)	(2.017)	(9.723)	(2.185)	(10.89)	(2.790)	(18.03)	(13.62)
Coverage threshold	75%		80%		85%		90%		90%	
Excluding US stocks	N		N		N		N		Y	
Observations	298,564	280,716	249,640	234,516	187,933	176,364	127,766	119,714	31,615	30,308
Adjusted R^2	0.855	0.359	0.865	0.372	0.879	0.402	0.896	0.448	0.529	0.320

Table OA2: Numbers of firms with ownership and emissions data.

This table reports annual firm counts. Column 1 reports firms with ownership data. Column 2 reports firms with both ownership and emissions data. Column 3 reports firms in the firm-level sample, which additionally requires a single class of common stock, at least 75% ownership coverage, at least three consecutive observations, and no subsidiary relation to another sample firm.

	1	2	3
Year	Firms with ownership data	Firms with ownership and emissions data	Firm-level sample
2002	17,682	473	92
2003	19,190	653	157
2004	20,522	1,065	258
2005	22,266	1,458	372
2006	24,704	1,696	442
2007	28,708	1,862	497
2008	30,931	2,170	617
2009	32,854	2,489	739
2010	34,165	2,927	903
2011	35,108	3,188	1,016
2012	36,035	3,312	1,076
2013	36,748	3,419	1,154
2014	37,836	3,511	1,168
2015	38,976	3,947	1,303
2016	39,282	4,619	1,636
2017	40,887	5,596	2,020
2018	42,463	6,310	2,373
2019	43,418	7,232	2,661
2020	44,872	8,357	2,471
2021	48,340	9,246	2,190

OA.2 Additional data construction

OA.2.1 Investor classifications

We classify investors by their role using the LSEG investor-type classification. *Delegated* investors include investment advisors, asset managers, hedge funds, banks and trusts, private-equity firms, and venture capital firms. *Stewards* include pension funds, insurance companies, sovereign wealth funds, foundations, and endowments. *Strategic* investors include corporations, holding companies, individuals, insiders, and governments. We aggregate holdings within each investor-country–firm–year by investor category. When an investor country holds a firm but has no reported holdings for a given category, we assign zero to that category.

Delegated investors account for 85.6% of investor records, stewards for 6.4%, and strategic investors for 4.5%. The remaining 3.5% have unknown investor type and are not assigned to a category. These frequencies reflect differences in both investor composition and reporting requirements. Delegated investors are numerous and generally subject to broad mandatory reporting. Strategic investors are fewer and commonly report only positions above disclosure thresholds. The median observed holding is therefore approximately 6 basis points for delegated investors and 88 basis points for strategic investors.

We separately classify investors by portfolio turnover, computed by Refinitiv as trading volume relative to portfolio value over the preceding 12 months. High-, medium-, and low-turnover portfolios have implied average holding periods below one year, between one and two years, and above two years, respectively. We aggregate turnover-specific ownership within each investor-country–firm–year.

OA.2.2 Divestment commitment dates

The Stand.earth registry does not report commitment dates, so we identify them from public announcements and archived versions of the registry. We exclude 116 records (6.7%) because the only dated source is a later summary webpage that confirms the commitment without identifying when it was made or announced. We also exclude 39 records (2.3%) for which no date can be identified.

OA.2.3 Fossil-fuel tier assignment

We classify firms' fossil-fuel exposure using Urgewald workbooks covering the current and historical Global Oil and Gas Exit Lists, the Global Coal Exit List, and the Metallurgical Coal Exit List. We harmonize these files and match them to our firm sample. We first match on LSEG PermID, followed by equity ISIN, normalized firm name and country, and normalized firm name alone.

For firms matched to Urgewald, we evaluate all available fossil-fuel indicators jointly and assign the highest tier indicated by any criterion. Heavy firms are primary divestment targets. They include firms with dominant fossil-fuel revenue, dominant fossil-fuel power generation among power or oil-and-gas firms, large coal production, or the highest-severity coal-power indicators. Moderate firms have material but less dominant fossil-fuel exposure. The criteria include intermediate fossil-fuel revenue or power shares, coal-mining operations, quantitative coal-exposure indicators, material coal-fired capacity, or active fossil-fuel expansion by a power or oil-and-gas firm. Low firms have peripheral exposure. The criteria include minimal fossil-fuel revenue, exposure through finance or holding-company activities, coal-related services, expansion indicators below the Paris-aligned benchmark threshold, or a match that appears in only one edition and has limited supporting evidence.

