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Relative ESG positions among OECD countries in the presence of international competition for FDI inflow: A gravity model perspective☆

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ABSTRACT

Eliciting from a gravity model framework, this study formulates a country's attractiveness to FDI inflow as a function of its ESG distance from competing countries. This formulation considers two opposing forces governing how ESG influences a country's FDI inflow: while the neo-classical cost-based view (NC) posits that ESG regulations raise private costs and lower firms' productivity, the Porter Hypothesis (PH) posits that ESG regulations induce innovations and improve productivity. Theoretically, a country's attractiveness to FDI increases (decreases) with its competitive ESG position relative to those of competing countries if the PH (NC) force dominates. This theoretical implication is empirically tested using a sample of 38 OECD countries, plus China, and Singapore from 2013 to 2022. The results suggest that the PH force dominates and that the intensity of FDI competition between countries decreases with the geographic distance between them. Moreover, the evidence for PH is mainly driven by the environmental (E) and social (S) dimensions.

1. Introduction

A large body of research has been conducted on the determinants of a host country's attractiveness to foreign direct investment (FDI) in the presence of international competition for FDI. King et al. (1993), for instance, documented a large variety of policy incentives offered by OECD countries aiming to attract FDI from multinational companies. Taxes and subsidies were the most frequently investigated policy instruments in prior research concerning international FDI competition. Haaparanta's (1996) theoretical model, for instance, shows that national governments act as principals who compete for FDI inflows by subsidizing multinationals. Bailey and Warby (2019) found that competition arises among countries with similar attractiveness to FDI and drives them to offer more concessions to foreign investors. Moreover, Shear et al.'s (2023) findings revealed that FDI inflows are lower in countries with higher climate-related risks and these high-risk countries would respond by strengthening their social, economic, and institutional environments. Following this line of prior research, the current study conceptually and empirically investigates how a host country's relative environmental, social, and governance (ESG) positions affect the country's attractiveness to FDI in the presence of international competition for such resources. Specifically, this is done with a host country's relative ESG position measured using competing

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countries' ESG positions as reference points.

Governments, investors, and firms are paying increasing attentions to national ESG performance as global ESG-related issues emerge. A strand of research was conducted on the relationship between a country's ESG performance and its attractiveness to FDI. For instance, Wang et al. (2023) found that ESG improvements attract foreign investments. The present study postulates that a country's relative competitiveness in attracting FDI is determined by its ESG position relative to those of competing countries in the presence of international competition for FDI. This postulation stems from two opposing forces governing the impacts of a country's ESG performance on FDI and are discussed below.

First, the neoclassical cost-based view (hereafter, "NC") posits that environmental regulations increase private costs and hence undermine firms' competitiveness and productivity (Palmer et al., 1995). Consistent with this view, the pollution haven hypothesis suggests that host countries, in response, may loosen environmental regulations to attract FDI. It implies that FDI tends to be diverted from host countries with stringent ESG regulations to those with lax regulations. In contrast to NC, Porter and Van der Linde's (1995) Porter Hypothesis (hereafter, "PH") posits that strict environmental regulations induce product and process innovations that improve firms' productivity. Since the productivity improvement may offset the costs of compliance, the relationship between the stringency of ESG regulations and FDI inflow is not necessarily negative.

Past empirical studies on environmental regulations and FDI yielded mixed findings. Naughton (2014), for instance, found that host countries' regulations discourage inward FDI. Similarly, Mulatu (2017) found that multinational firms in polluting industries tend to invest in host countries with lax environmental regulations. Other studies rendering supportive evidence for a negative relationship between environmental regulations and FDI include, *inter alia*: Xing and Kolstad (2002), Dean et al. (2005), Ederington et al. (2005), and Hunjra et al. (2024). Nevertheless, findings from another strand of research including Waldkirch and Gopinath (2008), Costantini and Mazzanti (2012), Groba (2014), and Shear et al.'s (2023) suggest that environmental regulations and FDI can be non-negatively related. See, for example, Cole et al. (2017) for a review of the empirical research and evidence on this issue.

Contributing to the ongoing debate over ESG regulations and FDI, this study theoretically shows that, from a gravity model perspective, a host country's competitiveness in attracting FDI increases (decreases) with its ESG position relative to those of competing countries if the PH (NC) force dominates. This theoretical implication is tested using FDI and ESG data from 38 OECD countries, China, and Singapore. The empirical findings unambiguously confirm that PH is the dominating force. It is also revealed that the intensity of FDI competition between two host countries decreases with their geographical distance, meaning that the impacts of PH and NC on the countries' relative attractiveness to FDI vanish as their geographical distance increases.

In the FDI literature, "distance" between countries determines firms' locational choices of FDI. In the context of gravity models, the notion of "distance" encompasses not only geographic distance but also distance metaphorically defined in terms of various economic, cultural, and institutional attributes. Since the seminal paper of Isard (1954), geographical distance has dominated trade related applications of gravity models due to its functional superiority, e.g. Anderson and van Wincoop (2004) managed to explain the border effect witnessed in international trade using gravity equations; Chaney (2008) incorporated firm level heterogeneity into gravity models to explain trade margins; and Schneider and Wacker (2022) showed that gravity models have an edge in out-of-sample FDI prediction. Continuous efforts of researchers like Blonigen and Piger (2014) have led to explorations of other distance measures deemed pivotal to the characterization of FDI, such as economic distances, cultural distances and institutional distances. Candidates for economic distances include differences in GDP per capita (Blanc-Brude et al., 2014; Pan et al., 2022), differences in labor skills (Schneider and Wacker, 2022) and differences in bond market and equity market development (Aggarwal et al., 2012). Those for cultural distances include bilateral trade flows in cultural goods (Fiorini et al., 2021) and differences in degrees of individualism, masculinity, and uncertainty avoidance (Aggarwal et al., 2012). Meanwhile, proxies for institutional distances include differences in government spending in administration (Blanc-Brude et al., 2014), differences in corporate accounting quality (Aggarwal et al., 2012) and various constituents of the World Bank Worldwide Governance Indicators – political stability, rule of law, and regulatory quality, and the like (Li et al., 2020).

