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EXPLORING THE BIDIRECTIONAL ENVIRONMENTAL, SOCIAL AND GOVERNANCE SPILLOVER EFFECTS IN FOREIGN DIRECT INVESTMENT

Key points

- *Foreign direct investment (FDI) has been recognised as a driver of economic growth, bringing not only capital but also technology and knowledge to recipient economies. While traditional research has focused on productivity and technological spillovers, the spillover effects of environmental, social, and governance (ESG) practices remain underexplored.*
- *Using a comprehensive dataset covering 52 economies from 2015 to 2023, we examine how ESG practices diffuse between foreign investors and local firms in both directions, and identify factors that influence the strength of these spillovers.*
- *Our results reveal that FDI from ESG-superior investors significantly enhances the ESG performance of firms in recipient economies, although the effect varies across different contexts:*
  - *The positive spillover effect is stronger in advanced economies than in emerging market economies.*
  - *Low-emitting sectors experience larger improvements compared to high-emitting sectors.*
  - *Connector economies show amplified positive ESG spillovers, particularly after 2018.*
  - *Supply-side motivated FDI projects demonstrate stronger potential to drive ESG improvements, likely through supply chain pressures.*
- *In contrast, we find no significant ESG spillovers when domestic firms invest in ESG-superior destinations abroad, highlighting the asymmetric nature of ESG practice diffusion between inbound and outbound investments.*

- *These findings have important policy implications for leveraging FDI to promote sustainable development. Policymakers should prioritise attracting ESG-superior investors and design targeted incentives for supply-side motivated FDI projects. Supporting local firms' capacity to absorb and implement ESG practices, particularly in emerging markets, is also crucial for maximising the benefits of these spillovers.*

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I. INTRODUCTION

Foreign direct investment (FDI) has long been recognised as a driver of economic growth and development, bringing capital, technology, and knowledge from investors to recipients. Beyond its direct effects, FDI can also induce indirect or "spillover" effects that shape the competitive landscape of domestic industries. These spillovers can manifest in various forms, including productivity gains, technological advancement, and improvements in environmental, social, and governance (ESG) practices. While the literature on FDI spillovers has traditionally focused on productivity and technological advancements, the spillover effects of ESG practices remain largely underexplored. This study aims to address this gap by investigating the ESG spillover effects in FDI, examining how ESG practices diffuse between firms.

The motivation for this research stems from the growing importance of ESG factors in global business practices and their potential to influence cross-border investment decisions. As policymakers and financial markets increasingly prioritise sustainable development and climate action, understanding the mechanisms through which ESG practices spread via FDI channels becomes important for designing effective policies and fostering green and transition finance markets. By examining the bidirectional spillover effects of ESG practices in FDI, this study provides insights into how policymakers can leverage inbound and outbound investments to promote sustainable development and improve ESG standards in both home and host economies.

The findings of this study should have significant policy implications. Most importantly, by identifying the determinants of ESG spillovers, this research may help policymakers develop targeted incentives for attracting ESG-superior foreign investments. Accordingly, there are three core research questions:

1. Do foreign investing firms contribute to raising the ESG standards of local firms in host economies?
2. To what extent do local firms influence the ESG practices of their foreign investors?
3. What are the key determinants of the strength of these spillover effects?

By addressing these questions, our study contributes to the ongoing discussion about the broader role of FDI; our work also provides insights into how policy measures can be tailored to maximise the positive externalities of cross-border investments.

The remainder of this paper is organised as follows. Section II reviews the literature on FDI spillovers. Section III outlines the methodology and data used in the study, while Section IV presents the key empirical findings. Section

V discusses the policy implications of the results, and Section VI concludes the study.

II. LITERATURE REVIEW

FDI spillovers refer to the indirect impact, both positive and negative, that economies or firms may experience as a consequence of FDI (Giroud, 2013). In fact, FDI not only brings in capital and creates jobs, but it can also accelerate technological adoption, improve production methods, and foster a culture of innovation. This is critical for a country aiming to upgrade its economic structure (Alfaro et al., 2004; Anwar and Sun, 2014).

While studies in the literature focus on productivity gains, the broader concept covers a range of outcomes. For instance, FDI can contribute to human capital development through training programmes and wage increases, stimulating local investment in education (Javorcik, 2004). FDI can also spur different types of innovation activities within recipient economies, whether through "knowledge creation" or "knowledge use", and this helps explain variations in the short- and long-term capacity building of domestic firms (Vujanovic et al., 2022).

Some studies have examined the bidirectional nature of spillover effects. For example, Amann and Virmani (2014) demonstrate that FDI can stimulate mutual technology transfers, whereby outward FDI not only generates reverse technological spillovers that enhance domestic total factor productivity but also benefits from a reciprocal flow of knowledge and innovation from the host country. Similarly, Zhu and Ye (2018) find that reverse green technology spillovers are contingent upon both the absorptive capacity at home and the developmental characteristics of the investment destination, highlighting the dynamic, two-way nature of technological diffusion. These findings suggest that the benefits of FDI may be more mutual than traditionally perceived.

Despite rising concerns over ESG, there remains a notable lack of studies specifically investigating ESG-related FDI spillovers – studies that directly examine how ESG benefits diffuse through FDI channels to influence host economies beyond traditional productivity gains. Although it is believed that FDI can promote good ESG practices (e.g. UNCTAD, 2021), the mechanism of ESG spillovers via FDI remains underexplored. Feng et al. (2023) provide evidence that robust ESG performance may influence two-way FDI behaviour among Chinese listed companies by enhancing innovation and operational efficiency, which, in turn, strengthens ownership advantages through improved information symmetry. However, their study does not directly investigate the diffusion of ESG benefits across FDI investors and domestic firms. Our study

aims to fill this gap by incorporating these bidirectional spillover insights into the analysis of ESG practice diffusion via FDI channels.

