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Research article

Host country characteristics attracting climate projects through public-private partnerships

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Abstract: Climate technology transfer to developing countries face a range of challenges stemming from the capacity of destination or host countries. Access to finance has been identified as a major barrier in academic literature as well as by the donor community, and efforts were made to not only fill some of the gap, but also to reduce local hurdles and usher in private sector investments. This latter phenomenon has not gained similar scrutiny as projects under carbon finance schemes or technical assistance projects of international development organizations. This paper offers an outcome evaluation of a public-private partnership as it relates to climate finance & technology investment in developing countries. The analysis focused on the activities of Private Financing Advisory Network (PFAN), which works through open solicitation of projects sought from developing countries. Therefore, it would be expected that some countries are better equipped to attract investments than others. Using cross-sectional country characteristics data, negative binomial regression was used to associate the characteristics with the count of projects in host countries. Results show that key characteristics associated with the respective number of projects are the size of the market, and a composite score measuring health of the financial sector in host countries. It reaffirms the pattern that private-sector driven initiatives tends to tilt towards destination where the returns of investments are greatest, or the risks of investments are lower. The findings highlight the question of additionality of climate technology investments, and whether the public-private partnership address the barrier of access to finance.

Keywords: financial markets; Clean Development Mechanism (CDM); Getting Credit Distance to Frontier; outcome evaluation; additionality

JEL Codes: 057, 043, 022, 019

1. Introduction

Technology transfer to developing countries was and remains a priority under the United Nations Framework Convention on Climate Change (UNFCCC). It is generally well understood that to prevent lock-in of old, inefficient and carbon-intensive technologies, the global community needs to facilitate transfer of technology through successful adoption and diffusion. Achieving the goals of the Paris Agreement requires momentous industrial change that involves development, installation and use of efficient & renewable technologies, many of which are widely available only in relatively few countries. Concerted efforts are needed to facilitate the transformational change utilizing all avenues & platforms of technology transfer that seeks to address well-known barriers: access to finance, technology familiarity, regulatory barriers and lack of technical capacity.

Climate finance and technology governance have been dominated with the ideals of free market economy. This school of thought maintains that markets can expand sufficiently to allow appropriate technology & services to compete in the market if trade barriers are reduced and governments take an active role in creating incentives (Hogarth, 2012). There are also sceptics of market modernization potential, making the case for more socially beneficial technology deployment which may not always be profitable (Stevenson, 2013). There is wider recognition that governments alone cannot provide enough capital for clean energy transition at the speed and scale necessary to meet global climate and energy challenges (UNIDO, 2016). There is a huge need for energy investment in poor countries, and there is a huge amount of capital in rich-world pension funds. However, currently these prospects in developing countries does not appeal to those funds' appetite for safe and reliable investments (The Economist, 2019). International Finance Corporation (IFC) forecasts that there will be approximately US$ 23 trillion of climate investment opportunities between 2016 and 2030 in emerging markets which equates to over US$ 1.6 trillion per year when distributed equally across the 14-year period (Clark et al., 2018).

Operationalizing the process of climate technology transfer requires better understanding of not only the actors involved but also mechanisms they use to operate. Whereas multilateral initiatives such as funds under the Global Environmental Facility (GEF), and mechanism of the United Nations Framework Convention on Climate Change (UNFCCC), have been extensively studied and analyzed by researchers, private sector driven initiatives have seen less scrutiny. Researchers have been particularly keen in studying country-wise allocation of multilateral funds, as well as market mechanisms where China and India dominated supply of credits under Clean Development Mechanism (CDM). The modality of Public-Private Partnership (PPP) in climate technology diffusion also needs similar attention for impact evaluation & cost-effectiveness. This latter modality is increasingly being adopted by bilateral & multilateral funds in the form of blended finance and innovative financing for sustainable development goals. However, critical analysis on their processes, outcomes and externalities have lagged in climate finance and policy debates. This study addresses part of the gap by offering an outcome evaluation of a prominent public-private partnership financing mechanism for climate technologies, where the stated intentions are matched with outcomes in a manner that is traditionally beyond the scope of evaluation reports of donor supported interventions. Following a brief review of literature on the emergence of climate partnerships, Private Financing

Advisory Network (PFAN) is introduced in subsequent sections as the PPP studied in this paper. Distribution of projects in countries and existing donor centered evaluation report of PFAN prompted further investigation to identify why some host countries have more projects than others. Using similar analytical approaches used for GEF and UNFCCC mechanisms in academic literature, this paper highlights some shortcomings in public-private partnership & totally private driven approach, which can aid in further reforms of this important channel.

2. Literature review

Risky environment and uncertain returns have not deterred several multilateral and bilateral agencies to work on technology transfer in last two decades, even as these low carbon technologies themselves matured. Agencies such as Global Environmental Facility (GEF), which is considered a forerunner to the Clean Technology Fund (Dixon et al., 2010), are mainly involved under a non-market mechanism of technology transfer made on project-by-project basis. Under the market mechanism, Clean Development Mechanism (CDM) and Joint Implementation (JI) have been attributed for successful cases of climate technology transfer. Existing literature has mainly studied the market-based instrument of CDM and whether projects under this mechanism entails technology transfer or reap development dividends (Dirix et al., 2015; Gandenberger et al., 2015). On the other hand the types & distribution of projects of GEF have been well studied as non-market mechanism (Dixon et al., 2010; Rahman & Ahmad, 2015).

In recent years, other avenues of climate technology transfers have developed through PPPs, which differs in structural settings of multilateral agencies with rules governing project conduct. Public-private partnerships build on a voluntary agreement between actors from various sectors to govern a distinct issue area in the sustainability agenda (Pattberg, 2010). Climate PPPs institutionalize a hybrid authority in the international arena by establishing common norms, rules, objectives, and decision making & implementation procedure for a specific policy problem. A prime illustration of such partnership in climate governance is Renewable Energy and Energy Efficiency Partnership (REEEP) which is a market-oriented group of actors facilitating exchange of technologies, identifying and removing policy and regulatory barriers in the renewable energy market, and providing information for various stakeholders (Pattberg, 2010). Emergence of such partnerships signifies a shift to new modes of climate governance, which builds on having non-hierarchical structure; being more decentralized, voluntary, and market-oriented (Backstrand, 2008).

There are supporters and critics of the partnership approach in global environmental governance. Proponents support partnerships because they are effective in performance due to their decentralized structure, collaborative nature, speed and bringing in diverse expertise from public and private sectors. Inclusion of various stakeholders are thought to increase legitimacy and accountability. Partnerships can also reduce the implementation deficit by connecting local practice and global rules in a flexible and decentralized manner (Backstrand, 2008). On the other hand, there are drawbacks in using partnership approach as an implementation mechanism. Partnerships can have negative effects such as increased business influence, power inequalities and skewed representation of stakeholders, fragmentation of global governance, and the retreat of state responsibility in the production of public goods (Backstrand, 2008). Andonova (2010) argues that such fragmentation of environmental regimes and the parallel growth of nonstate actors created the structural pressures and opportunities for public-private collaboration. Furthermore, bilateral and multilateral organizations acted as entrepreneurs to facilitate collaboration with private actors within their spheres of expertise. Explanation of their role as entrepreneurs in attracting nonstate partners for environmental governance are more likely due to budgetary pressures or limited resources (Andonova, 2010).

