HONG KONG MONETARY AUTHORITY

Research Memorandum 08/2025

15 April 2025

THE IMPACT OF CLIMATE-RELATED FACTORS ON THE GREENFIELD FOREIGN DIRECT INVESTMENT

Key points

- *Amid the increasingly common extreme weather events, governments worldwide have been rolling out climate policies and promoting green finance. The foreign direct investment (FDI) flows represent a significant channel driving this green transformation, and related technology spillovers and supply chain reconfiguration. Against this backdrop, this study evaluates the impact of climate-related factors, namely (i) climate policy, (ii) green bond issuance, and (iii) extreme weather events, on different types of greenfield FDI.*

- *Our study leverages a granular dataset of cross-border greenfield FDI, which encompasses approximately 220,000 FDI projects across more than 200 economies from 2013 to 2023. The description and categorisation of the projects within the dataset allow us to identify FDI projects of different types (e.g. green FDI, manufacturing FDI).*

  - *Our empirical results based on a cross-country panel regression reveal that more climate policies are associated with a greater number of greenfield FDI projects, thereby helping promote the green transition and sustainable growth. In particular, the positive impact is more pronounced for green FDI (even more so in the manufacturing sector), and from binding climate policies that involve fiscal consequences and strict regulations.*

  - *By country groups, the nexus between climate policy and green FDI is stronger for advanced economies (AEs) compared to emerging market economies (EMEs), partly reflecting the generally higher proportion of binding climate policies implemented by AEs. We also find that more green bond issuance is positively correlated with outward green FDI, generating green spillovers to other*

economies. Finally, extreme weather events may disproportionately dampen (both green and non-green) FDI inflows in the manufacturing sector.

- *Regarding the policy implications, we document that while the number of green FDI projects has been picking up in recent years, its share in total FDI remains small, suggesting that further efforts are needed to promote the green transition and sustainable growth. Our results show that promoting climate policy and green bond issuance appears to be useful for this goal. In particular, EMEs should continue to improve their ability to leverage climate policies, especially binding policies, to attract green FDI. Given the adverse impact of extreme weather events on the manufacturing FDI inflows, the authorities should consider measures to proactively mitigate and adapt to these climate risks.*

Prepared by: Yida Li, Philip Ng and Alice Wang[1]
Economic Research Division, Research Department
Hong Kong Monetary Authority

[1] The authors would like to thank Lillian Cheung, Michael Cheng, and Paul Luk for their useful comments.

I. INTRODUCTION

1. With the increasing frequency of extreme weather events, governments worldwide have been implementing climate policies and promoting green finance. On the other hand, the presence of multinational enterprises (MNEs) and their foreign direct investment (FDI) flows represent a significant channel driving this green transformation, along with related technology spillovers and supply chain reconfigurations. In particular, the international reach of MNEs enables them to access pertinent green knowledge within the global economy, thereby providing them with advantages in sustainability-oriented innovation.

2. Against this backdrop, this study evaluates the impact of climate-related factors – namely (i) climate policy, (ii) green bond issuance, and (iii) extreme weather events – on greenfield FDI flows and their composition. Specifically, we leverage Moody's Orbis granular data on cross-border greenfield FDI, which encompasses approximately 220,000 projects across more than 200 economies from 2013 to 2023. The detailed descriptions of the greenfield projects within the dataset allow us to identify green-related FDI projects through textual analysis.

3. To preview our major findings, we find that more climate policies, particularly binding policies (see explanation below), are generally associated with a greater number of greenfield FDI projects, especially green-related ones. This positive association is notably stronger in advanced economies (AEs) compared to emerging market economies (EMEs). Furthermore, the significance of green bonds may lie in their capacity to incentivise outward green-related FDI, while extreme weather events may exert a disproportionately adverse impact on FDI inflows in the manufacturing sector. In terms of policy implications, the promotion of climate policies and the issuance of green bonds could be important for the further development of green FDI, thereby helping achieve the goal of the green transition and sustainable growth, and the authorities should carefully manage the risks arising from extreme weather events.

4. The rest of the paper is organised as follows. Section II reviews the relationship between climate factors and FDI, and discusses our empirical strategies. Section III presents the results of the empirical estimations. Finally, Section IV offers relevant policy implications and concluding

remarks.

II. HOW CLIMATE-RELATED FACTORS IMPACT FDI: STYLISED FACTS AND EMPIRICAL STRATEGY

Data

5. The data on greenfield FDI projects is sourced from Moody's Orbis Crossborder Investment, which compiles comprehensive global announcements of cross-border greenfield FDI. The dataset commences in 2013 and is updated monthly. It covers new projects, and the expansions, co-locations, and relocations of existing projects, primarily derived from public sources, including various news aggregation products, newsfeeds, and official documentation such as press releases and stock exchange announcements. Our sample comprises approximately 220,000 greenfield FDI projects across more than 200 economies from 2013 to 2023.

6. In addition, the project names and descriptions allow us to identify FDI projects related to green activities through textual analysis. Specifically, we identify greenfield FDI projects related to green activities, including climate change mitigation and environmentally sustainable technologies, as green FDI projects, by searching for keywords within project descriptions. Moreover, the dataset categorises FDI projects into various sectors (e.g. manufacturing, utilities, information technology, etc.), thereby facilitating sectoral analyses.

7. Our analysis incorporates three climate-related variables of interest: (i) climate policy data, sourced from the Climate Policy Database (CPD), a public dataset recognised for its comprehensive coverage of international climate policies and widely utilised in the literature[2]; (ii) green bond issuance data[3], obtained from the IMF Climate Change Indicators Dashboard; and (iii) data on extreme weather events, sourced from the Emergency Events Database (EM-DAT), which documents the occurrence and impacts of mass natural disasters worldwide from 1900 to the present.

[2] See Nascimento et al. (2022) and Linsenmeier, Mohommad, and Schwerho (2022).

[3] According to the IMF definition, the green bonds in the dataset include any type of self-labelled fixed income instruments where the proceeds will be exclusively directed to finance or re-finance, in part or in full, new and/or existing green projects. Due to the constraint of data availability and better alignment with our green FDI project classification, our analysis does not include the sustainability linked bond, which is a borrowing instrument where financial and structural characteristics are based on sustainability target.

This database is compiled from various sources, including United Nations (UN) agencies, non-governmental organisations, reinsurance companies, research institutes, and press agencies.

8. The control variables in the subsequent empirical analysis include country-level macroeconomic variables (including trade over GDP, real GDP growth rate, logarithm of GDP per capita, capital formalisation as a percentage of GDP, and logarithm of energy consumption), which are conventionally used in literature[4]. In the alternative model specification, we also incorporate the ideal point distance derived from UN General Assembly voting data, as established in Bailey et al. (2017), to control for the geopolitical distance between the source and destination of FDI projects, and our estimation results remain largely robust to these changes.

