Master's Thesis of Sera Yun

Empirical Analysis on the Determinants of Allocation and Development Effects of Multilateral Climate Finance:

Evidence from 19 Multilateral Climate Financiers (2003-2021)

다자 기후기금 자금 배분의 결정요인 및 개발효과에 대한 실증분석

August 2022

Graduate School of International Studies
Seoul National University
International Commerce Major

Sera Yun

Empirical Analysis on the Determinants of Allocation and Development Effects of Multilateral Climate Finance:
Evidence from 19 Multilateral Climate Financiers (2003-2021)

Jeong Hyeok

Submitting a Master's Thesis of International Studies

August 2022

Graduate School of International Studies
Seoul National University
International Commerce Major

Sera Yun

Confirming the Master's Thesis written by Sera Yun
August 2022

Chair	Jong Ho HONG
Vice Chair	Soo Hyung LEE
Examiner	Hyeok JEONG

Abstract

In the context of the growing presence and importance of multilateral climate finance as a tool for achieving the twin goals of climate mitigation/adaptation and development, this paper examines 2,623 climate finance projects/programs delivered by 19 official multilateral climate financiers to assess their distribution patterns and development effects across 130 recipient countries during the period of 2003-2021. Based on a multiple linear regression model with country- and year-fixed effects, the paper finds that the yearly level of disbursed funding from multilateral climate financiers for a recipient country is positively correlated with its improvement in corruption and transparency, greater policy and institutional alignment with climate action, and total CO2 emissions at meaningful but varying degrees of statistical significance. It further finds that this allocation is negatively correlated with the recipient country's level of debt to multilateral organizations, whereas it shares no statistical significance with the measure of its climate vulnerability.

Furthermore, through a cross-comparison of the Results Frameworks of the three representative multilateral climate financiers (Green Climate Fund, Global Environment Facility, and Adaptation Fund of the World Bank), the study selects indicators from four impact dimensions (Environmental, Social, Policy & Institutional, and Economic) to assess the development effects of climate finance on the recipient countries. The paper finds that three years after the disbursement, the climate finance disbursed to a country shares a positive correlation with the amount of CO2 emission reductions (Environmental Impact), the Industry, Value Added (Economic Impact), and the Country Policy and Institutional Assessment (CPIA) Environment Rating (Policy & Institutional Impact), while sharing a negative correlation with the number of environmentally displaced populations (Social Impact). In particular, these correlations vary by the income group or development stage of the recipient nations, with a stronger statistical significance for lower- and upper-middle income countries in comparison to low- or high-income groups. For the effects of multilateral climate finance on the Climate Readiness Index, the statistical significance of correlations is not apparent.

Based on these findings, this paper offers policy recommendations that require responsibilities from both the recipient countries and multilateral climate financiers with emphasis on: (i) Mainstreaming Climate Resilience, (ii) Building Capacity and Readiness with Focus on the Expansion of National Implementing Entities (NIEs), and (iii) Addressing the Climate Financing Gap.

Keywords: multilateral climate finance, development finance, distributional equality, development effectiveness, climate change

Student Number: 2020-21964

Table of Contents

LIST OF FIGURES

Figures

Tables

I. Introduction

1-1. Background and Definitions

In the past decade, climate change has emerged as one of the greatest threats that face human security and health. Global warming and the effects of climate change have continued to intensify, with the year 2020 marked as the warmest year to be ever recorded. If the anthropogenic activities driving climate change are left unaddressed, they will bring forth dire consequences that are simply unprecedented.

Against this backdrop, in an effort to enhance the capacity of developing countries to mitigate and adapt to the effects of climate change, the 21st session of the Conference of Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) introduced a new era of 'climate finance' in 2015. It defined climate finance as "flows of funds and capital from developed to developing nations to enable a shift towards low-emission and climate-resilient development pathways". It aims to reduce emissions, to enhance sinks of greenhouse gases, and to maintain the resilience of human and ecological systems against the impacts of climate change. Further, in the hopes of alleviating the due concern of developing countries on the potential trade-off between sustaining their economic growth and reducing emissions, climate finance is purposed to achieve the twin goals of both economic prosperity and climate mitigation/adaptation.

With the introduction of the 'New Climate Regime', the UNFCCC called for "new and additional" sources of climate finance to enable climate-specific support mechanisms and financial aid for a transition towards low-carbon, climate-resilient growth and development. To this end, climate financing by the world's six largest multilateral development banks (World Bank, Inter-American Development Bank, European Investment Bank, European Bank for Reconstruction and Development, African Development Bank, and Asian Development Bank) reached a 7-year high of USD 35.2 billion in 2017 and is further projected to increase, with the 2015 Paris Agreement committed to continue the collective mobilization of climate finance until 2025. As such, climate finance has grown in quantity and importance in the international community with its objective of addressing environmental sustainability and climate resilience of developing nations against the intensifying effects of climate change

1-2. Purpose and Significance of Research

Research on climate finance has grown in number as a result of its increasing importance. However, empirical analysis examining the distributional equality and development effects of multilateral climate finance remains an area of little prior research. Against such backdrop, this study intends to answer the following questions:

(1) What characteristics of recipient countries have a correlation with the allocation of multilateral climate finance? Do their effects vary across time?

(2) What are the effects of multilateral climate finance on improving the development impact of the recipient countries? Do these effects differ by the income status/group of the recipient countries?

(3) Based on the findings from a quantitative analysis, what are some important policy implications that can improve the distribution and development effectiveness of multilateral climate finance?

The UNFCCC Biennial Assessment and Overview of Climate Finance Flows track and monitor the flows of international climate finance on a yearly basis. Based on the said data, through multiple liner regression models with country- and year-fixed effects, this paper is purposed to examine 19 official multilateral climate funds to assess the degree of inequality in the distribution, the contributing factors to the allocational patterns, and the development effects of multilateral climate finance that was delivered to 130 recipient countries during the time period of 2003-2021. From the above findings, the study intends to suggest a set of policy recommendations that target both the recipient countries and multilateral climate financiers with the purpose of improving the distributional equality and development effects of multilateral climate finance.

1-3. Literature Review

1-3-1. Distributional Inequality of Climate Finance

Examining the distribution of climate finance through the lens of 'equality' has not been common. Instead, the discussion of 'inequality' with regard to climate finance has largely focused on two main areas. First is the climate injustice that arises from a small number of advanced economies being responsible for generating

significantly higher carbon emissions, both historically and currently, while climate change inflicts disproportionate effects on the low- and middle-income countries whose emission contributions are much lower. Second is the climate injustice that occurs at the intra-national scope, wherein the distribution of and access to climate finance has been inequitable to marginalized groups, such as women and the poor.

However, the inequality and lack of inclusion in the distribution and allocation of climate finance amongst the recipient countries did not gain much attention from the development and climate communities until recent years. In *Exploring the Inequities of Climate Finance*, the financial inequities of the global climate finance architecture are explored to find that a fair and inclusive climate transition in developing nations is made inherently difficult as a result of the current inadequacy in including climate change metrics in capital allocation and disbursement processes (Mannat and Chapman, 2022). The annual publication by Climate Policy Initiative, G*lobal Landscape of Climate Finance 2021*, further observed that almost one-third of global climate investments in the year had been concentrated in East Asia & Pacific, Western Europe, and North America, while the remaining regions received less than one-quarter of the share. This trend was also witnessed in 2020, when almost half of the year's tracked global climate funds flew into East Asia & Pacific, with 81% of that finance being allocated to China. It further found that on average, only 20.5% of climate-related development finance goes to the least developed countries on a yearly basis, with less than 3% distributed to small island developing states (SIDS). Lastly, *The Unequal Distribution of International Climate Finance Flows and Its Underlying Drivers* (Rickman et al., 2022) used financing data for wind and solar energy to highlight the importance of recipient countries' investment suitability and business environment as significant drivers for the unequal distribution of international climate finance from the private sector.

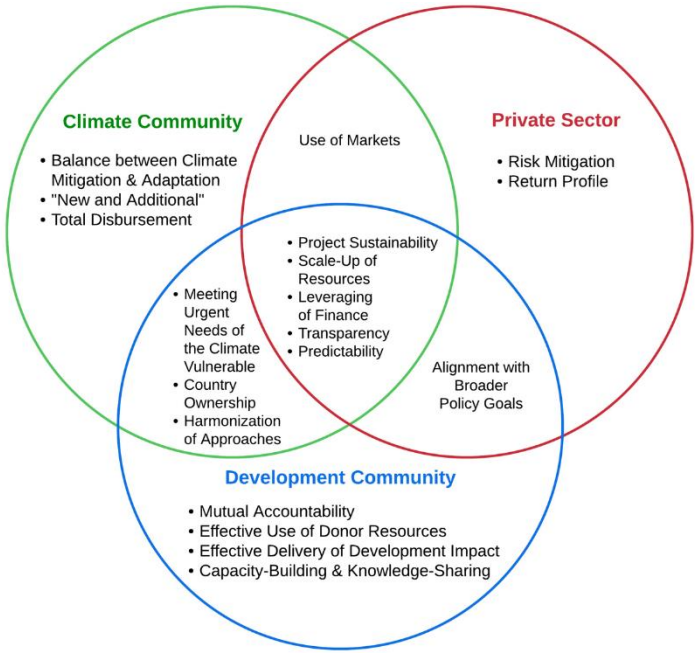
Although these studies highlight observations and patterns surrounding the emerging issue of inequality and lack of inclusion in the distribution of climate finance, they do not examine the conditionalities and factors that may drive and determine such allocational patterns, especially with regard to public and multilateral climate finance. In this regard, what contributes to the distributional decisions and preferences of multilateral climate financiers is worth an academic evaluation.

1-3-2. Development Effects of Climate Finance

There is existing literature review that assesses the development effects of climate finance on multiple fronts. In the publication by the OECD, *Scaling up and Replicating Effective Climate Finance Interventions,* Kato and Ellis explore how climate finance is viewed by different communities and the pre-conditions that can further elevate its effectiveness, such as policies or institutional capacities (Kato et al., 2014). Also from OECD, what enables effective climate finance in the context of development cooperation is investigated through a qualitative research approach of conducting a series of in-depth interviews with international climate finance stakeholder groups representing recipient and provider countries, experts from international organizations, and research institutions (Zou, Ye, and Ockenden, 2016). Similarly, in *Measuring the Effectiveness of Public Climate Finance Delivery,* Overseas Development Institute (ODI) investigated the importance of intra-governmental coordination in the mobilization of climate aid and fulfillment of the recipient countries' climate objectives (Bird et al., 2013).