Given the complex definitions, modalities of technology transfer and the involvement of multiple stakeholders, it is difficult to analyze and evaluate all platforms under one framework. Whereas CDM projects rush towards the bottom-line of carbon credits, projects of GEF and other bilateral agencies are products of country negotiations based on gaps and needs. JI projects can be categorized in the middle as it shares both country initiation (host and source), as well as opportunity for earning carbon credits. However, projects under climate PPPs have previously not been analyzed, collectively grouped or have had their impact assessed broadly. Pattberg (2010) highlights few problems in assessing broader implications of public-private partnerships in global climate governance. First, partnerships have different ambitions, scope and scale making comparison across the board difficult. Second, the long-term effects of public–private partnerships on greenhouse gas concentration levels are impossible to estimate. Therefore, most attention is directed toward their output and outcome i.e. evaluating how the activities of the partnerships are affecting changes in the issue area of the sustainability agenda. Finally, there is a dearth of reliable data on climate change partnerships, and even when they exist it is biased toward the most visible partnerships.

In contrast, similar climate project activities under Official Development Assistance (ODA) and carbon finance mechanisms have been extensively studied internally as well as by academic researchers. Kennedy and Basu (2013) explored the impact assessment procedures of international mechanisms and found that logical framework and outcome mapping approach dominates, which captures criteria such as energy savings, generation from renewable sources, greenhouse gas emissions averted, and development impacts such as employment generation. Impact assessment beyond these variables remains beyond the scope of these institutions, and there are often attribution gaps for the interventions (Kennedy & Basu, 2013). Similarly, there are ample academic literature connecting the indicators of national innovation system with CDM projects. Although most of the studies considered the hardware and software manifestation of technology transfer, relatively low number of studies exist on the dimensions of "orgware" (institutional and policy capabilities) as coined by de Coninck and Bhasin (2015). Studying mostly the sourcing pattern and technology determinants, these studies found that technology transfer is positively associated with larger projects, availability of foreign partners, affiliations with foreign company, countries that are small and have larger GDP (Doranova et al., 2010). Other studies have also tested measures of economic and regulatory environments, human capital (Schmid, 2012) as well as country level technological capability (Dechezleprêtre et al., 2008) associated with sourcing of technology.

What is missing in the literature is testing the association of similar factors for the platform of public-private partnership for climate technology transfer. Studying these associations are important because unlike other institutions (CDM and GEF), platforms like PFAN solicit proposals from private sector which then undergoes project development and finally match-making with funding partners and donors. The latter platform may not insist strongly on additionality conditions, which mandates that the projects will not be possible without deliberate interventions. Micro-economic additionality is a key condition for registration of CDM projects, where project developers demonstrate that CDM revenues (from the sale of carbon credits) are necessary to make the project viable. The project, as an offset activity, must have its own baseline which is defined in terms of what would have been the case in the absence of the mechanism. Comparison of the two scenarios will determine if the project is additional or not. In the case of GEF, the agency pays the incremental costs of greenhouse gas reduction demonstration projects in developing countries (Sugiyama & Michaelowa, 2001), making additionality key criteria in project finance. However, macro-economic additionality is overlooked in most type of projects. An example to illustrate macro-economic additionality is the lack of feed-in-tariff program in countries, that may make solar or wind projects additional. However, when such tariffs are introduced, the projects may not be additional. This policy shift favors low carbon energy sources; negating the previous business-as-usual scenarios will not apply to make individual projects an additional source of emission abatement. Therefore, the enabling frameworks of the countries, as well as the capacity of the private sector, needs to be adequately examined to realize the full potential of all platforms, but specially the public-private partnership approach due to its open solicitation modality.

2.1. Private Financing Advisory Network (PFAN)—an introduction

PFAN is a public-private partnership of investors, entrepreneurs, and technical experts designed in response to the lack of public resources available for investment in clean energy technology. It was created in 2006 by the Climate Technology Initiative (CTI) in cooperation with the UN Framework Convention on Climate Change (UNFCCC) to provide advice & guidance on project development, technical assistance, and match-making services with potential investors. These services are offered at no cost to selected projects and entrepreneurs as that cost is covered by USAID, SIDA and other public agencies. Using a small amount of public funding to leverage private sector investment (leverage rate of USD 80-100 for every dollar of donor funds), PFAN's stated goal is to address the barriers to finance for small & medium enterprises, and build capacity of local financial institutions to engage with the low carbon, climate resilient technology sector (PFAN, 2017). PFAN has financially closed some 87 projects, with almost three hundred projects inducted into the Project Development Pipeline[1]. In 2016, PFAN passed the milestone of having raised over $1 billion in financing for clean energy in 35 developing countries, even though it operates in total 56 countries (Figure 1). It is under transition to become a project activity of UNIDO, with its activities executed through Renewable Energy and Energy Efficiency Partnership (REEEP). Project data were sourced from the Project Management Information System (PMIS) that lists the projects according to countries, technology and status type. There are 380 projects inducted in the project pipeline, but the implementation or grooming status of most of the projects are not clearly identified.

Figure 2 shows the distribution of the projects according to technology types. A good portion of the projects belonged to the adaptation sub-field which started to emerge from year 2013. Figure 3 shows the total capacities of each energy types across all regions. Figure 4 shows the distribution of the projects in each of the 56 countries where PFAN operates and how the distribution differs with CDM projects.

[1] CTI PFAN, "About", http://cti---pfan.net/about/

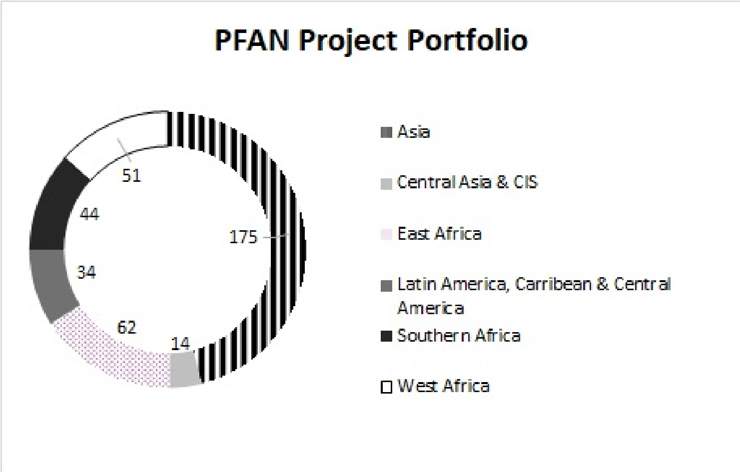

Figure 1. Regional distribution of the PFAN projects in the pipeline.

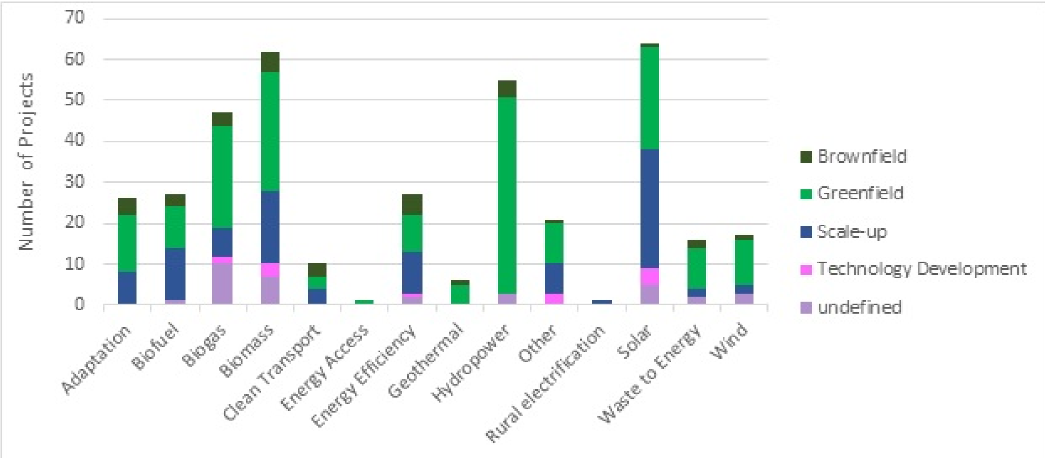

Figure 2. Project Business categories according to technology & energy.