In the same vein as Bu and Wagner's (2016) study, where firms' locational choices of FDI are associated with intra-country differences in terms of environmental regulations, the current study operationalizes ESG differentials among countries as a "distance" attribute that determines firms' locational choices of FDI from a gravity model perspective. Based on this formulation, this study contributes to both the ESG and FDI literatures by conceptually and empirically investigating how a host country's ESG position relative to those of competing countries (i.e., its "ESG distance" from rivals) affects the country's attractiveness to FDI in the presence of international competition for FDI.

In addition, this study draws on the existing literature on international FDI competition to reconceptualize the investigation of a country's ESG performance. Prior research on national ESG performance has often focused on individual countries' own performance. The current study formulates a host country's ESG performance as a competitive position relative to those of competing countries and empirically shows that the international distribution of FDI is determined by host countries' relative attractiveness in terms of their "ESG distance". In doing so, this study extends prior investigations of individual countries' own ESG performance to a formulation using peer countries' ESG performance as reference points. Such an extension provides a new perspective and richer content for the ESG literature.

This study's findings also have notable policy implications concerning FDI competition. As Bailey and Warby (2019) pointed out, policy makers view FDI inflow as a major part of their countries' economic development goals and thus they strive to improve their countries' institutional and economic environments to attract FDI. This policy practice can be found not only in developing countries but also in developed countries (Haaparanta, 1996). Much of the past literature on a host country's FDI attractiveness focuses on various factors including geographic and cultural proximity, market size, infrastructure, natural resources, political systems and stability, and policy incentives (e.g., concessions and subsidizations). Beyond typical policy instruments such as tax and subsidy, it follows from the present study's findings that a country's relative ESG position provides an alternative policy dimension that targets and enhances the competitive edge in international FDI competition.

The remainder of this paper proceeds as follows. Section 2 develops the main hypotheses from a theorical model. Sections 3 and 4 describe the data and report the empirical findings, respectively. Finally, Section 5 draws the conclusions.

2. Theory and hypothesis

Following Haaparanta's (1996) theoretical setting for international FDI competition, a firm chooses to invest physical capital k_m in country m and k_n in country n with $K = k_m + k_n$ being exogenously decided.[1] To incorporate the notion of competitive ESG positions into this framework, this study postulates that the productivity of k_i, for $i = m, n$, is influenced by country i's ESG performance, denoted by e_i, which is correlated to the stringency of country i's ESG regulations. We consider two opposing forces imposed by e_i on k_i's productivity, namely, the neoclassical cost-based view (NC) and the Porter Hypothesis (PH). NC posits that ESG regulations increase private costs and hence undermine k_i's productivity, while PH posits that ESG regulations induce product and process innovations that improve k_i's productivity.

For simplicity, the per-unit cost of capital (r) is assumed to be constant and the investing firm's revenue in country i is assumed to be generated by a Cobb–Douglas function of k_i and e_i. As such, the firm's profit (π_i) in country i is given by:

$$\pi_i = e_i^{\phi} k_i^{\theta} - r k_i \tag{1}$$

where, $-1 < \phi < 1$, $0 < \theta < 1$, and $0 < \phi + \theta < 1$. Note that ϕ is positive (negative) if the PH (NC) force dominates, and that $\phi = 0$ if the two forces exactly offset each other. Country i's ESG performance increases (decreases) FDI productivity if ϕ is positive (negative). Eq. (1) is in the same spirit as Pearson's (1987) theoretical setting where environmental service is a factor input alongside other inputs. The firm sets k_m to maximize its overall profit made from its investment in countries m and n:

$$\max_{k_m} \quad \left[e_m^{\phi} k_m^{\theta} + e_n^{\phi} (K - k_m)^{\theta} - rK \right] \tag{2}$$

The first order condition is:

$$\left(\frac{e_m}{e_n} \right)^{\phi} = \left(\frac{k_m}{k_n} \right)^{1-\theta} \tag{3}$$

Eq. (3) suggests that a country's relative competitiveness in attracting FDI is determined by its ESG position relative to the peer country. It provides the following testable implications:

Case (i). If NC dominates (i.e., $\phi < 0$), k_m / k_n is inversely related to e_m / e_n.

Case (ii). If PH dominates (i.e., $\phi > 0$), k_m / k_n is positively related to e_m / e_n.

Case (iii). If NC and PH exactly offset each other (i.e., $\phi = 0$), $k_m = k_n$.

In favor of NC, i.e., Case (i), Palmer *et al.*'s (1995) model of innovation in pollution abatement analytically shows that a tightening of environmental regulations unambiguously lowers a polluting firm's profit even if the firm has an option to adopt a more efficient pollution-reducing technology. The intuition is that the costs saved by adopting the more efficient technology should be insufficient to cover the increased compliance costs if the firm does not find it optimal to adopt the technology before the environmental regulations are tightened. Similarly, Baumol and Oates' (1988) two-country model predicts that more developed countries suffer comparative disadvantage in pollution-intensive activities because they have more stringent regulations. Empirical studies including Xing and Kolstad (2002), Dean et al. (2005), Ederington et al. (2005), Naughton (2014), Mulatu (2017), and Hunjra et al. (2024) provided supportive evidence for NC.

In contrast to NC, Porter and Van der Linde's (1995) PH postulates that regulations trigger "innovation offsets" that can exceed the costs of compliance in the following ways, i.e., Case (ii). First, product innovations are triggered when regulations create higher-performance, higher-quality, safer, or lower-cost products. Second, process innovations are triggered when regulations improve productivity, for example, by reducing energy and materials consumption through simplifying product packaging and designs. Consistent with this view, studies such as Lanjouw and Mody (1996) and Popp (2006) found a positive relationship between environmental regulations and innovation. Similarly, Frondel et al. (2007) documented that strict environmental regulations in OECD countries induce firms to lower their costs.

It follows from Cases (i) and (ii) that country i's government can strategically position its ESG performance relative to its rival in the presence of international competition for FDI. Given a fixed K and the presence of international FDI competition (i.e., $k_m = K - k_n$), country i's attractiveness to FDI is determined by its ESG position relative to the competing country (i.e., e_m / e_n), not solely by the

[1] Following Haaparanta's (1996), K is conceptually measured in physical terms. Alternatively, K can be measured in dollar terms without losing generality.

country's own ESG performance. As such, the competing country's FDI performance (e_n) provides a reference point for evaluating the impact of country i's ESG performance (e_m) on its attractiveness to FDI.[2] These testable implications give rise to the following hypotheses:

H1: k_m / k_n is inversely related to e_m / e_n, implying that $\phi < 0$.