III. CONCEPT AND DATA

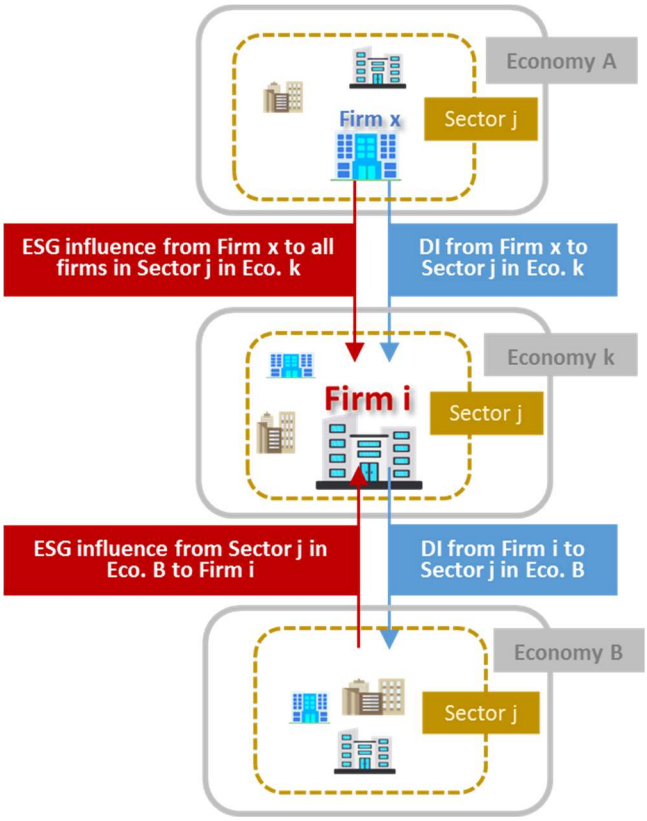
3.1 Concept of FDI spillovers

Conceptually, the spillovers of ESG practice via FDI can occur in both directions: from foreign investors to local firms and vice versa. This bidirectional interaction highlights the dynamic nature of global economic interactions, where the flow of capital is accompanied by the exchange of practices and norms between firms from different economies.

Chart 1 depicts a central firm, "Firm i", embedded in its home economy, Economy k, and engaged in both inbound and outbound investment activities. At any given time, "Firm x" from Economy A may invest in Sector j of Economy k (represented by the blue arrow indicating capital flow). Alongside this investment, ESG practices from Firm x may influence local firms, including Firm i (as shown by the red arrow). Simultaneously, Firm i might invest in Economy B, potentially being influenced by Economy B's ESG standards (as indicated by the red arrow from Sector j in Economy B to Firm i).

This bidirectional flow of ESG practices underscores the complex interplay between foreign investors and local firms. We examine the factors that affect the strength of ESG spillovers under this framework. A key factor may be the ESG performance gap between foreign investors and local firms, suggesting that stricter ESG standards on one side could inspire improvements on the other. Additionally, the sector and economic context of a local firm can influence its openness to adopting ESG measures. The motives underpinning FDI – whether driven by supply-side factors such as resource access or demand-side factors like market expansion – are also likely to impact these spillovers. Finally, the broader economic landscape, including the rise of connector economies as alternative supply chain hubs, may further amplify the influence of FDI on ESG practices.

Chart 1. How ESG practices spread through FDI – the concept



Source: HKMA staff.

3.1 Data

We rely on two primary data sources in this study: the Orbis Crossborder Investment database and Capital IQ Pro. The former provides comprehensive information on both inward FDI and outward direct investment (ODI) projects, while the latter gives firm-level ESG scores alongside essential financial data at the firm level. The firm-level FDI projects data and ESG data are consolidated by matching the firm's International Securities Identification Number (ISIN) across both datasets.

To maintain consistency of the dataset, we restrict our sample to those Orbis projects for which matching ESG scores are available in Capital IQ Pro throughout the whole sample period. Although this filtering step reduces the overall sample size, it guarantees a clean overlap between investment project data and the corresponding ESG performance metrics.

To perform a comparison on a comparable basis of ESG performance across different sectors, we normalise the ESG scores using an industry-year percentile approach. Specifically, each firm's annual ESG score is ranked against the scores of other firms within the same industry on a global scale, thereby

generating an "industry-year percentile". This avoids misleading comparisons that could arise from inherent differences in ESG benchmarks across various sectors.[1]

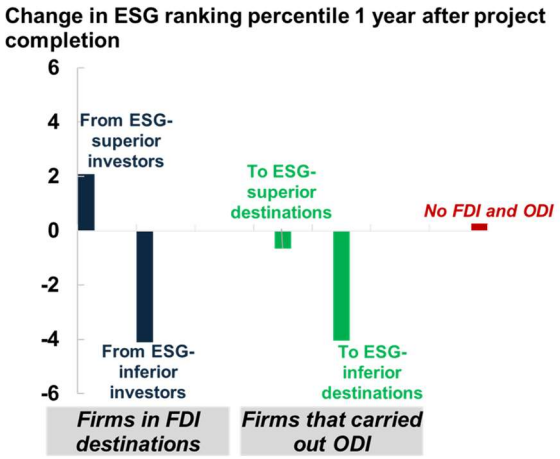
In situations where several FDI projects occur within the same sector and economy during a given period, the attributes of these projects, including their ESG scores, are aggregated through a capex-weighted average. An analogous approach is applied to ODI projects undertaken by a firm at the same time, ensuring that all concurrent investment influences are coherently synthesised.

