CSAE Working Paper WPS/2023-13

The Infrastructure Catalyst: Analysing the Impact of Development Finance Institutions on Private Infrastructure Financing in Developing Countries

Arth Mishra[1]

September 2023

Abstract

The widening financing gaps for the Sustainable Development Goals (SDGs) and the Green Energy Transition in developing countries have established an impetus to mobilise foreign private resources for infrastructure. By developing a novel theoretical framework and leveraging a large dataset of infrastructure projects in developing countries from 1989-2022, this analysis investigates the role of Development Finance Institutions (DFIs) in indirectly mobilising private finance. Theoretical analysis demonstrates that DFI participation in a particular country-sector can catalyse private finance by specifically reducing the perceived risks of financing. Empirical analysis assessing the presence and magnitude of mobilisation effects at the extensive margin is consistent with theory on mobilisation. DFI participation is strongly correlated with an increase in the number of commercial foreign banks, total project activity, and the number of projects with at least one commercial foreign bank. Evidence suggests that this effect is amplified by DFI participation induced private financing acting as an independent signal for further private financing. However, the mobilisation effect does not seem to spill over across countries and sectors and does not extend to projects that are entirely financed by commercial foreign financiers. These findings suggest that DFI capital should target infrastructure segments with high growth potential, through project structures that resemble the conditions for private financing and contribute towards creating a pipeline of investable projects in those country-sectors. Immediate policy implications include improving data reporting on current and future projects to bolster demonstration effects and facilitate research on intensive margin mobilisation effects.

[1]Independent Researcher. Email: arthmishra@gmail.com. All views expressed are mine and do not represent the views of mycurrent employer. This work is built on extensive discussions and feedback from Professor Christopher Woodruff. I am gratefulfor his support throughout.

Centre for the Study of African Economies
Department of Economics · University of Oxford · Manor Road Building · Oxford OX1 3UQ
T: +44 (0)1865 271084 · F: +44 (0)1865 281447 · E: csae.enquiries@economics.ox.ac.uk · W: www.csae.ox.ac.uk

Contents

1. Introduction

1.1 Motivation

In 2015, two global agreements emerged: the 2030 Sustainable Development Agenda, which has since evolved into the Sustainable Development Goals (SDGs), and the Paris Agreement, in which signatories committed to significantly reducing global greenhouse gas emissions to limit warming.[2] However, progress has slowed after the COVID-19 pandemic, as concessional capital shifted toward economic recovery and healthcare spending. By 2020, the SDG financing gap reached US$3.9 trillion, a 56% increase from pre-pandemic levels (OECD 2022a), while the Paris Agreement required up to US$1 trillion annually for renewable energy investments in developing countries (IMF 2022a). This excludes adaptation finance required to secure at-risk infrastructure threatened by Climate Change.

The primary cause for these dual financing gaps is insufficient infrastructure financing for developing countries due to high perceived investor risk and limited bankable projects (IEA 2021). The increasing pressure on Overseas Development Assistance (ODA) from economic challenges and ongoing instability highlights the need to unlock private finance for sustainable development. In this context, Development Finance Institutions (DFIs) and Multilateral Development Banks (MDBs, collectively referred to as "DFIs") provide financing to developing countries, including large-scale infrastructure, and have an explicit mandate to catalyse private investment. Mobilisation can be direct, with private financiers joining DFIs in specific transactions, or indirect, where DFI involvement in a country's sector signals low financing risks, attracting additional private finance for future projects.

1.2 Theory

The theoretical case for *indirect* DFI mobilisation of private capital for infrastructure is strong. DFIs can alleviate informational asymmetries through technical assistance and capacity building (Chelsky et al. 2013), improve policy and regulatory environments for investment (Buiter and Fries 2002), and create positive signals for future projects through "within" market externalities (Stiglitz 1993). DFI institutional credibility signals trust in markets and opportunities for financing (Basílio 2014).

