Climate and the geography of multinationals *

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Abstract

We study the effects of climate policies on the geographic location of manufacturing multinationals' affiliates. By combining information on the location of subsidiaries, their emissions, and local climate policies, we are able to document a reduction in Foreign Direct Investment (FDI) exposure of multinationals to countries with tighter climate policies. The relocation away from these countries is stronger for subsidiaries in the most carbon-intensive manufacturing sub-sectors and is mostly observed in advanced economies. By constructing a measure of exogenous climate policy shocks, we document a significant pass-through of such shocks to the balance sheets of the affiliates. Multinationals respond to the tightening of climate policies by lowering capital and employment in affiliates in advanced economies and increasing the size of their controlled firms in emerging economies. At the same time, we do not find consistent evidence of multinationals decreasing their global emissions in response to climate policy shocks.

JEL classification: F21, F23, F64
Keywords: climate change, climate risks, multinationals, FDI

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1 Introduction

Despite recent trends towards protectionism and geopolitical tensions, international trade and investments remain one of the sources of economic growth for many jurisdictions across the globe. Understanding the determinants of cross-border flows is an object of extensive studies in the literature. Recent evidence points to the relevance of global value chains in shaping the structure of international trade and investment patterns, with strong emphasis being placed on their sensitivity to various types of policies (see Antràs and Chor [2022] for a comprehensive review). A strand of this literature has focused on a particular subset of policies, namely environmental standards and climate policies, thereby forming a bridge between international and environmental economics. While the literature has been rapidly expanding, we still lack a clear picture of how climate policies (often referred to as transition risk) affect the global allocation of industrial production and how this relationship might evolve in the presence of extreme weather events (physical risk). In this paper, we contribute to the body of knowledge on this issue by studying to what extent manufacturing firms are internalizing climate policies in their decisions of how to allocate their affiliates globally.

The effectiveness and implications of the standard Pigouvian tax on carbon emissions have been widely analyzed from several different angles, starting from Nordhaus [1992]. Most of the macroeconomic environmental literature, however, abstracts from heterogeneity in carbon prices across jurisdictions, as well as the possibility for firms to relocate carbon intensive production towards countries with weaker climate policies, an argument directly derivable from the standard cost-minimization problem in an environment with global value chains (GVC). This possibility is high on the agenda of countries with ambitious climate policies as witnessed by the recent operationalization of the EU Carbon Border Adjustment Mechanism (CBAM). It imposes the EU's carbon price derived from the EU Emissions Trading System (ETS) to five types of carbon-intensive goods (cement, aluminum, fertilizers, iron and steel, hydrogen and electricity) imported from outside the EU.

At the same time, global warming continues to increase the occurrence and severity of extreme climate events as confirmed recently by the IPCC [IPCC, 2022], with their related material damages in terms of livelihood and economic losses. In a stylized cost-minimization framework, it is conceivable that firms factor in physical climate-related events in their decision of where to open and operate plants, possibly trading-off this type of risk with other cost or benefits characterizing a given jurisdiction. As we are mainly interested in the impact of climate policies on multinationals' location decisions, we include physical risk and firm-level carbon emissions as possible drivers of the relationship between climate policies and the geography of subsidiaries.

We provide novel empirical evidence on the interaction between environmental policies, physical climate risks, and location decisions of large multinationals operating manufacturing subsidiaries across the globe. By leveraging a granular firm-level dataset on ownership links, we are able to track the dynamics of foreign direct investment of the multinationals both on the extensive and intensive margin, complementing and expanding previous work by Gu and Hale [2023]. Relying on a combination of different public databases, we also obtain data on country-level indicators for the relative tightness of climate policies, as well as expected extreme climate

events. Matching the two datasets, and applying careful econometric identification techniques, we show that manufacturing firms internalize, at least to some extent, the effects of climate policies and therefore relocate their business towards countries with more favorable regimes.

Controlling for unobserved static and dynamic variation at headquarter (HQ) and destination country level, we obtain estimates indicative of a significant negative effect of tighter climate policies on FDI in countries where multinationals own high-carbon intensity production. These estimates, while small in magnitudes in line with the previously documented stickiness of GVC links, allow us to conclude that multinationals are well aware both of the costs resulting from environmental regulation and the regulatory arbitrage existing by the lack of coordination in this area. Leveraging the heterogeneity in MNEs exposures to different jurisdictions, we follow Känzig et al. [2024] in constructing a series of shift-share (or 'Bartik') instruments providing us with an exogenous measure of firm-level exposure to global policy shocks. We then use the instruments in a series of local-projection estimations at the affiliate level to document dynamic *causal* responses to climate policy shocks occurring since the Paris agreement in December 2015.

Several patterns emerge from this exercise. In the full sample of affiliates, responses are generally muted, especially over longer horizons. However, splitting the sample by the type of target country reveals sharper effects. Affiliates in advanced economies experience a persistent decline in capital and employment following tighter climate policies. The effect on affiliates in emerging markets is the opposite, suggesting the possibility of carbon leakages. In line with this observation, we find no robust evidence that multinationals reduce their overall global emissions in response to climate policy shocks. Additional evidence comes from heterogeneity analyses based on exposure to physical climate risk. Responses to tighter policies are weaker in countries facing higher expected risks of extreme climate events, many of which are emerging markets that receive increased FDI after climate policy shocks.

Among the closest studies to ours, Känzig et al. [2024] and Gu and Hale [2023] both leverage ORBIS data to trace HQ and affiliate relationships in line with the present paper. Känzig et al. [2024] then implement a geo-location approach to infer emissions of affiliates of European carbon-intensive multinationals, which are shown to respond significantly and positively to a Bartik measure averaging exposure to heterogeneous carbon prices in different European jurisdictions. They also provide evidence suggesting a decrease in capital and employment in European affiliates of multinationals more exposed to high carbon prices. Gu and Hale [2023] provide a stylized theoretical framework for firm production location choice that explicitly incorporates transition and physical risks. Model implications are subsequently tested empirically at different levels of aggregation, including preliminary evidence from firm-level regressions using less granular data than the present paper.

This paper contributions are the following: first, it expands the geographical coverage relative to Känzig et al. [2024] to cover multinationals headquartered in different countries than the EU, while also employing measures of climate policy stringency covering extra European jurisdictions. Second, it offers novel insights in the dynamics of GVC links in response to climate policy shocks, leveraging local projections in association with the plausibly exogenous measure of exposure to costs arising from climate policies. Lastly, we add physical risk as possibly affecting the relationship between climate policies and FDI. Compared to the previous work in Gu and Hale

[2023] we focus solely on variation across and within multinationals, adopting novel identification approaches and thus offering micro-level evidence, complementing results from standard bilateral trade data.

Our results fit in the wider literature on GVCs and climate risks. Another recent study investigating the response of FDI stocks to environmental policies is Böschemeier and Jochem [2024]. Looking at German manufacturing FDI, they find higher effective carbon tax rates in target countries being negatively associated with investment activity in those countries. Taking a more stringently climate perspective, Ben-David et al. [2021] provide evidence of carbon leakage for firms residing in jurisdictions with higher environmental standards relative to the target countries where they operate production. On supply chains, Coster et al. [2024] documents an increase in imports of carbon intensive intermediate goods for French firms, following the implementation of the ETS. On the pricing in financial markets of the real costs entailed by exposure to environmental policies via GVC links, di Giovanni et al. [2025] find a significant albeit small negative pricing impact for firms in sectors with high import shares of intermediate goods produced by European firms subject to the ETS.

With respect to physical risk, Pankratz and Schiller [2024] provide evidence on the higher likelihood for firms to terminate a trade relationship with suppliers located in geographies experiencing increases in heat and flooding risks. In addition, Castro-Vincenzi et al. [2024] document the trade-offs from diversifying the supply chain in order to decrease exposure to firms located in areas with risks of natural disasters. The authors document firms' willingness to pay a higher unit price for imports in order to achieve diversification gains in climate risk exposures.

The rest of the paper is organized as follows: section 2 describes the firm and country level data used in the study, section 3 describes the hypotheses derived from the empirical stylized facts, section 4 presents results for FDI's responses to environmental policies and the interplay between FDI decisions, environmental policies and physical risk, section 5 describes the dynamic responses of affiliate level and consolidated real variables as well as emissions, section 6 concludes.

2 Data

For our analysis we combine multiple data sets. Ownership linkages come from ORBIS. Country-level measures of climate policies come from IEA and OECD. Data on long-term physical risks come from Climate Analytics/NGFS. Firm-level financials are obtained from ORBIS, while firm-level emissions are from Urgentem. Macroeconomic controls come from usual sources.

2.1 Ownership links and definition of FDI

The first building block in our dataset is the selection of multinational enterprises and their affiliates from the ORBIS vintage ownership dataset. Relationships, with key variables relating to the nature of the link and the direct or indirect quantitative ownerships share are defined at yearly level in ORBIS. We begin by imposing a restriction in the size of the multinational

headquarter for which we retrieve the ownership links. To enter our sample, a multinational must have at least 1 billion USD in total assets in one of the years of the panel. Following this restriction, we start collecting parent-affiliate relationships that are of the global-ultimate owner type, with a controlling share of at least 50 percent. In the cases where a multinational is found to be in a parent position in a given link, but being controlled at the 25% level by another multinational in another link, we adjust the ownership tree by allocating the affiliate to the highest hierarchical parent. Data on the quantitative ownership is fundamental in ensuring a proper scaling of affiliates' assets and employment when aggregating measures of FDI at the parent or parent-target country level. For cases where this variable is not populated, we rely on Orbis´s categorization of independence of companies in the ownership data files. This variable describes the degree of dilution in the ownership of both parents and affiliates. For our purposes, we retain only parents that have the highest independence score, implying that ORBIS has verified the existence of at least 6 shareholders in the parent company, none of whom holds a controlling stake. This implies that we can consider the global ultimate owner in that specific ownership tree as exerting control over the affiliates' decisions. For the few cases where we are presented with multiple global ultimate owners, effectively cases of joint ventures, we allocate the affiliate to the global ultimate owner with the largest total assets.