As shown, previous research has largely been focused on analyzing and evaluating the qualitative and characteristic factors that lead to greater effectiveness of climate finance. In this regard, the paper may add academic value by quantitatively examining the development effects of multilateral climate finance on the recipient nations. Furthermore, another challenge that is repeatedly mentioned across the literature is the lack of a common definition or conceptualization of 'development effectiveness' with regard to climate finance. Despite the larger discussion around principles for effective development finance through the Paris Declaration on Aid Effectiveness (2005) and emphasis on extending the linkage of such principles beyond aid to cover international climate finance through the Busan Partnership on Effective Development Cooperation (2011), the results frameworks used for measuring and evaluating the development effectiveness of climate finance remain fragmented. This can be mainly attributed to the fact that different climate financiers—namely the development community, climate community, and the private sector—have varying aims and priorities, which have been briefly summarized in Figure 1.

Figure 1. Points of Emphasis in Development Effectiveness by Different Communities in Multilateral Climate Finance



Source: Recreated by the author with data
from Exploring Climate Finance Effectiveness (Ellis, Caruso, and Ockenden, 2013)

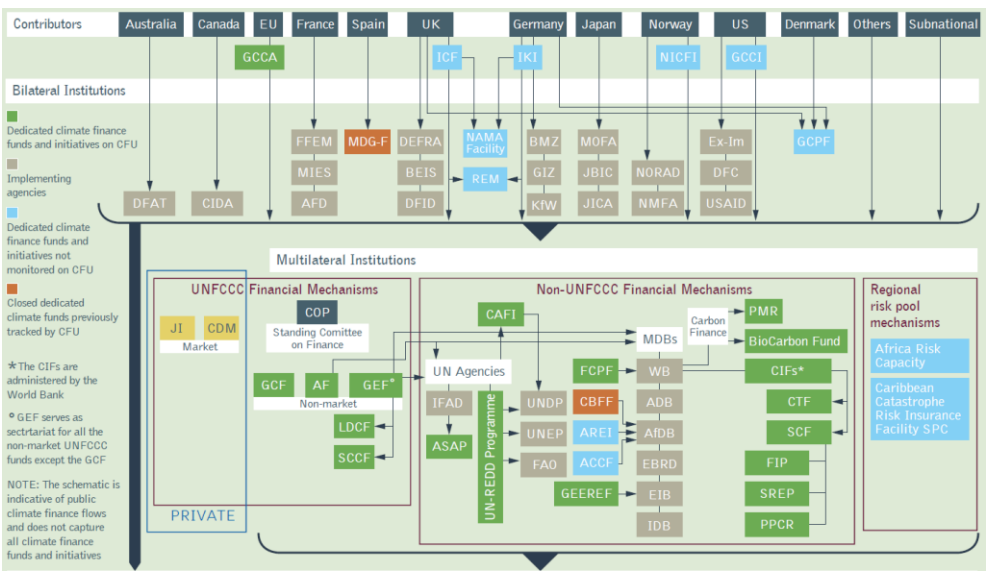
With this understanding, the study intends to examine and cross-compare the results frameworks of the three representative UNFCCC multilateral climate financiers (Integrated Results Management Framework from the Green Climate Fund (GCF), Climate Change Adaptation/Mitigation Tracking Tools from Global Environmental Facility (GEF), and Strategic Results & Effectiveness/Efficiency Results Framework from the Adaptation Fund (AF)) in order to select a set of common indicators to evaluate the development effects of climate finance. This will be carried out by assessing the correlational impact of yearly disbursed funding to the recipient countries' performances in the selected indicators.

II. Overview of Multilateral Climate Finance

2-1. Overall Trends of Multilateral Climate Finance

The main sources of international climate finance today are from multilateral institutions (both UNFCCC and non-UNFCCC financiers), bilateral institutions, and the private sector. Figure 2 illustrates the current architecture of international climate finance, among which this study will focus on the 19 multilateral climate financing institutions due to the accessible and centralized nature of available climate finance data. A full list of the 19 multilateral climate financiers used for this study is provided under Appendix, Table A1.

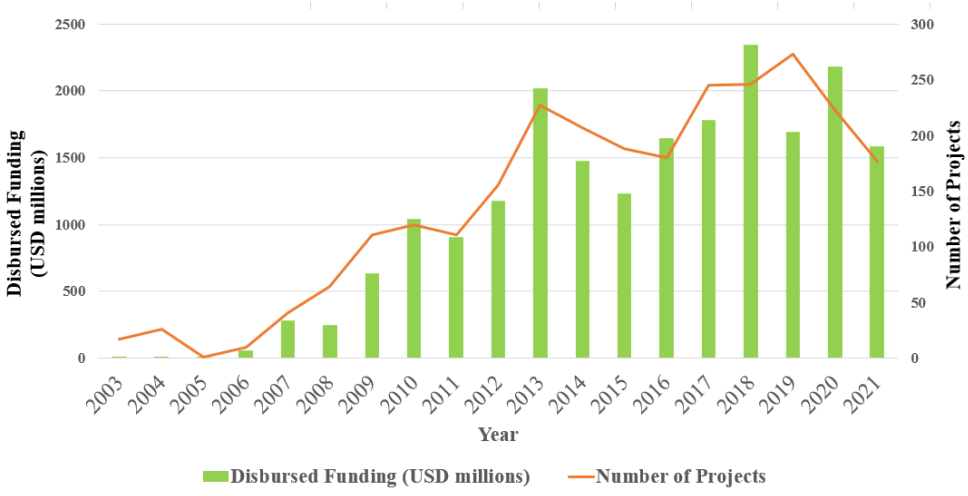
Figure 2. Global Architecture of Climate Finance



Source: Climate Funds Update

The indicative evolution of multilateral climate finance around the world from 2003 to 2021, as shown in Figure 3, demonstrates that starting from 2006, despite a few dips, there has been a clear increase in both the number of projects and disbursed funding. During this time period, a total of USD 20.3 billion was delivered by multilateral climate financiers to implement 2,623 projects in 130 countries.

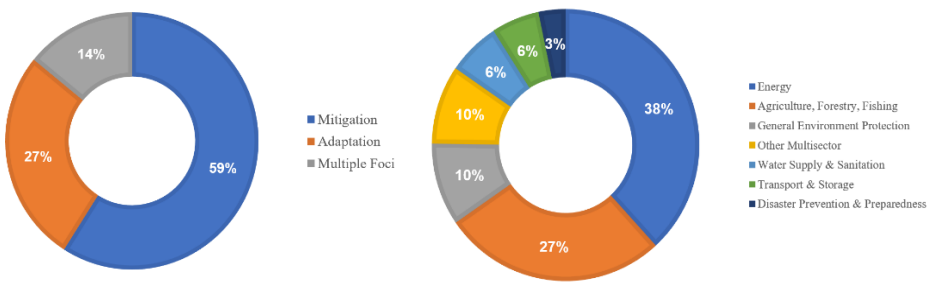
Figure 3. Evolution of Multilateral Climate Finance
by Disbursed Funding and Number of Projects (2003-2021)



Source: Recreated by the author with data
from the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC

At a closer inspection of the data disaggregated by objective, as presented in Figure 4, 59% of the climate finance projects were aimed towards climate mitigation, whereas 27% and 14% were dedicated to support for climate adaptation and multi-focus activities, respectively.

Figure 4-5. Multilateral Climate Finance Projects
by Objective (left) and Top 10 Sectors (right)

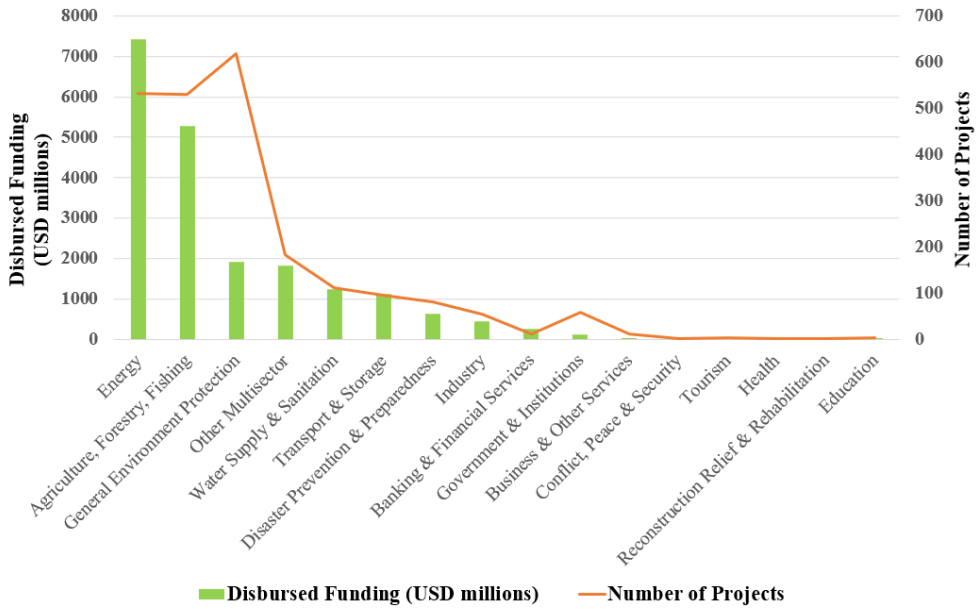


Source: Recreated by the author with data
from the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC

When evaluated in terms of the number of projects, per Figures 5 and 6, the energy sector by far exceeds the rest of the sectors, occupying approximately 38% of the total number of projects. Other prominent sectors include: Agriculture, Forestry, Fishing (27%), General Environment Protection (10%), Other Multi-Sector (10%), Water Supply & Sanitation (6%), Transport & Storage (6%), and Disaster Prevention & Preparedness (3%).

It is notable to observe that even though the sector of 'General Environment Protection' takes up almost 10% in terms of the number of projects, when viewed as a share of the total finance, it occupies a much lower portion. This can be explained by the fact that the said sector is delivered in the form of building frameworks, roadmaps, guidelines, technical assistance, and sharing of knowledge, technology, and expertise, which incur substantially lower costs compared to other sectors (e.g. energy and agriculture) that often require the construction of physical infrastructure.