DFI participation can mitigate a number of infrastructure-specific risks that prevent the flow of private capital. By successfully executing infrastructure projects with high initial perceived risk, DFIs can correct noisy risk signals that prevent financing (Mazzucato and Semieniuk 2018), and reduce the risk premia (Egli 2020). In the case of relation-specific infrastructure, a single off-taker, normally a government, can "hold-up" a project once capital costs have been sunk to renegotiate terms. The susceptibility to "hold-up" risks reduces the availability of finance in terms of pricing and access (Joskow 1985; Ryan 2021). DFIs can reduce perceived "hold-up" risk by executing structures that limit the likelihood of renegotiation and signal the credibility of off-takers. Finally, DFIs can improve macroeconomic performance and investor conditions, increasing the entry of private financiers (Eichengreen and Mody 1998).

However, the theoretical case for DFI mobilisation has some limitations. It is uncertain whether risk reduction mechanisms extend to indirect mobilisation or if political protection persists over time and across projects (Gamso and Nelson 2019; Hainz and Kleimeier 2012). DFI financing may crowd out private capital by

[2] The agreement's explicit goal is to limit temperature rise to 1.5°C above pre-industrial levels, with a required 50% reduction in greenhouse gas emissions by 2030 (UNFCCC 2015).

supporting projects that would have been privately financed (Carter et al. 2021; Basílio 2014). Additionally, limited competition and lower hurdle requirements for DFIs (McHugh 2023), could lead to adverse project selection and weaken signal credibility to private financiers.

Notably, the literature lacks clear predictions for mobilisation effects across countries and sectors with similar risk attributes. For instance, it is unclear whether financing solar infrastructure in Guinea would catalyse private finance for similar projects in Liberia or other renewable energy projects within Guinea. Cross-sector and cross-border mobilisation effects could potentially accelerate renewable energy investment to address the energy transition financing gap.

DFI participation might demonstrate that infrastructure sub-sectors are insulated from perceived regional risks, catalysing private finance for countries with similar institutional settings and risks. Komendantova et al. (2019) provide theoretical evidence of regional spillovers from de-risking policies for renewable energy projects using a Computable General Equilibrium (CGE) model. Infrastructure can also extend across borders, creating complementarities (Viviescas et al. 2019), and regional information cascades and demonstration effects (Morales and Andreosso-O'Callaghan 2012) which can also apply to infrastructure financing.

Moreover, DFI financing could generate private financing spillovers into other infrastructure by signalling lower risk across a sector. Jee and Srivastav (2022) show substantive knowledge spillovers between non-renewable and renewable energy sectors, extending to risk similarities. Findings from industrial policy literature suggest FDI can mobilise investment and productivity in related industries (Blalock and Gertler 2008; Javorcik 2004; Markusen and Venables 1999), potentially applying to DFI financing for cross-sector spillovers.[3]

Section 2 aims to formalise this theory, considering the effects of DFI participation on private financier decision-making across temporal, country, and sectoral dimensions.

1.3 Descriptive and Empirical Evidence

Considering the insights and limitations of the theoretical work discussed above, this paper will focus on the indirect, extensive margin private capital mobilisation effects of DFI participation in infrastructure.

Descriptive and empirical evidence on mobilisation effects is mixed. Official estimates indicate that MDBs mobilised US$62 Billion for infrastructure in 2019 (MDB TFM 2021). However, the Overseas Development Institute estimates that for every dollar of DFI commitments in low-income countries, only 37 cents was mobilised in private capital (Attridge and Engen 2019). Most research reports attempting to quantify mobilisation effects are limited in applicability due to difficulties in attributing future private capital flows to DFI participation specifically by controlling for relevant factors.

Whilst most evidence on mobilisation relates to the positive catalytic effect of IMF flows, recent evidence on DFI mobilisation effects is inconclusive, with limited applicability to infrastructure. A series of papers looking at the lending activity of large MDBs differ in their conclusions. Clemens (2002) uses a structural vector autoregression to determine that there is no evidence of World Bank loans mobilising private capital. Rodrik (1995) finds that MDB transfers do not predict private capital inflows.