Having mapped the headquarter-affiliate-year ownership links, we impose restrictions on the sectoral composition of the sample. As our research question deals with interlisation of climate policies and physical risks, the core object is physical production that is affected both by the real costs entailed by the climate policies and the potential damages to physical capital entailed by extreme climate events. Following this, we restrict the sample to consider only affiliates in the manufacturing sector (NACE2 sector code C, NAICS codes 31-33). On the multinationals side, we ensure that we are capturing only non-financial corporations and drop financials and real-estate firms (NACE2 sector codes K-L).[1] An additional restriction is applied on the geographical dimension of the data. Following the insights of Hines Jr and Rice [1994] and Damgaard et al. [2024] we opt to exclude affiliates located in off-shore financial centers, due to the fundamentally different dynamic of profit-shifting relative to conventional foreign-direct investment. The list of countries classified as off-shore financial centers is obtained from Eurostat. Lastly, we drop all the affiliates located in the same country as the HQ.

The panel constructed in this way yields a sample of 2653 multinationals headquartered in 65 jurisdictions. These multinationals have links with circa 133 thousand distinct affiliates, spanning 131 jurisdictions globally. As typical with relationships data from Orbis however, a large share of affiliates do not have any data available other than their identifier and sector. Table 1 summarizes the yearly counts for both type of companies, as well as the share of affiliates for which we have either have total assets or employment. The unbalanced nature of the panel, with entrance and exit across all the dimensions is something we take into account when describing our identification strategies, with the empirical exercises employing local-projections being conducted on a fully-balanced version of the panel.

[1] While in principle there could be non-manufacturing headquarters owning a manufacturing affiliate, we find the correspondence between affiliate and parent NACE sectors to be particularly strong. In our sample, 90% of affiliates are owned by manufacturing HQs, with remaining links primarily being with wholesale and retail traders, mining, construction and information technology.

Table 1: Headquarters and affiliates by year

Year	N HQs	HQ Cnty	N Aff	Tgt Cnty	Tgt Cnty w assets	% Aff w assets	% Aff w employement
2010	1,259	49	37,456	114	78	7.0%	5.0%
2011	1,335	47	45,347	115	77	10.4%	6.7%
2012	1,401	48	56,139	117	79	17.1%	11.8%
2013	1,464	55	62,365	118	80	18.6%	11.0%
2014	1,524	53	68,309	122	81	18.7%	10.9%
2015	1,517	54	88,132	123	82	14.6%	9.2%
2016	1,567	57	93,653	124	85	14.5%	9.6%
2017	1,631	56	98,529	123	88	14.2%	10.0%
2018	1,664	56	101,186	124	87	13.7%	10.1%
2019	1,673	54	101,686	124	86	13.2%	9.7%
2020	1,692	55	101,166	124	82	12.4%	9.1%
2021	1,672	50	97,865	124	75	8.9%	6.2%

Notes: N HQs and N Aff show distinct firm counts per year. HQ Cnty and Tgt Cnty show the number of unique countries. Tgt Cnty w assets indicates the number of target countries for which we have at least one link with quantitative FDI data. All percentages are calculated as the share of affiliates with non-missing data.

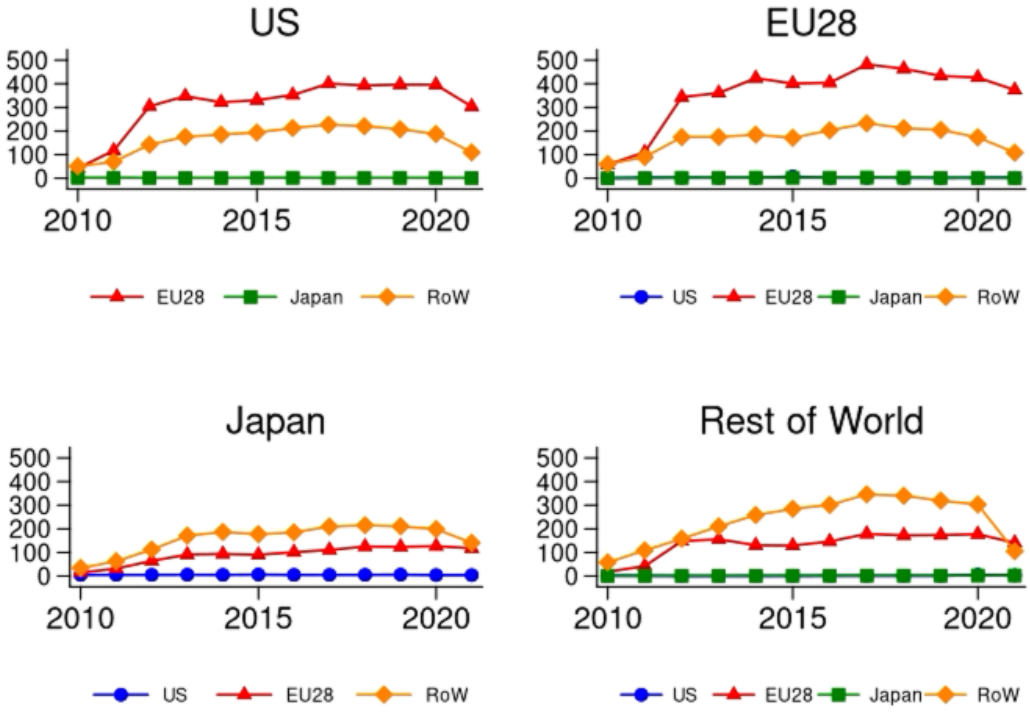
Having outlined the sample construction, we move to the definition of FDI from the parent-affiliate-year data. We use three measures: raw count of affiliates, scaled affiliates' total assets, scaled affiliates' employment. The former metric is mostly employed to have a gauge of the extensive margin of investment of a given MNE in a country. The latter two metrics, which allow for a more precise quantification of the scales of FDI committed in a given affiliate and target country, capture the intensive margin of international investments. Crucially, they rely on balance sheet data being non-missing at the affiliate level. However, as visible from the table, we manage to get a good coverage in terms of jurisdictions even when employing those quantitative metrics. Finally, the scaling of affiliates' assets and employment is performed at ownership link level multiplying those figures with the corresponding ownership share of the parent company.

In figure 1 we display the time-series evolution of the FDI stocks obtained by aggregating the total assets of affiliates for all the parent companies headquartered in the US, in the EU 27 + UK (EU28), in Japan and in the other countries within our sample. The data is not directly comparable to the bilateral FDI statistics provided by the OECD due to differences in the sample of firms we consider and data constraints on the balance sheet figures of affiliates. It however manages to capture non-negligible shares of those aggregates.

2.2 Country level measures of climate policies.

In selecting measures of country level climate policymaking we are faced with an inherent trade-off between geographical coverage and robustness of the measure. For our identification to hold, we need indicators of policies that entail real costs for firms engaged in manufacturing activities. The natural candidate would be the effective tax rates on tonnes of CO2 emissions, as compiled by Metcalf and Stock [2023] or yearly averages of the ETS permit prices from the secondary market. While the tax rates are the ideal instrument for the kind of exercise we are conducting in this paper, they come with two major limitations in our setting. First, they completely exclude jurisdictions where no explicit carbon tax has been implemented. Second, they do not

Figure 1: Bilateral manufacturing FDI dynamics from micro-data.



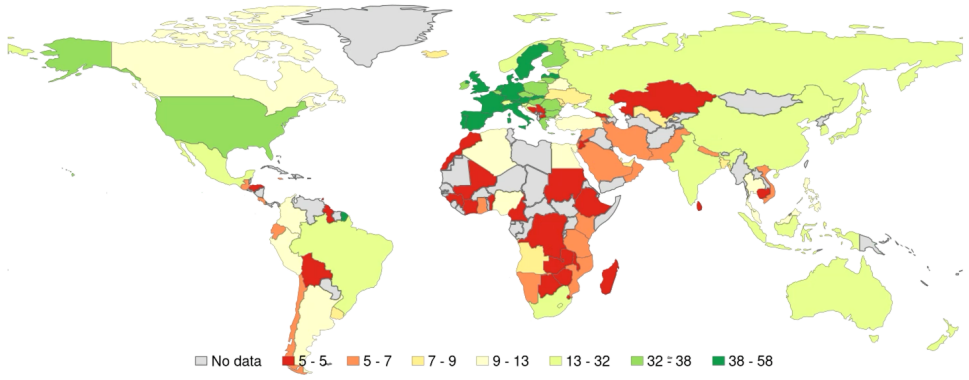
Notes: The chart displays the aggregate FDI positions held by multinational companies headquartered in the selected geographies. All figures are in USD billions. Each panel represents the country of headquarters of the multinationals. For EU 28 and rest of the world, given the multiple jurisdictions included in those blocks, within block FDI positions are displayed.

take into account other types of costs embedded in environmental policies, such as technological requirements in production, with the related compliance costs for firms, as well as outright bans and removal of subsidies on environmentally damaging intermediate / final goods. For these reasons, we decide to employ two metrics that proxy carbon taxes while also being broader in scope on a geographical and cost dimension.

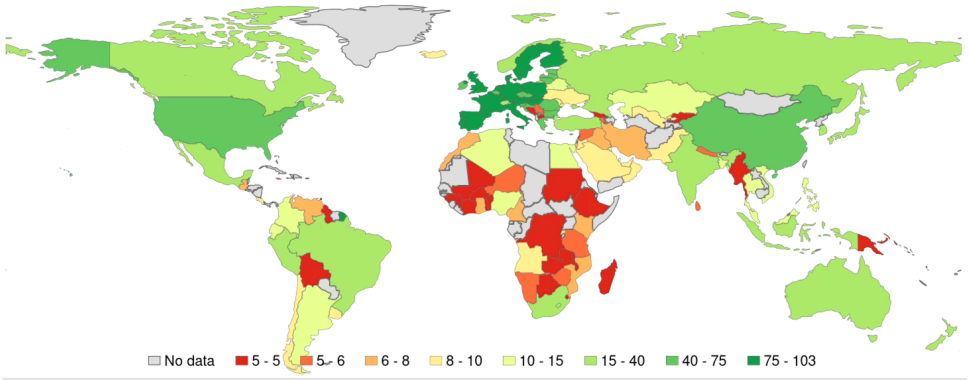
The first metric constructed is a similar version of the count of country-level environmental policies from the IEA employed by Gu and Hale [2023]. We go through the list of policies available on IEA's webpage, filter for those applied at national or international level, and keep only those that explicitly entail costs for firms, dropping policies as subsidies or nationalizations of particular energy sectors. The counts are aggregated at country and yearly level, with international binding agreements being allocated to the signatory countries of the treaties. The interpretation of this variable is that higher levels of country-year counts correspond to a tighter environmental policy regime. The second metric employed is the OECD environmental policy stringency index, as developed by Kruse et al. [2022]. Its range is from 0 to 6, with an higher value indicating tighter climate policies in a jurisdiction. The index is available for 40 countries, which is a subset of the countries covered by the IEA policy counts. As the index is constructed as the average of three components, one of which captures countries' ambitiousness in providing subsidies to clean production technologies, we retain solely on the arithmetic mean of the sub-components related to the tightness of market and non-market policy measures addressing environmentally damaging economic activities. Despite the lower geographical count and some differences in the

types of policies employed in its construction relative to what we include in the IEA indicator, the correlation in our sample between the two measures is 46 %. Figure 2 shows the distribution of countries based on yearly quantiles of the IEA policy counts (cfr. fig A.1 for the corresponding plot of the OECD stringency index). Table A.1 provides summary statistics for climate policy variables, macroeconomic controls and physical risk measures.