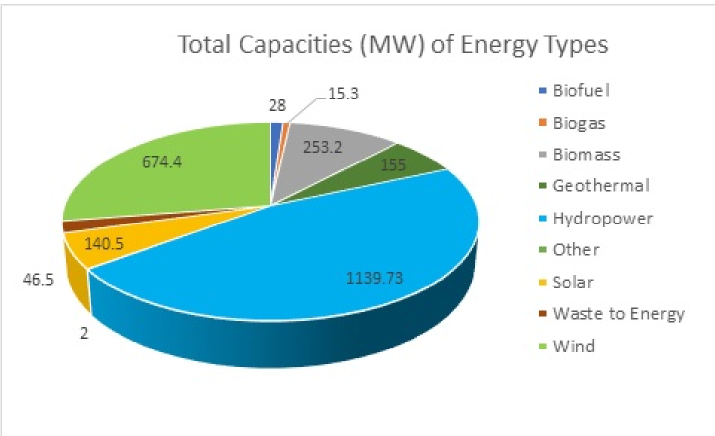

Figure 3. Total Capacities across all regions.

3. Research objectives

A cursory look at the projects confirm that most of the projects involve technology transfer in the form of hardware, but it is essentially initiated by project developers in unsolicited forms or special calls for proposal. This approach is significant departure from other forms of climate technology transfer projects. Whereas CDM projects follow the emission reduction potential, and GEF financed non-market projects are negotiated outcome in accordance to host country needs, projects under PFAN have open invitation despite certain limitations in the form of investment caps. This presents an interesting scope to study how capacities related to access to finance of each host countries may play a role in attracting climate technology projects through this PFAN channel. Although PFAN has been operating since 2006, literature reveals there is a lack of comprehensive scholarly review, summary and analysis of the PFAN investment portfolio dealing with technology transfer.

Figure 4 also shows interesting patterns that prompts further exploration. The countries attracting more CDM projects (carbon finance), and countries attracting PFAN projects (public private partnership investments) differ. Since the mode of operation for PFAN is open call for proposals, one would expect that CDM participation would expose countries to other opportunities, and there would be some countries that will attract investments better than others. Although there are no country preferences, PFAN's aim to provide vital, additional services so that projects become financially viable, bankable and ultimately reach financial closure—suggest that a stable investment environment will be conducive to more projects. Well-developed local financial markets are considered necessary to commercialize new ventures in the early stages (Comin & Nanda, 2014; Kim & Park, 2018). The project document for PFAN highlights clean energy investment readiness frameworks like Climatescope or RISE—Readiness for Investment in Sustainable Energy (World Bank) as indicators for countries with enabling policy environments in place for project involvement (UNIDO, 2016). In addition, an evaluation report of PFAN (Addison et al., 2015) points out that the number of "right projects" is a function of many factors including:

- market size (the number of right projects will be higher in India compared to Malawi, with the familiar ceteris paribus conditions);
- the presence of fossil fuel subsidies and rural electrification by grid extension (the number of projects will be higher in Cambodia compared to another country where only these differences prevail);
- the number of alternatives;
- the current level of clean energy penetration; and
- the degree of local funding sources.

This evaluation report is mostly qualitative, and findings are based on interviews of project managers & other stakeholders. As a donor driven evaluation, the objective was to justify funding continuation through a process review and not an outcome review. However, stakeholder perception on the influence of these indicators on project numbers offers a pathway to explain existing distribution of the projects as seen in Figure 4. As these qualitatively determined indicators have not been tested the way it has been done for CDM projects in academic literature, the fundamental research question of this study is exploring what are the host country characteristics associated with greater public-private investment (PFAN projects) in climate technologies? The grouping of the business types by PFAN was also examined as a secondary research question. The objective was to explore if similar host country characteristics affected the business type of projects—greenfield, brownfield, scale-up or technology development, that are in the host countries.