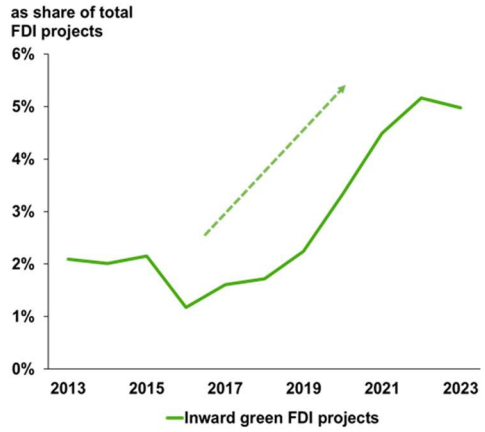
Stylised facts

9. The granular project-level FDI data indicate that the trend towards the green transition has accelerated in recent years, with green FDI projects constituting approximately 1% to 2% of total global greenfield FDI projects before 2019, and rising to around 5% by 2023 (Chart 1). Nevertheless, it is important to acknowledge that the share of green FDI within the total FDI remains relatively small. Furthermore, by classifying green FDI projects into different major categories[5], we find that the sectors related to new energy vehicles (NEVs) and renewable energy have emerged as the primary drivers of green FDI in recent years (Chart 2).

[4] For example, see Gu and Hale (2023) and Pienknagura (2024).

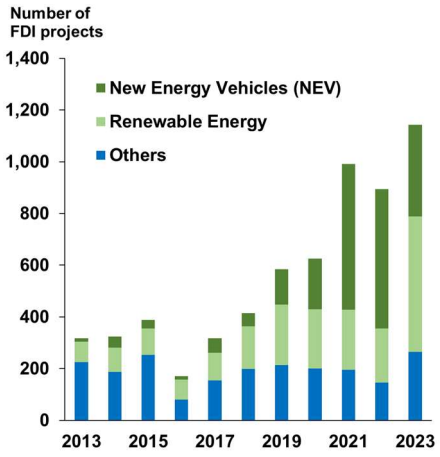
[5] The major green FDI categories include: (i) renewable energy (e.g. hydro, nuclear, solar, wind, geothermal, biomass, etc.), (ii) new energy vehicle (e.g. hybrid and pure electric vehicle, components or battery, charging station, etc.), and (iii) others (e.g. environmental technology, alternative protein, waste to energy, desalination, etc.). Our identifying standard and results are generally in line with other existing research (e.g. Pienknagura, 2024; IMF staff discussion notes, 2023).

Chart 1: Share of green-related greenfield FDI projects



Sources: Moody's Orbis Crossborder Investment and HKMA staff estimation.

Chart 2: Breakdown of green-related greenfield FDI projects



Notes: New energy vehicles (NEVs) category includes all NEV-related projects such as hybrid and pure electric vehicle manufacturing, components or battery manufacturing, charging station, etc.

Sources: Moody's Orbis Crossborder Investment and HKMA staff estimation.

10. Behind this trend of "greening" FDI, governments worldwide have been consistently pushing ahead with climate policies. Each climate policy collected in our dataset (i.e. from the CPD) contains information on policy objectives and instrument types. Following existing literature[6], we classify these climate policies into two groups based on their binding effects, in order to shed more light on their underlying patterns (also see Annex A).

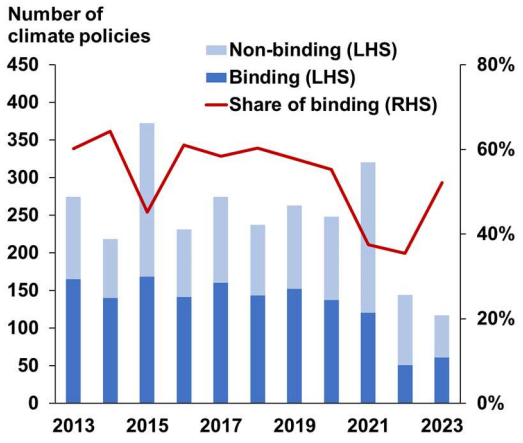
- Binding policies: This group includes policies that generate government revenue (e.g. CO_2 taxes, energy and other taxes), incur government expenditure (e.g. direct investment, grant and subsidies), or impose binding regulations with no budget impact (e.g. industrial air pollution standards, obligation schemes).

- Non-binding policies: This group includes non-regulatory policies with no budget impact (e.g. voluntary approach, tendering schemes).

[6] See Pienknagura (2024).

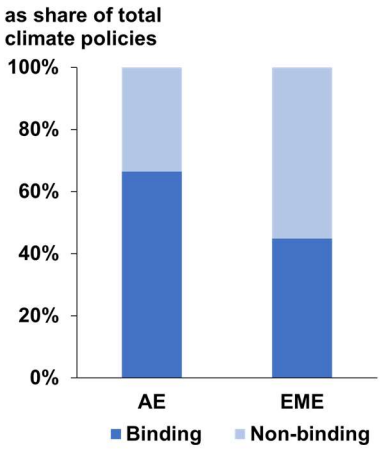
11. A simple analysis of these climate policy data reveals several interesting patterns (Chart 3). First, the total number of new active climate policies peaked in 2015 amid the negotiation of the Paris Agreement. New climate policy actions were largely stable between 2016 and 2020, but they have begun to moderate in more recent years[7]. Second, binding policies consistently account for around 40% to 60% of new climate policies. Third, on average, around 70% of climate policies in AEs were binding from 2013 to 2023, whereas this figure was only 40% in EMEs (Chart 4). This disparity may reflect the more advanced stage of climate policy development in AEs, characterised by their greater fiscal flexibility to adopt budget-related policies and more developed institutional frameworks for enforcing binding regulations (e.g. Linsenmeier, Mohommad, and Schwerhoff, 2022).

Chart 3: Binding and non-binding new climate policy since 2013



Sources: Climate Policy Database and HKMA staff estimation.

Chart 4: Composition of climate policy for AE and EME



Notes: AE = advanced economies; EME = emerging market economies. The chart shows the composition of binding and non-binding climate policy between 2013 and 2023.

Sources: Climate Policy Database and HKMA staff estimation.

[7] The moderation partly reflected the recent global energy crisis amid the Russia–Ukraine conflict, which has compelled many countries, particularly European countries, to reconsider the use of fossil fuels and has disrupted the process of green transition (Ji et al., 2024). Impacts from the COVID-19 pandemic also have compounded the rise in climate-related disasters, threatening the global efforts towards green transition and disrupting the pace of climate adaptation responses (Corfee-Morlot et al., 2021). Meanwhile, the 2024 OECD Climate Action Monitor revealed that the expansion of climate policy action in recent years was mostly driven by the strengthening of existing policies rather than the adoption of new ones.