H2: k_m / k_n is positively related to e_m / e_n, implying that $\phi > 0$.

Hypotheses H1 and H2 can be empirically tested by running the following regression.

Model 1: $\log\left(\frac{FDI_m}{FDI_n}\right) = \alpha_1 \log\left(\frac{ESG_m}{ESG_n}\right) + \alpha_2 \log\left(\frac{GDP_m}{GDP_n}\right) + \varepsilon_{mn}$, for all m $\neq$ n,where, ESG_i and FDI_i respectively measure e_i and k_i, and $\alpha_1 = \phi/(1-\theta)$. Model 1, a log-linearized version of Eq. (3), is essentially a gravity model based on the logarithmic ESG distance between countries m and n, while their GDP distance is a control variable. H1 (H2) is supported if α_1 is negative (positive).

Model 2 is an alternative specification that captures the possible effect of the geographic distance between countries m and n (as denoted by D_{mn}) on the intensity of their competitive relationship:

Model 2: $\log\left(\frac{FDI_m}{FDI_n}\right) = \beta_1 \log\left(\frac{ESG_m}{ESG_n}\right) + \beta_2 \log\left(\frac{GDP_m}{GDP_n}\right) + \beta_3 D_{mn} + \beta_4 \log\left(\frac{ESG_m}{ESG_n}\right) D_{mn} + \beta_5 \log\left(\frac{GDP_m}{GDP_n}\right) D_{mn} + \varepsilon_{mn}$, for all m $\neq$ n.

If international FDI competition is less intense between countries who are geographically far apart, β_4 and β_5 are expected to have opposite signs to β_1 and β_2, respectively.

In addition to Models 1 and 2, this study also specifies auxiliary models where ESG_i is replaced by each of its constituents, namely, environmental performance (E_i), social performance (S_i), and governance performance (G_i), for $i = m, n$. The purpose of doing so is to investigate how a country's relative position in each of the three ESG dimensions affect the country's relative competitiveness in attracting FDI.

3. Data

Table 1 presents a summary of data sources. The sample includes 38 OECD countries, China, and Singapore (i.e., a total of 40 countries) over the period of 2013–2022. In 2022, for instance, the OECD countries' aggregate stock of inward FDI was 67 % of the world total. China and Singapore are included in the sample because these two non-OECD countries account for 13 % of the world total FDI stock in the same year. As such, this study's sample covered 80 % of the world's FDI stock.[3] Annual data on inward FDI positions were taken from the Coordinated Direct Investment Survey conducted by International Monetary Fund. For each host country in the sample, contributions by 121 origin countries were aggregated with censored and missing data excluded. Cross comparing all the $m \neq n$ pairs of host countries gives 780 unique observations each year (i.e., the total number of dyad-year observations is 7800 with duplicative but inverse *n, m* comparisons ignored). For these 780 unique cross-country ratios, there is no clear-cut temporal pattern observed. The average *beginning to end* change in differentials is 0.0118 or a widening in the gap by 1.18 %. Of these ratios, 415 witnessed an increase in the differential by an average of 9.1 % while the remaining 365 saw a decrease of (-)7.82 %. The average *annual* change in differential, however, is −0.68 % with 378 showing positive annual changes that averaged at 8.0 % and 402 showing negative annual changes averaged at −8.8 %.

ESG data for the sample countries were taken from the Global Sustainable Competitiveness Index (GSCI) compiled by the SolAbility Sustainable Intelligence, which cover the following ESG performance dimensions:[4]

- Environmental (E) dimension: Agriculture (e.g., degradation desertification); Biodiversity (e.g., biodiversity pressure); Water; Resources (e.g., renewable and non-renewable freshwater); Pollution (e.g., water, air, and biodiversity pollution).
- Social (S) dimension: Health (e.g., health care availability and child mortality); Equality (e.g., income and gender equality); Crime (e.g., violent crime and prison population); Freedom (e.g., press freedom and human rights); Satisfaction (e.g., individual happiness and public service satisfaction).
- Governance (G) dimension: Government Cohesion (e.g., public services); Infrastructure (e.g., Roads and Rail); Business Environment (e.g., ease of doing business); Corruption (e.g., corruption index); Financial Stability (financial regulation and exposure to financial shocks).[5]

The above ESG dimensions comprise specific elements similar to those for constructing Jiang et al.'s (2024) national ESG index. Data on GDP (constant 2015 USD) were obtained from the World Bank. The geographic distance (D_{mn}) data for all $m \neq n$ country pairs were extracted from the CEPII GeoDist database.

[2] If the marginal social cost of lowering (raising) e_i is increasing when NC (PH) dominates, the race-to-the-bottom (race-to-the-top) phenomenon is unlikely to occur because the marginal effect of e_i on k_i is decreasing.

[3] World Development Indicators, World Bank.

[4] GSCI employs 190 quantitative indicators from inter-governmental sources including World Bank, IMF, and various UN Agencies. It is the most comprehensive cross-countries sustainability analysis currently available (https://solability.com/all-news/10277).

[5] The missing 2013 data on the G dimension were imputed using a dynamic panel data model to estimate the relationship between G and six World Bank Governance Indicators (including control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability) for 2014–2022. The estimates were then used to backward predict the missing 2013 data on G.

Table 1
Data sources.

Inward Foreign Direct Investment Position (USD millions)	
Sample Period	Annual, 2013–2022
Source	IMF CDIS database https://data.imf.org/
Destination Countries (40)	Australia, Austria, Belgium, Canada, Chile, China, Colombia, Costa Rica, Czech Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Singapore, Slovak Rep., Slovenia, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States.
Other Variables	
ESG Data (Global Sustainable Competitiveness Index)	SolAbility Sustainable Intelligence: https://solability.com/
GDP constant 2015 USD	World Bank National Accounts Data: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD
Geodesic Distances	CEPII: https://cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp
Regulatory Quality, Rule of Law	Kaufmann and Kraay (2023). Worldwide Governance Indicators, 2023 Update. https://www.govindicators.org
Human Development Index, Gender Inequality Index	United Nations Development Programme: https://hdr.undp.org/data-center/documentation-and-downloads

Tables 2 and 3 provide summary statistics for the key variables. Of the 40 host countries, 7 experienced negative growth in FDI stock between 2013 and 2022 with the rest witnessing growth that ranges from 2.4 % to 365.9 %. The average stock of inward FDI is the largest in the United States and smallest for Costa Rica, standing at USD4643,258 million and USD2667 million respectively. The total stock of inward FDI amounts to USD29,486,141 million at the end of 2022, representing a growth in the sample period of close to 37 %. The top 10 recipients together took over 80 % of this amount while the top 10 contributors account for about 64 % of such investment. The 10-year average ESG ranges between 136 (Lithuania) and 175.1 (Denmark). A total of 7 countries saw negative growth in it with the lowest coming from Canada (-6.9 %). Among those with positive growth in ESG, Germany had the fastest rate of 23.8 %. Fig. 1 illustrates the host countries' aggregated FDI values and raw ESG scores for the starting year and end year, and a scatter-diagram relating the log ratios of country-pair FDI and ESG is also included for easy reference.