We use a calibrated fallback review for 144 firms in the divestment-pressure firm universe that cannot be uniquely matched by LSEG organization identifier or equity ISIN. In May 2026, we used Claude Opus 4.8 (Anthropic), accessed through Claude Code, to evaluate firm names, countries of incorporation, and available business descriptions against the Urgewald criteria. The model generated candidate classifications only. We reviewed the supporting information, calibrated the suggested tiers against the Urgewald-based assignments, and made all final classification decisions. Firms without Urgewald evidence or a validated fallback classification are assigned to No risk.

OA.3 Determination of brown vs. non-brown sectors

In this paper, we define brown industries consistently with how we construct emission variables for the gravity sample. To do so, we compare the medians of emission variables for each sector-year combination, and alternatively each industry-year combination leading to a more granular classification.

Figure OA2 and Figure OA3 show the sectoral differences in terms of emission intensity and total emission levels. The figures present bar charts where each bar indicates a sector-year or industry-year combination. Hence, we see several bars per sector or industry. Three economic sectors, identified by 2-digit TRBC codes, stand out in both measures. They are Energy (50), Basic Materials (51), and Utilities (59).

Business sectors are subsets of economic sectors and are identified by 4-digit TRBC codes. Transportation (5240) has relatively high emissions intensity. Within Energy (5), Renewable Energy (5020) has much lower emissions than the other business sectors. Food & Drug Retailing (5430) and Consumer Goods Conglomerates (5440) have relatively high total emissions, mainly because of their operating scale. Uranium (5030) has relatively low total emissions, while emissions from Mineral Resources (5120) decline markedly over time.

Our final check reviews the industry groups, identified by 6-digit TRBC codes. We identify two industry groups within highly emitting sectors that are on the low side toward the end of the period. These are Oil & Gas Related Equipment and Services (501030) and Water & Related Utilities (591030).

Based on the discussion above, we form two slightly different lists of brown industries. The first consists of the three most emitting economic sectors, which are Energy (50), Basic Materials (51), and Utilities (59). The second uses a more granular set of TRBC industry groups, comprising Coal (501010), Oil & Gas (501020), Chemicals (511010), Metals & Mining (512010), Construction Materials (512020), Paper & Forest Products (513010), Containers & Packaging (513020), Freight & Logistics Services (524050), Passenger Transportation Services (524060), Food & Drug Retailing (543010), Consumer Goods Conglomerates (544010), Electric Utilities & IPPs (591010), Natural Gas Utilities (591020), and Multiline Utilities (591040).

In our paper, we use the second list because of its greater precision, but the main findings

remain mostly unchanged when the first list is employed instead.