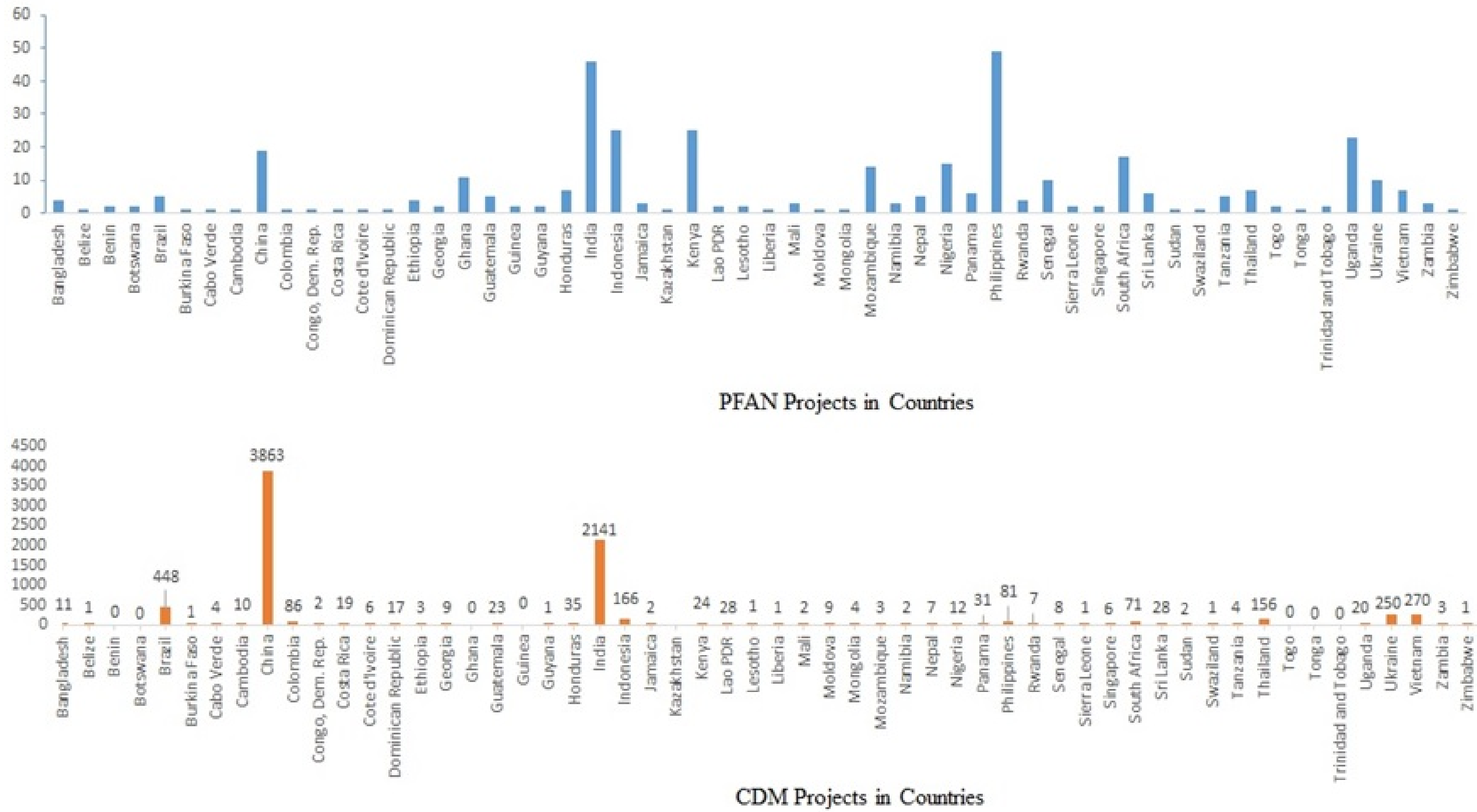

Figure 4. Comparison of country-wise CDM and PFAN projects.

4. Methods of analysis

4.1. Negative binomial regression

For the first research question aimed at understanding host country characteristics associated with PFAN projects in the country, the dependent variable is count data of the number of PFAN projects from each country. Using Ordinary Least Square (OLS) regression is problematic due to several inherent violations in the assumptions used for estimation. The count of PFAN project in countries is best reflected by the Poisson distribution where count outcomes take value that is greater than 0 and has positive skewness. Since the data violates the equi-dispersion assumption of Poisson model, negative binomial model is used to account for the problem (Coxe, et al., 2009). The regression model considered in this question has the following form:

$$f(y_i|x_i) = \frac{\Gamma\left(y_i+\frac{1}{\alpha}\right)}{\Gamma(y_i)\Gamma\left(\frac{1}{\alpha}\right)} \left(\frac{1}{1+\alpha\mu_i}\right)^{\frac{1}{\alpha}} \left(\frac{\alpha\mu_i}{1+\alpha\mu_i}\right)^{y_i}; \quad y_i = 0,1,2,3, \dots \dots \tag{1}$$

where, the conditional mean is

$$\mu_i = E(y_i) = e^{\sum_{j-1}^{k} x_{ij}\beta_j}; \quad i = 1,2,3,4, \dots \dots . n \tag{2}$$

and the conditional variance is

$$Var(y_i) = \mu_i + \alpha\mu_i^2 > E(y_i|x_i) \tag{3}$$

Three different negative binomial regression models were assessed, since addition of important independent variables led to further reduction of sample size. Due to multicollinearity, some of the variables were used interchangeably across models, with the intention of determining association and not predict the number of projects.

4.2. Multinomial logit model estimation

Since the dependent variable in the second research question is the nominal variable of project business type with four possible outcomes, multinomial logistic regression model was used as simultaneous estimator of separate binary logit for each pair of outcome categories. The reference category for this analysis was “Brownfield” projects, although traditionally it is decided based on the modal category, or category having the least frequency. The reason for this selection was because in the context of climate technology and associated investment brownfield projects are not common or expected. There are no generally accepted definition of brownfield projects, but it is commonly used to refer sites or facilities that have been developed and/or currently being utilized (Alker et al., 2000). Although some of the brownfield projects in the PFAN pipeline include expansion of existing hydropower facilities or other renewable energy facilities, such projects are generally financed internally or through multilateral financing organizations. Therefore, the analysis contrast categories that are Greenfield projects versus Brownfield projects, Scale-up projects versus Brownfield projects, and Technology Development projects versus Brownfield projects. The probability of choosing project business type j is given by

$$p_j = \exp[X'\beta_j]/D; \quad j = 1,2,3 \tag{4}$$

$$\text{and } p_4 = \frac{1}{D}$$

where

$$D = 1 + \sum_{j=1}^{3} \exp[X'\beta_j] \tag{5}$$

(j = 1, 2, . . .,4) are the different alternatives, p_j is the probability of choosing project business type j, X is a vector of control variables, and βj is the vector of coefficients pertaining to different business types.

4.3. Data sources

Unlike CDM projects, which is hosted by a robust database system by the UNFCCC, PFAN project pipeline records are not comprehensive thereby restricting the scope of the analysis. For the first research question, the countries were the unit of analysis, restricting the sample size to 89 countries where CDM projects are available. This set of countries were chosen to include the countries where PFAN projects exists as well as countries with no PFAN investments. Since the intention of PFAN is to address barrier of access to finance, CDM host countries offers practical comparison since these countries are also the ones needing climate technology investments. For the second research question, 312 PFAN projects were the unit of analysis, after correcting for missing data.

The country level data for constructing independent and control variables were acquired mostly from World Bank open database. Since the number of projects inducted each year is small to deduce any association, cross-sectional data was used for the analysis. Instead the strengths of the distribution of the projects over ten years were matched with key explanatory variables, which includes some recent values. Other country level data making up the independent variables were sourced from UNEP DTU Pipeline of CDM/JI projects, International Energy Agency (IEA), and other specialized reports of World Bank such as Ease of Doing Business Index, and Regulator Indicators for Sustainable Energy (RISE).

4.3.1. Dependent variable

For the first research question, the dependent variable is the count variable of number of projects in a country. Based on the information contained in the Project Pipeline, the business types were sorted to count the number of projects that are categorized as "Greenfield", "Brownfield", "Scale-up" or "Technology Development". Such categories are determined by PFAN, and was available for 312 projects in the pipeline, although there are project similarities that could have been used to categorize the projects where it is not explicitly mentioned. Figure 5 illustrates the project business types that have been identified.

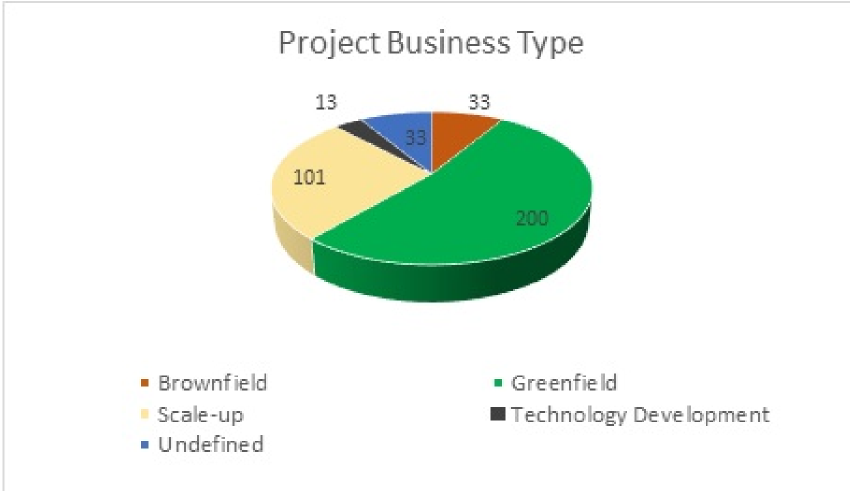

Figure 5. Type of PFAN projects.

4.3.2. Independent variables

Country specific characteristics included in the analysis were mostly based on country size, income level, trade & related investments, and share of renewable energy in electricity generation. Indicators were also chosen representing the multidimensional concepts of policy & institutional capacity to attract in private investment in climate technology. Some of these measures were qualitatively discussed in the evaluation report and project proposal, and the aim of this analysis was to test the association across countries to see if these factors play a role on PFAN investment or investments are much more diffused.