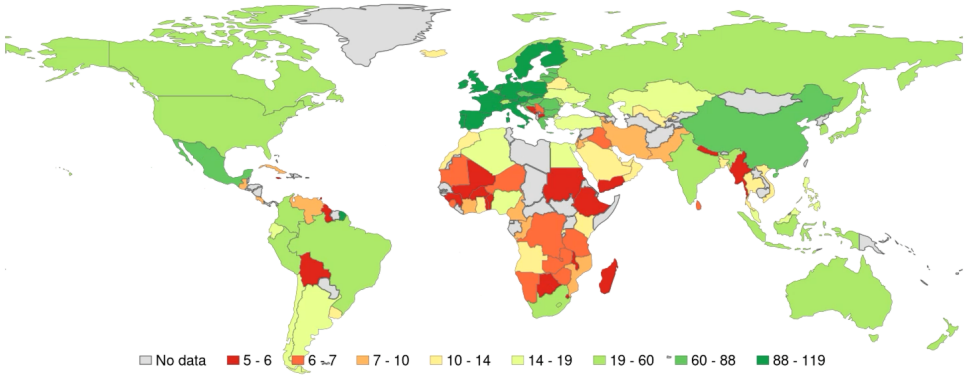
Figure 2: Cross-country and temporal variation in relative stringency of environmental policies (IEA policy counts).



(a) 2010



(b) 2015



(c) 2019

Notes: Countries are shaded by their count of IEA climate policies, with buckets computed for the reference year. Red indicates countries in the left tail of the IEA count distribution, with higher values moving the coloring to green. Countries in gray are those for which no data is not available.

2.3 Country level measures of long-term physical risk.

In one of our additional empirical exercises, we investigate whether countries exposure to long-term physical risk is a factor altering the pricing of climate policies' costs in multinationals FDI decisions. While historical measures of extreme climate events, such as their frequency and intensity, provide valuable information on the risks associated with a particular geographical area, mapping these events to jurisdictions with different geographical sizes could lead to significant measurement error. For our purposes, we opt to rely instead on static metrics that allow a ranking of the countries we have in our sample along the distribution of expected physical risk. The variables retrieved for the ranking are the estimated shares of the land area of a given country subject to wildfires, river floods and heatwaves as computed by Climate Analytics in collaboration with the NGFS (Climate Analytics [2025]). As the estimates are model-based and are provided only at 5-years intervals, we opt to take a conservative stand and select the 2030 median estimates from the Net Zero 2050 model suit. As explained in section 4.1, we are going to use the ranking of countries along each of the three measures as well as their sum exclusively to investigate whether heterogeneity in the response to climate policies exists on the physical risk dimension. Figure A.2 plots the distribution of the aggregate physical risk variable, constructed by summing the land shares exposed to each of the three extreme climate events.

2.4 Country level macroeconomic controls.

In order to control for time-varying characteristics of target-countries we employ the same set of variables as in Gu and Hale [2023]. These are real GDP growth, PPI inflation and trade as share of GDP. The latter is defined as the sum of imported and exported goods and services as share of GDP. All country-level time-series are obtained either from the World Bank or IMF.

2.5 Firm level financials and emissions variables.

We use ORBIS to collect balance sheet information for both the multinationals and their affiliates. The key variables we populate are total assets and employment. All assets figures are converted yearly in USD figures for comparability. We winsorize at the 1% level assets and employment figures for affiliates. On the environmental side, we use Urgentem to obtain reported and inferred Scope 1, 2 and 3 GHG emissions. While available for a vast majority of the multinationals in our sample, the coverage for affiliates is significantly smaller. Given the well known measurement issues with Scope 3 emissions, we focus throughout our analysis only on the direct, Scope 1 and 2 metrics. Table 2 displays summary statistics over the whole panel for these variables. Correlations between FDI measures, the stringency indicators and macro controls are avaible in table A.2.

Table 2: Summary statistics of financials and emissions data of parent and affiliate companies.

Variable	Count	Mean	Median	SD	Min	Max
Panel A: MNE-Level Variables						
Log Tot Assets	18,393	22.38	22.11	1.26	13.98	27.34
Number of employees	15,982	29429	10713	58658	0.00	1608000
Log Scope 1 and 2 GHG emissions	16,782	12.39	12.15	1.96	3.53	19.46
Panel B: Subsidiary-Level Variables						
Log Tot Assets	130,269	17.14	17.32	2.24	6.55	21.90
Number of employees	88,254	447	133	983	0.00	7500
Log Scope 1 and 2 GHG emissions	1,061	10.59	10.36	2.11	2.38	17.21

3 Hypotheses and empirical methodology

Our analysis is split into two parts. First, we focus on the static effect of climate policies on location of MNEs affiliates, relying on the most disaggregated data possible. We then turn to the analysis of dynamic effects by aggregating our data to the MNE-year level using a shift-share approach.

3.1 Panel regressions on yearly changes in FDI allocation of MNEs across target countries.

The constructed panel tracks variation across three dimensions: multinational i, affiliate j and time t. In order to investigate whether multinationals are internalizing the costs from climate policies in their FDI decisions one could thus investigate either the cross-sectional re-allocation over time depending on the heterogeneous geographic distribution of affiliates across parent companies or within a given link between parent-affiliate over time. We begin by investigating the latter, and posit the following hypothesis.

- **H1:** The allocation of FDI for a given MNE in a given target country responds negatively to higher levels of climate policy stringency in that country.
- **H1a:** The response is stronger if the MNE's affiliates in the target country produce high emissions.

The rationale of the hypothesis is that while policy costs ought to be minimized by any MNE, the frictions typical of significantly altering a GVC relationship might lead to inertia unless the costs are material. Materiality in the context of exposure to climate policies can be defined along different dimensions, of which we implement the following given our data availability. We construct a dummy indicator taking value 1 if the MNE held affiliates from the most carbon intensive sectors within manufacturing in a given target country and year. Based on country-industry average emissions in each of the NACE 4 industry codes, we are able to identify the most polluting manufacturing sectors as C17- Manufacture of paper and paper products, C19- Manufacture of coke and refined petroleum products, C20- Manufacture of chemicals, C21-

Manufacture of basic pharmaceuticals, C22-Manufacture of rubber and plastic products, C23-Manufacture of other non-metallic mineral products, C24-Manufacture of basic metals.

We operationalize FDI to test our hypothesis in the following way. For each MNE, target country and year we compute the sum of the number of affiliates they have in that country, the sum of their scaled assets and scaled employment. These values are then divided by the aggregate yearly counts of affiliates and aggregate assets and employment from affiliates to obtain MNE-target country shares of FDI.

$$FDI_{i,j,t} = \frac{\sum_{i,j,t} Aff}{\sum_{i,t} Aff}$$

Where Aff is one of the three measures just outlined.

To identify the effect of climate policies on FDI, we significantly constrain the variation we analyze, aiming to minimize the risk for spurious relationships due to unobserved variables. The first set of specifications, which we run across the three definitions of FDI and the two target-country level measures of climate policy stringency, analyse within MNE re-allocation relative to the average exposure of the MNE vis-a-vis a particular target country j. Formally:

$$\begin{aligned}\Delta FDI_{i,j,t} = \alpha_{it} + \alpha_{ij} + \beta_1 ClimatePolicy_{j,t-1} + \beta_2 TopEmitterAff_{i,j,t-1} \\ + \beta_3 ClimatePolicy_{j,t-1} * TopEmitterAff_{i,j,t-1} + \boldsymbol{\beta'} \mathbf{MacroControls_{j,t-1}} + \varepsilon_{i,j,t},\end{aligned} \tag{1}$$

where $TopEmitterAff_{i,j,t-1}$ is the dummy indicator on industry of affiliates and the vector $\mathbf{MacroControls_{j,t-1}}$ includes trade to GDP ratios, PPI inflation and real GDP growth rate. Notice that given the specification employing the first-difference of the FDI metrics, the coefficients are to be interpreted as the effect on the yearly changes in the allocation of capital, employment or extensive margin rather than their long-term levels. The fixed-effects partial out yearly contractions or expansions in FDI activity at the consolidated MNE level, as well as the long-term growth rates in FDI idiosyncratic to a given MNE and target-country pair. Moreover, they absorb all the static gravity factors in the pair. We additionally control for time-varying target countries characteristics that might influence the changes in FDI. To conduct inference, we cluster standard errors at the parent-target country level, which allows for a flexible correlation structure of unobserved components in each bilateral link. As a concern with this approach might be that additional hidden characteristics of a target-country influence FDI allocations, we conduct also the following set of estimations.

$$\begin{aligned}\Delta FDI_{i,j,t} =& \alpha_{it} + \alpha_{ij} + \alpha_{jt} + \beta_1 TopEmitterAff_{i,j,t-1} \\ &+ \beta_2 ClimatePolicy_{j,t-1} * TopEmitterAff_{i,j,t-1} + \varepsilon_{i,j,t}.\end{aligned} \tag{2}$$

Absorbing all the time variation at target country level identifies the differential effect of climate policies on FDI for MNEs engaging in the most carbon intensive manufacturing production in that country relative to other types of affiliate activity. While having the backdrop of losing the main effect of climate policies, it is not subject to omitted-variable bias on this dimension. A remaining threat to the coefficients identified via this specification could be a reverse causality argument between climate policymaking and the economic leverage represented by multination-

als' investment in country. Given the large sample of countries included in our analysis, we rule this condition as being unlikely albeit acknowledging that this dimension should be subject of further investigations.

3.2 Dynamic impact of climate policy shocks

Having outlined the baseline exercises we conduct in the paper, aimed at ascertaining whether general patterns emerge in the relationship between FDI and climate policies, we move towards providing evidence on how the policies transmit to affiliates via the GVC of their controlling parents and what are the timelines involved with these effects.