OA.4 Additional figures

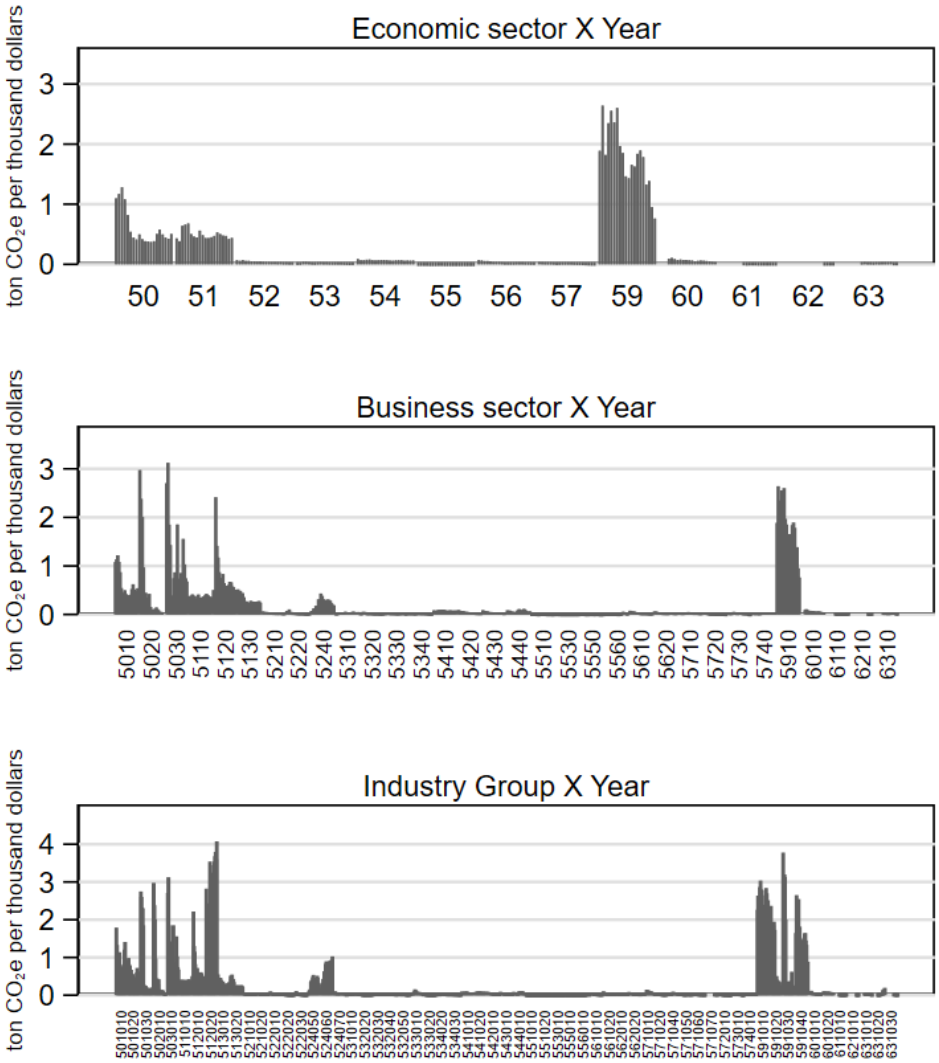


Figure OA2: Median emission intensity across industries.
This figure compares median emission intensity (Scope 1+2 emissions per thousand dollars of revenue) across, respectively, economic sectors (2-digit TRBC), business sectors (4-digit), and industry groups (6-digit). Each bar indicates a sector-year or industry-year combination. Multiple bars per sector illustrate within-sector heterogeneity.