4. Results

Models 1, 2, and their auxiliary models were estimated with various panel data methods, including the Pooled OLS, Fixed Effects (FE), and Random Effects (RE) approach. In addition, Two-Stage Least Squares (2SLS) was used to test and correct for the presence of potential endogeneity in the model variables. For succinctness, we report only selective outcomes as our principal task is to investigate the significance of the log ESG distance and not the parameter estimates *per se*. It should be noted that the structural parameters ϕ and θ in Eq. (3) cannot be individually retrieved from the estimated $\widehat{\alpha}_1$or $\widehat{\beta}_1$ without arbitrary restrictions imposed, a fact that is valid regardless of the choice of the empirical model. As such, the Pooled OLS results will be reported unless they are contradicted by findings in the FE and RE counterparts.

Table 4 summarizes the Pooled OLS estimation results of Model 1, 2 and their respectively auxiliary models. First and foremost, the significantly positive coefficient on $\log(ESG_m/ESG_n)$ as reported in the first column (Model 1) supports H2 against H1, indicating that $\phi > 0$. In other words, the PH force dominates the NC force, and thus raising a country m's ESG position relative to those of competing countries $n \neq m$ enhances the country m's attractiveness to FDI in the presence of international FDI competition. Note that the values of R^2 are not directly comparable across 2SLS models because endogeneity in the regressor(s) makes the backdrop equation Total Sum of Squares = Estimated Sum of Squares + Residual Sum of Squares no longer valid.

The supportive evidence for H2 is in line with prior research suggesting that environmental regulations and firms' productivity are not necessarily inversely related. For instance, Waldkirch and Gopinath's (2008) findings reveal that non-polluting US firms made larger FDI than polluting ones in Mexico. Costantini and Mazzanti (2012) found that environmental policies raised innovative performance in European Union and that energy taxes positively impacted EU's high-tech and low-to-medium-tech exports. According to Dasgupta et al. (2002), multinational firms develop environmental technologies and management standards and then apply them to foreign facilities. This echoes Lanjouw and Mody's (1996) findings that FDI enables innovations in host countries by transferring technologies and standards from home countries. Moreover, Shear et al.'s (2023) study on 152 countries documented that those with higher climate-related risks tend to have lower FDI inflows and the high-risk countries may, in turn, respond by strengthening their social, economic, and institutional environments.

The positive coefficient on the GDP ratio echoes what is typically observed in gravity models which boils down to implying that income or growth prospect has a positive impact on FDI. The coefficient is essentially the elasticity as the variable is expressed as a log ratio. Since the estimated coefficient's face value is greater than unity, the host country's relative attractiveness to FDI is rather sensitive to its market size relative to those of competing countries.

Models 1a to 1c in Table 4 replace the composite ESG measure (ESG_i) with each of its constituents, namely, the environmental (E_i), social (S_i), and governance (G_i) performance measures, respectively. The significantly positive coefficients on $\log(E_m/E_n)$ and $\log(S_m/$

Table 2
Summary statistics of FDI and ESG data.

Country	FDI (Inward)		ESG		Country	FDI (Inward)		ESG	
	Mean USDm	Growth 2013-22	Mean Level	Growth 2013-22		Mean USDm	Growth 2013–22	Mean Level	Growth 2013–22
AUS	224,1176	62.4 %	151.9	0.6 %	**JPN**	1,481,925	66.8 %	156.5	15.7 %
AUT	272,020	−9.8 %	166.8	6.3 %	**KOR**	236,510	100.6 %	163.9	8.1 %
BEL	657,132	6.5 %	151.6	11.0 %	**LTU**	4496	97.6 %	136.0	2.5 %
CAN	946,904	129.1 %	152.9	−6.9 %	**LUX**	2,710,782	4.2 %	150.8	8.2 %
CHL	25,722	79.9 %	146.8	−5.6 %	**LVA**	3115	305.7 %	164.8	3.4 %
CHN	704,006	90.5 %	141.0	3.5 %	**MEX**	104,664	67.6 %	169.5	−1.4 %
COL	23,710	59.4 %	149.2	9.9 %	**NLD**	3,408,241	13.9 %	153.9	9.0 %
CRI	2667	221.2 %	157.2	17.2 %	**NOR**	154,040	18.7 %	151.6	21.5 %
CZE	29,871	82.7 %	168.1	3.4 %	**NZL**	17,710	−4.1 %	138.9	7.5 %
DNK	172,826	19.6 %	175.1	−3.2 %	**POL**	15,042	153.2 %	157.9	13.4 %
EST	6618	365.9 %	162.1	−6.2 %	**PRT**	47,397	18.0 %	159.0	14.4 %
FIN	112,619	−15.2 %	139.0	19.1 %	**SGP**	649,811	125.1 %	153.2	12.1 %
FRA	1,288,184	27.1 %	145.6	4.5 %	**SVK**	7668	108.3 %	170.2	1.1 %
DEU	1,490,530	68.6 %	165.4	23.8 %	**SVN**	4274	−13.2 %	165.8	−1.0 %
GRC	16,146	−31.0 %	165.0	9.8 %	**ESP**	510,806	2.4 %	156.4	5.1 %
HUN	110,044	81.0 %	137.2	13.8 %	**SWE**	357,832	7.7 %	134.0	16.6 %
IRL	930,623	114.1 %	150.5	9.0 %	**CHE**	1,349,738	27.4 %	141.4	9.6 %
ISL	6685	−47.6 %	155.3	0.8 %	**TUR**	33,821	108.1 %	146.5	6.8 %
ISR	61,724	325.5 %	141.3	18.0 %	**GBR**	2,692,220	26.0 %	172.8	11.2 %
ITA	362,465	−12.4 %	158.9	19.3 %	**USA**	4,643,258	49.9 %	140.0	−1.8 %

Table 3
Summary statistics of top ten destination and origin countries.