The starting point for this analysis is to carefully identify an exogenous measure of each MNE's exposure to climate policies which we can then relate to its affiliate level outcomes. In constructing such metric, we follow the approach of Känzig et al. [2024]. We begin from the FDI shares of MNEs in target countries, defined on the affiliates' assets as described in the previous section. We then average these shares between 2010 and 2012 to smooth the effect of yearly re-allocations. These static shares, are thus defined for each link i, j and serve as the basis of the Bartik instrument aggregating climate policies in target countries at the parent company level. To ensure exogeneity, we construct the shift-share instruments for all years in our sample following 2015 and conduct estimations following this date. In addition to ensuring the predeterminacy of the shares, we select 2015 as starting point for estimations as we expect the Paris Agreement to represent an event leading to re-assessment of climate policy costs for all firms. The base shares are thus

$$BaseShare_{i,j} = \frac{1}{3} \sum_{2010-2012} \left(\frac{\sum_{i,j,t} AffAssets}{\sum_{i,t} AffAssets} \right) \tag{3}$$

yielding the MNE level Bartik instrument of climate policies exposure as

$$ClimatePolicyExp_{i,t} = \sum_{i,j,t} (BaseShare_{i,j} * ClimatePolicy_{j,t}), \tag{4}$$

where climate policies are either the IEA policy counts or the OECD stringency index.

While the Bartik instrument constructed in this way has its useful application in identifying static effects for MNEs with different levels of exposure to climate policies, its application in a dynamic estimation setting is highly problematic. The core issue is the high degree of autocorrelation of the shift-share metric, stemming from the persistence in the level of the environmental stringency variables. Such auto-correlation leads to biased estimates in a traditional local projection setting. While we could employ the approach proposed by Montiel Olea and Plagborg-Møller [2021] and include lagged values of the shift-share instrument, we elect to address the autocorrelation in climate policies directly. Our approach follows the vast literature on identification of macroeconomic shocks, in particular Bauer and Swanson [2023]. We adapt the conclusions of this work to our panel context. Effectively this implies orthogonalizing changes in our two indicators of climate policy stringency with respect to lagged country-level macroeconomic indicators and the country-level and yearly average changes in climate policy ambitiousness. We further control for

two lags of the dependent variable itself, allowing for short-term country-specific momentum in tightness of these policies. The residuals obtained via these regressions are what we identify as the exogenous shock. Formally:

$$\begin{aligned}\Delta ClimatePolicy_{j,t} =& \alpha_j + \alpha_t + \beta_1 \Delta ClimatePolicy_{j,t-1} + \beta_2 \Delta ClimatePolicy_{j,t-2} \\ &+ \boldsymbol{\beta}' \mathbf{MacroControls_{j,t-1}} + \varepsilon_{j,t}\end{aligned}$$

$$\Longrightarrow$$

$$ClimatePolicyShock_{j,t} = \widehat{\varepsilon_{j,t}}$$

Conducting a standard Woolridge test for autocorrelation in the target country yearly panel where we estimate the residuals fails to reject the null of no autocorrelation by significant margins. The residuals are then aggregated at parent company level as described in equation (4).

The two shift-share instruments are employed in a series of long-differences local projections following Jordà and Taylor [2025]. The outcome variables we are interested in are affiliates' total assets, employment and GHG emissions. Given we have geographical heterogeneity in the countries where the affiliates are located, we investigate whether the impact of climate policy exposure via their controlling parents is different depending on the country where the affiliate operates. We hence posit:

- **H2:** Higher exposure to tight climate policies in the GVC of multinationals leads these companies to scale down activities of their foreign affiliates. The scaling down of economic activity is conditional on the jurisdiction where the affiliate is located.

As FDI relationship are sticky, we consider changes in the dependent variables up to 4 years in the future. The long-difference setting allows to control for the growth rates in the dependent variables prior to the observation of our regressors of interest, which is key to ensure we are capturing the differential impact of the climate policy shocks via the GVC. All estimations are conducted with affiliate level and time fixed effects, which yields an interpretation of the coefficients as within affiliate changes in their growth rates rather than cross-sectional differences. Inference relies on clustering of the standard errors at parent company level, given the commonality of the shocks faced by affiliates on this dimension. The specifications have thus the form:

$$y_{j,t+h} - y_{j,t-1} = \alpha_j + \alpha_t + \beta_h s_t + \beta_2 \Delta y_{t-1} + \varepsilon_{j,t}. \tag{5}$$

Note that here the j subscript denotes the affiliate rather than the target country where it is located. s_t is the MNE-level shift-share shock. For both variables, we consider constructions relying either on the IEA policy counts or the OECD index. When analyzing heterogeneous effects across different group of economies, we interact the shock with a dummy indicator taking value one for affiliates located in advanced economies. Lastly, when we estimate the responses of consolidated MNEs' emissions to the shocks, we employ MNE fixed-effect in lieu of affiliate.

4 Effects of climate policies on cross-country allocation of FDI

We begin by presenting the results of the panel regressions outlined in equation (1). All estimations are conducted up to 2019 to avoid the strong changes in GVC positions occurring during the COVID-19 pandemic. Figure 3 plots the linear average effects of target countries' lagged policy counts on the yearly changes in target-country level FDI shares defined in terms of affiliates' assets (panel A) and employment (panel B). The red line corresponds to the linear combination of the main effect of the policy and the interaction between the dummy indicator for the presence of highly emitting affiliates in the target country. We perform an F-test on the linear combination of the two regressors and plot the resulting standard-errors in the shaded red-area.

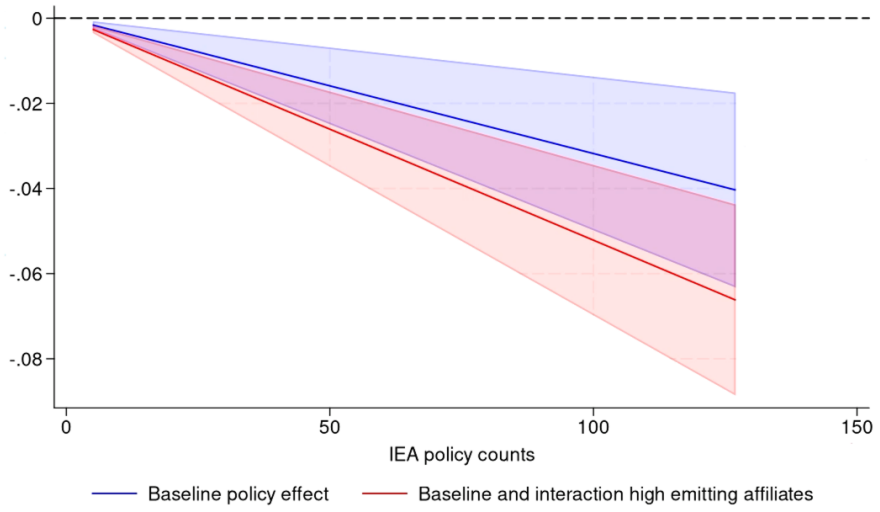
As expected, we find a negative relationship between the location of a MNEs affiliates and target countries' ambitiousness in climate policymaking. The point estimates, albeit of small magnitude, show how even at yearly frequency the multinationals are adjusting their production network to minimize the costs arising from climate policies. The estimation is conducted within parent-target country link, and we are absorbing changes in aggregate MNE FDI via the time-varying HQ fixed-effects. Therefore, we can interpret the coefficients as being the re-allocation effects across the geographies where the multinational conducts its foreign productive activities in response to climate policies. Of particular relevance is the difference in slopes in those countries where multinationals hold affiliates from the most polluting NACE4 manufacturing sub-sectors. According to our estimation, the relocation effect on high polluters is almost 60% stronger than baseline. Turning to the effects on employment, we can see that the direction of the effect is the same, while the point estimates are larger compared to assets' shares. While the differences between the definitions of FDI are statistically significant, the modest marginal economic impact is consistent across the two estimations. While we cannot rule out that MNEs might be adjusting more on their labor margin, particularly when affiliates are located in countries with less rigid labor markets, the differences in sample size and number of target countries for which we have data on affiliates' assets and employment leads us to a cautionary interpretation of this result.

The key takeaway from this exercise are:

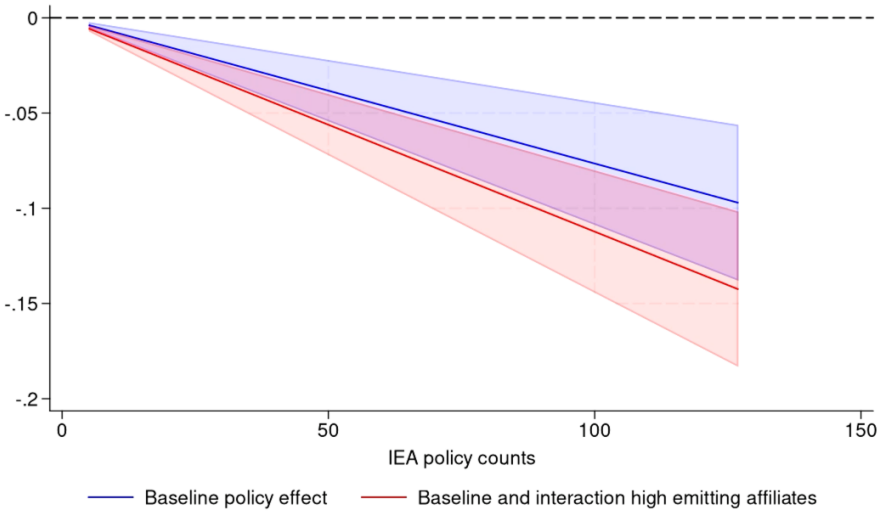
- The presence of consistent evidence for the re-allocation of FDI away from jurisdictions with more ambitious climate policies and
- The significantly stronger re-allocation should the tightening country host affiliates particularly dependent on carbon-emitting technology in their production.

Before moving to the differences in results depending on the definition of climate policy stringency, we discuss the evidence found on the extensive margin of FDI. When constructing the parent-target country FDI stock via the raw count of its affiliates in that country, we manage to capture a substantially larger number of MNEs and their bilateral links, as visible in the first and fourth columns of table A.3. The better coverage however comes at the cost of losing precision in the definition of FDI. The correlation between the FDI shares defined on capital and labor is 83%, dropping to 70 and and 64% respectively in their correlation with the share

Figure 3: Average effects on country-level FDI of IEA policy counts: main effects and for MNEs holding highly carbon intensive affiliates.