On the contrary, Ratha (2001) and Dasgupta and Ratha (1999) provide evidence consistent with mobilisation in response to MDB lending and commitments, respectively. Most recently, Broccolini et al. (2021) provide

[3]The industrial network spillover literature suggests that downstream industries benefit from increased productivity in input-producing sectors and upstream sectors gain from knowledge and technology spillovers.

evidence that DFI participation in the syndicated lending market contributes to both direct and indirect mobilisation, with a large global panel dataset. At a project level, Probst et al. (2021) determine that concessional DFI capital crowds in additional private investment, while Kotchen and Negi (2019)[4] find that the ratio of DFI-Private Sector capital in co-financed transactions depends on the size and thematic focus of the project — both papers are limited to analysing direct mobilisation.

However, most existing evidence mainly addresses infrastructure financing and overlooks extensive margin indirect mobilisation effects. The subsequent analysis in this paper focuses on this specific effect across time, country, and sector dimensions for two main reasons. First, as noted by Carter et al. (2021), estimating intensive margin and direct mobilisation effects faces endogeneity and estimation issues due to uncertain counterfactual outcomes at the project level. Second, while papers like Broccolini et al. (2021) deal with indirect mobilisation, they do not focus exclusively on project and infrastructure finance, which is more likely to be employed in riskier settings (Byoun et al. 2013; Gurara et al. 2020; Sawant 2010) typical of developing countries' investment environments.

The subsequent analysis focuses on extensive margin, indirect mobilisation effects across time, country, and sector dimensions. This focus is due to the importance of long-run sustainable financing activity for infrastructure and the need to increase the extent of private financing activity in developing countries with limited resources. Extensive margin mobilisation effects have greater potential impact and decrease the need for further resources for processes like deal sourcing and due diligence.

The remainder of the paper is structured as follows: Section 2 outlines a formal theoretical framework, Section 3 describes the data, Section 4 outlines the empirical strategy, Section 5 presents results and robustness checks, Section 6 introduces extensions, and Section 7 concludes with a discussion of implications.

2. Theoretical Framework

The theoretical framework is a simple analysis of the decision problem of a representative private financier of infrastructure projects, consistent with indirect resource mobilisation of DFI activity, motivated by the discussion in Section 1.

The representative private financier responds to changes in the risk-adjusted return of a project in Country-Sector cs, at time t, as a result of DFI participation and the number of private transactions prior to time t. This framework, and the subsequent empirical analysis, abstracts from the instruments deployed for financing (e.g. bonds, loans) and from pricing decisions made by financiers at the intensive margin once they have decided to participate.

The focus of the theoretical framework is to specifically examine the effect of DFI and non-DFI participation on the representative private financier's expected returns, and as such other institutional and sector risks are largely taken as exogenous in its construction. The exogenously determined factors related to Country and Sector risk in the framework are accounted for in the interactive fixed effects empirical strategy.

[4]Relevantly, the paper finds that higher government effectiveness and regulatory quality are associated with higher cofinancing ratios, and counter-intuitively, greater accountability and control of corruption are associated with lower ratios.

2.1 Specifying Aggregate Perceived Risk

First, we specify the determinants of aggregate risk that the representative private financier considers for investment decisions. Define $R_{c,s,t}(\cdot)$, as an aggregate risk composite function of country, $C_{cs,t}(\cdot)$, and sector, $S_{cs,t}(\cdot)$, level risks, and non-fundamental perceived risk, $P_{cs,t}(\cdot)$. For simplicity each is assumed to carry equal weight and all are decreasing, concave functions:

$$R_{cs,t}[C_{cs,t}(\cdot), S_{cs,t}(\cdot), P_{cs,t}(\cdot)] = \begin{cases} \frac{1}{3}[C_{cs,t}(\cdot) + S_{cs,t}(\cdot) + P_{cs,t}(\cdot)], & \text{if } P(\cdot) > 0 \\ \frac{1}{2}[C_{cs,t}(\cdot) + S_{cs,t}(\cdot)], & \text{if } P(\cdot) = 0 \end{cases} \tag{1}$$

In modelling the uncertainty and noise associated with investment risk, the representative private financier does not observe each constituent function of the aggregate risk, but instead observes only $R_{cs,t}$.