Top 10 Destination Countries (2022)			Top 10 Origin Countries (2022)		
Country	FDI (Inward) USDm.	Share of Total	Country	FDI (Outward) USDm.	Share of Total
USA	46,432,575	19.75 %	**USA**	4,975,451	16.87 %
NLD	34,082,408	11.99 %	**NLD**	3,604,712	12.23 %
GBR	26,922,197	10.43 %	**LUX**	2,131,386	7.23 %
LUX	27,107,819	8.98 %	**GBR**	1,876,922	6.37 %
JPN	14,819,247	6.36 %	**SGP**	1,248,912	4.24 %
DEU	14,905,299	6.28 %	**IRL**	1,100,077	3.73 %
CHE	13,497,377	4.83 %	**CHE**	1,016,285	3.45 %
FRA	12,881,835	4.69 %	**HKG**	1,013,640	3.44 %
CAN	9,469,044	4.37 %	**DEU**	1,005,760	3.41 %
CHN	7,040,057	3.20 %	**CHN**	876,063	2.97 %

S_n) are consistent with that on $\log(ESG_m/ESG_n)$ reported in Model 1, suggesting that a country's relative competitiveness in attracting FDI increases with its relative performance in the environmental and social dimensions. However, the significantly negative coefficient on $\log(G_m/G_n)$ suggests the opposite: NC is evidenced to be the dominating force in the governance dimension, and hence a country's attractiveness to FDI decreases with its relative performance in this dimension.[6] A plausible reason is that countries with stronger governance are usually those with higher taxes. Fig. 2 plots the G score against two proxies obtained from World Bank data – tax revenue as a percentage of GDP and tax on goods and services as a percentage of tax revenue – and it appears that both are positively aligned with the G score in the diagram. In fact, the correlation coefficients of the G score with the two series are 0.094 and 0.222, respectively. In sum, the positive effect of $\log(ESG_m/ESG_n)$ on $\log(FDI_m/FDI_n)$ in Model 1 is mainly driven by the environmental and social dimensions of ESG.

Models 2, 2a, 2b and 2c capture how the geographic distance between countries m and n (i.e., D_{mn}) influences the intensity of the two countries' FDI competition by allowing their relative ESG measure to interact with D_{mn}. As expected, the coefficient on the interaction term $\log(ESG_m/ESG_n)D_{mn}$ is of opposite sign to that of $\log(ESG_m/ESG_n)$ across Models 2, 2a, 2b and 2c, implying that the intensity of FDI competition between countries m and n falls with their geographic distance. That is to say, the impacts of PH and NC on any two countries' relative attractiveness to FDI tend to weaken as their geographical distance increases. There are several plausible explanations for this phenomenon. First, neighboring countries typically share the same (or, similar) language and culture, making them equally (or, similarly) competitive in terms of lowering the language and cultural barriers to foreign investors (see, for example, Anderson and van Wincoop, 2004; Guiso et al., 2009; Ettalibi et al., 2025). Moreover, as Bahar *et al.* (2014) argued, neighboring countries should have more similar patterns of comparative advantage because they share or have more knowledge in common.

[6] Despite the negative coefficient on $\log(G_m/G_n)$, ESG and all its elements are positively correlated. The correlation coefficients of ESG with respect to E, S, and G are 0.594, 0.707 and 0.574, respectively.

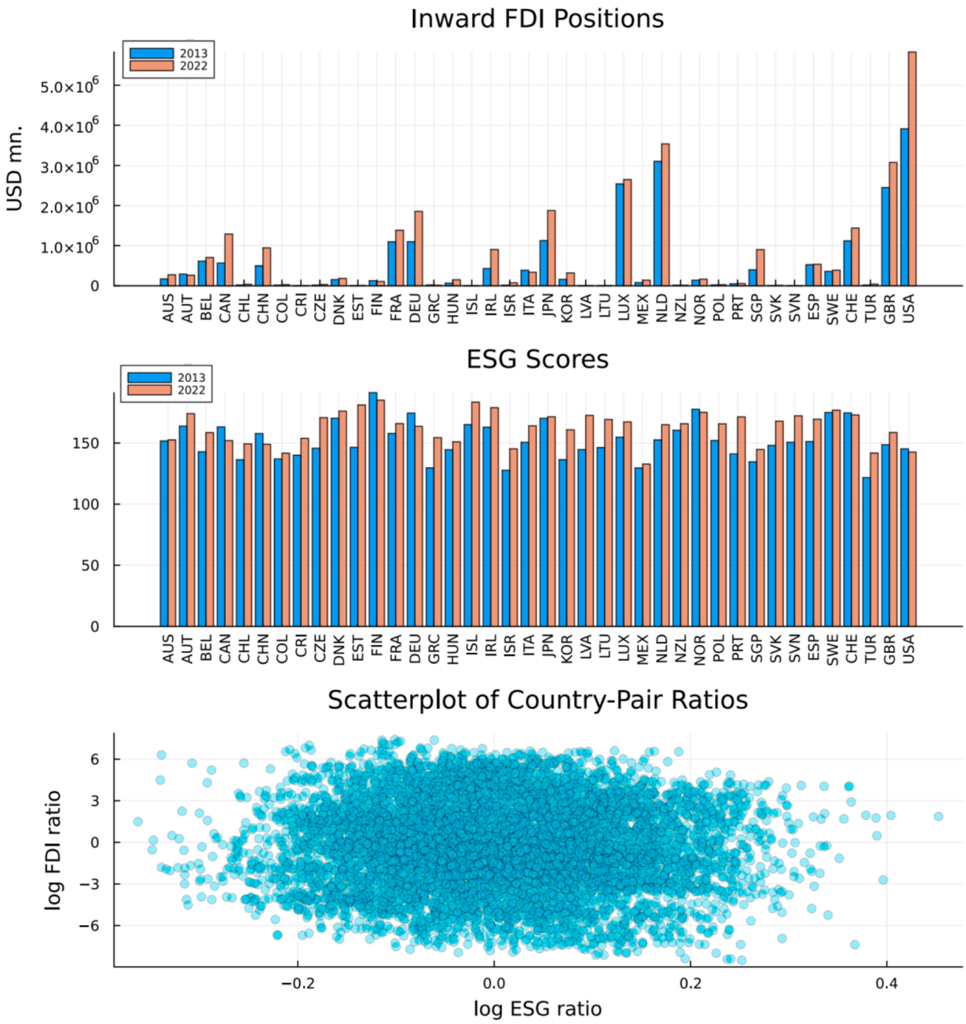

Fig. 1. Data plots of host country FDI and ESG.