The yearly dataset spans the period from 2015 to 2023, covering 52 economies, including 34 advanced economies (AEs) and 18 emerging market economies (EMEs).[2] In the empirical analysis, we further disaggregate this sample into distinct subgroups to estimate heterogeneous FDI spillover effects. Specifically, we consider the differential impacts across AEs and EMEs; high- versus low-carbon emission sectors;[3] and a set of three connector economies: Indonesia, Mexico, and Poland.[4]

Chart 2 presents the average change in ESG percentile one year after the completion of either FDI or ODI. Firms in the sector receiving FDI from investors with superior ESG rankings exhibit an increase in their ESG score, while those receiving FDI from inferior ESG investors experience a decline. In contrast, ODI into ESG-superior destinations does not yield a significant change, whereas ODI into ESG-inferior destinations is linked to a decrease. These uncontrolled observations suggest that FDI may facilitate the diffusion of superior ESG practices amongst firms in the recipient economies, warranting further empirical analyses.

[1] For more details about the S&P Global ESG scores' comparability across industries, please see "ESG Scores & CSA: Frequently Asked Questions" by S&P Global
(URL: https://www.spglobal.com/esg/documents/sp_faq_global_esg_scores_csa_v1.pdf).
[2] Please see the appendix for the economy list.
[3] High-emission sectors refer to those sectors among the 11 Global Industry Classification Standard (GICS) sectors that had average greenhouse gas (GHG) scope 1 emission intensity exceeding 100 tonnes of carbon dioxide (CO_2) equivalent per US$1 million in 2023. This includes utilities, materials, energy and industrials; others are low emission sectors.
[4] These "connector economies" gained economic importance along with the rising geoeconomic fragmentation in recent years by offering alternative supply chain routes between major economic blocs. In 2023, an article published in *Bloomberg Business Week* identified five key connector economies – Indonesia, Mexico, Morocco, Poland, and Vietnam. Our sample covers Indonesia, Mexico, and Poland.

Chart 2. Change in ESG ranking percentile 1 year after project completion



Sources: Capital IQ Pro, Orbis Crossborder Investment, and HKMA staff calculation.

IV. MODELS AND EMPIRICAL FINDINGS

4.1 The baseline model

To investigate the bidirectional spillover effects of ESG practices between foreign investors and local firms, we adopt a fixed effects model. Equation 1 represents the baseline model.

$$\Delta ESG_{i,j,k,t} = b_0 + b_1 NOFDI_{i,j,k,t-1} + b_2 GOODFDI_{i,j,k,t-1} + b_3 NOODI_{i,j,k,t-1} + b_4 GOODODI_{i,j,k,t-1} + \sum_{p=1}^{P} d_p X_{i,j,k,t-1} + \gamma_i^{firm} + \gamma_{k,t}^{eco \times year} + \gamma_{j,t}^{sec \times year} + e_{i,j,k,t} \quad (1)$$

The dependent variable, $\Delta ESG_{i,j,k,t}$, is the year-on-year change in Firm i's ESG percentile score. This measure captures the dynamic improvement or decline in a firm's ESG performance, thereby mitigating the influence of time-invariant firm characteristics. The model incorporates several independent variables:

- $GOODFDI_{i,j,k,t-1}$: a dummy variable used to identify periods when a firm receives inbound FDI from an ESG-superior foreign firm. It equals 1 if (1) at least one FDI project was completed in Sector j in Economy k in t-1; and (2) the investing foreign firm(s) had higher ESG ranking than Firm i; otherwise, it equals 0.
- $GOODODI_{i,j,k,t-1}$: a dummy variable marks instances of outbound direct investment into an economy-sector characterised by higher ESG ranking. It equals 1 if (1) at least one ODI project was completed in Sector j

abroad in t-1; and (2) the recipient economy(ies) had higher ESG ranking than Firm i; otherwise, it equals 0.

- These binary indicators were used to represent a foreign investor or foreign destination as ESG-superior or not, simplifying the model and enhancing interpretability. Although using the numerical difference in ESG scores between investors and local firms was also considered, this alternative posed a risk of collinearity, especially given that the dependent variable is the change in ESG score, which could distort the estimates and undermine the reliability of the results.

- $NOFDI_{i,j,k,t-1}$: a dummy variable serves as the indicator for periods during which a firm does not experience inbound investment. It equals 1 when there is no FDI in Sector j in Economy k in t-1; otherwise, it equals 0.

- $NOODI_{i,j,k,t-1}$: a dummy variable serves as the indicator for periods during which a firm does not experience outbound investment. It equals 1 when there is no ODI made by Firm i in Sector j in other economy(ies) in t-1; otherwise, it equals 0.

- $X_{i,j,k,t-1}$: a set of variables that control Firm i's characteristics, including (1) the firm's total assets to gauge the firm's size; (2) the debt-to-asset ratio to measure firm's financial leverage; and (3) the return on equity (ROE) ratio that captures the firm's profitability.

- γ_i^{firm}, $\gamma_{k,t}^{eco\times year}$ and $\gamma_{j,t}^{sec\times year}$: firm, economy-year and sector-year fixed effects respectively. The firm fixed effect eliminates time-invariant factors (e.g. corporate culture) of firms; while the economy-year and sector-year fixed effects control for time-variant, economy-wide, and sector-wide factors respectively.