2.1.1 Country Risk

Country Risk, $C_{cs,t}(\cdot)$, is defined as being a function of institutional quality ($0 \leq G < 1$) and macroeconomic performance ($0 \leq M < 1$), as observed by the private financier at time t:

$$C_{cs,t}(G, M) = (1 - G)(1 - M) \tag{2}$$

As is intuitive, country-risk is decreasing in both institutional quality and macroeconomic performance ($\partial C_{cs,t}/\partial G > 0, \partial C_{cs,t}/\partial M > 0$).

2.1.2 Sector Risk

Sector Risk, $S_{cs,t}(\cdot)$, is defined as being a function of infrastructure technology and input stability ($0 \leq T < 1$) (e.g. technology cost shifts), idiosyncratic implementation risks ($0 \leq L < 1$) and domestic market risks ($0 \leq D < 1$) , for instance, "hold-up" risks described in Section 1, all realised at time t:

$$S_{cs,t}(T, L, D) = (1 - T) \cdot D \cdot L \tag{3}$$

As above, sector-risk is increasing in infrastructure technology and input stability ($\partial S_{cs,t}/\partial T < 0$), implementation complexity ($\partial S_{cs,t}/\partial L > 0$), and market risks ($\partial S_{cs,t}/\partial D > 0$).

2.1.3 Non-fundamental Risk

Non-fundamental risk, $P_{cs,t}(\cdot)$, is endogenously determined in the model, to draw theoretical propositions on private participation mobilisation effects.

We define $P_{cs,t}(\cdot)$, where $\epsilon_{cs,t} \sim U[0, 1]$ represents the noisy signal that the representative private financier receives for a particular country sector at a given time t, and $\delta(\cdot)$ represents the market signal based on historic DFI participation and previous private financed projects, given by:

$$P_{cs,t}[\delta(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}), \epsilon_{cs,t}] = [1 - \delta(n_{cs,t}^{DFI}, n_{cs,t}^{PProj})] \cdot \epsilon_{cs,t}, \tag{4}$$

where $n_{cs,t}^{DFI}$ is the number of DFIs that are involved in the country sector and $n_{cs,t}^{PProj}$ is the number of projects with exclusively private participation.

Implementing insights from the valuation and hold-up risk literature on how investors weight historic data as signals of current risk (Ryan 2021; Wang et al. 2011; Yee 2004), we can further decompose $\delta(\cdot)$ to temporally discount financing activity, representing the decay of the investment signal over time:

$$\delta(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}) = \gamma\left(\sum_{\tau=t}^{\infty} \alpha^{t-\tau} \cdot n_{cs,t}^{DFI} + \sum_{\tau=t}^{\infty} \mu^{t-\tau} n_{cs,t}^{PProj}\right), \tag{5}$$

where $0 \leq \gamma(\cdot) \leq 1$, while $0 < \alpha < 1$ and $0 < \mu < 1$ reflect the discount factor imposed exponentially on historical financing activity.

This reflects the fact that, in expectation, proximate time period signals are more reflective than distant periods of risk in the period of the financing decision.

2.1.4 Observed Aggregate Risk

Combining country, sector and perceived non-fundamental risk, we attain the following for the aggregate risk measure given as (where $P_{cs,t}(\cdot) > 0$):

$$\begin{aligned} &R_{cs,t}[C_{cs,t}(G, M), S_{cs,t}(T, L, D), P_{cs,t}(\delta(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}), \epsilon_{cs,t})] \\ &\quad = \frac{1}{3}[C_{cs,t}(G, M) + S_{cs,t}(T, L, D) + P_{cs,t}(\delta(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}), \epsilon_{cs,t})] \end{aligned} \tag{6}$$

2.2 Private Financier's Decision Problem

Building on equation (6), we derive the objective function to examine the theoretical conditions under which it decides to finance an infrastructure project.