Empirical strategies

12. To capture the impact of relevant climate variables on greenfield FDI, our empirical strategy employs cross-country panel regression, which regresses the number of greenfield FDI projects against a set of pertinent climate variables while controlling for other country-level macroeconomic variables. We aggregate greenfield FDI data at the source or recipient country-year level, and we further distinguish between total greenfield FDI projects, green FDI projects, non-green FDI projects, and FDI projects in different sectors. In practice, we estimate the following regressions.

$$ln(FDI_{i,t}^{s}) = \alpha_i + \lambda_t + \beta_1 ln(CP_{i,t-1}) + \beta_2 ln(Greenbond_{i,t-1}) + \beta_3 ln(Weather_{i,t-1}) + \gamma \cdot Controls_{i,t-1} + \varepsilon_{it}$$

13. The dependent variable $ln(FDI_{i,t}^{s})$ is the natural logarithm of the number of greenfield FDI projects of type s in economy i of year t, while s represents different measures of greenfield FDI, e.g. aggregate FDI, green and non-green FDI, and FDI in different sectors. The reason we focus on the number of FDI projects, instead of their nominal investment value, is that in some cases the value of investment is only a rough estimate in the dataset. The other difficulty as mentioned in the literature is that the right tail of the density of investment values is fat, which could bias linear model towards high-value investments. $ln(CP_{i,t-1})$, $ln(Greenbond_{i,t-1})$ and $ln(Weather_{i,t-1})$ are the natural logarithm of the stock of climate policies, the value of green bond issuance over GDP and the number of extreme weather events, respectively. β_i is the set of parameters of our interest that captures the impact of corresponding climate-related variables.

III. EMPIRICAL ESTIMATION RESULTS

14. This section presents the empirical estimation results and discusses the relationship between climate-related factors (i.e. climate policies, green bond issuance, and extreme weather events) and different types of FDIs.

Impact of climate policy

15. We first focus on the impact of climate policies on greenfield

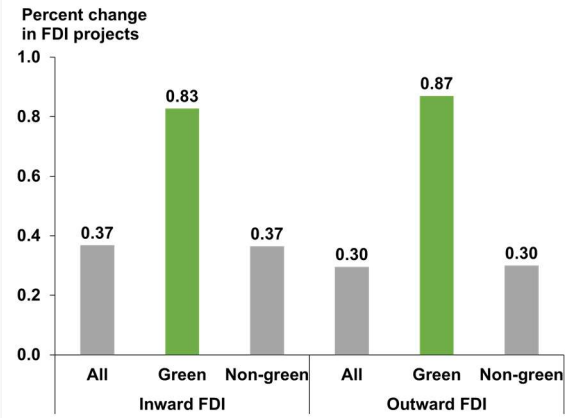
FDI. The bars in Chart 5 illustrate the estimated coefficients for climate policy count derived from the panel regression[8], quantifying the effect of a one percent change in the number of climate policies on the percentage change in the number of projects for each FDI measure. The results indicate that the number of active climate policies is positively associated with both aggregate inward and outward FDI projects, with both coefficients being statistically significant. This suggests that countries experience increases in both inward and outward greenfield FDI projects as the number of climate policies rises.

16. Next, we differentiate the aggregate FDI projects into green FDI and non-green FDI to explore the potentially heterogeneous effects of climate policies. As indicated by the green bars in Chart 5, the impact of climate policies is more pronounced on green FDI projects in both inward and outward directions. In particular, a 1% increase in the number of active climate policies in the FDI recipient (source) country is associated with an approximate 0.8% increase in inward (outward) green FDI projects on average. This finding underscores the role of climate policy in promoting green FDI, which in turn contributes to the global green transition and sustainable growth through investment channels. One caveat on the relationship between climate policy and green FDI is the endogeneity concerns, and Annex C partly addresses these concerns with the results of an instrumental variables exercise.

17. Chart 6 illustrates the heterogeneous effects of binding and non-binding climate policies on inward and outward green FDI projects. Both inward and outward green FDI projects exhibit a stronger positive association with binding policies compared to non-binding policies, with all estimated coefficients being statistically significant. These heterogeneous effects highlight the relative importance of binding policies in promoting green FDI.

[8] Detailed regression results are presented in Annex B.

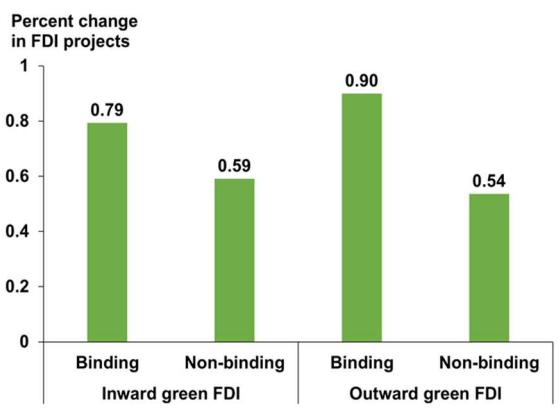
Chart 5: Impact of climate policies, green FDI vs. non-green FDI



Notes: The bars show the panel regression results quantifying the impact of one percent change in number of climate policies on the percentage change in project number of each FDI measure. All estimated coefficients are statistically significant at the 10 percent level.

Sources: Climate Policy Database, Moody's Orbis Crossborder Investment and HKMA staff estimation.

Chart 6: Impact of climate policies by policy type

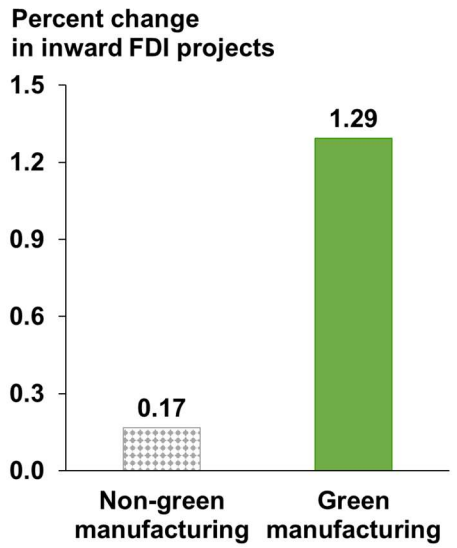


Notes: The bars show the panel regression results quantifying the impact of one percent change in number of climate policies on the percentage change in project number of each FDI measure. All estimated coefficients are statistically significant at the 10 percent level.

Sources: Climate Policy Database, Moody's Orbis Crossborder Investment and HKMA staff estimation.

18. To investigate the implications for supply chain reconfiguration, we next examine the impacts of climate policy on FDI in the manufacturing sector. While we find no significant effects of climate policy on aggregate greenfield FDI in the manufacturing sector, some heterogeneity emerges when differentiating between green manufacturing and non-green manufacturing FDI inflows (but not outflows). Specifically, Chart 7 reveals that the estimated coefficient for inward green manufacturing FDI is significantly higher than that for non-green manufacturing FDI, indicating a particularly strong positive relationship between climate policies (in the destination economy) and inward green manufacturing FDI. To gain a clearer understanding of green manufacturing FDI projects, we present a word cloud (Chart 8) that illustrates the frequency of terms in the descriptive text of all green manufacturing FDI projects. These keywords suggest that the green manufacturing FDI inflows are more likely associated with the new green products, such as batteries, NEVs, and other renewable energy (e.g. hydrogen, solar).