Therefore, the estimated coefficient b_2 should be significantly positive and larger than b_1 if investments from foreign investors with superior ESG rankings facilitate ESG improvement in firms in the recipient economies. Similarly, the estimated coefficient b_4 should be significantly positive and larger than b_3 if outward investments in sectors of economies with higher ESG rankings drive investors' ESG improvement.

Table 1 shows the estimation results of the baseline model. There are seven major observations from the results:

1. In the full-sample estimation (Column 1), the estimated coefficient of $GOODFDI$ is significantly positive and larger than that of $NOFDI$. This suggests that, in general, FDI from foreign investors with superior ESG

rankings promotes improvements in the ESG performance of firms in recipient economies.

2. These findings also hold for the AEs sub-sample estimation (Column 2). However, in the EMEs sub-sample (Column 3), although the coefficient for $GOODFDI$ remains significantly positive, it is smaller than that for $NOFDI$. This suggests that in EMEs the positive ESG spillovers associated with FDI from investors with superior ESG rankings are relatively weaker than in the absence of such FDI. One possible reason is that AEs tend to have robust regulatory frameworks and stronger institutional support, which can amplify the benefits of high-quality FDI, including adoption of good ESG practices. In contrast, EMEs may face regulatory challenges that limit firms' ability to fully absorb and implement these practices.

3. Both high- and low-emitting sectors could benefit from ESG improvement from ESG-superior foreign investors (Columns 4 and 5). However, compared to the absence of FDI, the larger increase in ESG percentile observed for low-emitting sectors is likely to be driven by their lower practical barriers to implementing sustainability measures. For example, industries such as banking can easily adopt digital solutions and optimise resource use, leading to rapid, measurable ESG gains. In contrast, high-emitting sectors – such as steel production or oil drilling – face complex, inherent challenges due to the nature of their operations, which often require significant technological and operational overhauls to achieve comparable ESG improvements.

4. Results of the estimation of the sub-sample of connector economies – Indonesia, Mexico, and Poland – are consistent with those observed in the EMEs estimation, with the estimated coefficient of $GOODFDI$ smaller than that for $NOFDI$ (Column 6). This is not surprising given that all three connectors are EMEs. When restricting the sample to the period after the onset of the China-US trade war in 2018, however, the positive ESG spillovers become markedly larger (Column 7). This amplification likely reflects these economies' heightened role as strategic intermediaries in global supply chains amid geoeconomic fragmentation. Positioned as pivotal nodes in an increasingly fragmented geoeconomic landscape, these economies have boosted their fundamentals, including ESG performance, to secure further investment and signal stability amid global trade uncertainties. Moreover, regulatory reforms targeting eco-friendly infrastructure and renewable energy, as seen in Indonesia's electric vehicle supply chain development or Mexico's manufacturing hubs, have accelerated institutional ESG alignment. These dynamics, catalysed by the reconfiguration of trade

and investment flows in recent years, underscore the growing nexus between geopolitical repositioning and ESG diffusion in connector economies.

5. The estimated coefficient of *GOODODI* suggests that there are no significant ESG spillovers when domestic firms invest abroad in ESG-superior destinations. One possible explanation is that when firms invest abroad, they may not be as strongly incentivised or equipped to internalise foreign ESG practices. In most cases, the strategic objectives driving outward investment, such as accessing foreign markets or securing supply chains, do not necessarily translate into enhanced ESG practices in the home market.

6. Regarding firms' characteristics, firms with higher profitability and larger asset size tend to have larger improvements in ESG performance. This result is consistent with the concept of the resource-based or "free-cash flow theory" (Jenson, 1986) that firms with higher profitability or larger financial resources have greater means to fund non-business core initiatives.

7. A key limitation of Equation 1 is the well-known challenge in ESG scores across different institutions (Bissoondoyal-Bheenick, 2024). To address this concern and ensure the robustness of our findings, we re-estimated the model using the yearly change in the percentile ranking of GHG emission intensity as the dependent variable instead of the ESG score. The results confirm that FDI from foreign investors characterised by lower greenhouse gas emission intensities is associated with a subsequent reduction in the greenhouse gas emission intensity of firms in the recipient economies. This confirms the robustness of the baseline estimation result.[5]

In summary, the baseline model results reveal that inward FDI from ESG-superior foreign investors is significantly associated with improvements in recipient firms' ESG performance, although the effect is much weaker in EMEs. Furthermore, the ESG spillover effect is notably stronger in low-emitting sectors compared to high-emitting sectors. In addition to their increasing significance in the global supply chain in recent years, the connector economies also enjoy positive ESG spillovers from ESG-superior foreign investors. In contrast, outward ODI investments do not generate any discernible ESG spillovers, highlighting the distinct dynamics of learning and diffusion between inbound and outbound investment flows.

[5] Results of the robustness test can be found in the appendix.