2.2.1 Risk-Adjusted Rate of Return

We can model the expected returns for the representative private financier as:

$$\mathbb{E}[\pi_{cs,t}] = (1 - R_{cs,t}(\cdot)) \cdot Y - F, \tag{7}$$

where, $R_{cs,t}(\cdot)$ is an aggregate risk function, Y is the revenue generated by the project, and the additional assumption that the representative private financier is able to raise capital for investment at a fixed unit cost F (i.e. cost of raising funds for investment managers and project banks).

2.2.2 Hurdle Constraint

The representative private financier faces a hurdle requirement, the risk-adjusted rate of return at which it is willing to invest, H. $H > 0$, given the value of cash flows generated from the infrastructure financing needs to exceed the opportunity cost of financing other projects.[5]

As such, the representative private financier provides financing to the infrastructure project if and only if:

$$\mathbb{E}[\pi_{cs,t}] = (1 - R_{cs,t}(\cdot)) \cdot Y - F \geq H > 0 \tag{8}$$

[5] In practice, different project banks face different hurdle rates depending on the risk tolerance.

2.3 Theoretical Analysis and Propositions

Analysing the model creates three clear theoretical predictions, outlined below, that will act as the basis for the empirical analysis in Section 4.[6]

2.3.1 DFI participation as a de-risking signal

Taking the partial derivative of Equation (8), we attain:[7]

- $\frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{DFI}_{cs,t}} > 0, \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{DFI}_{cs,t-1}} > 0, \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{DFI}_{cs,t-2}} > 0, ..., \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{DFI}_{cs,t-k}} > 0$
- $\frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{PProj}_{cs,t}} > 0, \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{PProj}_{cs,t-1}} > 0, \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{PProj}_{cs,t-2}} > 0, ..., \frac{\partial \mathbb{E}[\Pi_{cs,t}]}{\partial n^{PProj}_{cs,t-k}} > 0$

This result lends the basis for our first proposition on the mobilisation of private finance.

Proposition 1: *Private financing participation is increasing in the historic number of transactions with DFI participation and number of private projects in a particular country-sector.*

Theoretically, sustained, inter-temporal DFI and private financing activity demonstrates that the country-sector is resilient to institutional and macroeconomic factors that adversely affect expected returns. DFI participation can reduce perceived aggregate risk by reducing the non-fundamental noise, such that the expected rate of return now lies above H for that country-sector. Theoretically, DFI participation signals macroeconomic and investment climate stability, and institutional quality, which are conducive to private investment, as discussed above.

Solving for $n^{DFI}_{cs,t}$, we can derive the threshold signal to crowd-in the private investor:

$$n^{DFI}_{cs,t} = \frac{x}{1-\alpha} \tag{9}$$

Where $x = \gamma^{-1}\{\frac{1}{\epsilon_{cs,t}}[3(\frac{F+H}{Y}) + C_{cs,t}(\cdot) + S_{cs,t}(\cdot) - 2]\} - \sum_{\tau=t}^{\infty} \mu^{t-\tau} n^{PProj}_{cs,t}$, such that we conclude that for a given H, F, $C_{cs,t}(\cdot)$ and $S_{cs,t}(\cdot)$, there exists a level for which the signal from DFI participation is sufficient to catalyse private financing for a particular country-sector, depending on the rate of the decay of the signal α. Implicitly, if DFI participation is sufficiently high, such that $P_{cs,t}(\cdot) = 0$, and thus, the effect of noisy signal $\epsilon_{cs,t}$ is eroded, the representative private financier still may decide to not finance a project in Country-Sector cs, if $n^{DFI}_{cs,t} < \frac{x}{1-\alpha}$.