Figure 6. Multilateral Climate Finance Projects by Sector (2003-2021)



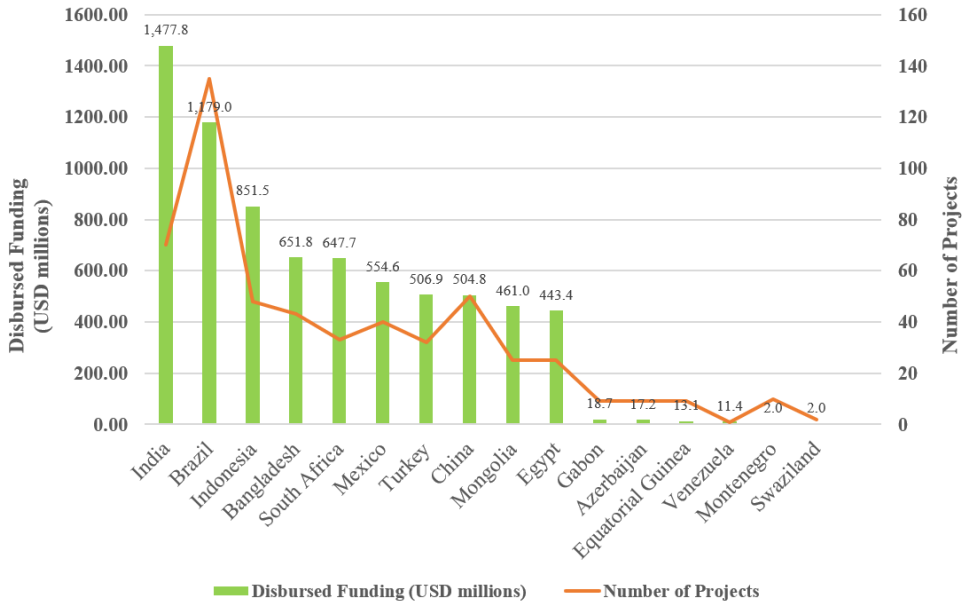
Source: Recreated by the author with data
from the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC

2-2. Country Distribution of Multilateral Climate Finance

Despite the growing prevalence and diversity of active climate financing across the globe as discussed, such presence has not been matched by a similar degree of equality and inclusion in the distribution of the climate finance. As observable from Figure 7, both in terms of the number of projects and amount of disbursed funding, there is a high concentration of climate finance in a number of fast-growing economies, namely India, Brazil, Indonesia, South Africa, Bangladesh, and China. This starkly contrasts against the thin distribution of climate finance in countries placed at the other end of the spectrum. In fact, from 2003 to 2021, the eight countries (Mongolia, Egypt, Gabon, Azerbaijan, Equatorial Guinea, Venezuela, Montenegro, and Swaziland), when combined together, account for only 0.07% of

the total climate finance that was disbursed across the world. This figure is less than half of the climate finance that India had received alone during the same time period.

Figure 7. Distribution of Multilateral Climate Finance by Disbursed Funding and Number of Projects for Highest and Lowest Recipient Countries (2003-2021)



Source: Recreated by the author with data
from the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC

Given that benefits of climate finance are wide-encompassing, this trend of uneven distribution signifies that it may translate to a more concerning disparity not only in terms of the financial support, but also in terms of the non-financial spillover benefits that it carries. In particular, this problem adds more weight and gravity as the need and urgency for climate resilience are equally, if not more severely, witnessed in countries that receive less attention in multilateral climate finance.

To demonstrate the said concern, measures of vulnerability to climate change for the aforementioned countries are compared through a number of global indices, such as the Climate Vulnerability Score from the Notre-Dame Global Adaptation Initiative (ND-GAIN) Index, the Planetary Pressures-Adjusted Human Development Index (PHDI) from the United Nations Development Programme (UNDP), and the Global Climate Risk Index from the Resource Watch, averaged across 2014-2019. From Table 1, it is revealed that countries that receive the lowest climate finance are equally, if not more, vulnerable to the effects of climate change.

Table 1. Measure of Climate Vulnerability (Average, 2014-2019) for Countries with Highest and Lowest Allocation of Multilateral Climate Finance

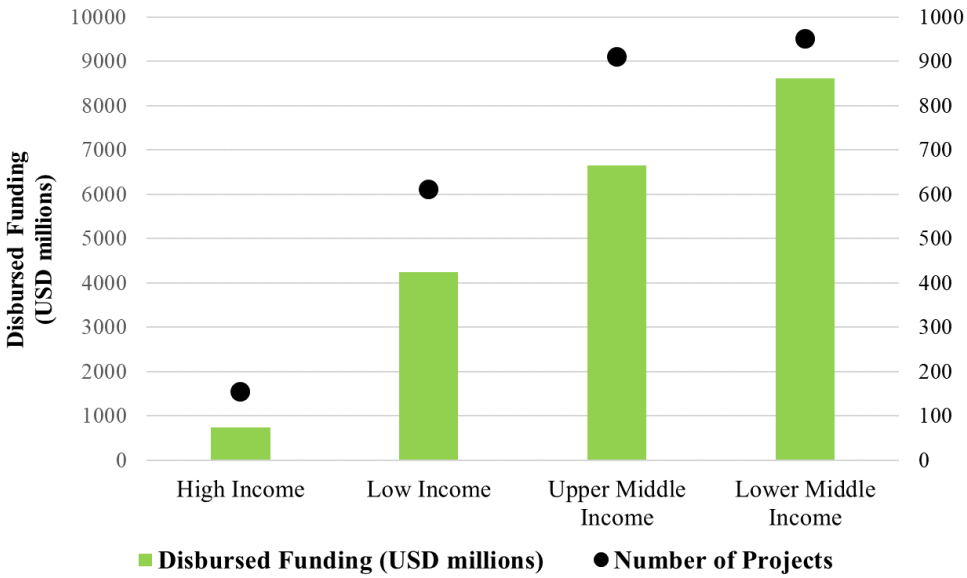
Country	Climate Vulnerability Score	Planetary Pressures-Adjusted Human Development Index	Global Climate Risk Index
India	41.8	0.635	23.7
Brazil	48.4	0.554	33.6
Indonesia	47.1	0.718	55.8
Bangladesh	36.0	0.632	16.0
South Africa	44.9	0.589	32.2
Gabon	43.2	0.765	36.8
Azerbaijan	42.6	0.513	34.6
Equatorial Guinea	47.2	0.476	35.1
Venezuela	43.4	0.698	46.3
Montenegro	36.6	0.721	37.2
Swaziland	43.5	0.548	38.9

Source: Recreated by the author with data
from Climate Vulnerability Score of the ND-GAIN Index, Planetary Pressures-Adjusted Human Development Index, and Global Climate Risk Index for 2014-2019

For example, even though India and Swaziland stand on opposite ends of the distribution spectrum, their degree of climate vulnerability is not very far apart. In fact, the figures are much worse for Swaziland when viewed with Climate Vulnerability Score from ND-GAIN Index and the Global Climate Risk Index from Resource Watch. Despite being in a greater need to address climate resilience and access its financing channels, Swaziland has not been prioritized in the allocation of multilateral climate finance. This comparison indicates that there is a mismatch between the distribution of multilateral climate finance and the climate risk and vulnerability that countries experience. The findings suggest that there clearly exists an uneven distribution of climate finance to recipient countries, which is not primarily determined by their level of climate vulnerability. Against this backdrop, there is a need to investigate what causes and contributes to such dispersion patterns.

Lastly, as displayed in Figure 8, there are notable differences in the distribution of climate finance according to the income group of recipient countries (per the classification by the World Bank). It can be observed that in both the disbursed funding and number of projects, upper- and lower-middle income countries have received a much greater attention in climate finance. This pattern suggests that disaggregating the observation sample by income status in the analyses that follow may offer a more discrete insight on how the correlations may differ by the recipient countries' stage of development.

Figure 8. Distribution of Multilateral Climate Finance
by the Income Classification of Recipient Countries (2003-2021)



Source: Recreated by the author with data
from the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC

III. Data and Methodology

3-1. Evaluating the Distributional Inequality of Multilateral Climate Finance

3-1-1. Data

A dataset comprised of project-level data of the 19 multilateral climate funds and various measures of country performances of the 130 recipient countries during the period from 2003-2021 was compiled. For the dependent variable of climate finance, multilateral climate funds were chosen due to the more centralized and accessible nature of the dataset from international organizations and multilateral development banks. In particular, the Biennial Assessment and Overview of Climate Finance Flows from the UNFCCC and yearly publications of the Global Landscape of Climate Finance from the Climate Policy Initiative were used as the primary sources of data to derive the yearly amount of disbursed multilateral climate finance for the recipient countries. A total of 2,623 climate finance projects/programs were examined for the analysis.

The independent variables that may contribute to the patterns of climate finance allocation and distribution were carefully selected based on literature review, whose definitions, objectives, and sources are outlined as below:

Table 2. Independent Variables

Variable	Objective	Source
Total CO2 Emissions	to examine whether and to what extent the level of total CO2 emissions affects the allocation/distribution of climate finance	World Development Indicators, World Bank
Debt Service to Multilateral Organizations as a Share of Publicly Guaranteed Debt	to examine whether and to what extent the level of debt to multilateral organizations affects the allocation/distribution of climate finance	
CPIA Policy and Institutions for Environment Sustainability Rating	to examine whether and to what extent a strong policy and institutional alignment to climate change affects the allocation/distribution of climate finance	
Corruption Perceptions Index	to examine whether and to what extent the level of corruption affects the allocation/distribution of climate finance	Transparency International
Climate Vulnerability	to examine whether and to what extent the level of climate vulnerability affects the allocation/distribution of climate finance	Notre Dame Global Adaptation Initiative (ND-GAIN)

Table 3. Variables for Estimation

Variable	Definition	Unit
Dependent		
$ln\text{Fund}_{it+n}$	(logged) Aggregate amount of climate finance from multilateral climate financiers disbursed for recipient country i in year t	USD millions
Explanatory		
g_CO2_{it}	Growth rate (percentage change) of the total CO2 emissions of recipient country i in year t	%
CPI_{it}	Corruption Perceptions Index (CPI) of recipient country i in year t (0~100, 0 = highly corrupt, 100 = very clean)	Index
$CPIA_{it}$	Country Policy and Institutional Assessment (CPIA) score for environment sustainability rating of recipient country i in year t (1~6, 1 = low, 6 = high)	Index
$Debt_{it}$	(logged) Repayment of principal and interest to the World Bank, regional development banks, and other multilateral agencies (e.g. climate financiers) of recipient country i in year t	% share of publicly guaranteed debt
$Vuln_{it}$	Climate Vulnerability score of recipient country i in year t (0~1, 0 = not vulnerable, 1 = vulnerable)	Index
Control		
X_{it} (vector of country-specific variables that affect the outcome variable of recipient country i in year t)	$ln\text{GDP\_pc}_{it}$ (logged) Gross Domestic Product (GDP) per capita of recipient country i in year t	constant 2015 USD, millions
	$ln\text{pop}_{it}$ (logged) total population of country i in year t	thousands
	$ln\text{REC}_{it}$ (logged) renewable energy consumption of country i in year t	% of total final energy consumption
	$ln\text{trade}_{it}$ (logged) sum of exports and imports of goods and services measured as a share of country i's GDP in year t	% of GDP
α_{it}	country-fixed effects	
δ_t	year-fixed effects	
ε_{it}	random error term	