(a) Panel A: Y-axis: yearly change in FDI(share of assets) X-axis:IEA policy counts



(b) Panel B: Y-axis: yearly change in FDI(share of employment) X-axis:IEA policy counts

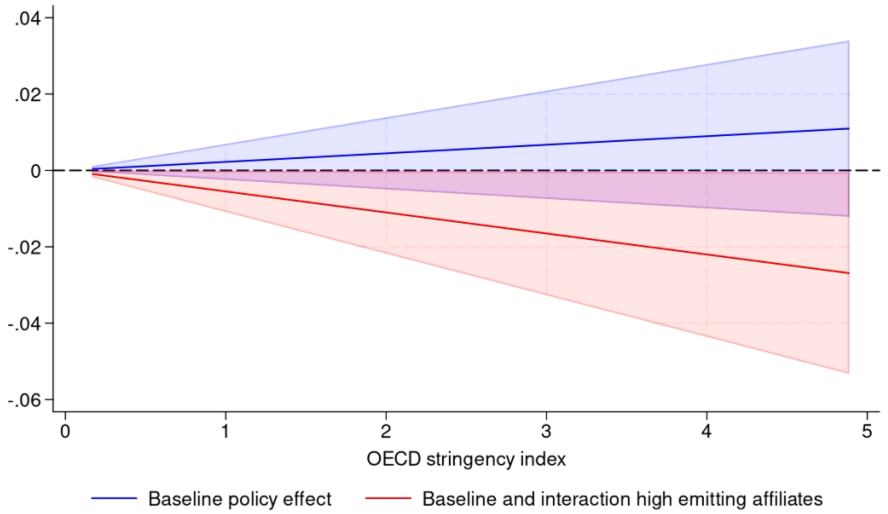
Notes: Coefficients from panel regressions (equation (1)) are scaled by the range of IEA policy counts. Shaded area denote the 95% confidence intervals. The curve in blue plots the average baseline effect of IEA policy counts. The curve red is the linear combination of the baseline and the interacted term with the dummy indicator for affiliates in the most polluting NACE4 sectors. Standard errors are clustered at the HQ and target country level. Table A.3 presents the full results from the estimation.

of FDI defined on counts. While a high share of affiliates is thus partially predictive of the relative importance of that country in a MNE's portfolio, the size of employment and assets at target-country level display a significantly lower correlation with the number of affiliates in that country. The the two intensive metrics have a correlation of 67%, while the number of affiliates correlates only weakly with capital (15%) and labor (10%). Bearing these caveats in mind, we understand why the magnitude of the point-estimates for this definition of FDI is almost a tenth of what found on the other two definitions. We do not find this coefficients to be statistically different from zero. Restricting the estimation sample to the same MNE-target country pairs for which we have data on assets and employment of the affiliates does not change significantly

the results, which leads to the conclusion that adjustments in the GVC might be taking place more consistently on the intensive rather than extensive margin.

Turning to the results for the subset of countries where the OECD computes its stringency index, we find that the baseline effect is not statistically different from zero, while the total effect for high emitters is still negative. The difference from the previous results is not due to change in sample (which is now limited to OECD and BRICS), but due to a different policy measure: our previous results hold when we use the IEA policy count measure in this restricted sample. With the index being a synthetic measure of ranking, it is not entirely surprising it might be missing hard information on the costs idiosyncratic to a specific jurisdiction. Despite this limitation in our application, we do find the index to be capturing some dimensions of international differences in climate policy stringency by looking at the response of MNEs in countries where they have affiliates from the most emitting sectors. Figure 4 plots the coefficients of the baseline and combined effect of the index on changes in the share of FDI defined in terms of affiliates assets. Similarly to what found for policy counts, we observe a significantly stronger negative response in countries where the MNEs hold high-emitting affiliates. The magnitude of the estimated effect is in line with our previous exercise, as a one-unit change in the index, which is slightly more than a standard-deviation increase, decreases the share of FDI allocated to a target country with high emitting affiliates by 0.5%.

Figure 4: Average effects on country-level FDI (asset share) of the OECD stringency index: main effects and for MNEs holding highly carbon intensive affiliates.



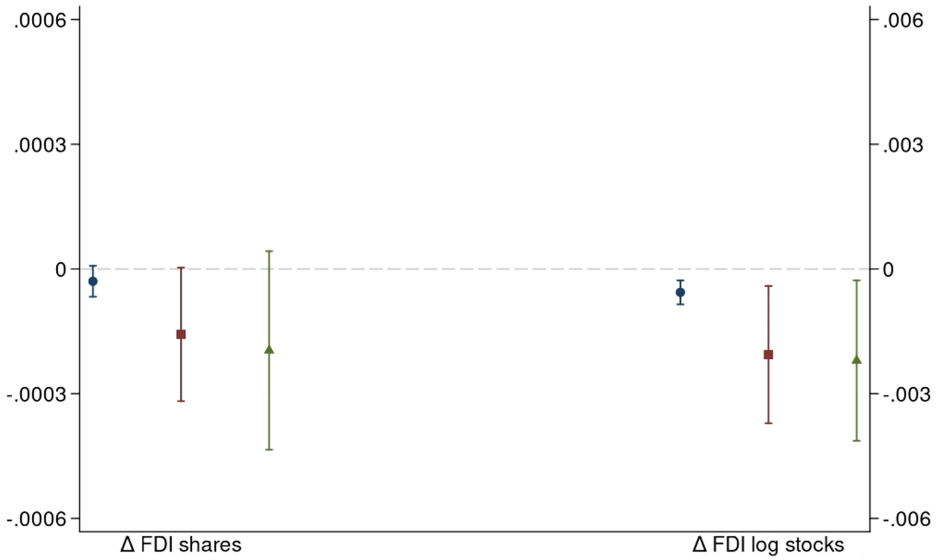
Notes: Coefficients from panel regressions described in equation 1 are scaled by the range of the OECD stringency index. Shaded area denote the 95% confidence intervals. The curve in blue plots the average baseline effect of the index. The curve red is the linear combination of the baseline and the interacted term with the dummy indicator for affiliates in the most polluting NACE4 sectors. Standard errors are clustered at the HQ and target country level.

As outlined in the methodology section, all the results above do not partial out aggregate shifts in inward FDI in a given target-country. Should higher environmental stringency be consistently correlated with factors other than the included macroeconomic controls, we might be overestimating the role of these policies in MNEs investment decisions. We address this concern by including target-country-year fixed-effects. Given the loss in variation in the main effect that comes with this specification, we present results both on the shares employed earlier

and on the log of the total number of affiliates, assets and employment held by an MNE in target country j.[2] The results on the latter metrics are interpreted as the semi-elasticity with respect to policies, conditional on tightening happening in countries where MNEs hold high-emitting affiliates, of the absolute growth rates of FDI in these countries, rather than relocation.

Figure 5 plots the coefficients for the interaction term of IEA policy counts and the dummy indicator for the presence of high-emitting affiliates held by an MNE in the target country.[3] As we have variation both within and across MNEs in the dummy indicator, we able to identify the interaction term while fully absorbing the baseline effect of climate policies. The magnitude of the point estimates for the change in FDI shares is smaller compared to the linear combination of baseline and interaction we plotted in the previous chart, but the coefficient remains negative and borderline statistically significant. We do find highly significant coefficients on the absolute growth rates of FDI in target countries with tighter climate policies and characterized by the presence of high-emitting affiliates. All three point estimates indicate that even after fully controlling for time-varying characteristics of target countries, MNEs are decreasing their exposure to countries where they are likely to incur in higher costs for carbon intensive production. Looking at the two coefficients for growth rates in total assets and total employment (furthest on the right in the chart) we estimate that an additional environmental policy enacted in these target countries decreases the growth rates by $\approx 0.2\%$, which is in line with the small magnitudes in yearly relocation we documented earlier.

Figure 5: Average effects of IEA policy counts on FDI shares and absolute growth rates.



Notes: Coefficients from panel regressions described in equation 2 are plotted for FDI shares on the left and growth rates in FDI stocks on the right. The coefficients are for the interaction of IEA policy counts and the dummy indicator for the countries where MNE hold affiliates in the most polluting NACE4 sectors. Table output is presented in table A.4. 90% confidence intervals are plotted alongside the point estimates. Coefficients in blue refer to the FDI definition on affiliates' counts, those in red for affiliates' total assets and in green for affiliates' employment. Standard errors are clustered at the HQ and target country level.

[2]These version of the FDI dependent variable are the log of the numerator used to construct the shares.

[3]When conducting the same estimations employing the OECD stringency index as measure of environmental tightness, we find results in line with the regressions without target country-time fixed-effects. The interaction term is significant only for the change in shares of FDI defined on affiliates' assets. These results are available upon request.

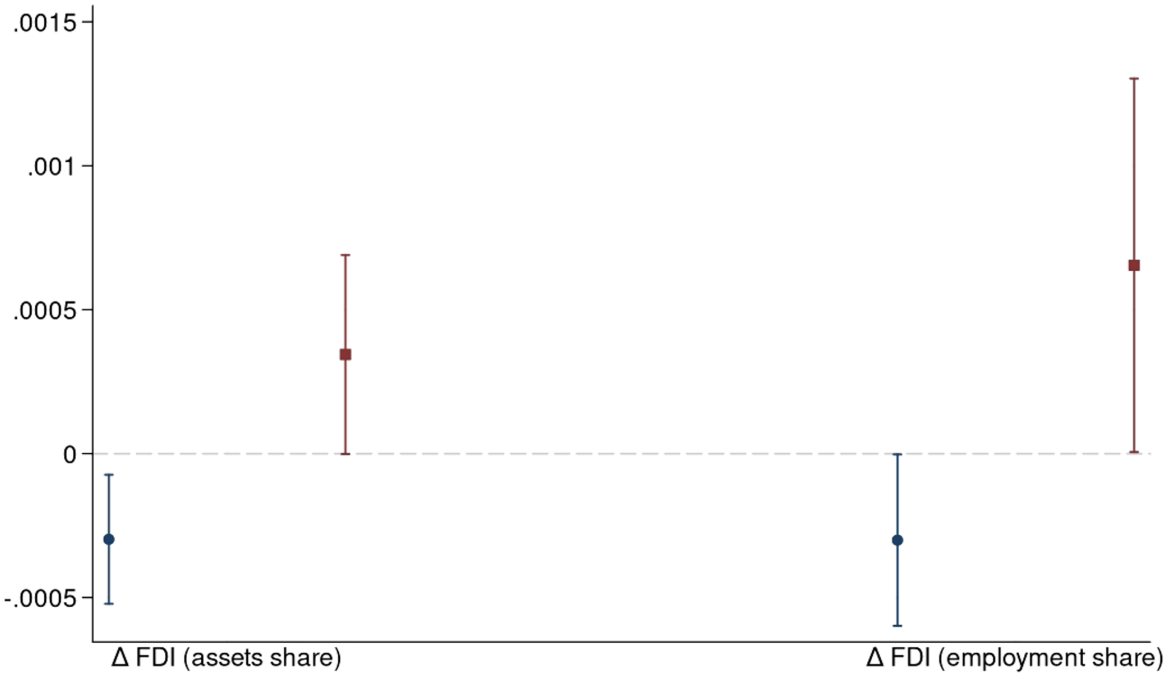
4.1 The role of physical risk in cross-country re-allocation of FDI.