Country size is measured through the size of population, as it is reflective of the market size that invites investment (Addison et al., 2015). Countries with higher level of wealth, reflected by GDP per capita, will require lower outside investment in climate technologies. Due to measurement differences with other variables, these two variables were transformed using natural log following the model used by Doranova et al. (2010). Access to electricity is the percentage of population with access to electricity, which is an important parameter to test considering the "scale-up" projects involved which mostly deal with energy access issues such as improved lighting, cook-stoves, solar-home systems etc. Since the PFAN evaluation report specifically acknowledged that rural electrification by grid influences the number of "right projects", access to rural electricity as percentage of population was also considered in one of the models. As the two-separate metrics of access to electricity were found to be highly correlated GDP per capita, the later variable was not used in the analysis and it was also not explicitly identified in the PFAN evaluation report.

The number of CDM projects in the country were treated as the alternatives to PFAN projects. As a general measure of pollution, carbon dioxide emissions per capita is added to the model to see whether PFAN projects countries end up with higher emissions per capita or not. RISE is a composite indicator comparing policy and regulatory frameworks for sustainable energy that can indicate the investment readiness of a country (Banerjee et al., 2017). For the sample of 89 countries in this analysis, RISE scores were only available for 65 countries, thereby necessitating a separate model.

Getting Credit Distance to Frontier (GCDTF) illustrates the distance of an economy to the "frontier", which represents the best performance observed Getting Credit criteria under the Ease of Doing Business index developed by the World Bank. An economy's distance to frontier is indicated on a scale from 0 to 100, where 0 represents the lowest performance and 100 the frontier. For example, a score of 75 in 2017 means an economy was 25 percentage points away from the frontier constructed from the best performances across all economies and across time. GCDTF explores two sets of issues—the strength of credit reporting systems and the effectiveness of collateral and bankruptcy laws in facilitating lending. Research has shown that legal protections for both creditors and institutions for sharing credit information are associated with higher ratios of private credit to GDP (World Bank, 2017).

Since the technology types associated with the projects often involve import of technologies, overall imports as percentage of GDP was also used in the multinomial analysis along with Foreign Direct Investment (% of GDP), which have been identified as the source of new knowledge & technology (Doranova et al., 2010). Table 1 summarizes the information on the variable and their descriptive statistics. Table 2 presents the correlation coefficients among all variable.

Table 1. Descriptive Statistics of dependent & independent variables.

Variable	Ob.	Mean	Std. Dev.	Median	Min	Max
Countries with CDM Projects	89	4.27	8.61	1	0	49.00
Access to Electricity (%)	89	70.33	33.2	88.66	7	100
Access to Rural Electricity (%)	89	61.94	38.18	78.31	0.4	100
Population (ln)	89	16.48	1.68	16.59	11.58	21.04
GDP/capita (ln)	89	7.86	1.05	8.01	5.65	10.87
Getting Credit Distance to Frontier (GCDTF)	89	51.29	22.47	50	0	95
Foreign Direct Investment (% of GDP)	89	4.46	6.48	2.92	−1.04	43.33
Import of goods (% of GDP)	87	44.8	24.38	39.52	12.58	163.21
Renewable Energy Output (% total Electricity)	89	41.99	34.17	41.18	0	100
No. of CDM Projects	88	100.02	469.07	7	0	3863
Fossil Fuel Subsidy (% of GDP)	62	6.04	8.86	2.97	0.01	60.73
Readiness for Investment in Sustainable Energy (RISE) score 2016	65	51.2	19.65	53	11	81.00
CO_2 emissions (metric tons per capita)	88	2.48	4.25	1.3	0	34.2

Table 2. Pearson's Correlation matrix for dependent & independent variables.

	Projects	Access to Electricity	Access to Rural E	Pop. (ln)	GDP/cap (ln)	GCDTF	FDIP	Import	REO	CDM	SubsidyP	RISE 2016	CO_2
Projects	1												
AccesstoE	−0.0379	1											
AccesstoRE	0.0497	0.9069	1										
Population (ln)	0.4822	−0.0584	−0.0230	1									
GDP/cap (ln)	−0.0893	0.8008	0.7231	−0.1489	1								
GCDTF	0.2333	0.1928	0.2501	0.1132	0.1273	1							
FDIP	0.0129	−0.1198	−0.1236	−0.1584	−0.0499	−0.0799	1						
Imports	−0.1559	0.0238	0.0155	−0.4782	0.0714	−0.1601	0.3696	1					
REO	−0.0553	−0.3551	−0.2818	0.0568	−0.2992	0.1330	−0.0251	−0.0653	1				
CDM	0.4346	0.1377	0.1456	0.4515	0.1114	0.1041	−0.0446	−0.1562	−0.098	1			
SubsidyP	0.0903	0.2576	0.1792	0.1576	0.0911	0.0829	−0.0253	−0.0667	−0.274	0.2582	1		
RISE 2016	0.1546	0.6680	0.6684	0.3991	0.5907	0.2293	−0.2560	−0.2027	−0.293	0.3012	0.2376	1	
CO_2	−0.0407	0.3349	0.2446	−0.065	0.4460	0.0541	0.0846	0.0247	−0.321	0.1267	0.2943	0.584	1

5. Results

Table 3 shows results of the first research question presenting the estimates of the negative binomial regression where the dependent variable is the count of projects in host countries (Equation 1). Model 2 incorporates fossil-fuel subsidy (% of GDP) available for 60 countries, and model 3 incorporates RISE 2016 scores which is available for only 64 countries. This analysis is the first attempt to test the association of these variables, even though they have been qualitatively identified to be important factors (Addison et al., 2015; UNIDO, 2016). It is important to note that this analysis links the project number/type and host country characteristics in cross-section, offering a snapshot of the association. Such a snapshot of the links does not allow to draw robust conclusion on a causal relationship between number of projects and host country characteristics. By contrast the term determinants refers to a causal relationship between the variables over time. For these reasons, the paper discusses associations between number of projects and host country characteristics rather than determinants of climate project destination (Schmid, 2012). The incidence risk ratios are reported in Table 3, but a detailed interpretation is avoided as the purpose of the analysis is not to be predict the odds of having higher number of projects. In order to understand the current distribution of projects across recipient countries, the analysis is more geared towards understanding the direction and significance of independent variables, and not the effect size.

As seen in Table 3, population (log) is positively associated with the number of projects, and this result is statistically significant. It substantiates the claim that market size, reflected through country population, affects the number of "right projects" (Addison et al., 2015). Access to rural electrification is negatively associated with the number of projects, and this estimate is not statistically significant. This pattern makes sense since lack of rural electrification also reflect market opportunities of projects, and higher rates will diminish the market scope. Renewable energy output (% of total electricity) is negatively associated with number of projects, and these estimates are not statistically significant. Given the bulk of PFAN projects employing renewable energy generation, a higher percentage in a country reflects the existing scenario and market scope, thereby discouraging additional PFAN intervention. PFAN evaluation report suggested that presence of alternatives may affect number of projects (Addison et al., 2015), which in this model was tested using number of CDM projects. CDM projects employing renewable energy can offer financial intermediation to overcome funding difficulties due to lack of development of financial markets (Kim & Park, 2018). It was found to be negatively associated the number of projects although the coefficient was not statistically significant.