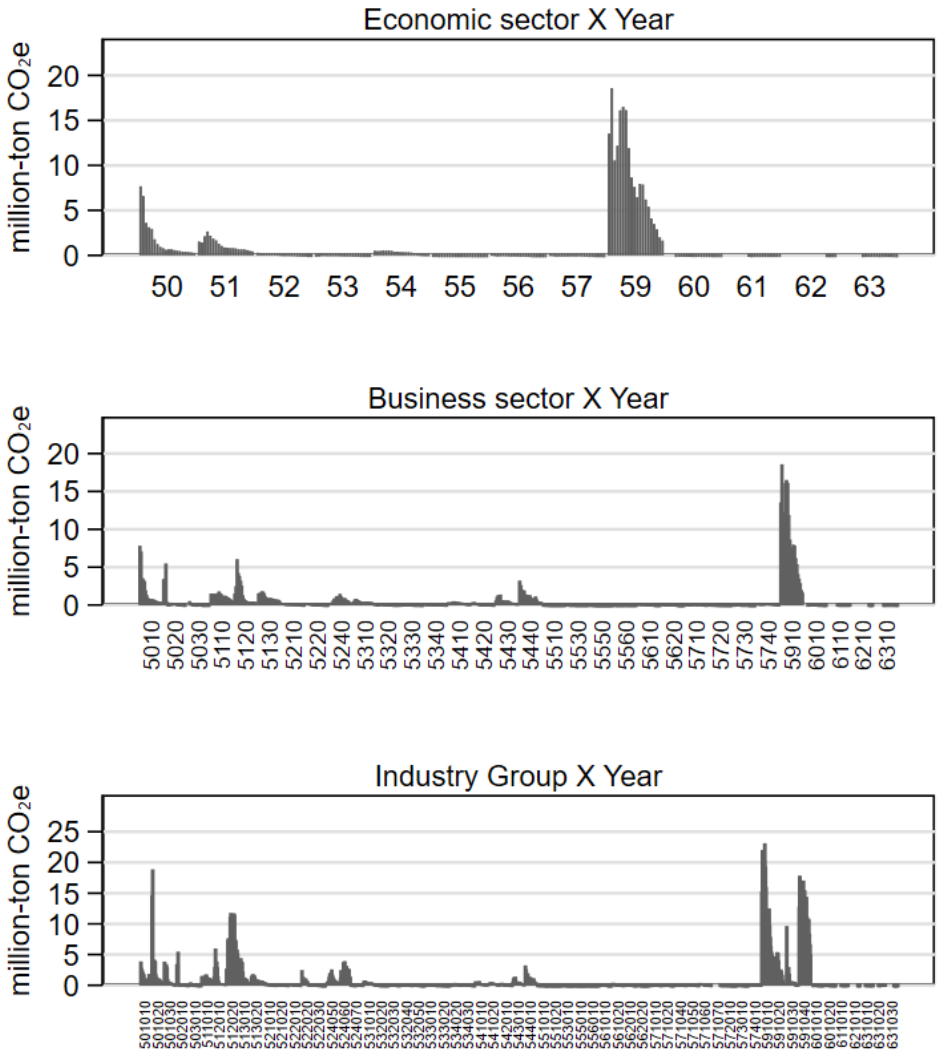
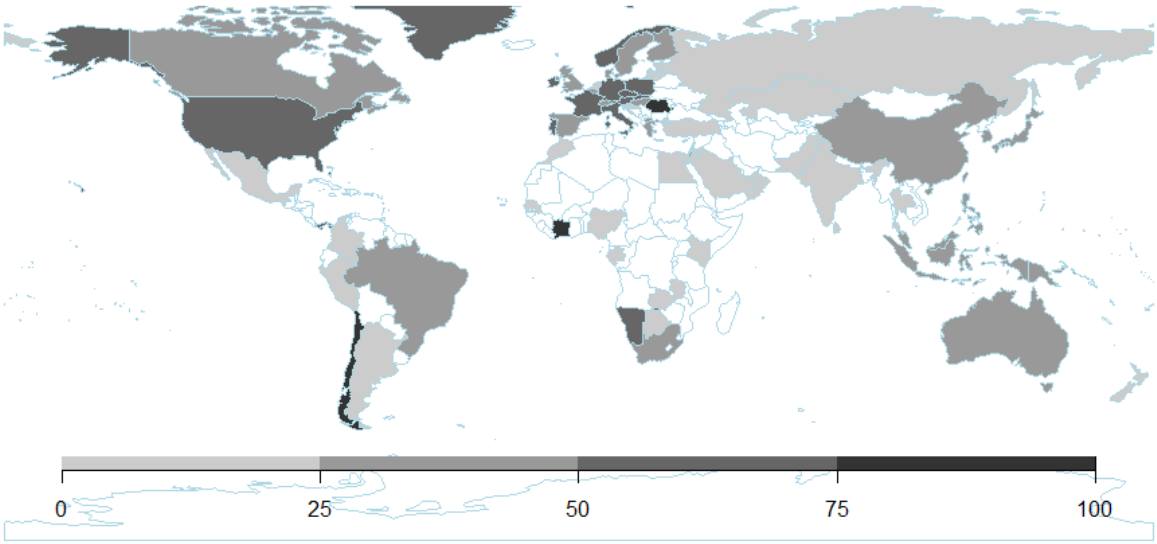
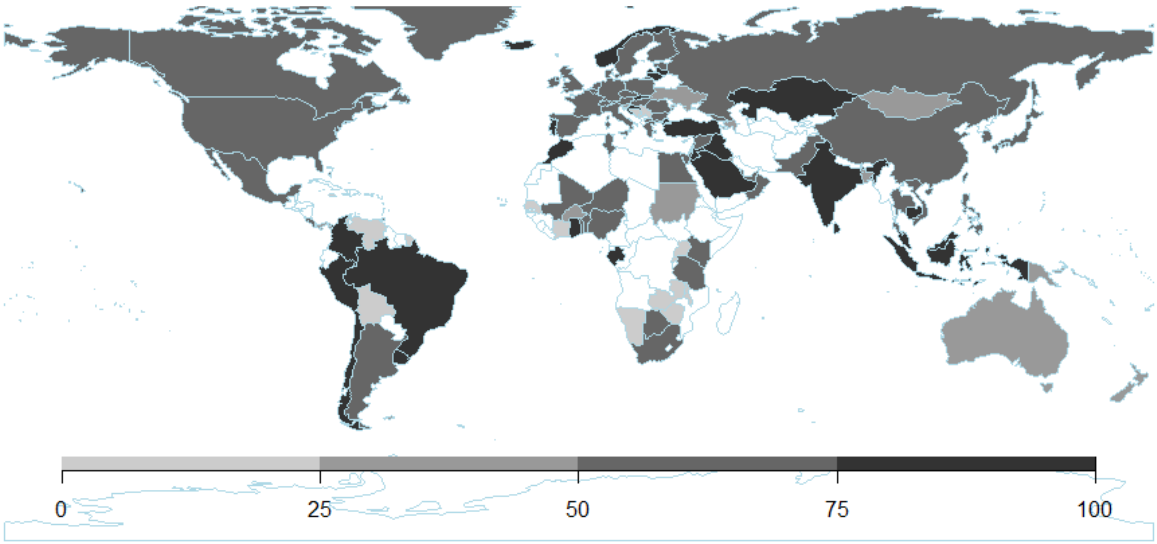