While climate policymaking and its costs to carbon-intensive manufacturing activities are characterized by uncertainty on several dimensions, including the timing of policies' implementation and most notable their reversibility subject to political cycles, both the costs and the uncertainty associated with extreme climate events are potentially of a fundamentally different nature (Barnett et al. [2020]). Having acknowledged the limitations of the measures of forward-looking physical risk in the data section, we describe the evidence from the empirical exercises combining the physical risk dimension with our existing framework on the yearly responses of MNEs foreign investment to climate policymaking.

We begin by grouping all countries in the dataset in terciles based on the distribution of the aggregate physical risk metric. Given the substantial heterogeneity in how physical risk affects different jurisdictions, we employ the terciles as interaction terms only with the IEA definition of climate policies' tightness, as to retain a broad coverage of jurisdictions. These indicators are added as additional regressors in both equations (1) and (2), generating coefficients that capture the heterogeneous responses to tighter climate policies conditional on the physical risk of the jurisdiction and whether the most carbon-intensive manufacturing activities are performed by the MNE´s subsidiaries.

We document a moderating role of high forward-looking physical risk exposure in MNE's responses to climate policies. As displayed in figure 6 the significant negative effect of tight climate policies on FDI documented in the previous section is not present in countries with higher physical risk. The blue point-estimates and confidence intervals are the average effects of the triple interaction between IEA policies, the dummy indicator for MNE's holding of affiliates in the highest emitting NACE sectors, and the indicator for the group of countries with lowest physical risk exposure. The estimates are from the fully saturated model including destination country time-varying fixed-effects. In red are the average effects of the same triple interaction in the group of countries belonging to the top tercile of the physical risk distribution. Relocation towards or outwards the most vulnerable jurisdictions from an expected likelihood of extreme climate events is thus not impacted by a marginal change in the climate ambitiousness of these countries. These results align with earlier evidence from the literature on carbon leakage, given the partial correlation between lax environmental policy regimes and likelihood of a jurisdiction of incurring in extreme climate events. They also indicate that, from a global perspective, multinationals' FDI is more responsive to the immediate costs stemming from climate policies rather than the longer-term likelihood of incurring losses due to the destruction of physical capital or decreases in labour productivity.

Figure 6: Average effects of IEA policy counts on FDI shares conditional on physical risk of target countries.



Notes: Coefficients from panel regressions described in equation 2 are plotted for FDI shares based on affiliates' assets (right) and employment (left). The coefficients in blue are for the triple interaction of the Top Emitter Aff dummy, IEA policy counts and the indicator for the target-countries in the first tercile of the distribution of the aggregate physical risk metric. Those in reds are the triple interaction for the countries in the top tercile of phisical risk's distribution. 90% confidence intervals are plotted alongside the point estimates. Standard errors are clustered at the HQ and target-country level.

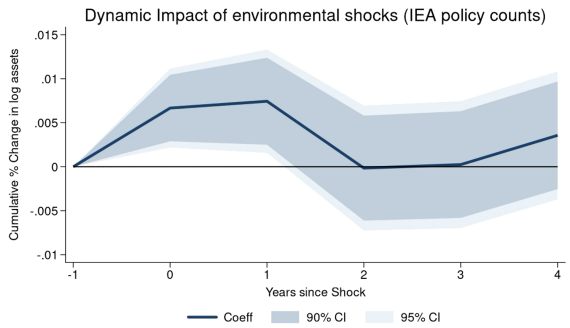
5 Dynamics of FDI responses to climate policy shocks

So far, we focused on the immediate, within a year, impact of climate policies on the affiliate location decision of the MNEs. It is reasonable to think that in many cases the response will take longer than a year. We analyze the dynamics of the response at the affiliate level, aggregating the exposure of all affiliates of a given MNE to climate policy shocks. In order to keep the environmental policies as our key predictor of responses in GVC decisions, we construct a time-varying metric linking heterogeneously the policies to each multinational, as a function of their affiliates' locations. As discussed in detail in the methodology section, we rely on a Bartik instrument combining pre-determined geographical exposure of multinationals and country-specific shocks in climate policies.

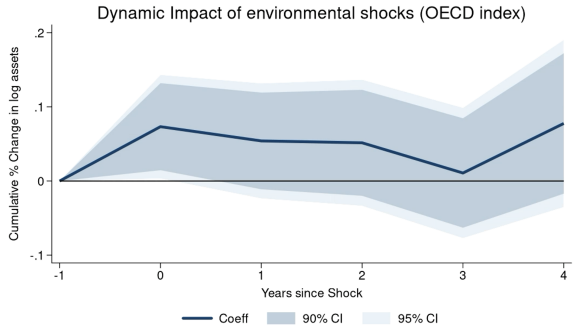
We begin by looking at the dynamic responses of individual affiliate companies' assets and employment conditional on the weighted exposure of their parent companies to climate policies shocks post Paris Agreement without differencing by geographic location of the affiliate. All the estimations are conducted between 2015 and 2021, using a strongly balanced panel of affiliates that we observe continuously between 2013 and 2021. The difference between the sample composition and the estimation window comes from the lagged difference in outcomes needed as control (equation (5)). Figure 7 displays local projections results for cumulative changes in log

assets and log employment of affiliates following a one unit shock in the shift-share instrument. The two panels on the left are the responses of the two dependent variables to shocks on the IEA counts definition of environmental stringency, while those on the right are for the OECD environmental stringency index. Overall, despite difference in magnitudes arising from the different scale of the two shock measures, we observe a modest growth in the size of affiliates on impact and up to one year following the shock. We do not observe statistically significant effects at higher lags.

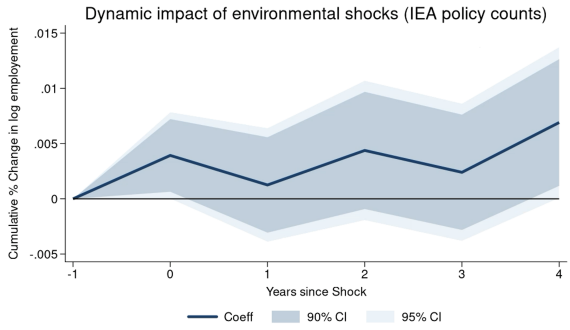
Figure 7: Dynamic responses of affiliate assets and employment to climate policy shocks in their holding companies' GVC.



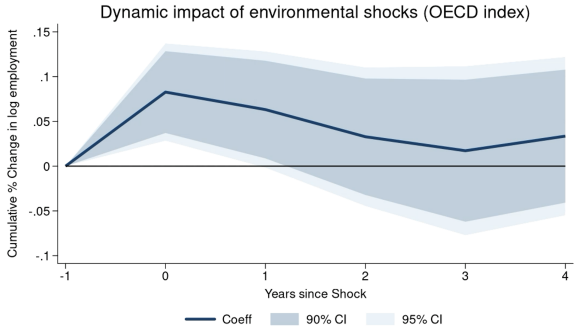
(a) Log assets - IEA policy counts



(b) Log assets - OECD stringency index



(c) Log employment - IEA policy counts

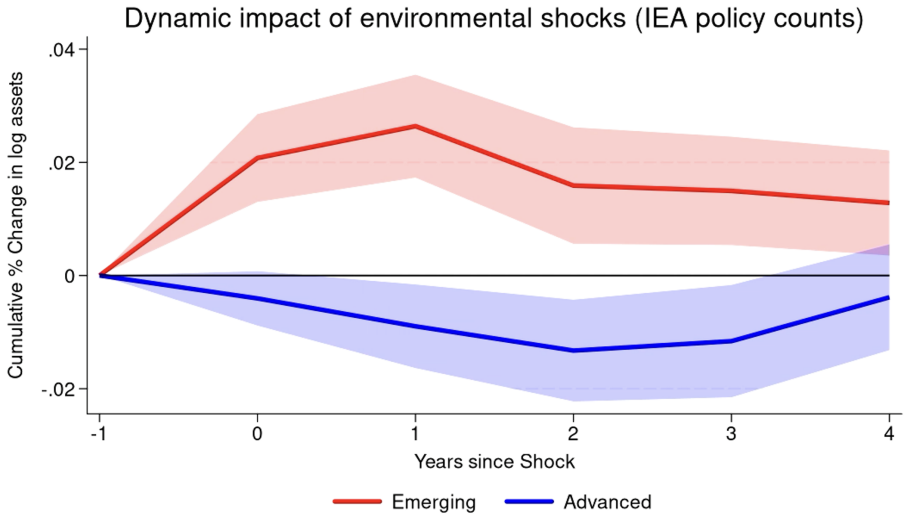


(d) Log employment - OECD stringency index

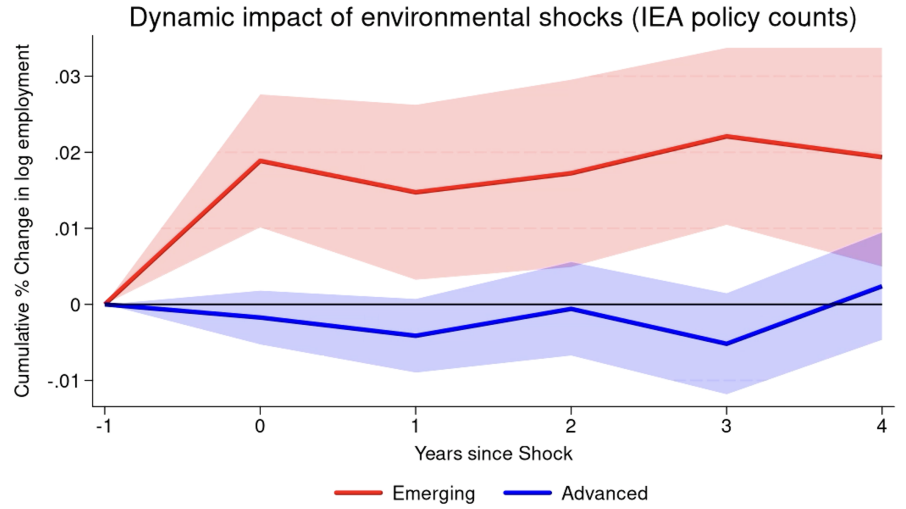
Notes: Local projections showing cumulative changes in log assets and log employment of affiliates following a one unit increase in the shift-share instruments of multinationals' exposure to climate policy shocks (equation (5)). The shaded area in dark blue is the 90% confidence interval, while the light blue area is the 95% confidence interval. Standard errors are clustered at the parent company level.