Table 4. Descriptive Statistics of Dependent and Independent Variables

Variable	Mean	Std. Dev.	Min	Max
Fund	5.805	19.262	0	316.124
g_CO2	0.135	1.505	-3.872	3.389
CPI	32.851	12.319	8	78
CPIA	3.499	0.653	1	4.527
MultiDebt	42.361	28.512	0	100
Vuln	0.469	0.0811	0.316	0.688

Table 5. Descriptive Statistics of Control Variables

Variable	Mean	Std. Dev.	Min	Max
GDP_pc	4829.043	5246.069	258.629	41170.671
pop	42221518	1.578e+08	17603	1.411e+09
REC	39.579	30.639	0.001	97.972
trade	78.676	38.524	0.785	347.997

3-1-2. Methodology

The data were merged into a panel dataset by aggregating up to the country by yearly levels. Fixed effects were used to control for the heterogeneity across countries in the sample and a set of control variables were also introduced, including GDP per capita, total population, renewable energy consumption, and trade-to-GDP ratio. Furthermore, the potential risk that may arise from the multicollinearity of the independent variables is tested through correlation analyses and Variance Inflation Factors (VIFs). Parameters α_i and δ_t capture country- and year-fixed effects, while ε_{it} represents unexplained random shock, clustered at the country level. Lastly, in an attempt to capture how the country's performances may affect the disbursed amount of climate finance over time, a lag effect is introduced with five time variations (t+1 to t+5). This is expressed through the following empirical specification:

$$(1)\quad ln\mathrm{Fund}_{it+n} = \beta_0 + \beta_1 \mathrm{g\_CO2} + \beta_2 \mathrm{CPI}_{it} + \beta_3 \mathrm{CPIA}_{it} + \beta_4 \mathrm{MultiDebt}_{it} + \beta_5 \mathrm{Vuln}_{it} + \beta_6 ln\mathrm{X}_{it} + \alpha_i + \delta_t + \varepsilon_{it}$$

3-2. Evaluating the Development Effects of Multilateral Climate Finance

3-2-1. Data

Utilizing the aggregated dataset from the first specification, a number of additional country performance variables were merged as indicators to measure the development effects of multilateral climate finance.

A cross-comparison was conducted for the results frameworks of the three representative UNFCCC multilateral climate financiers (Integrated Results Management Framework from the Green Climate Fund (GCF), Climate Change Adaptation/Mitigation Tracking Tools from Global Environmental Facility (GEF), and Strategic Results & Effectiveness/Efficiency Results Framework from the Adaptation Fund (AF)) in order to assess and select the most commonly and predominantly used indicators to measure the impact of the climate projects. Table 6 briefly outlines the four impact dimensions of climate finance and the indicators through which the development effects of climate finance will be measured.

Table 6. Impact Dimensions of Development Effectiveness of Climate Finance

Impact Dimension	Indicator	Variable	Source
Environmental	CO2 Emissions Reduction	Total Amount of CO2 Emissions Reduced, Avoided, and/or Sequestered	World Development Indicators, World Bank
	Climate Readiness	Climate Readiness Index	Notre Dame Global Adaptation Initiative (ND-GAIN) Index
Social	Internally Displaced Persons from Impacts of Climate Change	Total Number of Environmentally Displaced Persons	Internal Displacement Monitoring Centre
Institutional & Policy	Strength of Climate-Related Policy and Institutions	CPIA Policy and Institutions for Environment Sustainability Rating	World Development Indicators, World Bank
Economic	Economic Value Creation (including Job Opportunities)	Industry (including construction), value added (% of GDP)	World Development Indicators, World Bank

Table 7. Variables for Estimation

Variable	Definition	Unit
Dependent (Separate Regressions)		
lnCO2_R$_{it+3}$	(logged) Amount of CO2 emissions reduced, avoided, or sequestered in recipient country i in year t+3	metric tons per capita
Readiness$_{it+3}$	Climate Readiness Index (measure of a country's ability to leverage investments and convert them into climate mitigation and/or adaptation) of recipient country i in year t+3 (0~1, 0 = not climate-ready, 1 = climate-ready)	Index
lnEnvDisPop$_{it+3}$	(Logged) Total Number of Environmentally Displaced Persons in recipient country i in year t+3	Persons
CPIA$_{it+3}$	Country Policy and Institutional Assessment (CPIA) score for environment sustainability rating of recipient country i in year t+3 (1~6, 1 = low, 6 = high)	Index
Ind$_{it+3}$	Industry (including construction), Value Added of recipient country i in year t+3	% of GDP
Explanatory		
lnFund$_{it}$	(logged) Aggregate amount of climate finance from multilateral climate financiers disbursed for recipient country i in year t	USD millions
Control		
X$_{it+3}$ (vector of country-specific variables that	lnGDP_pc$_{it+3}$ (logged) Gross Domestic Product (GDP) per capita of recipient country i in year t+3	constant 2015 USD, millions

affect the outcome variable of recipient country i in year t+3)	lnpop$_{it+3}$ (logged) total population of country i in year t	thousands
	lnREC$_{it+3}$ (logged) renewable energy consumption of country i in year t+3	% of total final energy consumption
	lntrade$_{it+3}$ (logged) sum of exports and imports of goods and services measured as a share of country i's GDP in year t+3	% of GDP
α_{it}	country-fixed effects	
δ_t	year-fixed effects	
ε_{it}	random error term	

Table 8. Descriptive Statistics of Dependent and Independent Variables

Variable	Mean	Std. Dev.	Min	Max
CO2_R	2.846	3.936	0.021	29.623
Readiness	0.356	0.069	0.162	0.652
EnvDisPop	663032.1	1283663	2	7600000
CPIA	3.499	0.653	1	4.542
Ind	27.428	12.641	4.149	87.797
Fund	5.805	19.262	0	316.149

3-2-2. Methodology

Similar to the first specification, fixed effects were used to control for the heterogeneity across countries in the sample and a set of control variables were also introduced. Furthermore, the potential risk that may arise from the multicollinearity of the independent variables is tested through correlation analyses and Variance Inflation Factors (VIFs). Parameters α_i and δ_t capture country- and year-fixed effects, while ε_{it} represents unexplained random shock, clustered at the country level.

Lastly, it is assumed that there is a time lag of approximately 3 years for the disbursed climate finance to manifest into observable effects on the recipient country's performances in the selected indicators. This lag effect has been similarly adopted by previous literature that evaluates the effect of climate finance on greenhouse gas emissions and other national-level variables of interest (Carfora et al., 2017). This is expressed through the following empirical specifications:

(2) $ln\mathrm{CO2\_R}_{it+3} = \beta_0 + \beta_1 ln\mathrm{Fund}_{it} + \beta_2 ln\mathrm{X}_{it+3} + \alpha_i + \delta_t + \varepsilon_{it}$

(3) $\mathrm{Readiness}_{it+3} = \beta_0 + \beta_1 ln\mathrm{Fund}_{it} + \beta_2 ln\mathrm{X}_{it+3} + \alpha_i + \delta_t + \varepsilon_{it}$

(4) $ln\mathrm{EnvDisPop}_{it+3} = \beta_0 + \beta_1 ln\mathrm{Fund}_{it} + \beta_2 ln\mathrm{X}_{it+3} + \alpha_i + \delta_t + \varepsilon_{it}$

(5) $\mathrm{CPIA}_{it+3} = \beta_0 + \beta_1 ln\mathrm{Fund}_{it} + \beta_2 ln\mathrm{X}_{it+3} + \alpha_i + \delta_t + \varepsilon_{it}$

(6) $\mathrm{Ind}_{it+3} = \beta_0 + \beta_1 ln\mathrm{Fund}_{it} + \beta_2 ln\mathrm{X}_{it+3} + \alpha_i + \delta_t + \varepsilon_{it}$

VI. Key Findings and Discussion

4-1. Assessing the Determinants of the Distribution of Climate Finance

Across the time periods, it appears that the explanatory power of the independent variables tends to be the strongest for t+2 and t+3, suggesting that the characteristics or performances of the recipient country have the strongest effect on how much multilateral climate finance it receives in the mid-run (2-3 years). Aside from the explanatory variables, the recipient country's size of economy, population, renewable energy consumption, and trade-to-GDP ratio as a measure of trade openness, which were utilized as control variables in the model, are significant factors in determining the amount of multilateral climate finance that is disbursed.

Table 9. Regression Results for Specification (1)

Dependent:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
$ln\text{Fund}_{it+n}$	t+1	t+2	t+3	t+4	t+5
g_CO2_{it}	1.44*	2.58*	3.22**	2.52***	1.87*
	(6.13)	(4.20)	(3.67)	(3.36)	(3.08)
CPI_{it}	0.02**	0.08**	0.13**	0.11*	-0.04
	(0.22)	(0.54)	(0.33)	(0.50)	(0.15)
$CPIA_{it}$	2.98	3.04*	4.98*	2.87**	5.63
	(3.00)	(2.01)	(4.01)	(3.32)	(2.02)
$MultiDebt_{it}$	-0.02	-0.34*	-1.66*	-0.04	-0.06
	(0.03)	(0.92)	(1.85)	(0.39)	(0.98)
$Vuln_{it}$	-7.50	-5.91	-4.13	10.69	-10.49
	(8.95)	(7.42)	(4.88)	(5.54)	(5.16)
$ln\text{GDP\_pc}_{it}$	4.91**	6.04**	7.03**	3.51	1.87**
	(5.55)	(3.98)	(4.12)	(5.47)	(5.41)
$ln\text{pop}_{it}$	5.86*	4.24**	9.92*	3.02***	3.32*
	(13.84)	(9.29)	(7.01)	(4.48)	(6.37)
$ln\text{REC}_{it}$	0.05	0.11*	0.47*	0.12	0.15
	(0.31)	(1.29)	(2.26)	(1.12)	(1.28)
$ln\text{trade}_{it}$	3.02*	4.85**	7.12**	6.19	4.08*
	(0.09)	(0.17)	(0.22)	(0.33)	(0.32)
No. of Obs.	1447	1446	1445	1444	1443
Country FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within)R^2	0.284	0.312	0.321	0.330	0.296

Notes: This table reports estimation results from specification (1) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

4-1-1. Growth Rate of CO2 Emissions

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), across all time observations, the growth rate in the total CO2 emissions of the recipient country has a positive effect on the amount of yearly climate finance that it is disbursed with. The statistical significance of this variable appears to be particularly strong in the medium-run (t+3 and t+4, at 5% and 1% respectively). It can also be observed that with a 1% increase in the growth rate of CO2 emissions, the size of the positive effect on the disbursed climate fund increases from the first to third year, reaching almost 3.22% increase in t+3, after which point it declines from the fourth year.