Figure OA3: Median total emissions across industries.

This figure compares median total emissions (million tons CO_2e) across, respectively, economic sectors (2-digit TRBC), business sectors (4-digit), and industry groups (6-digit). Each bar indicates a sector-year or industry-year combination. Multiple bars per sector illustrate within-sector heterogeneity.



(a) Country-level coverage (value-weighted mean): 2002.



(b) Country-level coverage (value-weighted mean): 2021.

Figure OA4: Average in-sample coverage of ownership data in 2002 and 2021.

This figure compares ownership coverage by the data provider of firms at the country-year level for 2002 and 2021 based on all available ownership information for public firms. Ownership coverage is computed as the percentage of public firms with any ownership information within each country-year, weighted by firm-level market capitalization. Firms with more than 100% reported coverage are excluded.

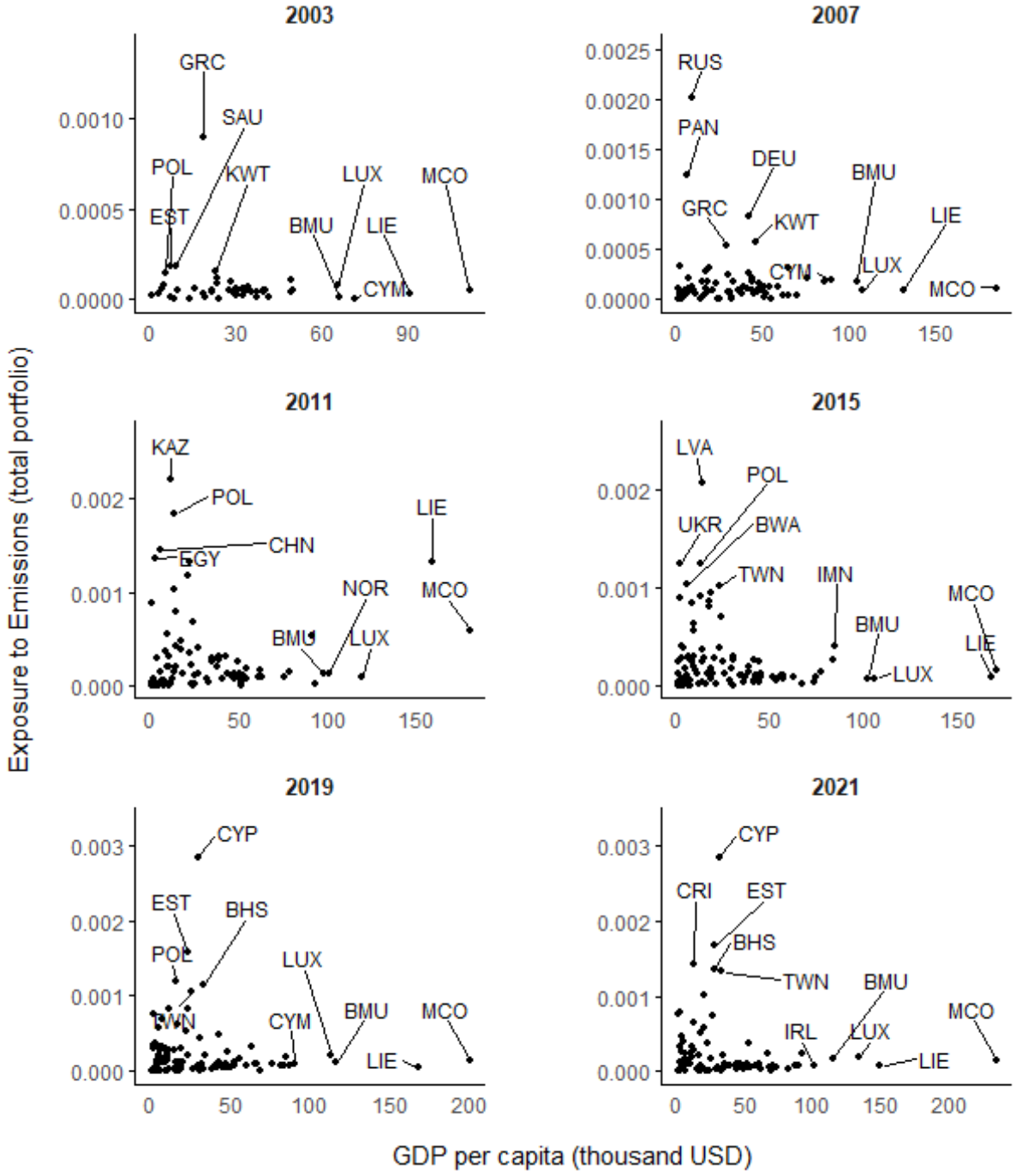


Figure OA5: Full portfolio emissions relative to revenues and GDP per capita, additional years.
This figure plots national portfolio exposure to emissions relative to revenues against GDP per capita for six additional years within the period 2002–2021. Exposure is computed using all firms in the firm-level sample, where i is a firm index, t is the year index, and w_{it} represents the percentage ownership held by a country in firm i at year-end. Emissions are the sum of Scope 1 and Scope 2 emissions from CDP or, if unavailable, Refinitiv Workspace.