A positive association is observed for Getting Credit Distance to Frontier (GCDTF) with number of projects. As the score reflects the vibrancy of financial sector of the host country, a higher score does attract more private sector project involvement. This result substantiates earlier findings on the role of domestic financial sector to reduce frictions associated with adoption and diffusion of new technologies (Comin & Nanda, 2014). Domestic financial systems and policy play a fundamental role in establishing enabling environments that can mobilize and leverage private finance (Clark et al., 2018). Fossil fuel subsidy is negatively associated with the number of PFAN projects, although this estimate in Model 2 is not statistically significant. RISE scores (2016) appears to be negatively associated with the number of PFAN projects, but the coefficient is not statistically significant in Model 3. The coefficient for CO_2 emissions per capita was not found to be statistically significant suggesting that it may not be a key characteristic of countries with higher PFAN projects.

Table 4 deconstructs the association of similar independent variables on the PFAN business types into binary choice models following multinomial logit regression (Equation 4). The relative risk ratios reflect the odds in the binary choice, which if greater than 1 indicates selection of that business type and a value smaller than 1 indicates a move in the opposite direction. Access to electricity show a negative & statistically significant association for greenfield, scale-up, and technology development projects. GDP per capita is positive for all business type sets, but only statistically significant for greenfield projects. Similarly, foreign direct investment is negative for all business type sets, except for scale-up projects. Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is not surprising that such enterprise investment will focus more on existing facilities, thereby favoring brownfield projects. Preference for hydro projects (Figure 3) is also unsurprising as similar trends are observed for energy aid projects to countries endowed with rich hydro resources (Keeley, 2017). The choice between scale-up and brownfield projects is more drastic as evidenced by statistical significance, which suggests limited role of foreign direct investment in scale-up type projects. On the other hand, CDM projects are found to be positive & statistically significant for the choice between scale-up projects & brownfield projects, reflecting greater role of CDM in addressing energy access issues. The estimate for CDM for the choice between greenfield vs. brownfield, and technology development vs. brownfield is also negative.

Table 3. Negative binomial estimates of project counts.

	(1)	(2)	(3)
Population (log)	0.457**	0.370**	0.783**
	1.58	1.45	2.18
	(0.111)	(0.117)	(0.242)
Access to Rural E (%)	−0.00341	−0.00131	
	0.9966	0.9987	
	(0.00489)	(0.00485)	
REO	0.000417	0.000888	0.00398
	1.00	1.00	1.003
	(0.00514)	(0.00526)	(0.00628)
GCDTF	0.0131*	0.0131*	0.0151*
	1.01	1.01	1.01
	(0.00747)	(0.00732)	(0.00909)
CDM	0.0000656	0.0000973	−0.000255
	1.00	1.00	0.9997
	(0.000378)	(0.000325)	(0.000430)
CO_2 emissions (per capita)	0.0104	−0.00801	
	1.01	0.9920	
	(0.0404)	(0.0379)	
Subsidy (% of GDP)		−0.00289	
		0.9971	
		(0.0163)	
RISE2016			−0.00908
			0.9909
			(0.0140)
alpha	1.650	1.100	1.878
N	86	60	64
Log-Likelihood	−189.4	−157.0	−149.8
LR χ^2	30.48***	23.97***	22.68***
chibar^2(01)	253.75***	194.96***	246.59***
Pseudo R^2	0.0745	0.0709	0.0704

Notes:

a) First number is the unstandardized negative binomial regression coefficient, second number is the incidence risk ratio, and the third number in parenthesis is the standard error.

b) * indicates $p < 0.1$, **$p < 0.05$ and ***$p < 0.01$.

Table 4. Multinomial Logit estimates of business type preference.

	Greenfield over Brownfield	Scale-up over Brownfield	Technology Development over Brownfield
Access to E	−0.0321*	−0.0341*	−0.0455*
	0.9683	0.9665	0.9555
	(−2.17)	(−2.24)	(−2.27)
GDP/capita	0.000287*	0.00000328	0.000292
	1.0002	1.0000	1.0002
	(1.97)	(0.02)	(1.19)
FDI (% GDP)	−0.0441	−0.0657*	−0.0181
	0.9568	0.9364	0.9821
	(−1.57)	(−2.21)	(−0.36)
Imports	0.0159	0.0345	0.0202
	1.1016	1.035	1.0204
	(0.79)	(1.65)	(0.65)
CDM	−0.0000638	0.000760*	−0.000103
	0.9999	1.0007	0.9999
	(−0.22)	(2.48)	(−0.20)
SubsidyP	−0.0143	−0.0288	−0.00123
	0.9858	0.9716	0.9987
	(−0.57)	(−1.25)	(−0.04)
RISE2016	0.000671	−0.0180	0.0312
	1.0006	0.9822	1.0316
	(0.03)	(−0.73)	(0.79)
_cons	3.147***	3.500***	−0.817
	23.2738	33.106	0.4416
	(3.40)	(3.49)	(−0.48)
N	312		
χ^2	41.14**		
Pseudo R^2	0.0662		
Highest VIF	2.33		
Mean VIF	1.98		

Notes:

a) First number is the multinomial logistic regression coefficient, second number is the relative risk ratio, and the third number in parenthesis is the t-statistic.

b) Reference Group is "Brownfield" projects

c) * indicates $p < 0.05$, **$p < 0.01$ and ***$p < 0.001$

6. Discussion

This paper's findings are not meant for prescribing countries better operating conditions to attract more investment through PFAN. As the results of Table 3 suggests, market size and health of financial sector are the key characteristics of countries with more PFAN projects. Even without considering causality, the results raise question of additionality with respect to tackling the barrier of access to finance, which is the stated mission of PFAN. If the key characteristics of countries having more PFAN projects are market size and robust financial system, it begs the question whether an intervention in the form of PFAN is needed that seeks to address the barrier of access to finance by mobilizing private sector. This does not suggest a mal-intention on the part of PFAN secretariat to direct more projects to countries with favorable environment. Such inequality in project distribution can be unintended consequences, which may only be discovered through unconventional modes of outcome evaluation employed in this study.

Such findings are not limited to PFAN only, but it was also found in the case of CDM, where projects are more prone to countries that already have the ability to absorb technologies, and therefore does not entail sufficient technology transfer. In the end, it becomes the most cost-effective means towards reduction of greenhouse gas emissions, and thus generate carbon credits (de Coninck & Sagar, 2014). In the case of PFAN, high Getting Credit Distance to Frontier (GCDTF) scores reflect the ability to handle the risks involved in handling median investment of USD 10 million leveraged for projects (PFAN, 2017). The bias also gives credence to Stevenson (2013) for suggesting that the real governing authority in CTI-PFAN effectively lies in the hands of those providing financing for projects instead of CTI secretariat. The Green Climate Fund of UNFCCC is also experiencing similar fate where projects were going toward private-sector enterprises led by global investment firms instead of locally owned hard-to-reach vulnerable communities (Tabuchi, 2017). Pattberg (2010) also found that public-private partnerships reflect existing interest structures and therefore seldom deliver additional benefits that have not already been realized through more traditional multilateral or bilateral development programs.