This confirms existing literature and research that the distribution of multilateral climate finance is heavily concentrated in countries with high and growing carbon emissions. As a matter of fact, it matches recent findings that the top 10 recipients of multilateral climate finance include three of the biggest carbon emitters in the world, namely India, Brazil, and Indonesia (Nakhooda, Smita, and Norman, 2014). This may be further explained in the context of the multilateral efforts to prevent and reverse 'carbon lock-in', a concept that refers to when fossil-fuel-intensive systems perpetuate, delay, or prevent the transition to low-carbon alternatives (Sato, Elliott, and Schumer, 2021). The core problem is that once fossil-driven and carbon-intensive equipment, facilities, and infrastructure are already installed, their replacement can take tremendous time, costs, and resources, while locking in more greenhouse gases and carbon emissions during their lifetime. In this context, given that the large carbon emitters are also fast-growing economies with a high level of industrialization and economic development, the greater concentration of climate finance to prevent and stall their 'carbon lock-in' may account for this correlation.

Understanding the distributional pattern of climate finance from this point of view, the high allocation of climate finance in a few number of rapidly-industrializing economies is not necessarily a *misallocation* of funding resources. Instead, particularly for climate finance targeted towards climate mitigation, the efforts to avoid and reduce emissions of heat-trapping greenhouse gases in countries with the highest emissions hence project impact (e.g. fast-growing, middle-income countries) stand well in line with their founding purpose.

4-1-2. Corruption Perceptions Index

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), across the time periods except for t+5, results show that the recipient country's CPI has a positive effect on the amount of yearly climate finance that it is allocated with, showing comparatively higher statistical significance in the short-run (t+1 to t+3). It can also be observed that with 1 unit increase in CPI, the size of the positive effect on the disbursed climate fund increases from the first to third year, reaching almost 0.13% increase in t+3, then declines after the fourth year and becomes no longer statistically significant in the fifth year.

This observation is consistent with pre-existing belief surrounding conventional development finance or official development assistance, in which an improvement in the corruption level implies greater transparency and accountability in the public sector, hence less potential for a misuse of the allocated finance. It is also in line with existing research on the importance of transparency and anti-corruption in enhancing the effectiveness of climate finance (Bird et al., 2013). If a country is well-equipped with functioning national systems for tracking climate finance flows and monitoring its results with greater transparency and accountability, multilateral donors and organizations can recognize such factors as critical and attractive pre-conditions. Furthermore, higher levels of transparency in recipient countries also signal that multilateral donors are able to more effectively report the flows of climate finance, as well as verify their impact with visible results that demonstrate the "value for money", which are both recognized as important criteria in the decision-making processes of multilateral climate financiers (Zou, Ye, and Ockenden, 2016).

4-1-3. CPIA Environment Sustainability Rating

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), from t+2 to t+4, results show that the recipient country's CPIA rating of policy and institutions for environment sustainability has a positive effect on the amount of yearly climate finance that it is allocated with. During the time variations where the correlation is

statistically significant, with 1 unit increase in CPIA rating, the size of the positive effect is the largest in the third year, showing almost a 4.98% increase in the disbursed climate fund.

This particular CPIA rating assesses the extent to which a nation's environmental policies and institutions are conducive to fostering the protection and sustainable use of natural resources. In the context of climate finance, this variable can be understood as an indirect measure of the recipient country's dedication to building and maintaining an effective system of policies and institutions to fight climate change and environmental pollution. This confirms existing literature that the distribution of climate finance not only reflects the environmental needs of recipient countries, but also their own active efforts and demonstrated ambition to combat climate change, which often manifest in the form of greater policy alignment with and institutional support for climate resilience (Zou, Ye, and Ockenden, 2016).

4-1-4. Share of Debt Service to Multilateral Organizations and Banks

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), results show that an increase in the recipient country's share of debt service to multilateral organizations and banks has a negative effect on the amount of yearly climate finance that it is allocated with. However, this is only statistically significant at 10% in the mid-run (t+2 and t+3). Among the time variations where the correlation is statistically significant, with 1 unit increase in the share of publicly guaranteed debt, the negative effect is the largest in the third year, showing a 1.66% decrease in the disbursed climate und.

There is no existing literature review that confirms the effect of this variable in determining the allocational preferences or patterns of multilateral organizations and climate finance providers. However, the recipient countries' financial/budgetary management, resource mobilization in the public sector, and preventive systems against financial mis-management have long been repeatedly recognized across multiple literature and case studies as an important pre-condition for the effectiveness of climate finance. In this regard, this variable that measures the recipient country's debt owed to multilateral organizations and banks may have served as a proxy measure of its fiduciary qualities.

4-1-5. Climate Vulnerability

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), results show that across all time observations, there is no statistically significant correlation between the measure of climate vulnerability and the amount of allocated yearly climate finance. This is a surprising result as it signifies that climate vulnerability of recipient nations has not functioned as a powerful and deciding factor in the allocation and distribution of climate finance. This is confirmed by existing literature review (Tilly, 2020), which reported that climate-vulnerable countries do not receive preferential treatment or targeting from multilateral donors, as well as that there is no correlation between the climate vulnerability of a country and the amount of received climate finance. As a matter of fact, based on climate finance disbursed from major multilateral providers across the world from 2010 to 2017, less than half was targeted for countries that are the most climate-vulnerable, with its majority receiving less than USD 20 per person in a year from the climate finance (Tilly, 2020).

This finding may be attributed to the fact that there is a perception amid the multilateral donors and organizations that the enabling environments in the most climate-vulnerable countries are simply too weak to leverage and maximize the climate finance (Tilly, 2020). Given that countries with high climate vulnerability often tend to be low-income and/or fragile states, such lack of capacity to realize and translate the climate finance into a sizable impact may not have aligned well with the growing efforts of multilateral donors to make the effects of climate finance more quantifiable and visible. Thus, it is possible that there may have been preferences towards countries that are able to generate a larger impact in terms of unit cost and emission reductions, especially given the finite nature of climate finance.

4-2. Assessing the Development Effects of Climate Finance

Tables below summarize the regression results for each dependent variable that represents different impact dimensions of development effectiveness of climate finance. The results are further disaggregated by the recipient countries' income status per the income classification of the Word Bank (Low Income, Lower Middle Income, Upper Middle Income, High Income) to examine whether the correlations vary by their development stage.

4-2-1. CO2 Emissions Reduction (Impact Dimension: Environmental)

Table 10. Regression Results for Specification (2)

Dependent: lnCO2_R$_{it+3}$	(1) All	(2) Low Income	(3) Lower Middle Income	(4) Upper Middle Income	(5) High Income
lnFund$_{it}$	0.02*	0.26*	0.38**	0.04**	-0.02*
	(4.28)	(2.37)	(6.74)	(3.03)	(4.18)
lnGDP_pc$_{it+3}$	0.22	0.73**	0.01	-0.41	1.46
	(1.16)	(0.24)	(0.31)	(0.37)	(0.81)
lnpop$_{it+3}$	1.83***	2.87***	2.63***	-3.99***	-7.89**
	(0.24)	(0.31)	(0.60)	(0.76)	(2.64)
lnREC$_{it}$	0.02***	0.02*	0.03***	0.01	0.03**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)
lntrade$_{it+3}$	0.03	-0.29	-0.17	1.01	-0.93
	(3.46)	(5.36)	(3.72)	(2.39)	(4.21)
No. of Obs.	1354	590	356	335	73
Country FE	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within) R^2	0.14	0.24	0.23	0.16	0.44

Notes: This table reports estimation results from specification (2) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), across all income groups, the amount of disbursed climate finance has a positive effect on the total amount of CO2 emissions that are reduced, avoided, and/or sequestered in the recipient country in three years after the time of disbursement. This correlation demonstrates a strong statistical significance for lower- and upper-middle income countries. The lower middle income group, in particular, experiences the largest size of the positive effect of increasing the disbursed climate fund by 1%, resulting in almost 0.38% increase in the amount of reduced, avoided, and/or sequestered CO2 emissions in the recipient country.

Recalling the discussion on how multilateral climate finance is heavily concentrated in high-emitting and rapidly-industrializing countries in an effort to prevent the 'carbon lock-in', the results support the empirical effectiveness of multilateral climate finance in reducing carbon emissions, especially in lower middle income countries.

4-2-2. Climate Readiness Index (Impact Dimension: Environmental)

Table 11. Regression Results for Specification (3)

Dependent: $Readiness_{it+3}$	(1) All	(2) Low Income	(3) Lower Middle Income	(4) Upper Middle Income	(5) High Income
$ln\text{Fund}_{it}$	0.03	0.29	1.36	0.02*	0.22
	(0.16)	(1.23)	(0.03)	(0.13)	(0.05)
$ln\text{GDP\_pc}_{it+3}$	-0.05***	0.03*	-0.07**	-0.17***	-0.06
	(0.01)	(0.01)	(0.02)	(0.02)	(0.08)
$ln\text{pop}_{it+3}$	0.09***	0.12***	0.13**	-0.13**	-1.08***
	(0.01)	(0.01)	(0.04)	(0.04)	(0.27)
$ln\text{REC}_{it}$	0.08***	0.22	0.13***	0.06	0.33**
	(0.12)	(0.11)	(0.04)	(0.09)	(0.17)
$ln\text{trade}_{it+3}$	-0.63**	-1.79***	-1.20	4.02***	16.62
	(0.21)	(0.24)	(0.65)	(0.65)	(3.93)
No. of Obs.	1415	591	383	365	73
Country FE	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within) R^2	0.14	0.24	0.23	0.16	0.44

Notes: This table reports estimation results from specification (3) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), except for the upper middle income group, there is no statistical significance between the amount of disbursed climate finance and the Climate Readiness Index of the recipient countries in three years after the time of disbursement. Even for the upper middle income group where there is 10% of statistical significance, the size of the positive effect of increasing the disbursed climate fund by 1% is rather low at 0.02.