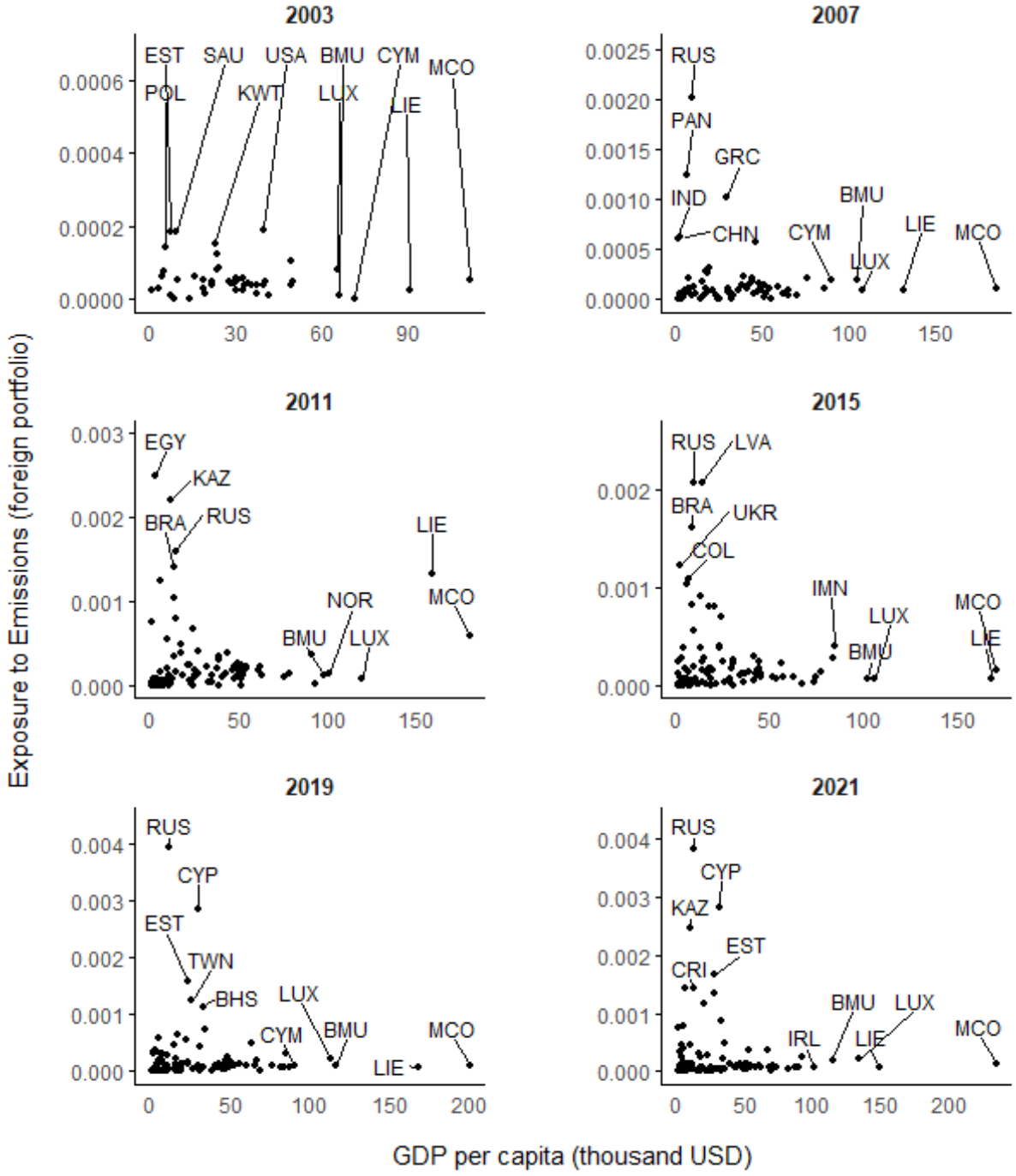


Figure OA6: Foreign portfolio emissions relative to revenues and GDP per capita, additional years. This figure plots national foreign portfolio exposure to emissions relative to revenues against GDP per capita for six additional years within the period 2002–2021. Exposure is computed using all foreign firms in the firm-level sample, where i is a firm index, t is the year index, and w_{it} represents the percentage ownership held by a country in firm i at year-end. Emissions