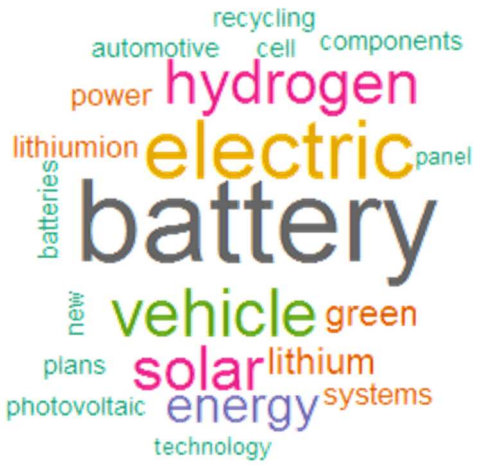
Chart 7: Impact of climate policies, green manufacturing vs. non-green manufacturing



Notes: The bars show the panel regression results quantifying the impact of one percent change in number of climate policies on the percentage change in project number of each FDI measure. A solid bar indicates statistical significance at the 10 percent level; a patterned bar means not statistically significant.

Sources: Climate Policy Database, Moody's Orbis Crossborder Investment and HKMA staff estimation.

Chart 8: Word cloud on project description text of green manufacturing FDI projects



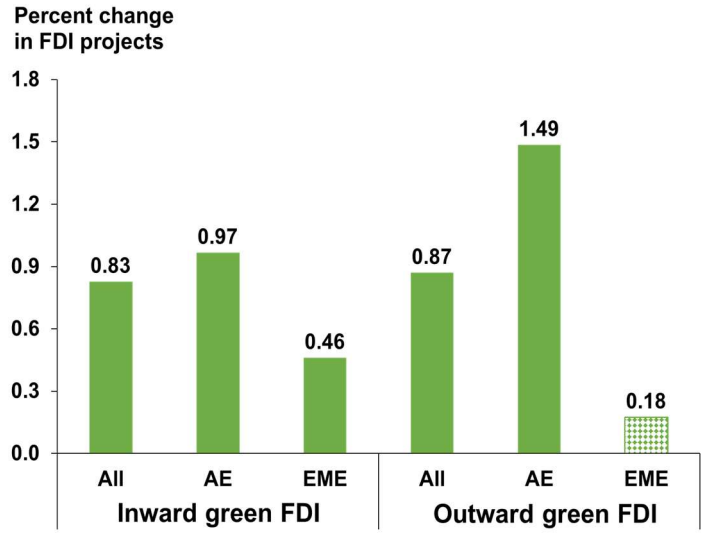
Notes: The word cloud shows the appearance frequency of words in text description of all green manufacturing FDI projects, with certain non-informative words excluded (e.g. prepositions, pronouns, company names, etc.).

Sources: Moody's Orbis Crossborder Investment and HKMA staff estimation.

19. As economies may be at different stages of development and implementation of climate policies, it is pertinent to examine their heterogeneous effects on green FDI across income groups. To address this question, we separate our sample into AEs and EMEs based on the recipient or source of the FDI projects, and re-estimate the model. The results presented in Chart 9 indicate that the positive relationship between climate policies and green FDI holds for both AEs and EMEs; however, the relationship is notably stronger for AEs than for EMEs. Within EMEs, the effect is more pronounced for inward green FDI, while the impact on outward green FDI is smaller and statistically insignificant.

20. It is noteworthy that the estimated effects of climate policies on FDI between AEs and EMEs vary in the literature. For instance, earlier research by the IMF (Pienknagura, 2024) suggests a stronger link between climate policies and green FDI in emerging market and developing economies. Conversely, other studies argue that weak fundamentals, such as low human capital and inadequate rule of law in EMEs, may hinder their ability to leverage climate policies to enhance green and low-carbon FDI (e.g. Pigato et al., 2020). While our findings align with the latter perspective, we acknowledge that this discrepancy may stem from differences in model specifications, data sources, and control variables. In response to this question, and considering the previously discussed heterogeneity between binding and non-binding policies, we posit that the relatively weaker impact observed in EMEs may be attributed to their less binding climate policy efforts. As previously illustrated in Chart 4, over the past decade, approximately 70% of climate policies in AEs have been binding, whereas this figure is only around 40% in EMEs. This disparity may reflect the more advanced stage of climate policy development in AEs, characterised by greater fiscal flexibility to adopt budget-related policies and more robust institutional frameworks for policy enforcement, thereby contributing to the stronger relationship between climate policies and green FDI projects in these economies.

Chart 9: Impact of climate policies on green FDI by income group of countries



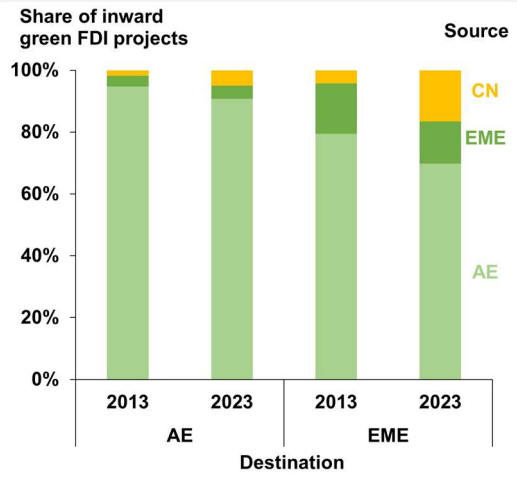
Notes: The bars show the panel regression results quantifying the impact of one percent change in number of climate policies on the percentage change in project number of each FDI measure. Solid bars indicate statistical significance at the 10 percent level; patterned bars mean not statistically significant.

Sources: Climate Policy Database, Moody's Orbis Crossborder Investment and HKMA staff estimation.

21. As China increasingly plays a pivotal role in green-related sectors, several implications regarding its influence on greenfield FDI merit attention. Chart 10 illustrates the sources of green FDI directed towards AEs and EMEs. For AEs, green FDI predominantly originates from other peer AEs, although investments from EMEs, particularly from China, have risen. In contrast, while EMEs remain highly reliant on FDI from AEs in green-related sectors, the share of green FDI projects into EMEs from AEs has declined from approximately 80% in 2013 to around 70% in 2023. Meanwhile, there has been a marked increase in green FDI inflows to EMEs from other EMEs, with China again assuming a more prominent role.

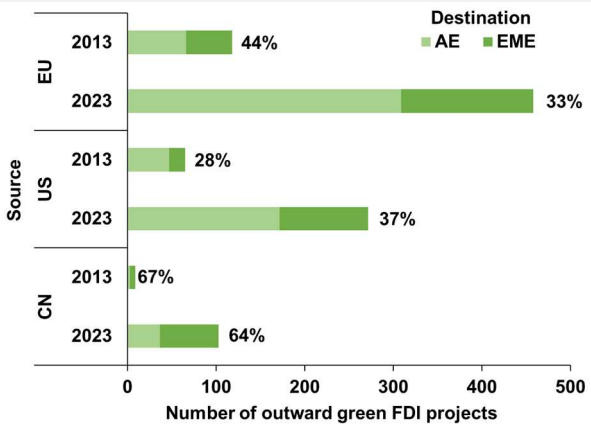
22. Additionally, we look at the three major sources of green FDI – namely Mainland China, the US, and the European Union (EU) – and analyse their investment destinations (Chart 11). Over the past decade, all three sources have experienced significant increases in their outward green FDI. In particular, China's outward green FDI projects have surged over the years, reflecting its emerging strength in new green sectors. Moreover, China's outward green FDI to EMEs has consistently constituted around two-thirds of its total green outward FDI, a notably higher proportion compared to the US and the EU, despite the overall size being smaller. This trend further indicates that China is, and is likely to continue being, a key source of green investments that can help stimulate the green transition in these economies. Looking ahead, we may see increased collaboration on green investments among EMEs, which could be beneficial to the green transition in these economies.