This lack of a statistically meaningful correlation may be attributable to a number of factors. First is that multilateral climate finance has largely been focused on the objective of climate mitigation in comparison to climate adaptation. Given that the composition of this Climate Readiness Index involves measuring the climate readiness of physical assets and infrastructure that are targeted and achieved by climate adaptation, the correlation may not have been apparent. Second is that the actualization of the benefits relevant to Climate Readiness may take a much longer time than the 3-year lag, thus not yet visible from the current estimation framework.

4-2-3. CPIA Sustainability Rating (Impact Dimension: Institutional & Policy)

Table 12. Regression Results for Specification (4)

Dependent: $CPIA_{it+3}$	(1) All	(2) Low Income	(3) Lower Middle Income	(4) Upper Middle Income	(5) High Income
$ln\text{Fund}_{it}$	0.01*	0.30	1.27*	-0.02*	0.05*
	(0.25)	(1.12)	(0.04)	(0.26)	(0.02)
$ln\text{GDP\_pc}_{it+3}$	0.24**	0.43***	-0.08	0.29	-0.73*
	(0.08)	(0.12)	(0.17)	(0.15)	(0.32)
$ln\text{pop}_{it+3}$	1.12***	1.45***	2.00***	-1.42***	-1.05
	(0.12)	(0.16)	(0.33)	(0.31)	(1.05)
$ln\text{REC}_{it}$	0.06***	0.29	0.24***	0.07	0.22**
	(0.23)	(0.88)	(0.20)	(0.17)	(0.81)
$ln\text{trade}_{it+3}$	-1.86**	-2.79*	-5.05*	4.87*	5.17
	(0.38)	(0.92)	(0.182)	(0.38)	(2.91)
No. of Obs.	1415	591	383	365	76
Country FE	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within) R^2	0.13	0.23	0.18	0.08	0.31

Notes: This table reports estimation results from specification (4) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), except for the low income group, the correlations between the amount of disbursed climate finance and the recipient country's CPIA Sustainability Rating in three years after the time of disbursement show statistical significance of 10%. It is also notable that the lower middle income group experiences the largest size of the positive effect of increasing the disbursed climate fund by 1%, resulting in almost 1.27 unit increase in the CPIA rating of the recipient country.

This matches existing literature that climate finance interventions dedicated to policy, regulatory, and institutional improvements often induce a large benefit for countries with a sufficient level of existing capacity and resources, as such pre-requisites better enable them to leverage the climate finance into meaningful policy guidance and relevant impacts within the country (Zou, Ye, and Ockenden, 2016). This may explain for the absence of a statistically significant correlation for low income groups that are often not equipped with the said pre-condition.

4-2-4. Industry Value Added (Impact Dimension: Economic)

Table 13. Regression Results for Specification (5)

Dependent: Ind_{it+3}	(1) All	(2) Low Income	(3) Lower Middle Income	(4) Upper Middle Income	(5) High Income
lnFund$_{it}$	0.04*	-0.07	0.09*	0.16**	0.27
	(0.10)	(0.12)	(0.27)	(0.29)	(0.42)
lnGDP_pc$_{it+3}$	3.30*	10.15***	-0.64	-5.15	-13.36*
	(1.38)	(1.96)	(2.82)	(3.22)	(6.36)
lnpop$_{it+3}$	8.30***	12.60***	-4.16	-14.56*	52.69*
	(2.04)	(2.56)	(5.38)	(6.47)	(20.88)
lnREC$_{it}$	0.03	0.20**	-0.16**	0.15***	-0.10
	(0.03)	(0.08)	(0.05)	(0.04)	(0.06)
lntrade$_{it+3}$	-0.02	-0.06***	-0.01	0.06	-0.05
	(0.01)	(0.02)	(0.02)	(0.03)	(0.05)
No. of Obs.	1415	591	383	365	76
Country FE	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within) R^2	0.03	0.14	0.03	0.07	0.26

Notes: This table reports estimation results from specification (5) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), across the income groups, the correlation between the amount of disbursed climate finance and the recipient country's industry value added (including construction) in three years after the time of disbursement shows statistical significance except for low and high income groups. Between the two income groups where there is a meaningful correlation, both the significance and size of effect are larger for the lower middle income countries. This may be explained by the fact that multilateral climate finance can directly and indirectly contribute to the economic and industrial growth of the recipient country by funding the construction and operation of low-carbon and renewable energy projects. Especially given that the energy sector receives the highest amount of disbursement from multilateral climate finance, as shown in Section 2, this correlation supports existing literature review on the positive contribution of multilateral climate finance to improved energy generation and job creation across industries, especially in the construction sector (Climate Investment Funds, 2021).

4-2-5. Environmentally Displaced Persons (Impact Dimension: Social)

Table 14. Regression Results for Specification (6)

Dependent: lnEnvDisPop$_{it+3}$	(1) All	(2) Low Income	(3) Lower Middle Income	(4) Upper Middle Income	(5) High Income
lnFund$_{it}$	-0.02*	-0.03**	-0.15**	-0.08*	0.17
	(0.14)	(0.02)	(0.04)	(0.06)	(0.24)
lnGDP_pc$_{it+3}$	0.25	-0.39	0.49	1.34**	-3.65*
	(0.24)	(0.39)	(0.41)	(0.51)	(0.67)
lnpop$_{it+3}$	1.00**	0.90	1.26	-1.63	2.96*
	(0.35)	(0.51)	(0.79)	(1.01)	(0.43)
lnREC$_{it}$	-0.00	-0.05	0.01	0.01*	-0.33
	(0.00)	(0.02)	(0.21)	(0.41)	(0.25)
lntrade$_{it+3}$	-0.95	-0.79**	-0.93	0.75	-3.42
	(0.42)	(0.62)	(0.55)	(0.02)	(0.41)
No. of Obs.	1489	624	402	385	78
Country FE	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO
Prob > F	0.000	0.000	0.000	0.000	0.000
(Within) R^2	0.01	0.05	0.02	0.05	0.04

Notes: This table reports estimation results from specification (6) with country- and year-fixed effects. Standard errors in parentheses.
*Significance: 10%, **Significance: 5%, ***Significance: 1%

Controlling for country-specific variables (e.g. GDP per capita, population, renewable energy consumption, and trade-to-GDP ratio), except for the high-income group, the amount of disbursed climate finance has a negative effect on the recipient country's number of environmentally displaced populations in three years after the time of disbursement. It is particularly more apparent at 5% level of statistical significance for low income and lower middle income countries. Furthermore, the effect of increasing 1% of disbursed climate fund is the largest in lower middle income countries, resulting in 0.15% decrease in environmentally displaced persons.

In short, having assessed the development effects of multilateral climate finance through four impact dimensions (environmental, social, policy & institutional, and economic), the findings suggest that climate finance disbursed to a recipient country shares a positive correlation with the amount of CO2 emission reductions, industry value added, and CPIA Rating, while sharing a negative correlation with the number of environmentally displaced populations. In particular, these correlations are stronger for lower- and upper-middle income countries. The effects of multilateral climate finance on Climate Readiness Index are not significant.

V. Policy Recommendations

The quantitative analyses from the previous Section have validated the explanatory power of the identified independent variables in explaining for the variance of multilateral climate finance allocations, as well as the effect of disbursed climate finance on the development effects experienced by the recipient countries.

Based on these findings, this Section offers a set of policy recommendations with the purpose of improving the distributional inclusion and development effectiveness of multilateral climate finance. With the aim of addressing the insights garnered from the quantitative analyses, the policy recommendations are comprised of three strategic targets: (i) Mainstreaming Climate Resilience, (ii) Building Capacity and Readiness with Focus on Expansion of National Implementing Entities (NIEs), and (iii) Addressing the Climate Financing Gap.

5-1. Mainstreaming Climate Resilience

The findings showed the important effect that mainstreaming climate change into national development agendas has on a greater allocation and inflow of multilateral climate finance. This signifies that on the part of recipient countries, there should be increased efforts to mainstream climate change and resilience into their national development strategies, as well as to create enabling environments, policy/legal frameworks, and accountability systems to attract greater inflows of multilateral climate finance. Furthermore, a concrete presence of national climate change plans, strategic visions, and systematic responses to climate change will encourage the providers to channel their finance through country-owned systems, which further empowers the recipient nations to leverage the climate funds in accordance to their own national priorities and growth strategies.

From the multilateral climate finance providers, they should undertake and upscale their efforts in assisting the developing countries to adequately reflect climate resilience into national development strategies and plans. In this respect, Nationally Determined Contributions (NDCs) Partnership is one example of a mechanism in which multilateral development banks collaborate with developing country partners to treat and incorporate climate change as a cross-cutting area of their growth strategies, in addition to assisting them with resources, expertise, and

other necessary tools to access, plan, and implement climate finance initiatives and projects to achieve their NDCs (Asian Development Bank, 2019).

5-2. Building Capacity and Readiness with Focus on Expansion of NIEs

As evident from the findings, the lack of country capacity and readiness to access and absorb multilateral climate finance remains as a prevalent barrier against the effective and sufficient allocation of the diverse climate funds and initiatives. For example, in Asia, a large constraint that prevents the developing countries from attracting and implementing multilateral climate finance is its gap in knowledge and capacity in planning, implementing, and monitoring climate finance (Asian Development Bank, 2017), which includes data availability on climate finance and technical capacity to develop related methodologies and systems. As such, there is a need for multilateral providers to increase the coupling of their finance with technical assistance to increase the in-country capacity and knowledge of recipient countries to access climate finance.

From the part of the recipient countries, they should complement such efforts from multilateral climate financiers by actively engaging in capacity- and readiness-building programs to develop high-quality project proposals, identifying pipelines for priority climate projects, and increasing the transparency and accountability in the management of their public resources.

As a specific approach, efforts should be exerted towards the establishment or expansion of the country's National Implementing Entity (NIE). In the context of multilateral climate finance, NIE is a national body or organization that is accredited by the multilateral climate financier to specialize in the development and delivery of funding proposals, as well as in the mobilization and management of climate finance. The presence of NIE signals the nation's capacity for intra-governmental coordination and a clear agreement on the division of roles and responsibilities, which enhances the identification and alignment of national priorities with climate finance, thereby improving the allocation of climate finance and its translation into impactful projects and programs in the recipient country. In this regard, the establishment or expansion of NIEs will be useful in strengthening the specialization in and engagement with the wide spectrum of available multilateral climate financiers and their separate procedural requirements and eligibility criteria, which

otherwise is a process that consumes a lot of time and resources for the recipient countries (Zou, Ye, and Ockenden, 2016). This approach can also leverage a multitude of co-benefits, such as a greater understanding and knowledge of the wide spectrum of available climate funds and how they may strategically align with the country's national priorities, better coordination of financial and technical support, and prevention of high transactional costs that often incur with external implementing agencies. This will contribute to accelerating the effectiveness and competence in the allocation, uptake, and timely delivery of climate finance in the recipient country.