are the sum of Scope 1 and Scope 2 emissions from CDP or, if unavailable, Refinitiv Workspace.

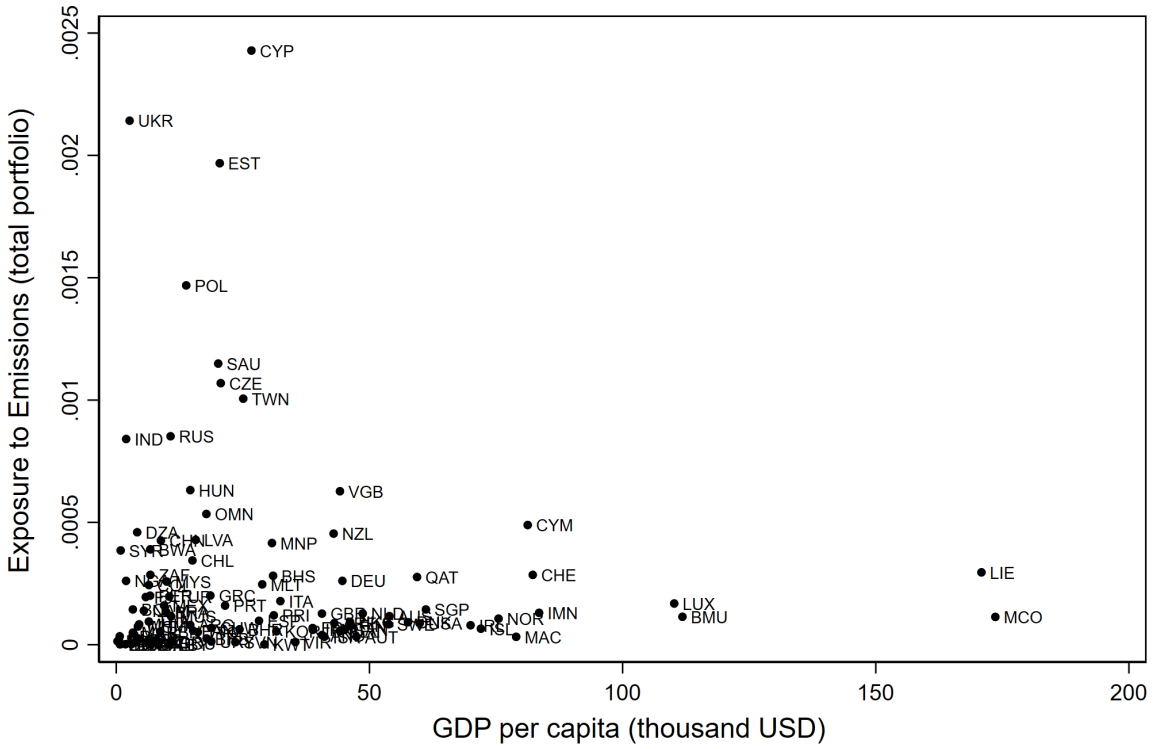


Figure OA7: Full portfolio exposure to emissions relative to assets and GDP per capita in 2017. This figure plots the national portfolio exposure to emissions relative to total assets against GDP per capita for countries included in the firm-level sample for the year 2017. This exposure is computed using information for all firms in the firm-level sample as follows,