Supporting this argument, they found that neighboring countries sharing a border or region tend to export similar baskets of goods. Taking spatial interaction into consideration, Crescenzi and Rodríguez-Pose (2008) found that investment in transport infrastructure in neighboring countries intensifies competition because economic activities can be diverted to better endowed neighbors. Finally, log output distance turns out to be positively and significantly related to FDI competitiveness, and similar to the case of log ESG distance the positive impact diminishes with geographical distance.

Endogeneity is an issue that could possibly scupper the findings reported so far because FDI itself may influence the stringency of ESG regulations (Cole et al., 2017). For instance, an increasing inflow of FDI could strengthen industrial groups' political power in lobbying the government for ESG regulation adjustments. By the same token, a country experiencing a fall in FDI inflow may adjust the stringency of its ESG regulations to increase the country's attractiveness to FDI. To invigorate the earlier findings, endogeneity tests are conducted with Two-stage Least Squares applied to the different model versions. It is well known that choosing the right instruments is a notoriously daunting task and we approach this issue two ways: (1) resort to using results of the Sargan Overidentification Test and the Weak Instrument F-test to help select valid instruments, and (2) resort to using the first lag of $\log(ESG_m/ESG_n)$ (and the individual constituent counterparts) as instruments. For route (1), a total of four proxy variables are chosen (with a fifth one Economic Freedom not considered a valid instrument in the tests and hence dropped). They are the Human Development Index (*HDI*) and Gender Inequality Index (*GI*) compiled by the United Nations, and Regulatory Quality Index (*RQ*) and Rule of Law Index (*RL*) compiled by the World Bank. As with other model variables, these proxies are evaluated as ratios or log ratios between cross country pairs depending on whether the log of zero is encountered given the data.

The valid instruments turn out to be different for the main model and the auxiliary models. In particular, the log *HDI* ratio combines well with *RQ* as an instrument for the log *ESG* distance but this mix fails the various tests for models with sub-index variables. *GI*, *RQ* and *RL* together perform satisfactorily as instrument for the log *S* ratio. The situations with the other two auxiliary models are similar. To complete the dual track modelling, the first lag of the log *ESG* ratios and their sub-index counterparts are run in parallel. Again,

Table 4
Results of hypothesis testing.

Regressor	Model 1	Model 1a	Model 1b	Model 1c	Model 2	Model 2a	Model 2b	Model 2c
$\log\left(\frac{ESG_m}{ESG_n}\right)$	5.6486 * *	-	-	-	7.4048 * *	-	-	-
$\log\left(\frac{E_m}{E_n}\right)$	-	0.7192 * *	-	-	-	3.2583 * *	-	-
$\log\left(\frac{S_m}{S_n}\right)$	-	-	3.9925 * *	-	-	-	5.0480 * *	-
$\log\left(\frac{G_m}{G_n}\right)$	-	-	-	−0.5592 * *	-	-	-	−0.6401
$\log\left(\frac{GDP_m}{GDP_n}\right)$	1.1222 * *	1.0578 * *	1.0885 * *	1.0322 * *	1.1922 * *	1.1737 * *	1.1525 * *	1.0855 * *
D_{mn}	-	-	-	-	−2.99e−5 * *	−2.80e−5 * *	−2.13e−5 * *	−3.12e−5 * *
$\log\left(\frac{ESG_m}{ESG_n}\right)D_{mn}$	-	-	-	-	−2.86e−4 * *	-	-	-
$\log\left(\frac{E_m}{E_n}\right)D_{mn}$	-	-	-	-	-	−3.45e−4 * *	-	-
$\log\left(\frac{S_m}{S_n}\right)D_{mn}$	-	-	-	-	-	-	−1.48e−4 * *	-
$\log\left(\frac{G_m}{G_n}\right)D_{mn}$	-	-	-	-	-	-	-	4.72e−6
$\log\left(\frac{GDP_m}{GDP_n}\right)D_{mn}$	-	-	-	-	−1.18e−5 *	−1.89e−5 * *	−1.02e−5	−9.00e−6
R^2	0.6106	0.5721	0.6502	0.5705	0.6188	0.5918	0.6561	0.5779
No. Obs.	7800	7800	7800	7800	7800	7800	7800	7800

Notes:

Model 1: $\log\left(\frac{FDI_m}{FDI_n}\right) = \alpha_1\log\left(\frac{ESG_m}{ESG_n}\right) + \alpha_2\log\left(\frac{GDP_m}{GDP_n}\right) + \varepsilon_{mn}$

Model 2: $\log\left(\frac{FDI_m}{FDI_n}\right) = \beta_1\log\left(\frac{ESG_m}{ESG_n}\right) + \beta_2\log\left(\frac{GDP_m}{GDP_n}\right) + \beta_3 D_{mn} + \beta_4\log\left(\frac{ESG_m}{ESG_n}\right)D_{mn} + \beta_5\log\left(\frac{GDP_m}{GDP_n}\right)D_{mn} + \varepsilon_{mn}$

Sub-models: a, b, c are the two models above with ratio of ESG replaced by ratios of E scores, S scores, and G scores, respectively
Figures shown are estimated coefficients.
* and * * indicate significance at the 5 % and 1 % level, respectively.