5-3. Addressing the Climate Financing Gap

The findings confirm that there is a real need to address the climate financing gap, especially with regard to the disproportionate lack of attention being given to severely climate-vulnerable countries. From the providers of multilateral climate finance, there should be greater intra-financier coordination to track and monitor the over-concentration of climate finance flowing into a select number of countries. This mirrors the classic understanding surrounding the more traditional forms of development assistance that coordination across donor agencies at the country-level can improve the effectiveness of resource allocation by avoiding duplication and identifying synergies across initiatives (Zou, Ye, and Ockenden, 2016). In fact, there are already emerging efforts amid multilateral donors on increasing the harmonization of their tracking methodologies and reporting of climate finance. These ongoing efforts can be upscaled towards an enabling environment for deeper intra-financier coordination to address the distributional inequality and its side effects.

Recipient nations can further complement and strengthen such efforts by rendering their climate-related expenditures and investments easier to track. This will be important in allowing the multilateral climate financiers to track the target countries' past and current distribution of climate finance, to identify where there is a financing gap or severe mismatch between climate vulnerability and inflows of climate finance, and to avoid the duplication and over-concentration of financial flows. To this date, based on the OECD methodology of the Rio markers system for climate, a number of countries have developed a national budget code to increase the

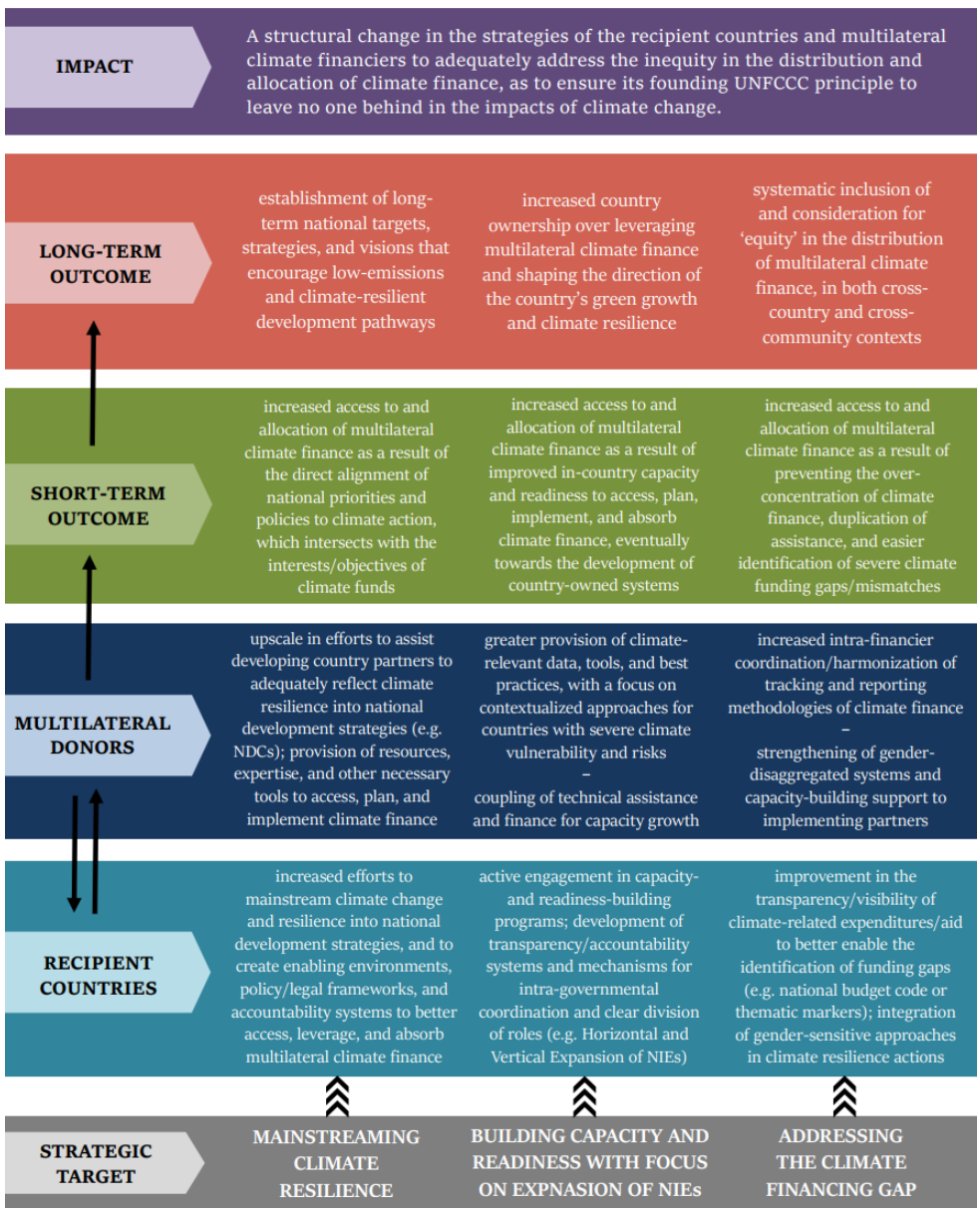
visibility and transparency of their climate-related financial flows (Zou, Ye, and Ockenden, 2016). For example, in Cambodia, the national ODA database allows for the tracking of climate-related and green aid through a sector code and thematic marker on projects with a component of climate change. (Zou, Ye, and Ockenden, 2016).

Lastly, findings demonstrate that the high allocation of multilateral climate finance in a few number of fast-growing economies is not necessarily a *misallocation* of funds, especially in respect to climate mitigation efforts. However, that it is not a fund misallocation does not resolve the severe problems that persist with climate-vulnerable countries not receiving the climate finance that is necessary to reduce their climate risks. This signifies that the current patterns and preferences of distribution in climate finance, wherein 'climate vulnerability' does not function as a significant deciding factor, stand contrary to Article 9 of UNFCCC, which stipulates that "countries that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints" should be prioritized in the allocation of climate finance. Thus, there should be a contextualized approach in providing the financial, technological, and capacity-building support that is uniquely tailored to the specific needs of countries with a high level of climate vulnerability. Such efforts and measures to allocate climate finance in accordance with real needs and risks will play an important role in closing the concerning discrepancy between the founding goals of multilateral climate finance and the reality of its impacts.

As a final component of this Section, a Theory of Change (ToC) diagram below illustrates the necessary inputs from the recipient countries and multilateral donors, as well as the short- and long-term outcomes. The interventions are purposed to generate the end-impact of enabling "a structural change in the strategies of the recipient countries and multilateral climate financiers to adequately address the allocation and development effectiveness of climate finance, as to ensure its founding UNFCCC principle to leave no one behind in the impacts of climate change". In particular, through the three strategic targets on 'Mainstreaming Climate Resilience', 'Building Capacity and Readiness with Focus on Expansion of NIEs', and 'Addressing the Climate Financing Gap', the ToC expects to generate the following long-term outcomes: (i) establishment of the recipient countries' long-term national targets, strategies and visions that encourage low-emissions and climate-

resilient development pathways, (ii) increased in-country capacity and readiness in leveraging multilateral climate finance and shaping the direction of the country's green growth and climate resilience, and (iii) systematic inclusion of and consideration for 'vulnerability' in the distribution and allocation of multilateral climate finance to lessen the financing gap. These are embedded as a reminder that climate finance has the potential to function as gateways to unlock the longer-term development outcomes for recipient countries.

Figure 9. Theory of Change



VI. Limitations and Suggested Research

Notwithstanding the important interpretations and insights offered from this study, it carries a number of limitations, which may suggest guiding points for areas of further research.

Firstly, the scope of this research covers climate finance that is approved and disbursed through multilateral financiers, with the exclusion of climate finance from the private sector and bilateral donors. Especially given the growing and accelerating role of the private sector in the provision and mobilization of development finance in the last decade, the field of climate finance and resilience is not an exception. As such, the exclusion of climate finance from the private sector and bilateral donors may have over-estimated the status and effects of distributional inequality. In this respect, it may be meaningful to examine whether the important patterns and findings of this research remain valid when flows of climate finance from the private sector and bilateral donors are taken into account. In the process, a comparative analysis of the objectives, priorities, funding behaviors, and climate impacts of the three different financier groups (e.g. multilateral, bilateral, and private) may draw important insight and clarity, particularly for developing countries in their portfolio management of from whom and how to seek climate funding sources that most effectively align with their country needs and strategies.

Secondly, in measuring the development effects of multilateral climate finance, this study specifically selected five indicators that are most commonly used by the three representative UNFCCC climate financiers and conducted separate regression models. This signifies that although there may be meaningful insights from assessing the effect of multilateral climate finance on its individual impact dimension, such estimation method may have limited the ability for a more holistic evaluation of 'development effectiveness'. In this regard, for future studies, if a greater number of indicators can be compiled into a composite index, it may be possible to assess how the impact dimensions of climate finance interact, complement or collide with one another.

Thirdly, if and when the data are available, a project-level analysis of the multilateral climate finance projects may provide a more accurate and granular evaluation of their development effects at the project- and community-level.

VII. Conclusions

With the growing presence and importance of multilateral climate finance as a tool for achieving the twin goals of climate mitigation/adaptation and development, this paper examined 2,623 climate finance projects delivered by 19 official multilateral climate financiers to 130 recipient nations during the period of 2003-2021. Based on this data, it assessed the degree of inequality in their distribution, contributing factors to the allocational patterns, and development effects on recipient countries.