Given our earlier results from the panel regressions indicating significant re-allocation of MNEs away from jurisdictions with tighter policies, these results might seem at first counterintuitive. In order to rectify the evidence from the two exercises, we need to leverage the heterogeneity in geographical exposure that characterizes MNEs FDI portfolio and investigate whether the transmission of environmental policies' costs is heterogeneous across the geographies where the MNE operates. Figure 8 displays the results of the local projections of IEA policy counts shocks on total assets and employment of affiliates, conditioning on the location where the affiliate operates. The advanced economies group includes the whole EU 28 and the other jurisdictions classified as belonging to this group by the IMF. Emerging economies include all the remaining countries in our dataset.

Figure 8: Dynamic responses of affiliate assets and employment to environmental shocks in their holding companies' GVC - heterogeneity across location of affiliate.



(a) Log assets - IEA policy counts



(b) Log employment - IEA policy counts

Notes: Local projections of cumulative changes in log assets and log employment of affiliates following a one unit increase in the shift-share instruments of multinationals' exposure to climate policy shocks (equation (5)). Point estimates in red are for the baseline effect in emerging economies. The projections in blue are the linear combination of the baseline effect and the interaction term between the shock and the dummy indicator for advanced jurisdictions. Shaded areas are 95% confidence-interals. Standard errors are clustered at the parent company level.

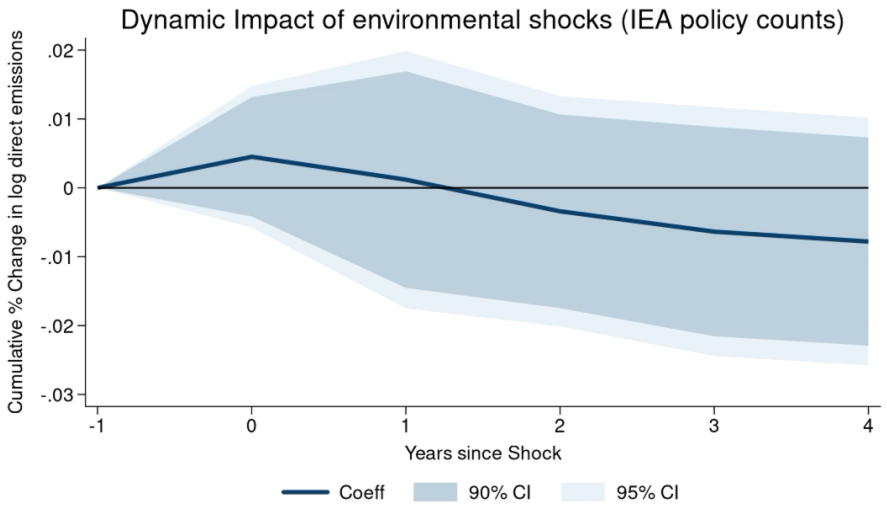
The decomposition of the aggregate effects into affiliates located in advanced and emerging economics is particularly insightful — it suggests that the lack of dynamic effect in the aggregates is due to the composition effect masking substantial relocation of business activities. Both assets and employment of subsidiaries located in emerging economies are 2% higher up to 4 years after the shock occurs. In advanced economies, the decline in size for these companies appears to be more slow-moving compared to the fast re-allocation in emerging markets. On the assets' side, affiliates in advanced economies register an ≈2% decrease only after 2 years following the

shock. The point-estimate at the 4 years horizon, albeit statistically insignificant, still points toward a shrinking in size. Employment responds less for both groups, which is consistent with the higher mobility of capital in FDI decisions. In advanced economies we observe a statistically significant decrease (at the 10% level) 1 year following the shock, which however does not seem to be persistent throughout the estimation horizon.

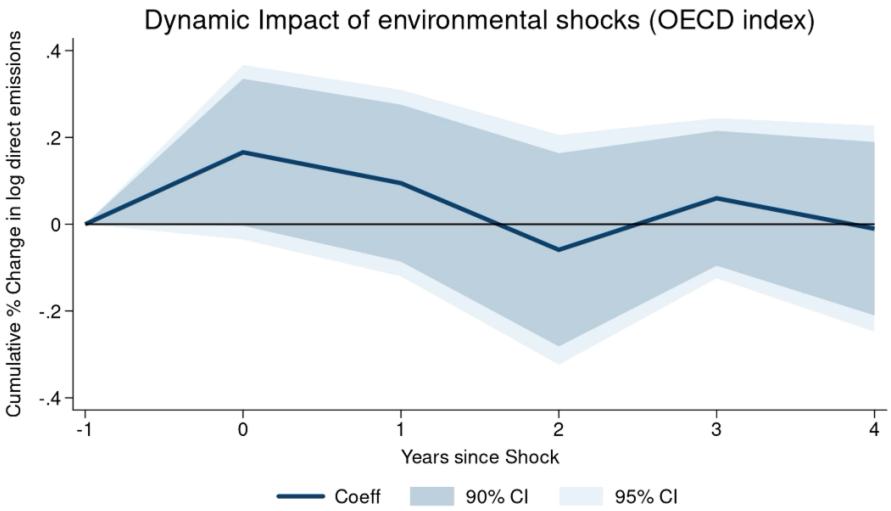
Analyzing this evidence jointly with the cross-country re-allocation effects we found earlier seems to confirm earlier results in the literature documenting carbon leakages. Facing higher cost of environmental policies in advanced economies, MNEs limit their footprint in these countries. They appear to increase their footprint in emerging economies in response to stricter policies, however. This is likely because even tightening environmental policies in EMEs are less costly than those in advance economies and allow MNEs with high emissions to control their costs while still appearing more environmentally conscious. It is also possible that large multinationals benefit from preferential treatment in special economic zones that may exempt them from stricter policies.

As further empirical evidence pointing towards carbon leakage, in figure 9 we plot the local projections estimates of changes in HQ-level Scope 1 and 2 emissions following the GVC climate shocks. Even at longer horizons, we do not observe significant reduction in the aggregate emissions of multinationals. While the point-estimates, especially when employing the IEA version of the shocks, suggest some internalization of climate policies in the carbon intensity of MNEs production, it would appear that the relocation effect offsets firms' incentives to shift to greener production technologies across their whole global value chain.

Figure 9: Dynamic responses of HQ-level direct (Scope 1 and 2) GHG emissions to environmental shocks



(a) Log direct emissions - IEA policy counts



(b) Log direct emissions - OECD stringency index

Notes: Local projections of cumulative changes in consolidated HQ direct GHG emissions following a one unit increase in the shift-share instruments of multinationals' exposure to climate policy shocks (equation (5)). The shaded area in dark blue is the 90% confidence interval, while the light blue area is the 95% confidence interval. Standard errors are clustered at the parent company level.

6 Conclusion

We analyze whether multinational enterprises in the manufacturing sector are internalizing the costs embedded in climate policies in their decisions on where to produce. Our findings contribute to the literature by offering a global perspective of the relocation of multinationals away from countries with tighter environmental policy regimes and by documenting the dynamics of these adjustments. We highlight how the lack of coordination across different jurisdictions on the

environmental policy dimension seems to be leveraged by these firms: they actively adjust at yearly frequency, although to small degrees, their foreign direct investment to minimize exposure to policy costs, especially in advanced economies. Controlling for unobserved and time-varying characteristics of the destination countries, we confirm the presence of differential effects of climate policies for affiliates in the most polluting sub-sectors of manufacturing. For countries hosting these type of affiliates, the reduction in FDI is more pronounced, although in line with the relatively small magnitudes of yearly adjustments.

Through the construction of exogenous measures of climate policy shocks, and leveraging predetermined exposure of multinationals to target countries, we find that multinationals increase capital and labor of their affiliates in emerging markets following unexpected increases in climate stringency across their value chain. These increases, of a magnitude of up to 2% for both assets and employment, are highly persistent, being observed up to 4 years after the shock. On the reverse, affiliates located in advanced economies seem to shrink in response to these cost increases. The evidence supports the interpretation of carbon leakage, as we do not find significant evidence of multinationals reducing their aggregate carbon footprint in reaction to unexpected climate policy tightening.

Some open questions remain. The differential impact of climate policies documented for countries with low and high physical risk exposure, suggests that multinationals might be prioritizing minimization of short-term costs due to policies rather than ensuring a lower exposure to expected extreme climate events. Taken together with the re-allocation towards emerging markets, which are for the major part characterized by higher physical risk, future work should explore whether the incentives of these jurisdictions through laxer environmental regimes are sufficient to keep MNEs production locally in face of the higher occurrence of extreme climate events that has characterized recent years. Finally, as the EU has recently finalized the adoption of its carbon adjust mechanism, the extent to which multinationals headquartered in the EU will keep their production in these jurisdictions might inform the debate of how unilateral climate policies addressing explicitly the global value chain of manufacturing firms are successful at curtailing carbon emissions.