Chart 10: Source breakdown of green FDI to AEs and EMEs



Notes: CN = Mainland China; AE = advanced economies; EME = emerging market economies.
Sources: Moody's Orbis Crossborder Investment and HKMA staff estimation.

Chart 11: Destination breakdown of green FDI from China, US and EU



Notes: CN = Mainland China; US = United States; EU = European Union; AE = advanced economies; EME = emerging market economies. The data labels show the number of outward green FDI projects to EMEs as the share of total outward green FDI projects.
Sources: Moody's Orbis Crossborder Investment and HKMA staff estimation.

Impact of green bond issuance

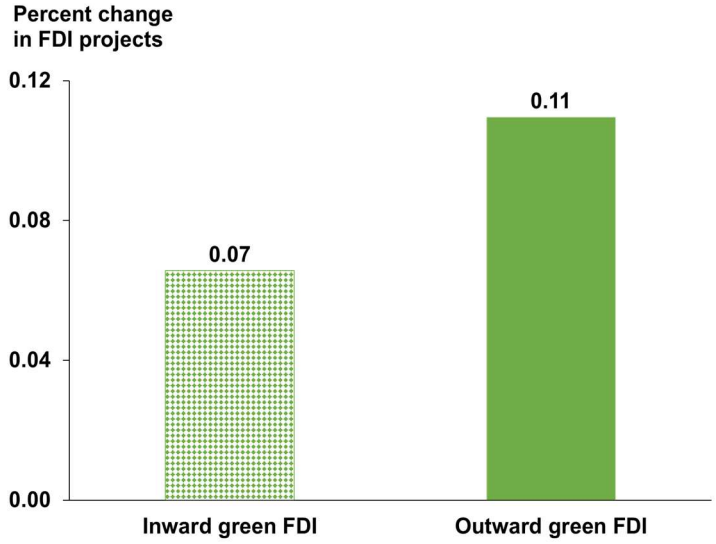
23. The development of the green bond market has accelerated significantly over the past decade, with its scale expanding from US$ 10.3 billion in 2012 to US$ 2.3 trillion in 2022.[9] In this context, central banks have played a pivotal role in fostering the growth of the green bond market and facilitating the transition towards a sustainable global economy (Fender et al., 2019). Given the emergence of the green bond market and its emphasis on environmentally sustainable initiatives, we aim to investigate the relationship between green FDI projects and green bond issuance.

24. Chart 12 illustrates the impact of green bond issuance on both inward and outward green FDI projects. Specifically, the estimated effect is statistically significant only for outward green FDI, where a 1% increase in the value of green bond issuance is associated with a 0.11% increase in

[9] IMF Climate Change Indicators Dashboard.

outward green FDI projects.[10] In contrast, the relationship between inward green FDI and green bond issuance is weaker and not statistically significant. This suggests that the primary significance of green bond issuance lies in incentivising outward green FDI, thereby facilitating green spillover to other economies.

Chart 12: Impact of green bond issuance on green FDI



Note: The bars show the panel regression results quantifying the impact of one percent change in "green bond issuance volume / GDP" ratio on the percentage change in project number of each FDI measure. A solid bar indicates statistically significance at the 10 percent level; a patterned bar means not statistically significant.

Sources: IMF Climate Change Indicators Dashboard, Moody's Orbis Crossborder Investment and HKMA staff estimation.

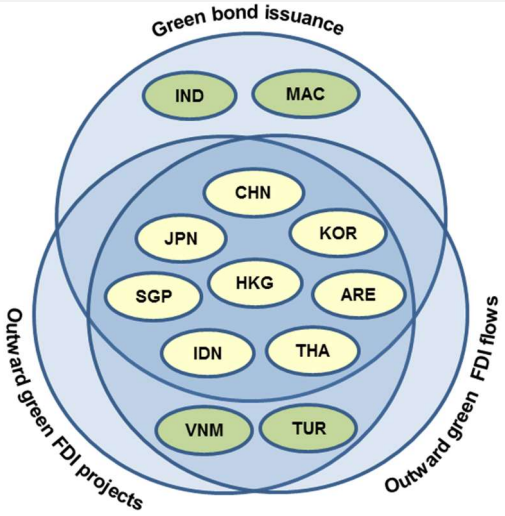
25. These empirical findings are corroborated by additional evidence that green bond issuance and green FDI have developed in tandem over the past decade. Chart 13 demonstrates that Asian economies that have issued the largest cumulative value of green bonds are also the main sources of outward green FDI, in terms of both project numbers and values. Notably, economies that rank among the top ten in all three categories (i.e. green bond issuance, outward green FDI values, and outward green FDI projects number)

[10] That is, if an economy issues more green bonds, its number of outward green FDI projects is likely to increase. However, one caveat is that it remains uncertain whether the similar conclusion can be drawn if using more granular firm-level data. Existing literature focused on the borrowing cost advantage from corporate green bonds, but this advantage primarily favours large and highly-rated firms, and may not necessarily incentivise additional green project investments (see Caramichael and Rapp, 2024; Flammer, 2021). Future research could provide a more detailed and refined characterisation of the implications of corporate green bonds as more data become available.

are quite concentrated (as highlighted in yellow in Chart 13), pointing to the positive relationship between green bond issuance and outward green FDI.

26. Furthermore, we seek to examine the role of governments and identify a proxy for a government's commitment to green initiatives. To this end, we isolate sovereign green bonds from the broader category of all green bonds, as the sovereign issuance may signal a strong governmental commitment to green policies and stimulate the sustainable bond market's development in both quality and quantity (Ehlers et al., 2024). As illustrated in Chart 14, the overall trend in sovereign green bond issuance aligns closely with the trend in outward green FDI projects during the same period, suggesting that government promotion of sovereign green bonds may act as a catalyst for the green transition. Taken together, a more active green bond market and a more favourable governmental stance towards green initiatives may facilitate the expansion of outward green FDI.

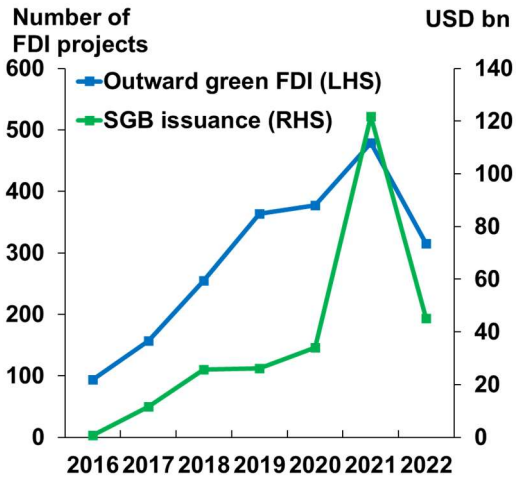
Chart 13: Relationship between green bond issuance and green FDI in Asia[11]



Notes: Each of the three blue circles represents the top 10 Asian economies under each category between 2013 and 2022, with the economies highlighted in yellow being the top 10 under all three categories.