Table 1. Estimation results of the baseline model

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	All economies	***Advanced economies***	***Emerging market economies***	***High-emitting sectors***	***Low-emitting sectors***	***Connector economies (Full sample)***	***Connector economies (Since 2018)***
NOFDI	2.231***	2.345***	2.031***	5.886***	2.115***	5.886**	4.163
	(0.286)	(0.316)	(0.578)	(2.096)	(0.339)	(2.096)	(2.543)
GOODFDI	2.715***	2.948***	1.436**	4.264***	2.860***	4.264***	4.955***
	(0.331)	(0.383)	(0.594)	(1.183)	(0.427)	(1.183)	(1.511)
NOODI	0.114	0.118	0.091	-0.189	0.477	-0.189	-4.564
	(0.349)	(0.372)	(0.940)	(2.487)	(0.472)	(2.487)	(5.283)
GOODODI	1.130**	1.187**	0.851	-1.154	1.430**	-1.154	-7.579
	(0.547)	(0.564)	(2.196)	(4.706)	(0.633)	(4.706)	(8.649)
Total Assets	0.683*	0.775*	0.205	1.104	0.736	1.104	2.606
	(0.357)	(0.402)	(0.798)	(3.179)	(0.446)	(3.179)	(2.664)
Debt/Assets	-0.002	0.002	-0.008	0.039	0.003	0.039	-0.018
	(0.012)	(0.013)	(0.037)	(0.081)	(0.012)	(0.081)	(0.098)
ROE	0.001***	0.001***	0.000	0.068	0.001***	0.068**	0.048
	(0.000)	(0.000)	(0.000)	(0.028)	(0.000)	(0.028)	(0.050)
No. of firms	2,465	1,951	514	904	1,556	73	73
No. of economies	52	34	18	48	51	3	3
No. of years	8	8	8	8	8	8	6
Total observations	19,720	15,608	4,112	7,232	12,448	584	438

Note: Robust standard errors are reported in the parentheses. *, **, and *** indicate the estimated coefficient significant at the 1%, 5%, and 10% levels, respectively.

4.2 The extended model

Having discussed the baseline model results, our analysis now advances to an extended model to explore in more detail how project-specific factors influence ESG spillovers via FDI. The baseline model is augmented by incorporating project-level characteristics that may condition the strength and direction of ESG spillover effects. In this regard, we include the following additional factors in the extended model:

- *Investment magnitude relative*:

  To examine whether a larger investment, relative to the firm's size, brings about greater improvements in ESG performance, we include the ratio of inward FDI capital expenditure to total assets of Firm i ($FCAPEX_{i,j,k,t-1}$) and the ratio of outward ODI capital expenditure by Firm i to its own total assets ($OCA_{i,j,k,t-1}$) in the model.

- *Relative size of investor and destination*:

  We consider the size of both the investing firm and the destination firm by including the ratio of inward FDI investor's total assets to Firm i's total assets ($FASSET_{i,j,k,t-1}$) and the ratio of Firm i's total assets to the median total assets of firms in Sector j in the outward ODI destination ($OASSET_{i,j,k,t-1}$) in the model. This helps us determine if larger companies can drive more significant ESG improvements.

- *Investment motives:*

  To analyse how supply-side and demand-side investment motives affect the spillovers of ESG practice, we incorporate both supply-side project motives (FDI: $FMOTS_{i,j,k,t-1}$, ODI: $OMOTS_{i,j,k,t-1}$) and demand-side project motives (FDI: $FMOTD_{i,j,k,t-1}$, ODI: $OMOTD_{i,j,k,t-1}$) in the extended model. Each motive variable is a binary dummy that takes the value of 1 if the project includes at least one motive of that category; 0 otherwise.[6] Perfect collinearity is unlikely to arise because demand-side and supply-side motives in investment projects are not mutually exclusive. A single investment may be driven by both motives simultaneously. For example, a firm might invest in a country to access its raw materials (i.e. supply-side motive) while also targeting its growing consumer market (i.e. demand-side motive).

- *ESG commitments – talk versus action*:

[6] The data source, Orbis Crossborder Investment, identifies 18 project motives from projects' announcements and public communications: 15 supply-side and 3 demand-side motives. Approximately 40% of sampled projects exhibit at least one motive. Details of project motives can be found in the appendix.

We also incorporate measures of public ESG commitments of FDI projects ($FESG_{i,j,k,t-1}$) and ODI projects ($OESG_{i,j,k,t-1}$) to check whether such statements lead to real ESG improvements. These binary dummy variables equal 1 if project communications, such as public speeches by key personnel of the investing firm, contain at least one ESG term.[7]

Interaction terms between key ESG indicators and project-specific features are incorporated in the extended model to capture the heterogeneity of spillover effects. This allows us to examine how factors such as investment motive and project size modulate the impact of ESG-superior investments, thereby providing a more precise understanding of the conditions under which these spillovers occur. Equation 2 represents the extended model:

$$\begin{aligned}\Delta ESG_{i,j,\,k,t} = {} & b_0 + b_1 NOFDI_{i,j,k,t-1} + b_2 GOODFDI_{i,j,k,t-1} + b_3 NOODI_{i,j,k,t-1} \\ & + b_4 GOODODI_{i,j,k,t-1} + \sum_{p=1}^{P} d_p X_{i,j,k,t-1} + \sum_{m=1}^{M} p_m^{FDI} PFDI_{i,j,k,t-1} \\ & + \sum_{m=1}^{M} p_m^{FDIX}\left(GOODFDI_{i,j,k,t-1} \times PFDI_{i,j,k,t-1}\right) \\ & + \sum_{n=1}^{N} p_n^{ODI} PODI_{i,j,k,t-1} \\ & + \sum_{n=1}^{N} p_n^{ODIX}\left(GOODODI_{i,j,k,t-1} \times PODI_{i,j,k,t-1}\right) + \gamma_i^{firm} \\ & + \gamma_{k,t}^{eco\times year} + \gamma_{j,t}^{sec\times year} + e_{i,j,k,t}\end{aligned} \tag{2}$$

The extended model incorporates all baseline variables along with the project features for both FDI and ODI projects, as well as their interactions with the ESG gaps (*GOODFDI* and *GOODODI*), where:

- $PFDI_{i,j,k,t-1}$ is the set of FDI project characteristics: $FCAPEX_{i,j,k,t-1}$, $FASSET_{i,j,k,t-1}$, $FMOTS_{i,j,k,t-1}$, $FMOTD_{i,j,k,t-1}$ and $FESG_{i,j,k,t-1}$.
- $PODI_{i,j,k,t-1}$ is the set of ODI project characteristics: $OCAPEX_{i,j,k,t-1}$, $OASSET_{i,j,k,t-1}$, $OMOTS_{i,j,k,t-1}$, $OMOTD_{i,j,k,t-1}$ and $OESG_{i,j,k,t-1}$

[7] The data source includes major project communications from investing firms' key personnel. We searched these communications for ESG-related keywords, using a predefined list of 33 terms drawn from established ESG literature and related research studies. Only about 1.5% of projects have at least one ESG-related keyword in their project communications. The ESG lexicon used in this study can be found in the appendix.