The results of this paper are similar to another study on blended finance, that used different methodology and country level scoring system to measure private sector attractiveness. By ranking individual countries in terms of private sector attractiveness, quality of energy access, and relevance for climate change investment, the study has identified India, South Africa, Mozambique, Cambodia, Mongolia, Uganda, Kenya and Rwanda as countries able to deliver the highest impact per dollar invested both in improving the quality of energy access and delivering climate impact (Tonkonogy et al., 2018). These identified countries are also recipients of higher PFAN projects as seen in Figure 4.

As for the business type of projects, the findings show a general preference of greenfield and brownfield projects, as opposed to scale-up and technology development. This pattern has important implication since most countries identified for access to finance interventions are also countries having low energy access statistics. For these low and middle-income countries, the challenges of attracting projects are greater since they are less likely to appear on the radar of donors and the international community, because their cumulative annual emissions are low and seemingly insignificant at the global level. However, climate technology investment opportunities also exist in these countries in facilitating low-carbon energy access as well for technology adoption in small & medium manufacturing facilities (de Coninck & Sagar, 2014). Many developing countries lack functioning internal financial markets, causing large-scale measures to rely primarily on services of international financial mechanisms (Hogarth, 2012). Kim and Park (2018) also found that CDM can play a crucial role for deploying renewable energy technologies in countries with less developed financial markets, but this influence is not significant in countries with well-developed financial markets. As the impact of CDM varies across countries due to differences in access to domestic financing (Kim & Park, 2018), the phenomenon can also be expected for PPPs addressing climate finance.

Criticism on the lack of transparency has led to adoption of a new monitoring framework for the Green Climate Fund, along with independent evaluation unit to assess the effectiveness of its projects (Tabuchi, 2017). Whereas this is a likely step for multilateral initiatives, such steps are minimal for private sector driven technology funds, and public-private initiatives such as PFAN. As the Asian network of PFAN is supported by the United States Agency for International Development (USAID, 2017), evaluation is limited within the scope of its funding support (Addison et al., 2015). It is therefore important for the policy research community to fill the gaps in effectiveness from a macro cross-country viewpoint, as have been done in the case of CDM, so that evidence-based reforms can take place for the interventions.

Although this study is the first attempt to analyze PFAN projects using similar methodological guides for CDM, there are certain limitations to the analysis. Unlike CDM, PFAN project databases does not host project documents that could be scoured for more information relevant in the context of innovation systems, such as technology origins, number of foreign & local partner organizations, implementation status, size of project in terms of mitigation potential, power generation capacity, as well as financial support being sought. The latter few variables were only available for about 180 projects, and there is also insufficient data to definitively conclude which projects have started operations and will remain in operation. This paper did not test the hypothesis of ‘eco-functionalist’ distribution of investment, which hypothesizes that aid and investment goes to places where it is needed most (Hicks et al., 2010). Although this analysis primarily focused on the supply side of investments, it placed less attention on the demand side of the projects, mainly due to huge variation in definitions & metrics associated with demand for climate technologies playing a critical role in driving their deployment. Using cross national analysis often simplifies the impact of intervention in a specific context. Case-study approaches are better suited for that purpose, and in the case of PFAN Kennedy and Basu (2013) assessed more in-depth impacts for Uganda and Mozambique, which are countries having higher number of PFAN projects than expected (Figure 4). This illustrates the greater role of in-country networks, and how PFAN activities support the networks, which have not garnered enough attention from other researchers to offer generalizations beyond the two countries. Therefore, further identification of the network effects factors can be added to models based on additional case-studies.

7. Conclusion

There is a strong interest in better understanding how public and private actors can most effectively encourage and finance technology transfer in developing countries. Questions regarding the finance of technology through public-private partnership, where the public-sector commitment is used for project development and bringing private leverage for projects in developing countries, was largely unexplored. This research offers insight on the approach of public-private partnership in clean energy investments and attempted to understand how some countries capitalizes on opportunities and others don't. Market size and strong financial market system in host countries were found to be key characteristics associated with higher number of PFAN projects. It is not known if these PFAN projects are avoiding duplication of projects supported by other mechanisms or serving other forms of unmet needs in countries with well-functioning financial markets, which is a limitation for this cross-national study. While these factors are not treated as determinants, association of the host-country attributes nonetheless shows how Private Financing Advisory Network (PFAN) has operated in the last decade and highlights some of the shortcomings. There may be other funds that are being used to mobilize private climate finance, but the lack of consistent and comprehensive data have become a significant barrier in understanding the effectiveness of such interventions (Whitley, 2015). Existing literature offers caution in granting open authority to investors, entrepreneurs and scientists to develop and deploy innovations without a high level of public scrutiny, as the types of technologies pursued, the interests they favor may not always serve social needs or goods (Stevenson, 2013).

The aim of the study was to shed light on the outcome of a climate PPP, that is generally beyond the scope of traditional internal evaluation. With hodgepodge of standards, competing methodologies and evaluation tools, there is a role for public policy in reforming these investment interventions with an environmental agenda (The Economist, 2018), especially when they are mobilized using public funds. Policy makers need to streamline mechanisms to track private finance by developing more reliable systems for Monitoring, Reporting & Verification (MRV), particularly for investments mobilized by bilateral and multilateral agencies (Stadelmann, Michaelowa, & Roberts, 2013). This is important for the donor countries if these mobilized funds to leverage private investments are to be counted as contributions for $100 billion-dollar support for developing countries pledged in the Paris Agreement (Yeo, 2019). The macro-additionality aspects of support must be a core principle, but currently missing in the agenda when it comes to climate PPP. For PFAN funding agencies such as USAID, such outcome evaluation offers comparison for maximizing climate funding impact—either through bilaterally engaging with countries facing access to finance issues or go through the channel of public-private partnerships. As for the policy recommendations to PFAN secretariat, it should be more transparent to all stakeholders & researchers in offering better information about the projects through the database. There is a lack of funding for data collection, monitoring, and evaluation of PFAN projects which ultimately prevents PFAN from testing its methods and refining its procedures. Important questions remain unanswered because of lack of data, the answers of which may help PFAN and its funding partners be more effective and to use its scarce resources in a more targeted manner (Addison et al., 2015). Even though it is mentioned as a strategy to engage in countries with better financial capacity (UNIDO, 2016), such strategies may be counterintuitive given their mission was to address the barrier of access to finance. The current median investment rate of $10 million is too high, along with the investment floors & caps of $1-5 million dollars highlighted in PFAN documents used to solicit proposals (PFAN, 2017). Such high investments deter small scale low carbon energy access projects from applying, and countries having more financial capacity access more investments, perpetuating the inequality.

As PFAN undergoes structural changes under the hosting agreement under UNIDO and REEEP, it presents a unique opportunity to incorporate reforms to address diversified needs of the countries where fewer climate technology investments have gone in. PFAN is considering procedures to ensure it operates in frontier markets where commercial lending and equity investment do not yet adequately reach, followed by exit strategies based on the level of development of the market, rather than level of a country's economic development (UNIDO, 2016). Active collaboration with other entities, such as International Finance Corporation (IFC)—Sustainable Energy Facility (SEF), having similar goals will serve to reduce the country level redundancies that may also hurt competition of local financial institutions. It is well recognized that finance for discrete projects and programs is likely to be most effective when used as part of efforts to strengthen national systems of innovation and institutional capacities for technology innovation and diffusion (Barnard & Nakhooda, 2015), and PFAN can take an active role in developing the financial aspects of the national innovation systems.

Conflict of interest

The authors declare no conflicts of interest in this paper.