Sources: IMF Climate Change Indicators Dashboard, Moody's Orbis Crossborder Investment and HKMA staff estimation.

Chart 14: Sovereign green bonds and outward green FDI



Notes: The chart shows the trend of outward green FDI projects and issuance of sovereign green bonds (SGB) in economies that ever issued SGB in recent years.

Sources: IMF Climate Change Indicators Dashboard, Moody's Orbis Crossborder Investment and HKMA staff estimation.

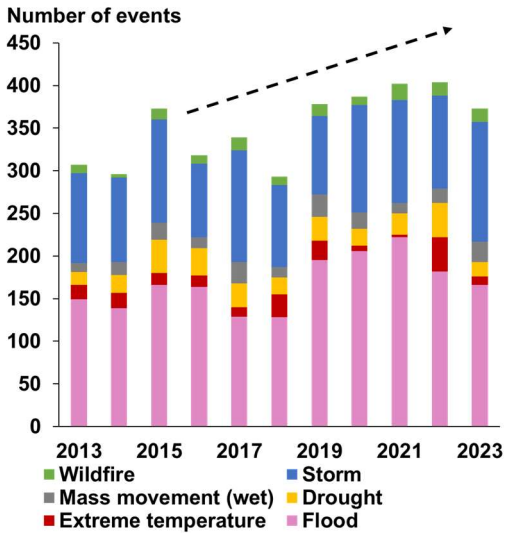
Impact of extreme weather events

27. Since 2018, there has been a marked increase in the frequency of extreme weather events, with floods and storms being the two most devastating disasters (Chart 15). Our final empirical results shed light on the impact of these extreme weather events on FDI, particularly within the manufacturing sector, thereby offering potential implications for future supply chain reconfiguration. The estimation results presented in Chart 16 indicate that extreme weather events are negatively correlated with both inward and outward aggregate FDI; however, the coefficients are not statistically significant. Notably, a degree of heterogeneity emerges when distinguishing between FDI in manufacturing and non-manufacturing sectors.

[11] Specifically, the chart includes the following Asian economies: United Arab Emirates (ARE), Mainland China (CHN), Hong Kong SAR (HKG), Indonesia (IDN), India (IND), Japan (JPN), Korea (KOR), Macau SAR (MAC), Singapore (SGP), Thailand (THA), Turkey (TUR), and Vietnam (VNM).

Specifically, the negative effect of extreme weather events is statistically significant for inward FDI in the manufacturing sector, with a 1% increase in extreme weather events corresponding to a 0.12% decrease in inward manufacturing FDI projects.[12] This finding aligns with some existing research. For instance, Doytch (2020) observed that manufacturing FDI can be adversely affected immediately following a disaster, while the subsequent processes of replacement and infrastructure rebuilding may present long-term upgrading opportunities. In summary, our findings suggest that extreme weather events may disproportionately impact the manufacturing sector, highlighting the need for government policy interventions to mitigate and adapt to these adverse effects (e.g. flood prevention measures).

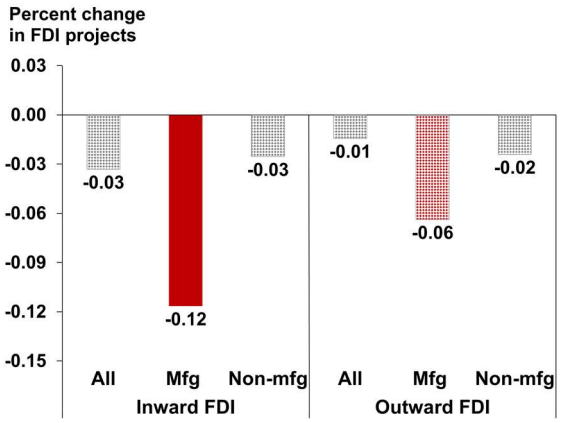
Chart 15: Extreme weather events breakdown by nature



Note: The extreme weather events only include climatological, hydrological or meteorological events that caused 10 or more deaths.

Source: EM-DAT.

Chart 16: Impact of extreme weather events, manufacturing vs. non-manufacturing



Notes: Mfg = Manufacturing. The bars show the panel regression results quantifying the impact of one percent change in number of extreme weathers on the percentage change in project number of each FDI measure. Solid bars indicate statistical significance at the 10 percent level; patterned bars mean not statistically significant.

Sources: EM-DAT, Moody's Orbis Crossborder Investment and HKMA staff estimation.

[12] That is, if an economy faces more extreme weather events, its number of inward manufacturing FDI projects is likely to decrease.

IV. POLICY IMPLICATIONS AND CONCLUDING REMARKS

28. In conclusion, our study documents a notable increase in green FDI in recent years, indicative of the "greening" of global FDI. That said, its share in total FDI remains relatively small, suggesting that further efforts are needed to promote the green transition and sustainable growth. We find that the promotion of climate policy is crucial for achieving this goal, as more climate policies – particularly binding policies that generate government revenue, incur government expenditure, and impose regulations – are associated with a greater number of both inward and outward FDI, especially green FDI. EMEs, which typically have fewer binding climate policies than AEs, should enhance their capacity to leverage such policies to attract green FDI. This could be achieved by improving their fundamentals, such as institutional implementation, business environment, and human capital. Partly reflecting its strengths in new green sectors, China has experienced significant increases in its outward green FDI, particularly towards EMEs. Going forward, enhanced collaboration among EMEs could facilitate more effective green transition in these economies.

29. Our findings also underscore the roles of green bond issuance and extreme weather events in their relationship with FDI. We find that the significance of green bonds for FDI primarily lies in their ability to incentivise outward green FDI, thereby facilitating green spillover to other economies. In this process, the issuance of sovereign green bonds may act as a catalyst. Additionally, extreme weather events may disproportionately dampen FDI inflows in the manufacturing sector, highlighting the need for government policy interventions to mitigate these adverse effects.

30. Finally, we acknowledge certain limitations of our study. Some of our findings diverge from existing literature, which may be attributable to differences in data sources and model specifications. Furthermore, our study focuses on the number of FDI projects rather than nominal investment value, as the investment values in the dataset are only rough estimates in many cases. Future research could benefit from more robust data on FDI investment values as they become available.

REFERENCES

Bailey, M. A., Strezhnev, A., & Voeten, E. (2017). Estimating dynamic state preferences from United Nations voting data. Journal of Conflict Resolution, 61(2), 430-456.

Caramichael, J., & Rapp, A. C. (2024). The green corporate bond issuance premium. Journal of Banking & Finance, 162, 107126.

Corfee-Morlot, J., Depledge, J., & Winkler, H. (2021). COVID-19 recovery and climate policy. Climate Policy, 21(10), 1249-1256.

Doytch, N. (2020). Upgrading destruction? How do climate-related and geophysical natural disasters impact sectoral FDI. International Journal of Climate Change Strategies and Management, 12(2), 182-200.

Ehlers, T., Packer, F., Cheng, G., & Xiao, Y. (2024). Sovereign green bonds: a catalyst for sustainable debt market development?. Available at SSRN 4874999.

Fender, I., McMorrow, M., Sahakyan, V., & Zulaica, O. (2019). Green bonds: the reserve management perspective. BIS Quarterly Review, September.