- p_m^{FDI} and p_m^{FDIX} denote, respectively, the estimated coefficients for FDI project characteristics and their interaction terms with the ESG gaps; similarly, p_n^{ODI} and p_n^{ODIX} represent the estimated coefficients for ODI project characteristics and their interaction terms with the ESG gaps.

Table 2 shows the estimation results of the extended model. There are several key observations from the results:

1. In general, the extended model confirms that the baseline results remain robust even after accounting for project-specific characteristics. However, the majority of the project features, along with their interactions with the ESG gap variables ($GOODFDI$ and $GOODODI$), included in the extended model do not yield significant ESG spillover effects.

2. The supply-side project motives present a notable exception. The estimation results across the full sample, AEs, and high- and low-emitting sectors indicate that supply-side motivated FDI projects initially exert a negative impact on the ESG performance of local firms due to increased competitive pressures from foreign entrants. However, this adverse effect is significantly mitigated when foreign investors exhibit higher ESG ratings, ultimately yielding a net positive or at least neutral outcome. This pattern suggests that superior ESG practices among foreign investors can generate positive externalities – offsetting competitive challenges and promoting beneficial demonstration effects, knowledge transfer, and the diffusion of best practices. A possible explanation for this dynamic is that supply-side FDI typically establishes or sources from local production bases, thereby enmeshing foreign firms within networks of local suppliers. When these investors enforce stringent standards concerning social responsibility, labour, emissions, and waste management, their requirements tend to ripple through the supply chain, compelling local firms to enhance their practices. In contrast, demand-side FDI primarily targets local markets via sales or distribution channels and relies less on local production inputs. As a result, the impetus for local firms to upgrade their ESG practices is considerably diminished, given the absence of robust supply chain pressures to align with the investor's global standards.

3. As in the baseline model estimation, the evidence for ODI spillovers remains insignificant in general. Local firms engaging in ODI towards ESG-superior destinations do not experience significant changes in their own ESG performance.

Table 2. Estimation results of the extended model

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	All economies	***Advanced economies***	***Emerging market economies***	***High-emitting sectors***	***Low-emitting sectors***	***Connector economies (Full sample)***	***Connector economies (Since 2018)***
NOFDI	1.210***	1.313***	1.148	1.229*	1.012**	4.892*	1.115
GOODFDI	1.691***	1.660***	1.394	1.724**	1.924***	3.747*	3.416**
NOODI	-0.198	-0.151	-0.378	-1.053*	-0.174	-8.196**	-18.612***
GOODODI	0.330	0.499	-1.737	-0.860	0.682	-2.537	-26.093***
Total Assets	0.610*	0.655	0.203	0.555	0.655	1.219	3.344
Debt/Assets	-0.003	0.001	-0.009	-0.011	0.002	0.038	-0.025
ROE	0.001***	0.001***	0.000	0.000	0.001***	0.065**	0.046
FCAPEX	-0.052	-0.073	-0.003	-0.089	-0.014	0.072*	-0.663***
GOODFDI×FCAPEX	0.050	0.064	0.004	0.088	0.006	-0.050	0.675***
OCAPEX	-0.015	0.060	-0.131	0.160	-0.279	-1.870	-6.658
GOODODI×OCAPEX	0.061	-0.006	0.370	0.056	0.216	2.223	10.956
FASSET	-0.000	0.000	-0.000	0.000	-0.000	-0.001	-0.001
GOODFDI×FASSET	0.000	0.000	0.000	-0.000	0.000	0.001	0.001
OASSET	-0.000	-0.000	-0.001	-0.009***	0.000	-0.081**	-0.124
GOODODI×OASSET	0.000	-0.000	0.009*	0.005	0.000	0.069*	0.030
FMOTS	-1.646***	-1.885***	1.362	-3.056***	-1.174	-1.812	0.532
GOODFDI×FMOTS	2.052***	2.301***	-1.414	2.817***	1.770*	-1.986	-4.850
OMOTS	-1.265*	-1.233*	-1.742	-1.022	-1.525*	-2.039	5.155
GOODODI×OMOTS	2.288	2.076	-0.437	0.560	3.077	n.a.	n.a.
FMOTD	-0.738*	-0.609	-1.724	-0.090	-1.382**	1.586	-1.083

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	All economies	***Advanced economies***	***Emerging market economies***	***High-emitting sectors***	***Low-emitting sectors***	***Connector economies (Full sample)***	***Connector economies (Since 2018)***
GOODFDI×FMOTD	0.501	0.726	0.086	0.509	0.717	-0.656	0.158
OMOTD	0.008	0.001	-0.062	0.927	-0.640	-3.633	-4.954**
GOODODI×OMOTD	0.583	0.686	-0.258	2.338	0.018	-18.290**	n.a.
FESG	-0.044	0.022	-1.165	-0.158	0.659	4.233	9.052
GOODFDI×FESG	0.725	1.017	2.054	-0.278	2.309*	5.695	1.307
OESG	-0.202	-0.741	3.108	-2.166	2.200	25.952***	42.717***
GOODODI×OESG	1.874	2.535	-6.069	0.429	0.602	-0.260	n.a.
No. of firms	2,465	1,951	514	904	1,556	73	73
No. of economies	52	34	18	48	51	3	3
No. of years	8	8	8	8	8	8	6
Total observations	19,720	15,608	4,112	7,232	12,448	584	438

Note: *, **, and *** indicate the estimated coefficient significant at the 1%, 5%, and 10% levels, respectively. Significance relies on robust standard errors, which have been omitted from this table for clarity given the large number of estimates.