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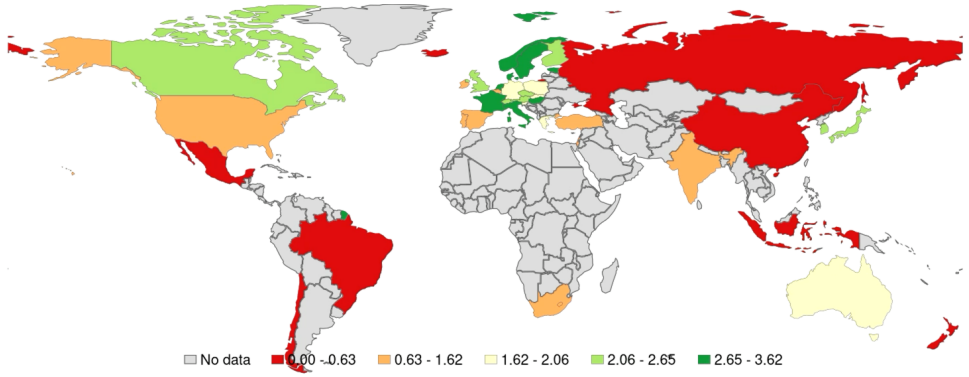
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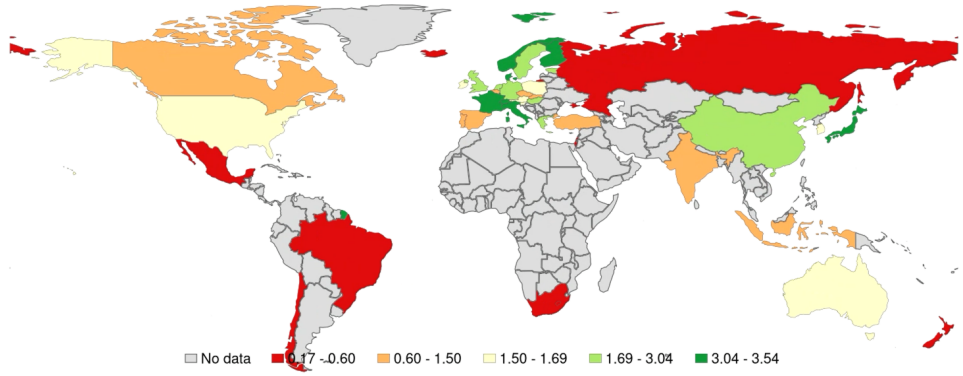
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A Appendix

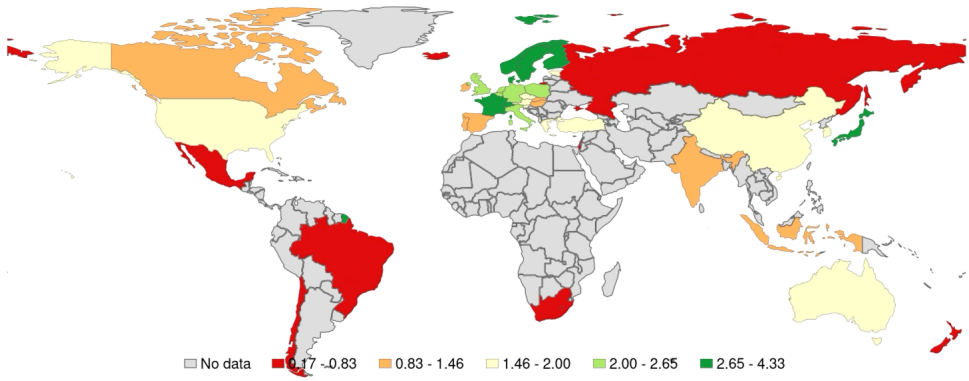
Figure A.1: Cross-country and temporal variation in relative stringency of environmental policies (OECD index).



(a) 2010



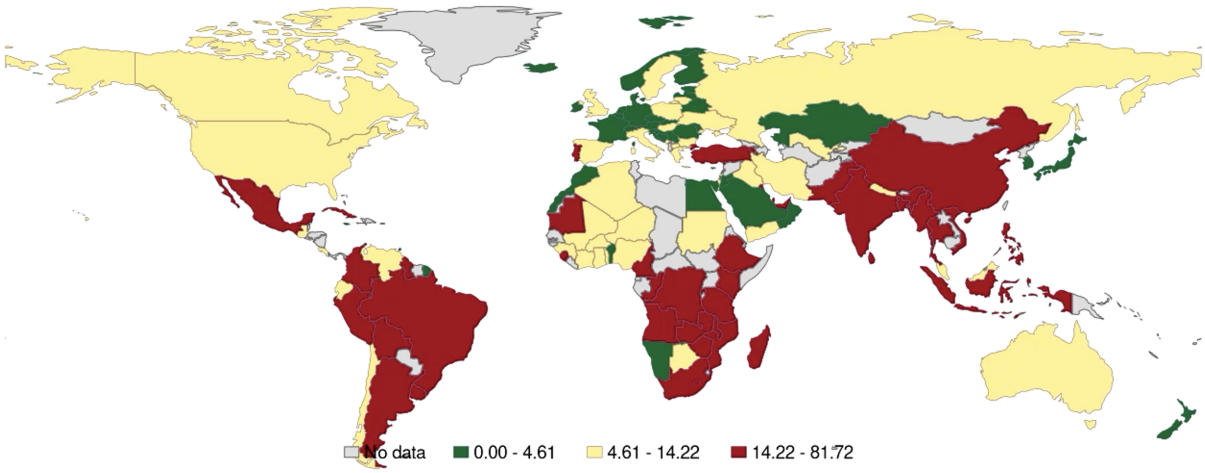
(b) 2015



(c) 2019

Notes: Countries are shaded by their OECD stringency index, with buckets computed for the reference year. Red indicates countries in the left tail of the index distribution, with higher values moving to coloring to green. Countries in gray are those for which the index is not available.

Figure A.2: Cross-country variation in aggregate physical risk exposure.



Notes: Countries are shaded by the tercile of the distribution of the 2030 physical risk metric computed as the sum of the land share of a given country exposed to wildfires, river floods and heatwaves as per the Net Zero 2050 model suit of Climate Analytics. Countries in green are in the bottom tercile, in yellow in the second tercile and in rec in the top tercile.

Table A.1: Summary Statistics: Macro controls, climate policy variables and physical risk metrics

Variable	Count	Mean	Median	SD	Min	Max	Countries
GDP growth	1,005	2.81	2.91	3.69	-27.99	25.18	95
Inflation	1,005	5.14	2.73	8.56	-25.96	75.28	95
Trade/GDP	990	86.33	76.01	50.08	16.14	408.36	93
% of land exposed to heatwaves in 2030	1,409	4.04	0.74	5.97	0.00	33.09	126
% of land exposed to wildfires in 2030	1,196	6.54	2.84	10.84	0.00	81.34	105
% of land exposed to river floods in 2030	878	5.72	2.25	9.07	0.00	59.27	79
IEA policy counts	1,440	27.43	11.00	31.19	5.00	148.00	130
OECD stringency index	439	2.69	2.89	1.05	0.17	4.89	40

Notes: Countries indicate the number of jurisdictions for which the variable is populated in at least one year of the panel.

Table A.2: Correlations between FDI metrics, climate policy variables and macroeconomic controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) FDI MNE-target country (share of assets)	1.00							
(2) FDI MNE-target country (share of employment)	0.83	1.00						
(3) FDI MNE-target country (share of count of affiliates)	0.70	0.65	1.00					
(4) IEA policy count	-0.07	-0.10	-0.05	1.00				
(5) OECD stringency index	-0.02	-0.06	-0.02	0.46	1.00			
(6) Lag GDP growth	0.16	0.20	0.15	-0.23	-0.30	1.00		
(7) Lag Trade/GDP	-0.13	-0.16	-0.12	0.13	-0.11	-0.03	1.00	
(8) Lag inflation	0.02	0.04	0.04	-0.30	-0.35	0.28	-0.09	1.00

Table A.3: Panel regressions on yearly changes in target-country level FDI

Dependent variable:	**Δ Count share**	**Δ Assets share**	**Δ Employment share**	**Δ Count share**	**Δ Assets share**	**Δ Employment share**
Lag TopEmitterAff	-0.0186***	0.000219	0.0157	-0.0195***	-0.000556	-0.00549
	(0.00206)	(0.00888)	(0.0143)	(0.00220)	(0.00904)	(0.0135)
Lag IEA Policy Count	-0.0000299	-0.000318***	-0.000765***			
	(0.0000202)	(0.0000921)	(0.000165)			
Lag TopEmitterAff x Lag IEA Policy Count	-0.0000211	-0.000204**	-0.000358**			
	(0.0000223)	(0.0000971)	(0.000149)			
Lag OECD Stringency Index				-0.00172***	0.00224	0.00155
				(0.000553)	(0.00241)	(0.00317)
Lag TopEmitterAff x Lag OECD Stringency Index				-0.0000565	-0.00775**	-0.00236
				(0.000793)	(0.00352)	(0.00487)
Lag GDP growth	-0.000275***	0.000285	0.000478	-0.000457***	0.000302	0.00120***
	(0.0000619)	(0.000249)	(0.000307)	(0.0000734)	(0.000293)	(0.000365)
Lag Trade/GDP	0.000107***	0.000324***	0.000109	0.000140***	0.000244**	0.0000843
	(0.0000188)	(0.0000916)	(0.000153)	(0.0000243)	(0.000117)	(0.000177)
Lag Inflation	0.000112**	-0.000285	-0.00202***	0.0000418	-0.00167***	-0.00437***
	(0.0000436)	(0.000245)	(0.000441)	(0.0000813)	(0.000461)	(0.000749)
TIME x HQ FE	Y	Y	Y	Y	Y	Y
TargetCountry x HQ FE	Y	Y	Y	Y	Y	Y
N	79262	41885	28134	67066	34307	25750
R^2	0.412	0.371	0.420	0.389	0.381	0.419
No. HQs	1419	1057	883	1354	959	849
No. Target Countries	93	77	67	40	40	39

Notes: SE clustered at HQ and Target Country level.

Table A.4: Panel regressions on yearly changes and absolute growth rates of target-country level FDI

Dependent variable:	**Δ count share**	**Δ assets share**	**Δ employment share**	**Δ log counts**	**Δ log assets**	**Δ log employment**
Lag TopEmitterAff	-0.0170***	-0.00465	-0.00119	-0.202***	-0.0710	0.0264
	(0.00206)	(0.00891)	(0.0138)	(0.0161)	(0.0859)	(0.108)
Lag TopEmitterAff x Lag IEA Policy Count	-0.0000297	-0.000157	-0.000196	-0.000563***	-0.00206**	-0.00220*
	(0.0000226)	(0.0000979)	(0.000146)	(0.000175)	(0.00101)	(0.00118)
TIME x HQ FE	Y	Y	Y	Y	Y	Y
TargetCountry x HQ FE	Y	Y	Y	Y	Y	Y
TargetCountry x TIME FE	Y	Y	Y	Y	Y	Y
N	79220	41822	28059	79220	41822	28059
R^2	0.441	0.395	0.455	0.370	0.365	0.437
No. HQs	1419	1056	881	1419	1056	881
No. Target Countries	90	71	58	90	71	58

Notes: SE clustered at HQ and Target Country level.