Flammer, C. (2021). Corporate green bonds. Journal of Financial Economics, 142(2), 499-516.

Gu, G. W., & Hale, G. (2023). Climate risks and FDI. Journal of International Economics, 146, 103731.

Hasna, M. Z., Jaumotte, M. F., Kim, J., Pienknagura, S., & Schwerhoff, G. (2023). Green Innovation and Diffusion: Policies to Accelerate Them and Expected Impact on Macroeconomic and Firm-Level Performance. Staff Discussion Notes, International Monetary Fund.

Ji, Q., Ma, D., Zhai, P., Fan, Y., & Zhang, D. (2024). Global climate policy uncertainty and financial markets. Journal of International Financial Markets, Institutions and Money, 95, 102047.

Linsenmeier, M., Mohommad, A., & Schwerhoff, G. (2022). Policy sequencing towards carbon pricing among the world's largest emitters. Nature Climate Change, 12(12), 1107-1110.

Nascimento, L., et al. (2022). Twenty years of climate policy: G20 coverage and gaps. Climate policy, 22(2), 158-174.

Pienknagura, S. (2024). Climate Policies as a Catalyst for Green FDI. Working Paper, International Monetary Fund.

Pigato, M., Black, S., Dussaux, D., Mao, Z., Rafaty, R., & Touboul, S. (2020). Technology transfer and innovation for low-carbon development. World Bank Publications.

Annex A

Classification of climate policies

Binding Policies	Government expenditure related	Demonstration project; Direct investment; Feed-in tariffs or premiums; Fiscal or financial incentives; Funds to sub-national governments; Grants and subsidies; Infrastructure investments; Loans; RD&D funding; Research & Development and Deployment (RD&D); Research programme; Retirement premium; Tax relief; Technology deployment and diffusion; Technology development
	Government revenue related	CO2 taxes; Energy and other taxes; GHG emission reduction crediting and offsetting mechanism; GHG emissions allowances; Removal of fossil fuel subsidies; User charges
	Regulations	Auditing; Barrier removal; Building codes and standards; Codes and standards; Grid access and priority for renewables; Industrial air pollution standards; Formal & legally binding climate strategy; Formal & legally binding energy efficiency target; Formal & legally binding GHG reduction target; Formal & legally binding renewable energy target;
Non-binding Policies	Non-regulatory	Advice or aid in implementation; Climate strategy; Comparison label; Coordinating body for climate strategy; Economic instruments; Endorsement label; Energy efficiency target; GHG reduction target; Green certificates; Information and education; Information provision; Institutional creation; Market-based instruments; Negotiated agreements (public-private sector); Net metering; Performance label; Policy support; Political & non-binding climate strategy; Political & non-binding energy efficiency target; Political & non-binding GHG reduction target; Political & non-binding renewable energy target; Procurement rules; Professional training and qualification; Public voluntary schemes; Strategic planning; Tendering schemes; Unilateral commitments (private sector); Voluntary approaches; White certificates

Source: Climate Policy Database.

Annex B

Tables for estimation results

Table B1. Climate Factors and FDI: Green vs. Non-green

	(1)	(2)	(3)	(4)	(5)	(6)
	Inward FDI			Outward FDI		
Variables	Overall	Green	Non-green	Overall	Green	Non-green
Log number of climate policies (t − 1)	0.368***	0.828***	0.365***	0.296***	0.870***	0.300***
	(0.092)	(0.235)	(0.094)	(0.114)	(0.224)	(0.114)
Log number of extreme weathers (t − 1)	-0.034	0.120	-0.032	-0.015	0.089	-0.021
	(0.039)	(0.084)	(0.040)	(0.046)	(0.073)	(0.046)
Green bond issuance volume over GDP (t − 1)	-0.056**	0.069	-0.060**	0.038	0.112**	0.032
	(0.026)	(0.057)	(0.027)	(0.031)	(0.046)	(0.031)
Trade over GDP (t − 1)	0.007**	0.014*	0.006**	-0.001	0.025***	-0.003
	(0.003)	(0.007)	(0.003)	(0.004)	(0.007)	(0.004)
Real GDP growth (t − 1)	-0.009	-0.014	-0.007	-0.002	-0.030**	-0.001
	(0.006)	(0.015)	(0.006)	(0.007)	(0.014)	(0.007)
Log GDP per capita (t − 1)	1.076***	2.832***	0.996***	0.200	0.364	0.177
	(0.350)	(0.916)	(0.360)	(0.428)	(0.740)	(0.426)
Capital formation over GDP (t − 1)	0.010	0.036	0.007	-0.012	0.011	-0.011
	(0.010)	(0.024)	(0.010)	(0.013)	(0.021)	(0.013)
Log energy cosumption (t − 1)	-0.535*	-1.693**	-0.498	0.776*	-0.722	0.691*
	(0.298)	(0.816)	(0.306)	(0.411)	(0.730)	(0.409)
Observations	427	351	427	408	269	408
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Table B2. Climate Factors and Green FDI:
Binding Policies vs. Non-binding Policies

Variables	(1)	(2)	(3)	(4)
	Inward green FDI		Outward green FDI	
Log number of binding climate policies (t − 1)	0.794***		0.900***	
	(0.230)		(0.209)	
Log number of non-binding climate policies (t − 1)		0.592***		0.537**
		(0.194)		(0.212)
Log number of extreme weathers (t − 1)	0.127	0.144*	0.091	0.115
	(0.085)	(0.084)	(0.072)	(0.074)
Green bond issuance volume over GDP (t − 1)	0.073	0.075	0.129***	0.117**
	(0.057)	(0.057)	(0.045)	(0.047)
Trade over GDP (t − 1)	0.014*	0.012	0.025***	0.023***
	(0.008)	(0.007)	(0.007)	(0.007)
Real GDP growth (t − 1)	-0.016	-0.015	-0.029**	-0.033**
	(0.015)	(0.015)	(0.014)	(0.014)
Log GDP per capita (t − 1)	3.012***	2.889***	0.512	0.543
	(0.907)	(0.929)	(0.723)	(0.777)
Capital formation over GDP (t − 1)	0.056**	0.032	0.008	0.010
	(0.027)	(0.024)	(0.021)	(0.022)
Log energy cosumption (t − 1)	-1.742**	-1.646**	-0.765	-0.754
	(0.823)	(0.826)	(0.727)	(0.758)
Observations	339	349	266	267
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Table B3. Climate Factors and Manufacturing FDI: Green vs. Non-green

	(1)	(2)
	Inward manufacturing FDI	
Variables	Green	Non-green
Log number of climate policies (t − 1)	1.294***	0.168
	(0.293)	-0.132
Log number of extreme weathers (t − 1)	0.014	-0.105**
	(0.082)	-0.053
Green bond issuance volume over GDP (t − 1)	0.026	-0.065*
	(0.069)	-0.036
Trade over GDP (t − 1)	0.006	0.012***
	(0.007)	-0.004
Real GDP growth (t − 1)	0.004	-0.002
	(0.014)	-0.009
Log GDP per capita (t − 1)	1.304	0.063
	(0.953)	-0.491
Capital formation over GDP (t − 1)	0.032	0.014
	(0.028)	-0.014
Log energy cosumption (t − 1)	-1.568*	0.315
	(0.845)	-0.482
Observations	212	406
Country FE	Yes	Yes
Time FE	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Table B4. Climate Factors and Green FDI: AE vs. EME