V. POLICY IMPLICATIONS

The findings of this study provide insights for policymakers seeking to leverage FDI as a tool for promoting sustainable development and improving ESG standards. Policymakers must prioritise attracting ESG-superior investors, regardless of the size of their investments, as these investors drive positive changes in local firms' ESG performance. To achieve this, governments may offer incentives such as tax breaks or simplified regulatory processes for firms with strong ESG track records. Additionally, creating ESG-focused investment promotion programmes can highlight the benefits of sustainable practices and showcase success stories of ESG-superior firms that have driven positive spillovers in host economies.

On the external front, policymakers may also design targeted incentives for supply-side motivated FDI projects, prioritising ESG-superior investors. This could involve requiring or encouraging foreign investors to adopt stringent ESG standards as a condition for accessing strategic resources or infrastructure. Furthermore, governments should encourage foreign investors to engage with local supply chains in ways that promote knowledge transfer and the adoption of best ESG practices, such as through mandatory or voluntary ESG training programmes for local suppliers.

In view of facilitating FDI from ESG-superior investors, promoting ESG transparency and accountability in FDI projects is vital. Policymakers should encourage foreign investors to disclose their ESG commitments and progress as part of their investment projects, possibly requiring ESG impact assessments or reports. Utilising digital tools, such as blockchain or A.I.-driven monitoring systems, can enhance transparency and accountability.

On the domestic front, supporting local firms, especially smaller or less-resourced ones in EMEs, is crucial. Policymakers should offer financial and technical assistance to help these firms sustain or enhance their ESG performance amid competition and opportunities from foreign investors. Moreover, establishing public-private partnerships can foster collaboration between foreign investors and domestic companies, enhancing the absorptive capacity of local firms to learn from ESG-superior investors.[8]

Building on these efforts, it is equally important to adopt a long-term perspective that integrates ESG principles into broader long-term development strategy. Policymakers may mainstream ESG considerations into national development plans and investment strategies, incorporating ESG criteria into FDI project evaluations. Aligning FDI policies with global initiatives like the

[8] An example is the Sino-Singapore Tianjin Eco-City (中新天津生态城) in Mainland China. The project is a collaboration between the Chinese and Singaporean governments, as well as the private sector. Conceived as a model for sustainable urban development, this project was designed with an eye toward environmental, social, and governance (ESG) principles.

UN Sustainable Development Goals or the Paris Agreement can help achieve climate action. Engaging in international cooperation to harmonise ESG standards and promote sustainable investment practices across borders is also important, such as participating in global ESG initiatives like the OECD's Responsible Business Conduct guidelines.

VI. CONCLUSION

This study sheds light on the bidirectional ESG spillover effects in cross-border direct investment projects (FDI and ODI), offering robust evidence on how ESG practices diffuse between foreign investors and local firms. The findings underscore the transformative potential of FDI in promoting sustainable development, revealing that FDI from ESG-superior investors significantly enhances the ESG performance of firms in the recipient economies, with stronger effects observed in AEs and low-emitting sectors. Supply-side motivated FDI projects also demonstrate the potential to drive ESG improvements, possibly through supply chain pressures. Conversely, ODI into ESG-superior destinations does not exhibit significant spillover effects, underlining the asymmetric dynamics of ESG diffusion between inbound and outbound investments.

Future research could explore how specific regulatory measures, such as ESG-linked investment incentives or public–private partnerships, influence the magnitude and direction of ESG spillovers. Additionally, examining the role of digital tools like AI or blockchain in monitoring and enhancing ESG practices could provide valuable insights for improving transparency and accountability. Another avenue for research could focus on sector-specific dynamics, particularly in high-emission industries, to identify tailored strategies that address practical barriers to adopting ESG measures.

In conclusion, this study highlights the critical role of FDI as a conduit for ESG practice diffusion, offering actionable insights for fostering sustainable development in both home and host economies. The findings underscore that while challenges persist, strategic policy design and international cooperation can unlock the full potential of ESG spillovers, contributing to a more inclusive and sustainable global economy.