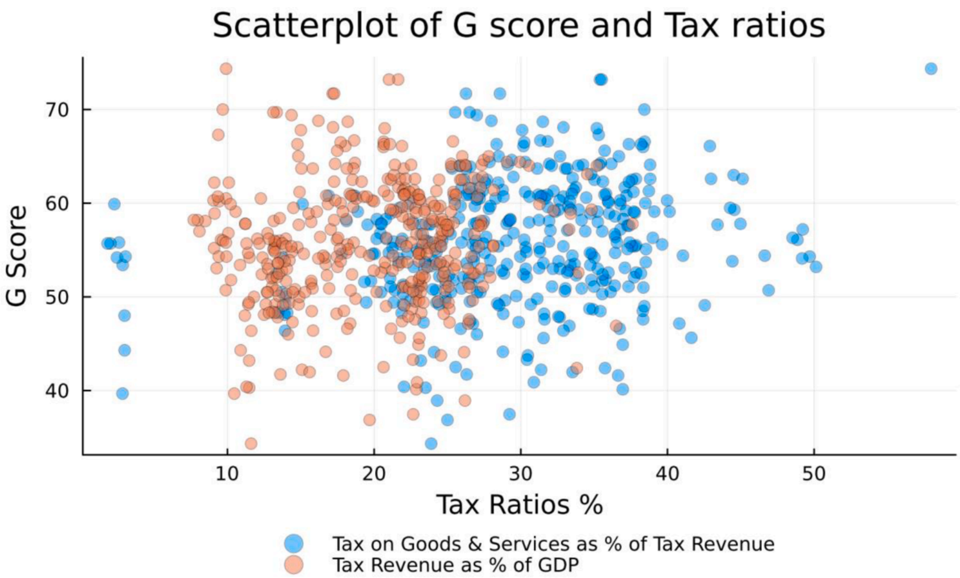

Fig. 2. Relationship between G Score and various tax ratios.

exercises are repeated for different estimation settings – Pooled, fixed effects (FE), and random effects (RE) – and when the latter two are involved the choice of which to report is determined by the result of the Hausman test. The results on the significance of the variables of interest are largely the same across the different formulations. Except for the main model where the Pooled, FE and RE results are all presented, only the best is reported for the auxiliary models. Table 5 presents selected results of these robustness tests.

Table 5
Robustness tests for country effects and endogeneity.

Model Descriptions	Model 3 (2SLS-Pooled)	Model 4 (2SLS-FE)	Model 5 (2SLS-FE)	Model 6a (2SLS-RE)	Model 6b (2SLS-FE)	Model 6c (2SLS-RE)
Country Pair Effects	No	Yes	Yes	Yes	Yes	Yes
Instruments (IV)	1st lag of log *ESG* ratio	Log *HDI* ratio, *RQ* ratio	1st lag of log *ESG* ratio	1st lag of log *E* ratio	*GI* ratio, *RL* ratio *RQ* ratio	1st lag of log *G* ratio
Regressors:						
Constant	-	−0.1426 * *	−0.2095 * *	−0.1627 * *	−0.1165 * *	−0.1285 * *
$\log\left(\frac{ESG_m}{ESG_n}\right)$	**7.4452 * ***	**1.3420 ***	**3.2423 * ***	-	-	-
$\log\left(\frac{E_m}{E_n}\right)$	-	-	-	**3.1874 * ***	-	-
$\log\left(\frac{S_m}{S_n}\right)$	-	-	-	-	**1.1184 * ***	-
$\log\left(\frac{G_m}{G_n}\right)$	-	-	-	-	-	**−0.2169 * ***
$\log\left(\frac{GDP_m}{GDP_n}\right)$	1.1649 * *	1.0054 * *	0.5824 * *	1.0866 * *	1.1013 * *	0.9893 * *
R^2	0.6025	0.0216	0.0001	0.0036	0.0092	0.0127

Notes:
RQ = Regulatory Quality, *RL* = Rule of Law, *GI* = Gender Inequality, *HDI* = Human Development Index.
* and * * indicate significance at the 5 % and 1 % level, respectively.

Rendering further support for H2, the estimated coefficients on $\log(ESG_m/ESG_n)$ in Table 5 (Models 3 – 5) are largely consistent with those reported in Table 4 (Models 1 and 2). Similar robustness tests are conducted on $\log(E_m/E_n)$, $\log(S_m/S_n)$, and $\log(G_m/G_n)$ separately. The results as reported in Table 5 (Models 6a – 6c) are not fundamentally different from those in Table 4 (Models 1a – 1c and 2a – 2c).

Table 6 presents results from further robustness check by applying a series of augmentation to Model 1. First, population is an alternative measure of market size and a country's labour supply increases with its population. Models 1(i) and 1(v) therefore examine whether the host country's attractiveness to FDI is influenced by its population size relative to those of competing countries ($\log \frac{POP_m}{POP_n}$). The sign of the estimated coefficient turns out to be statistically insignificant in both models.

Second, FDI inflows are likely to be influenced by inflation, as highlighted in Sayek (2009), who developed a theoretical model examining this relationship. The CPI ratio ($\log \frac{CPI_m}{CPI_n}$) is therefore imposed on Models 1(ii) and 1(v) to check if inflation risk posts a concern for the origin countries. The sign of the estimated coefficient is negative as expected, but it is statistically significant only in Model 1(ii).

Third, past studies, like Narula and Wakelin (1998), showed that inward FDI is associated with the host country's technological capability. Models 1(iii) and 1(v) therefore investigate whether the host country's attractiveness to FDI is influenced by its technological capability relative to those of competing countries ($\log \frac{HTX_m}{HTX_n}$), where HTX_i is country i's high-technology exports. The evidence is positive on this proposition, but the estimated coefficient is statistically insignificant in both models.

Table 6
Results of robustness tests on Model 1.

Regressor	Model 1(i)	Model 1(ii)	Model 1(iii)	Model 1(iv)	Model 1(v)
$\log\left(\frac{ESG_m}{ESG_n}\right)$	5.6459 * *	5.6291 * *	5.6326 * *	5.6405 * *	5.6021 * *
$\log\left(\frac{GDP_m}{GDP_n}\right)$	1.1222 * *	1.1244 * *	1.1218 * *	1.1219 * *	1.1234 * *
$\log\left(\frac{POP_m}{POP_n}\right)$	−0.0141	-	-	-	−0.0375
$\log\left(\frac{CPI_m}{CPI_n}\right)$	-	−0.6374 *	-	-	−0.4672
$\log\left(\frac{HTX_m}{HTX_n}\right)$	-	-	0.0256	-	0.0428
$\log\left(\frac{XM_m}{XM_n}\right)$	-	-	-	0.0233	−0.0058
R^2	0.6107	0.6119	0.6111	0.6108	0.6127
No. Obs.	7800	7800	7800	7800	7800

Notes: Model 1: $\log\left(\frac{FDI_m}{FDI_n}\right) = \alpha_1 \log\left(\frac{ESG_m}{ESG_n}\right) + \alpha_2 \log\left(\frac{GDP_m}{GDP_n}\right) + \varepsilon_{mn}$
Enhanced models: Models (i) - (iv) are Model 1 augmented with log ratios of Population, CPI, High-Tech Exports and Exports plus Imports, respectively, estimated with Pooled OLS. * and * * indicate significance at the 5 % and 1 % level, respectively.