References

Addison M, Rahman F, Shapiro MD, et al. (2015) *Performance Evaluation Final Report: Climate Technology Initiative Private Financing Advisory Network*. Retrieved from Arlington, Virginia, USA: Development & Training Services, Inc. (dTS).

Alker S, Joy V, Roberts P, et al. (2000) The Definition of Brownfield. *J Environ Plann Manage* 43: 49–69. doi:10.1080/09640560010766

Andonova LB (2010) Public-Private Partnerships for the Earth: Politics and Patterns of Hybrid Authority in the Multilateral System. *Global Environ Polit* 10: 25–53. doi: 10.1162/glep.2010.10.2.25

Backstrand K (2008) Accountability of networked climate governance: The rise of transnational climate partnerships. *Global Environ Polit* 8: 74–102. doi:DOI 10.1162/glep.2008.8.3.74

Banerjee SG, Moreno FA, Sinton JE, et al. (2017) *Regulatory indicators for sustainable energy: a global scorecard for policy makers* Retrieved from Washington, DC: World Bank Group: Available from: http://documents.worldbank.org/curated/en/538181487106403375/Regulatory-indicators-for-sustainable-energy-a-global-scorecard-for-policy-makers

Barnard S, Nakhooda S (2015) Financing climate technology transfer. Retrieved from Overseas Development Institute website. Available from: https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/10053.pdf

Clark R, Reed J, Sunderland T (2018) Bridging funding gaps for climate and sustainable development: Pitfalls, progress and potential of private finance. *Land Use Policy* 71: 335–346. doi:10.1016/j.landusepol.2017.12.013

Comin D, Nanda R (2014) Financial Development and Technology Diffusion. Working Paper 15-036. Harvard Business School. Available from: http://www.hbs.edu/faculty/Publication%20Files/15-036_0192fa1b-12a8-4464-afac-d9380c06f498.pdf

Coxe S, West SG, Aiken LS (2009) The analysis of count data: a gentle introduction to poisson regression and its alternatives. *J Pers Assess* 91: 121–136. doi:10.1080/00223890802634175

de Coninck H, Bhasin S (2015) Meaningful technology development and transfer: A necessary condition for a viable climate regime. In S. Barrett, C. Carraro, & J. de Melo (Eds.), *Towards a Workable and Effective Climate Regime*, London, UK: Centre for Economic Policy Research (CEPR) Press, 451–464.

de Coninck H, Sagar A (2014) Making sense of policy for climate technology development and transfer. *Climate Policy* 15: 1–11. doi:10.1080/14693062.2014.953909

Dechezleprêtre A, Glachant M, Ménière Y (2008) The Clean Development Mechanism and the international diffusion of technologies: An empirical study. *Energy Policy* 36: 1273–1283. doi:10.1016/j.enpol.2007.12.009

Dirix J, Peeters W, Sterckx S (2015) Is the Clean Development Mechanism delivering benefits to the poorest communities in the developing world? A critical evaluation and proposals for reform. *Environ Dev Sust* 18: 839–855. doi:10.1007/s10668-015-9680-8

Dixon RK, Scheer RM, Williams GT (2010) Sustainable energy investments: contributions of the Global Environment Facility. *Mitig Adapt Strat Gl* 16: 83–102. doi:10.1007/s11027-010-9253-y

Doranova A, Costa I, Duysters G (2010) Knowledge base determinants of technology sourcing in clean development mechanism projects. *Energy Policy* 38: 5550–5559. doi:10.1016/j.enpol.2010.04.055

Gandenberger C, Bodenheimer M, Schleich J, et al. (2015) Factors driving international technology transfer: empirical insights from a CDM project survey. *Climate Policy* 16: 1065–1084. doi:10.1080/14693062.2015.1069176

Hicks RL, Parks BC, Roberts JT (2010) *Greening aid?: Understanding the environmental impact of development assistance*, Oxford University Press.

Hogarth JR (2012) The role of climate finance in innovation systems. *J Sust Financ Investment* 2(3–4): 257–274. doi:10.1080/20430795.2012.742637

Keeley AR (2017) Renewable Energy in Pacific Small Island Developing States: the role of international aid and the enabling environment from donor's perspectives. *J Clean Prod* 146: 29–36. doi:10.1016/j.jclepro.2016.05.011

Kennedy M, Basu B (2013) Overcoming barriers to low carbon technology transfer and deployment: An exploration of the impact of projects in developing and emerging economies. *Renew Sust Energy Rev* 26: 685–693. doi:10.1016/j.rser.2013.05.071

Kim J, Park K (2018) Effect of the Clean Development Mechanism on the deployment of renewable energy: Less developed vs. well-developed financial markets. *Energy Econ* 75: 1–13. doi:10.1016/j.eneco.2018.07.034

Pattberg P (2010) Public-private partnerships in global climate governance. *Wiley Interdiscip Rev Climate Change* 1: 279–287. doi:10.1002/wcc.38

PFAN (2017) PFAN Brochure—Accelerating Investment for Climate and Clean Energy (1–8): CTI-PFAN.

Rahman SM, Ahmad MM (2015) Climate finance towards vulnerable countries: evidence from the Global Environment Facility (GEF). *Int J Green Econ* 9: 199–214.

Schmid G (2012) Technology transfer in the Clean Development Mechanism: the role of host country characteristics. *Climate Policy* 12: 722–740.

Stadelmann M, Michaelowa A, Roberts JT (2013). Difficulties in accounting for private finance in international climate policy. *Climate Policy* 13: 718–737. doi:10.1080/14693062.2013.791146

Stevenson H (2013) Governing Climate Technologies: Is there Room for Democracy? *Environ Values* 22: 567–587. doi:10.3197/096327113x13745164553752

Sugiyama T, Michaelowa A (2001) Reconciling the design of CDM with inborn paradox of additionality concept. *Climate Policy* 1: 75–83. doi:10.3763/cpol.2001.0107

Tabuchi H (2017) U.N. Climate Projects, Aimed at the Poorest, Raise Red Flags. *New York Times*, A10. Availabe from: https://www.nytimes.com/2017/11/16/climate/green-climate-fund.html

The Economist (2018) Green Tape: The European Union wants to make finance more environmentally friendly. *Economist* 426: 68.

The Economist (2019) Climate Action—The Day After Tomorrow. *Economist* 432: 56–57.

Tonkonogy B, Brown J, Micale V, et al. (2018) Blended Finance in Clean Energy: Experiences and Opportunities. Retrieved from Climate Policy Initiative: Available from: https://climatepolicyinitiative.org/wp-content/uploads/2018/01/Blended-Finance-in-Clean-Energy-Experiences-and-Opportunities.pdf

UNIDO (2016) *Project—150346. Hosting and managing the Private Financing Advisory Network*. United Nations Industrial Development Organization (UNIDO) Available from: https://open.unido.org/api/documents/4460373/download/PFAN_Project_document.pdf

USAID (2017) Private Financing Advisory Network Asia *USAID Factsheet*.

Whitley S (2015) Mapping climate-relevant incentives and investment at country level: a diagnostic tool to mobilise private climate finance. Retrieved from Overseas Development Institute website: https://www.odi.org/sites/odi.org.uk/files/resource-documents/10341.pdf

Yeo S (2019) Where climate cash is flowing and why it's not enough. *Nature* 573： 328–331. doi:10.1038/d41586-019-02712-3

World Bank (2017) Getting Credit Distance to Frontier. Available from: http://www.doingbusiness.org/data/distance-to-frontier