	(1)	(2)	(3)	(4)
	Inward green FDI		Outward green FDI	
Variables	**AE**	**EME**	**AE**	**EME**
Log number of climate policies (t − 1)	0.967*	0.461*	1.486***	0.175
	(0.553)	(0.261)	-0.313	(0.350)
Log number of extreme weathers (t − 1)	0.342**	-0.125	0.087	0.156
	(0.134)	(0.105)	-0.097	(0.106)
Green bond issuance volume over GDP (t − 1)	0.091	-0.035	0.103**	-0.077
	(0.070)	(0.127)	-0.047	(0.152)
Trade over GDP (t − 1)	0.007	0.014	0.020**	0.015
	(0.014)	(0.010)	-0.01	(0.010)
Real GDP growth (t − 1)	-0.034	0.002	-0.027	-0.015
	(0.029)	(0.019)	-0.018	(0.023)
Log GDP per capita (t − 1)	5.573***	2.542**	1.880*	-1.704
	(2.124)	(1.105)	-1.001	(1.239)
Capital formation over GDP (t − 1)	0.120***	-0.016	0.016	0.019
	(0.043)	(0.029)	-0.027	(0.034)
Log energy cosumption (t − 1)	-0.506	-1.265	0.272	1.094
	(1.630)	(1.207)	-1.06	(1.422)
Observations	212	406	149	369
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Table B5. Climate Factors and FDI: Manufacturing vs. Non-manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)
	Inward FDI			Outward FDI		
Variables	**Overall**	**Mfg**	**Non-mfg**	**Overall**	**Mfg**	**Non-mfg**
Log number of climate policies (t − 1)	0.368***	0.201	0.384***	0.296***	-0.169	0.432***
	(0.092)	(0.128)	(0.095)	(0.114)	(0.157)	(0.121)
Log number of extreme weathers (t − 1)	-0.034	-0.116**	-0.026	-0.015	-0.062	-0.025
	(0.039)	(0.053)	(0.041)	(0.046)	(0.056)	(0.048)
Green bond issuance volume over GDP (t − 1)	-0.056**	-0.049	-0.054**	0.038	-0.019	0.045
	(0.026)	(0.035)	(0.027)	(0.031)	(0.037)	(0.033)
Trade over GDP (t − 1)	0.007**	0.011**	0.007**	-0.001	0.010**	-0.001
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Real GDP growth (t − 1)	-0.009	-0.005	-0.010	-0.002	0.006	0.001
	(0.006)	(0.009)	(0.007)	(0.007)	(0.009)	(0.008)
Log GDP per capita (t − 1)	1.076***	0.626	1.073***	0.200	-0.560	0.412
	(0.350)	(0.482)	(0.362)	(0.428)	(0.550)	(0.441)
Capital formation over GDP (t − 1)	0.010	0.013	0.010	-0.012	-0.032**	-0.017
	(0.010)	(0.014)	(0.010)	(0.013)	(0.016)	(0.014)
Log energy cosumption (t − 1)	-0.535*	-0.486	-0.416	0.776*	0.330	0.641
	(0.298)	(0.473)	(0.308)	(0.411)	(0.510)	(0.423)
Observations	427	398	427	408	356	404
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01

Annex C

Additional Instrumental Variable Results

One caveat to the interpretation of our estimation results is the concerns over endogeneity, which may arise from the omission of variables that influence both climate policies and green FDI. To address these endogeneity concerns, this section employs an additional instrumental variable (IV) approach as a robustness check. We followed the literature to instrument a country's domestic climate policies with a distance-weighted sum of climate policies in other countries. This methodology adopted the approaches in Acemoglu et al. (2019) and David, Komatsuzaki, and Pienknagura (2022). Specifically, we re-estimate our empirical model using the following instrumental variable:

$$ln\left(CP^{IV}_{-c,t-1}\right) = ln\left\{\sum_{i \neq c}\left(\frac{1/distance_{c,i}}{\sum_i 1/distance_{c,i}}\right) CP_{c,t-1}\right\}$$

where $CP_{c,t-1}$ is the climate policy stock in country c, and $distance_{c,i}$ is the physical distance between country i and c.

The idea is that countries usually learn the experiences from other countries and follow the regional trend to implement climate policies. Consequently, we anticipate a positive correlation between a country's domestic climate policies and the instrumental variable constructed above.

In Table C below, columns (2) and (5) present the results for inward and outward green FDI projects derived from the IV exercise. Consistent with the baseline results displayed in columns (1) and (4), the IV results indicate a positive and statistically significant relationship between climate policies and both inward and outward green FDI projects. Furthermore, columns (3) and (6) expand the IV specification by incorporating the average green FDI projects of nearby countries, thereby addressing concerns regarding potential regional FDI spillovers. The results remain robust throughout this exercise. Collectively, these additional exercises help mitigate the endogeneity concerns.

Table C. Climate Policies and Green FDI — Instrumental Variable

	(1)	(2)	(3)	(4)	(5)	(6)
	Inward green FDI			Outward green FDI		
Variables	**Baseline**	**IV**	**IV+Reg.**	**Baseline**	**IV**	**IV+Reg.**
Log number of climate policies (t − 1)	0.828***	1.372***	1.395***	0.870***	1.242***	1.177***
	(0.235)	(0.338)	(0.341)	(0.224)	(0.292)	(0.299)
Log number of extreme weathers (t − 1)	0.120	0.141*	0.144*	0.089	0.080	0.073
	(0.084)	(0.085)	(0.085)	(0.073)	(0.073)	(0.073)
Green bond issuance volume over GDP (t − 1)	0.069	0.066	0.071	0.112**	0.111**	0.107**
	(0.057)	(0.057)	(0.058)	(0.046)	(0.045)	(0.045)
Trade over GDP (t − 1)	0.014*	0.015**	0.015**	0.025***	0.022***	0.022***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Real GDP growth (t − 1)	-0.014	0.002	0.002	-0.030**	-0.023	-0.022
	(0.015)	(0.016)	(0.016)	(0.014)	(0.014)	(0.014)
Log GDP per capita (t − 1)	2.832***	1.653	1.816*	0.364	-0.126	-0.304
	(0.916)	(1.060)	(1.100)	(0.740)	(0.847)	(0.865)
Capital formation over GDP (t − 1)	0.036	0.029	0.029	0.011	0.012	0.013
	(0.024)	(0.023)	(0.023)	(0.021)	(0.021)	(0.021)
Log energy cosumption (t − 1)	-1.693**	-1.583*	-1.733**	-0.722	-0.547	-0.309
	(0.816)	-0.829	-0.872	(0.730)	(0.736)	(0.773)
Average Reg. green FDI (t − 1)			-0.083			
			(0.148)			
Average Reg. green ODI (t − 1)						0.153
						(0.152)
Observations	351	342	342	269	266	266
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p<0.1; **p<0.05; ***p<0.01