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Appendix

Table A1. Robustness check: Estimation results of the baseline model (Dependent variable: yearly change in percentile ranking of GHG emission intensity (Scopes 1 and 2); higher = larger emission intensity)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	All economies	***Advanced economies***	***Emerging market economies***	***High-emitting sectors***	***Low-emitting sectors***	***Connector economies (Full sample)***	***Connector economies (Since 2018)***
NOFDI	-2.787***	-2.388***	-6.064***	-2.052**	-3.222***	-8.678**	-17.57***
	(0.434)	(0.453)	(1.195)	(0.842)	(0.575)	(3.764)	(5.548)
GOODFDI	-5.347***	-4.640***	-8.679***	-4.248***	-6.399***	-12.74***	-19.54***
	(0.475)	(0.488)	(1.320)	(0.650)	(0.627)	(3.803)	(5.673)
NOODI	-0.197	-0.163	-0.629	0.161	-0.233	2.315	4.607
	(0.372)	(0.355)	(2.410)	(0.554)	(0.494)	(4.668)	(8.870)
GOODODI	-1.416**	-1.511**	-1.509	-1.335	-1.141	-0.438	1.413
	(0.649)	(0.674)	(2.856)	(1.097)	(0.798)	(5.155)	(9.935)
Total Assets	-0.403	-0.917	1.321	-0.743	-0.444	18.68***	20.74**
	(0.675)	(0.709)	(1.808)	(1.361)	(0.754)	(5.398)	(9.964)
Debt/Assets	-0.0130	-0.0239	0.0327	-0.0377	-0.00258	-0.0221	0.173
	(0.0211)	(0.0221)	(0.0566)	(0.0449)	(0.0232)	(0.136)	(0.183)
ROE	0.000114	0.0000685	0.000408**	0.000340**	0.0000561	-0.0526	0.0216
	(0.000112)	(0.000119)	(0.000169)	(0.000144)	(0.000149)	(0.0481)	(0.0658)
No. of firms	2,465	1,951	514	904	1,556	73	73
No. of economies	52	34	18	48	51	3	3
No. of years	8	8	8	8	8	8	6
Total observations	19,720	15,608	4,112	7,232	12,448	584	438

Note: Robust standard errors are reported in the square brackets. *, **, and *** indicate the estimated coefficient significant at the 1%, 5%, and 10% levels, respectively.

Table A2. Investment project motives

	Motive	Detail	Number of projects having this motive
Supply-side motives	**Access to finance**	The investing firm has identified the ability to raise significant money by being listed in the location as a key reason for choosing to invest there.	**5**
	Government support	The investing firm has cited non-financial support from the local investment promotion agency or government body as a reason for locating there.	**119**
	ICT infrastructure	The investing firm has identified the location's internet or telecoms infrastructure as the reason for locating itself there.	**25**
	Industry cluster	The investing firm identifies the location as having multiple similar companies or companies working on similar projects in the area.	**127**
	Language availability	The investing firm has stated that a multilingual workforce in the area was one of the reasons to establish itself there.	**12**
	Location attractiveness	The investing firm has identified the country or city's general attractiveness as a place to be located.	**370**
	Lower costs	The investing firm identifies lower-cost labour or other resources when compared to competing locations.	**27**
	Natural resources	The investing firm has cited the natural resources the locality has to offer as a factor in its decision to locate itself there.	**9**
	Real estate availability	The investing firm has identified a building, business park, etc. as the reason for locating itself in the area.	**33**

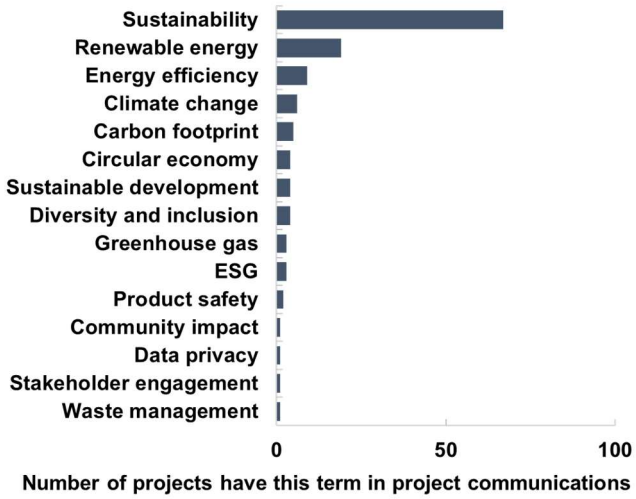
	Motive	Detail	Number of projects having this motive
	Skilled workforce availability	The investing firm has stated that a qualified, skilled, or appropriately educated workforce in the area was one of the reasons it chose to establish itself there.	**434**
	Supply chain	The investing firm cites a location as being desirable because its suppliers are close by.	**132**
	Taxation	The investing firm highlights the attractiveness of the local taxation structure in relation to corporate tax planning.	**1**
	Technology & innovation	The investing firm has identified a location as being an area of high innovation, development, and technology advances.	**231**
	Transport and utility infrastructure	The investing firm has identified the location as being easily accessible by any method of transport and also having good physical utilities infrastructure, including electricity grids, water works, etc.	**184**
	Universities or researchers	The investing firm has decided to locate in a city or country to be close to institutions of research and learning.	**113**
Demand-side motives	**Domestic market potential**	The investing firm has identified that demand in this market/country/city is growing or is on the cusp of growth.	**2,046**
	Market access	The investing firm has identified a location as beneficial due to its location being close to existing customers and potential clients.	**1,613**
	Business environment	The investing firm has identified the wider economic and political climate in the country as a reason to locate there.	**301**

Sources: Orbis Crossborder Investment; HKMA staff classification.

Table A3. The ESG lexicon

Active ownership	Intangible assets
Biodiversity	Labour practices
Carbon footprint	Negative screening
Circular economy	Positive screening
Climate change	Product safety
Community impact	Public benefits corporation
Corporate governance	Renewable energy
Data privacy	Responsible sourcing
Data security	Socially responsible investing
Diversity and inclusion	Stakeholder capitalism
Energy efficiency	Stakeholder engagement
ESG	Sustainability
Ethical business conduct	Sustainable development
Externalities	Sustainable investing
Greenhouse gas	Waste management
Human rights	Water usage
Impact investing	

Chart A1. ESG terms that appeared in project communications



Note: Only 15 out of 33 ESG terms in the lexicon were mentioned in the sample projects' communications.

Sources: Orbis Crossborder Investment; HKMA staff classification.