2.3.2 Cross-Sector and Cross-Border Catalysation Effects

The previous analysis assumes that mobilisation effects are confined within Country c, Sector s, at time t, which does not account the possibility that DFI participation can reduce perceived risk across countries and sectors with similar risk characteristics. For example, DFI participation in a successfully executed Solar project (i.e. Sector i), may indicate that the investment environment within Country c, is conducive to other renewable-type projects (i.e. Sector j) in the next period. Similarly, if there is a successfully executed Solar project in Country a, there may be a reduction in perceived non-fundamental risk in another Country in the

[6] The focus here is on the DFI signal, but the model can be extended for analysis of Country and Sector risks with endogenous determination.

[7] By the functional form of $\gamma(\cdot)$, the strength of the noise reduction is weaker as $k \to \infty$: $\frac{\partial^2 \mathbb{E}[\Pi_{cs,t}]}{\partial {n^{DFI}_{cs,t}}^2} > ... > \frac{\partial^2 \mathbb{E}[\Pi_{cs,t}]}{\partial {n^{DFI}_{cs,t-k}}^2}$. This applies also to the signal from $n^{PProj}_{cs,t}$, and reflects the fact that transactions that are further back in time reduce perceived risk less than those in more proximate periods. The full derivation can be found in Addendum A.1.

region, Country b, with a similar country risk profile (i.e. $C_{bi,t+1} - C_{ai,t} \leq |\sigma|$[8]), thereby catalysing private capital across borders.

Implementing both cross-cutting effects into the framework, we can now model for Country a, Sector i, at time t, $P_{ai,t}(\cdot)$ as:

$$\begin{aligned} &P_{ai,t}[\delta(n_{ai,t}^{DFI}, n_{ai,t}^{PProj}), \theta(n_{bi,t-1}^{DFI}), \beta(n_{aj,t-1}^{DFI}), \epsilon_{is,t}] \\ &\quad = (1 - \delta(n_{ai,t}^{DFI}, n_{ai,t}^{PProj})) \cdot (1 - \theta(n_{bi,t-1}^{DFI})) \cdot (1 - \beta(n_{aj,t-1}^{DFI})) \cdot \epsilon_{is,t} \end{aligned} \tag{10}$$

Where $\theta(\cdot)$ and $\beta(\cdot)$ are increasing, convex functions representing the effect of cross-border DFI participation in Country b within the same region, with a similar country risk level, and the effect of DFI participation on Sector j with a similar risk profile within Country a on $P_{ai,t}(\cdot)$, respectively. With this we have two additional propositions on the cross-cutting effects of DFI participation.

Proposition 2: *DFI participation in one sector, should mobilise private finance in sectors with a similar risk profile and technological implementation characteristics within the same country.*

Proposition 3: *DFI participation in Countries with a specific risk profile in a certain sector should mobilise private finance into countries with a similar country risk profile in the same sector.*

The three propositions of the theoretical framework will be carried forward into the empirical analysis, which will test whether the intended mobilisation effects of DFI participation is evident in the data.

3. Data

The ideal test for indirect mobilisation from DFI participation would randomly allocate DFI capital to select projects with mobilisation potential and assess subsequent private sector involvement in that country-sector. However, such an experiment is infeasible due to donor capital and DFI strategic objectives, requiring observational data analysis.[9]

This paper uses data on 13,352 completed infrastructure projects in 131 developing countries from 1990 to 2022 from various datasets. The project-level data creates a panel dataset with 875 country-sector pairs and 4,376 observations. The primary data source is the World Bank's Private Participation in Infrastructure (PPI) Database (World Bank 2022a), focusing on energy, waste, water, and transport infrastructure projects. The PPI records contract arrangements of public infrastructure projects in low and middle-income countries that reached financial close and includes data on project banks involved in the transaction.