Fourth, a recent study by Izadi et al. (2023) found a positive relationship between trade openness and FDI inflow. Models 1(iv) and 1(v) therefore check whether the findings are sensitive to the inclusion of relative trade openness as measured by the log of $\frac{XM_m}{XM_n}$, where XM_i is country i's exports plus imports. The estimated coefficient turns out to be statistically insignificant in both models. Importantly, for all these models where supplementary control variables are introduced, whether individually or jointly, the positive effect of log (ESG_m/ESG_n) and its significance remain unaltered.

Finally, Table 7 reports further robustness test results that rely on fragmentizing the sample as follows:

- Model 1(vi) is estimated sequentially with only 2013 data, then with 2013–2014 data, followed by an exercise on 2013–2015 data and so on. This is a standard approach to test for the presence of a structural break although this is not our purpose. By sequentially increasing sample size, we can verify if the estimated parameters are stable and whether their significance will change at some point.
- Model 1(vii) is another approach to fragmentize different proportions of the data using quantiles of the dependent variable. The idea is instead of relating the factors to the conditional mean of the dependent variable under OLS, we seek to relate them to the conditional quantiles of the dependent variable. This approach is implemented by way of Quantile Regression.

As reported in the table, all coefficients from either approach are all significant at the 1 % level with estimated values having similar sizes compared to those of Model 1 estimated using Pooled OLS. In sum, for the repeated OLS exercises, while there seems to be a structural break after 2016, the verdict in favor of the PH has not been overturned. Likewise, the impacts of log ESG ratio and log GDP ratio are largely the same on the lowest 25 percentile, the bottom half, and the bottom 75 percentile of the log FDI ratio.

5. Conclusions

This study conceptually and empirically investigates how a host country's competitive ESG position relative to those of peer countries influences the country's attractiveness to FDI. It first devises a theoretical model that considers two opposing forces governing the relationship between ESG on FDI: while the neo-classical cost-based view (NC) posits that ESG regulations increase private costs and lower firms' productivity, the Porter Hypothesis (PH) posits that ESG regulations induce innovations and improve productivity. Using competing countries' ESG positions as reference points, the theoretical model predicts that a country's relative ESG position has a positive (negative) impact on its attractiveness to FDI if PH (NC) is the dominating force. This theoretical implication is then tested by estimating a gravity model, where a country's attractiveness to FDI is a function of its logarithmic ESG distance from competing rivals. The empirical findings reveal that PH is the dominating force and thus a country's competitiveness in attracting FDI increases with its ESG position relative to its rivals. The findings also suggest that the intensity of FDI competition between countries decreases with the geographic distance between them. Moreover, the supportive evidence for PH is mainly driven by the environmental (E) and social (S) dimensions.

This study operationalizes ESG differentials among countries as a "distance" factor determining firms' locational choices of FDI from a gravity model perspective. It contributes to both the ESG and FDI literatures by conceptually and empirically investigating how a host country's competitive ESG position relative to those of its rivals (i.e., their "ESG distance") affect the country's attractiveness to FDI. As prior research on national ESG performance has often focused on individual countries' own performance, this study provides a new perspective and richer content for the ESG literature by formulating peer countries' ESG performance as a reference point for evaluating a country's ESG performance. The caveats are that the data utilized in the study are aggregated over the origin countries so any potential interactions on their part cannot be unveiled. Also, while the structural Eq. (1) can inherently accommodate both the neo-classical hypothesis and the Porter hypothesis, the reduced form analysis can only give a dichotomous verdict. Modeling with dyadic origin-destination country level data and incorporating nonlinearity in the reduced form model are promising future research directions. One can, for instance, adopt a spatial panel setting where bilateral FDI data are directly incorporated and contemplate how ESG differentials could interact with investment – linearly as covariates or nonlinearly as elements of spatial weights – and the different configurations can be cross-validated with model selection techniques. The disintegration of origin and destination information could facilitate assessment of heterogeneous impact of changing ESG differentials that could vary country by country. Another option is to frame the bilateral FDI data and ESG differentials in a network setting which is then analyzed with high dimensional data models like tensor regression.

CRediT authorship contribution statement

Chow William W: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Fung Michael K:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 7
Results of robustness tests based on data fragmentation.

Model 1(vi): Repeated OLS			Model 1(vii): Quantile Regression ($T = 7,800$)		
Regressors	$\log\left(\frac{ESG_m}{ESG_n}\right)$	$\log\left(\frac{GDP_m}{GDP_n}\right)$	Regressors	$\log\left(\frac{ESG_m}{ESG_n}\right)$	$\log\left(\frac{GDP_m}{GDP_n}\right)$
Trials			Trials		
$T = 780$	6.1505 * *	1.0257 * *	25- Percentile	5.9235 * *	1.2370 * *
$T = 1,560$	6.0694 * *	1.0683 * *	50-Percentile	6.2036 * *	1.2179 * *
$T = 2,340$	6.1962 * *	1.0706 * *	75-Percentile	6.5143 * *	1.1934 * *
$T = 3,120$	6.3389 * *	1.0768 * *			
$T = 3,900$	5.5624 * *	1.0731 * *			
$T = 4,680$	5.3831 * *	1.0799 * *			
$T = 5,460$	5.4860 * *	1.0978 * *			
$T = 6,240$	5.6292 * *	1.1143 * *			
$T = 7,020$	5.7323 * *	1.1181 * *			
$T = 7,800$	5.6495 * *	1.1221 * *			

Notes: Model 1 is $\log\left(\frac{FDI_m}{FDI_n}\right) = \alpha_1 \log\left(\frac{ESG_m}{ESG_n}\right) + \alpha_2 \log\left(\frac{GDP_m}{GDP_n}\right) + \varepsilon_{mn}$. * and * * indicate significance at the 5 % and 1 % level, respectively.

Data availability

Data will be made available on request.

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