$$\frac{\sum_{i \in Full\ Portfolio_t} w_{it} \times Emissions_{it}}{\sum_{i \in Full\ Portfolio_t} w_{it} \times Assets_{it}}$$

where i is a firm index, t is the year 2017, and w_{it} represents the percentage ownership held by a country in firm i at the end of 2017. Emissions are the sum of Scope 1 and Scope 2 emissions. Emissions data are from CDP and Refinitiv Workspace.

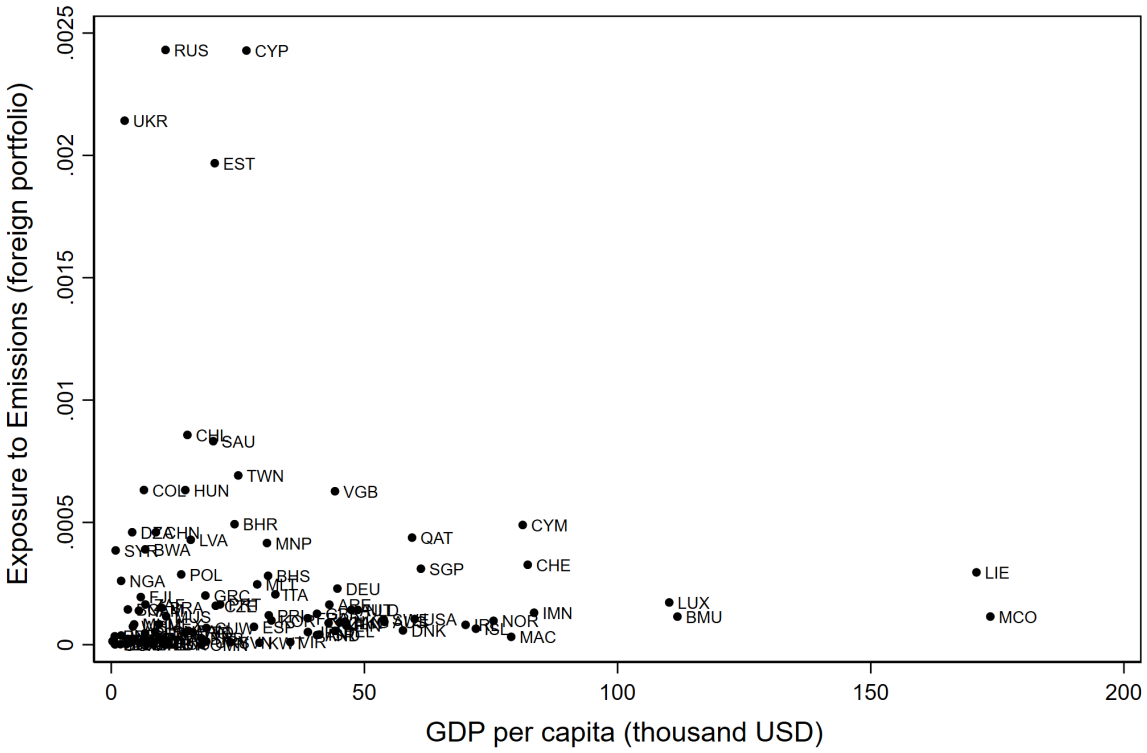


Figure OA8: Foreign portfolio exposure to emissions relative to assets and GDP per capita in 2017. This figure plots the national foreign portfolio exposure to emissions relative to total assets against GDP per capita for countries included in the firm-level sample for the year 2017. This exposure is computed using information for all foreign firms in the firm-level sample as follows,

$$\frac{\sum_{i \in Foreign\ Portfolio_t} w_{it} \times Emissions_{it}}{\sum_{i \in Foreign\ Portfolio_t} w_{it} \times Assets_{it}}$$

where i is a firm index, t is the year 2017, and w_{it} represents the percentage ownership held by a country in firm i at the end of 2017. Emissions are the sum of Scope 1 and Scope 2 emissions. Emissions data are from CDP and Refinitiv Workspace.