The findings suggest that the distribution and allocation of multilateral climate finance are uneven. In evaluating the contributing factors behind such distributional patterns, based on a multiple linear regression model with country- and year-fixed effects, the paper found that yearly disbursed funding from multilateral climate finance is, at meaningful but varying degrees of statistical significance, affected by country-specific characteristics of the recipient nations. It is positively correlated with the recipient countries' improvement in corruption and transparency, greater policy and institutional alignment with climate action, and total CO2 emissions. It further found that this allocation is negatively correlated with the recipient countries' level of debt service to multilateral organizations, whereas it shares no statistical significance with the climate vulnerability. These correlational effects change with time as the findings suggest that the characteristics or performances of the recipient country have the strongest effect on how much multilateral climate finance it receives in the mid-run (2-3 years). In evaluating the development effects of multilateral climate finance against four impact dimensions (e.g. Environmental, Social, Economic, and Institutional & Policy), the paper found that the amount of disbursed climate finance shares a positive correlation with the recipient country's amount of CO2 emission reductions, industry value added, and CPIA Sustainability Rating, while sharing a negative correlation with the number of environmentally displaced populations. In particular, these correlations are stronger for lower- and upper-middle income countries in comparison to low or high income groups, thereby suggesting that the effectiveness of climate finance is affected by the development stage of its recipient nations. For correlations of multilateral climate finance with the Climate Readiness Index, the statistical significance is not apparent.

Based on these findings, a contextualized set of policy recommendations was devised, highlighting the necessary inputs and actions from both the recipient countries and multilateral climate financiers. They emphasize on: (i) Mainstreaming Climate Resilience, (ii) Building Capacity and Readiness with Focus on the Expansion of NIEs, and (iii) Addressing the Climate Financing Gap. It is embedded in the understanding that the effective allocation and delivery of climate finance, as well as a holistic improvement in the international climate finance architecture at large, will require a multi-faceted and multi-stakeholder approach.

As climate change continues to pose increasing risks to both human and natural systems, the need for a shift towards low-carbon and sustainable development is imperative to meet the future challenges. In this context, combined and complementary efforts from both the recipient countries and multilateral climate financiers are absolutely vital to navigate climate finance towards not only greater quantity, but also better quality and equality. To that end, climate finance will be empowered to function in accordance with its founding UNFCCC principle and goal of truly leaving no one behind from the impacts of climate change.

References

Alcayna, Tilly. Rep. *At What Cost? How Chronic Gaps in Adaptation Finance Expose the World's Poorest People to Climate Chaos*. Mercy Corps, July 2020. https://europe.mercycorps.org/sites/default/files/2020-07/1087-PA-ZFRA-AtWhatCost-V15c-WEB.pdf.

Bird, Neil, Helen Tilley, Nella Canales Trujillo, Godber Tumushabe, Bryn Welham, and Pius Yanda. "Measuring the Effectiveness of Public Climate Finance Delivery at the National Level." Overseas Development Institute. Overseas Development Institute, March 2013. https://cdn.odi.org/media/documents/8303.pdf.

Carfora, Alfonso, Monica Ronghi, and Giuseppe Scandurra. "The Effect of Climate Finance on Greenhouse Gas Emission: A Quantile Regression Approach." *International Journal of Energy Economics and Policy* 7, no. 1 (2017): 185–99.

Carrozza, Ilaria. "Climate Finance: Challenges and Opportunities for the Asia-Pacific." United Nations Economic and Social Commission for Asia and the Pacific, July 2014. https://www.unescap.org/sites/default/files/RRSOED-Climate-finance-challenges-and-opportunities-for-the-Asia-Pacific-by-Ilaria-Carrozza.pdf.

"Climate Change Operational Framework 2017-2030." Asian Development Bank. Asian Development Bank, July 2017. https://www.adb.org/sites/default/files/institutional-document/358881/ccof-2017-2030.pdf.

Ellis, Jane, Randy Caruso, and Stephanie Ockenden. "Exploring Climate Finance Effectiveness." Organization of Economic Co-operation and Development, October 2013. https://www.oecd-ilibrary.org/docserver/5jzb44nmnbd2-en.pdf?expires=1659534993&id=id&accname=guest&checksum=599D263302071D258651E3047EDA765A.

Jaspal, Mannat, and Terri Chapman. "Exploring the Inequities of Climate Finance." Observer Research Foundation, May 22, 2022. https://www.orfonline.org/wp-content/uploads/2022/05/ORF_IB-543_Exploring-the-Inequities-of-Climate-Finance.pdf.

Kato, Takayoshi, Jane Ellis, Pieter Pauw, and Randy Caruso. Rep. *Scaling up and Replicating Effective Climate Finance Interventions*. Organization of Economic Co-operation and Development/International Energy Agency, May 2014. https://www.oecd-ilibrary.org/docserver/5js1qffvmnhk-en.pdf?expires=1627445748&id=id&accname=guest&checksum=62EC997AC1D2D2DEF923480ACCAAF2DF.

Nakhooda, Smita, and Marigold Norman. Publication. *Climate Finance: Is It Making a Difference? Review of the Effectiveness of Multilateral Climate Funds*. Overseas Development Institute, December 2014. https://cdn.odi.org/media/documents/9359.pdf.

Pasricha, Nicole, and Madu Selvakumar. "Social and Economic Development Impacts of Climate Finance: What We've Learned So Far." Climate Investment Funds, March 30, 2021. https://www.climateinvestmentfunds.org/news/social-and-economic-development-impacts-climate-finance-what-we%E2%80%99ve-learned-so-far.

Rickman, Jamie, Sumit Kothari, Francesca Larosa, and Nadia Ameli. "The Unequal Distribution of International Climate Finance Flows and Its Underlying Drivers." University College of London, February 9, 2022. https://assets.researchsquare.com/files/rs-1188981/v1_covered.pdf?c=1644431562.

Sato, Ichiro, Beth Elliott, and Clea Schumer. "What Is Carbon Lock-in and How Can We Avoid It?" World Resources Institute, May 25, 2021. https://www.wri.org/insights/carbon-lock-in-definition.

"Tackling Climate Change, Building Climate and Disaster Resilience, and Enhancing Environmental Sustainability 2019-2024." Asian Development Bank, September 2019. https://www.adb.org/sites/default/files/institutional-document/495961/strategy-2030-op3-climate-change-resilience-sustainability.pdf.

Watson, Charlene, and Liane Schalatek. Rep. *Climate Finance Regional Briefing: Asia*. Climate Funds Update, February 2021. https://climatefundsupdate.org/publications/climate-finance-regional-briefing-asia-2020/.

Zou, Sani Ye, and Stephanie Ockenden. "What Enables Effective International Climate Finance in the Context of Development Co-Operation?" Organisation for Economic Co-operation and Development (OECD). The Development Assistance Committee, June 2016. https://www.oecd-ilibrary.org/docserver/5jlwjg92n48x-en.pdf?expires=1627363626&id=id&accname=guest&checksum=DCCFE2EC65D20BD0B78FBEA5F3E7F9C2.

Appendix

Table A1. List of 19 Multilateral Climate Financiers

#	Name	Acronym	Focus
1	Adaptation for Smallholder Agriculture Programme	ASAP	Adaptation
2	Adaptation Fund	AF	Adaptation
3	Clean Technology Fund	CTF	Mitigation – General
4	Forest Carbon Partnership Facility: Readiness Fund	FCPF-RF	Mitigation – REDD
5	Forest Carbon Partnership Facility: Carbon Fund	FCPF-CF	Mitigation – REDD
6	Forest Investment Program	FIP	Mitigation – REDD
7	Global Environment Facility	GEF4	Multiple Foci
8	Global Environment Facility	GEF5	Multiple Foci
9	Global Environment Facility	GEF6	Multiple Foci
10	Global Environment Facility	GEF7	Multiple Foci
11	Global Climate Change Alliance	GCCA	Multiple Foci
12	Global Energy Efficiency and Renewable Energy Fund	GEEREF	Mitigation – General
13	Green Climate Fund IRM	GCF IRM	Multiple Foci
14	Green Climate Fund	GCF-1	Multiple Foci
15	Least Developed Countries Fund	LDCF	Adaptation
16	MDG Achievement Fund	MDGAF	Adaptation
17	Partnership for Market Readiness	PMR	Mitigation – General
18	Special Climate Change Fund	SCCF	Adaptation
19	UN-REDD Programme	UN-REDD	Mitigation – REDD

국문 초록

국제사회에서 기후금융의 중요성이 증가하고 있음에 따라, 본 연구의 목적은 2003년부터 2021년까지 19개의 다자 기후기금에서 130개 수혜국에 조달한 2,623 개의 기후금융 사업을 분석하여 다자간 기후금융 재원의 배분 양상과 개발효과를 조사하는 것이다.

패널 데이터와 다중선형 회귀분석을 바탕으로 본 연구는 다자간 기후금융 재원의 배분을 결정하는 주요 요인들과 국가적 특성을 분석하여 연간 승인된 기후자금이 수혜국의 부패 및 투명성 개선, 기후 행동과의 정책적 및 제도적 일관성, 총 CO2 배출량과 양의 상관 관계가 있음을 발견하였다. 이는 수혜국이 다자 기구 및 은행에 가진 부채 수준과 음의 상관관계를 보이는 반면, 수혜국의 기후 취약성과는 통계적으로 유의하지 않음을 발견하였다. 또한, 본 연구는 대표적인 다자 기후기금(녹색기후기금, 지구환경금융, 세계은행의 적응기금)의 결과프레임워크(Results Frameworks)를 비교 분석하여 기후금융자원의 개발효과를 평가할 수 있는 다섯 가지 지표를 선정하였다. 이에 따른 분석 결과, 기후금융 자원 조달은 수혜국의 총 CO2 배출 감축량, 산업 부가가치, 기후변화 관련 정책 및 제도적 지수와 양의 상관관계를 보였고 환경이재민 발생 수와는 음의 상관관계를 보였다. 특히, 이러한 상관관계는 저소득 및 고소득 국가들에 비해 중하위 및 중상위 소득 국가에서 보다 강하게 나타났다. 이에 반해, 기후변화 위험 · 취약성 지수와는 유의미한 상관관계가 드러나지 않았다.

이러한 결과를 바탕으로, 본 연구는 (i) 기후 회복력의 주류화, (ii) 국가이행기구(NIE)의 확장에 초점을 둔 역량 및 기후준비성 구축, 그리고 (iii) 기후자금 조달의 격차 해소에 중점을 둔 정책을 제시한다. 이는 기후금융의 개발효과와 재원 배분의 형평성을 향상시키고 국제 기후금융 구조의 전체적인 개선을 위해서는 다면적인 접근법이 필요하다는 주요 시사점을 전달하는 데에 의의가 있다. 이를 통해 다자 기후기금 조달의 결정요인 및 개발효과에 대한 논의를 조명해 보고자 한다.

주제어: 다자기후기금, 기후 · 녹색금융, 기후변화, 개발금융, 개발효과성

학번: 2020-21964