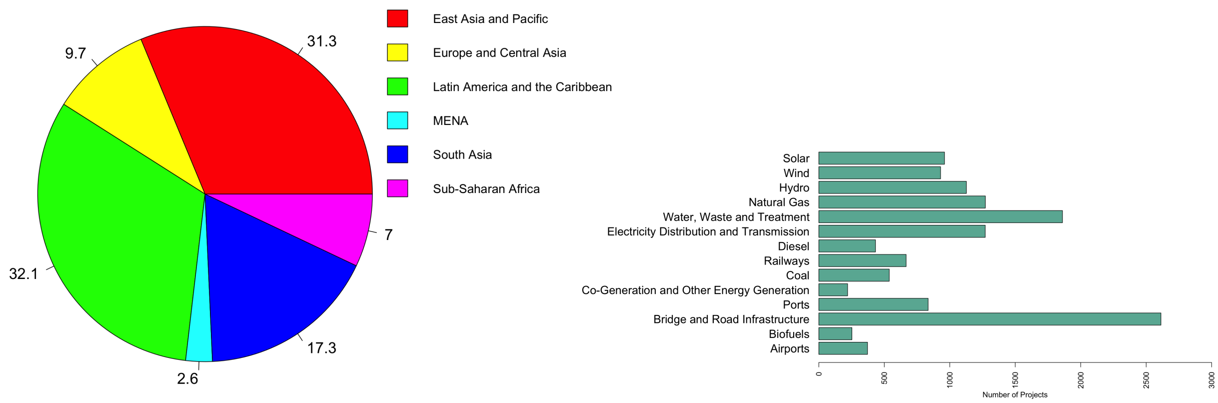
Whilst the PPI only records projects where private parties assume operating risks, it presents two key advantages. First, it is the largest publicly available dataset on private participation, which supports robustness in terms of coverage, discussed further below. Second, the PPI enables analysis of projects with private participation, rather than exclusively publicly operated projects financed through sovereign-style lending arrangements. Sovereign-style arrangements, where public infrastructure is financed through bond or loan financing with the government as the sole counter-party, are idiosyncratic to each public partner (Ryan 2021), and do not characterise the unique de-risking signal for the scalable infrastructure transaction structures motivating this paper.

[8] Where σ can be considered the threshold at which a private financier considers country risks as being 'similar'.

[9] Carter et al. (2021) provide evidence that this also may be an imperfect causal test of mobilisation, given it would be unclear whether the set of projects would have received private finance in the counter-factual.

To address the PPI's private sponsor-only coverage, additional project data was collected from Fitch Connect (Fitch Connect 2023) and the Eikon Infrastructure Database (Eikon 2023), in addition to project datasets from various DFIs, including the European Bank for Reconstruction and Development, World Bank, Multilateral Investment Guarantee Agency, International Finance Corporation, Asian Development Bank, African Development Bank, and several national DFIs. A large number of financing data gaps in the PPI dataset were addressed using data from these supplemental sources (1984 projects).

The composition of infrastructure by region and type is broken down in **Figure 1**.



(a) Project by Geography (%) (b) Project by Sector

Figure 1: Project breakdown: (a) by Geography, (b) by Sector

The principal concern for the data analysis is missing coverage across time, countries, sectors and privately financed projects may compromise the results. To mitigate the concern, data validation exercises were conducted to ensure that coverage was sufficient. The majority of projects in the dataset provided data on the size of projects, relative to the infrastructure type (e.g. megawatts for energy generation, kilometres for electricity distribution and road infrastructure, throughput for ports), the coverage of which was validated against the total construction of that infrastructure type across the country, or where available, projects with private participation (e.g. PPP or private infrastructure), during the time period examined. Other projects, without a clear measure of size (e.g. port and airport construction and maintenance projects), are compared against the total number of projects of that infrastructure type that were concluded in that time period, based on national databases and project listings.[10]

The dataset's proportion of total infrastructure coverage was assessed, starting with country-sectors with the highest number of projects and the largest projects to evaluate potential coverage gaps. Infrastructure types with persistent coverage issues across the sample period and in the last ten years were dropped from the final analysis.

Importantly, this validation exercise surpasses the robustness exercises in papers with similar analyses of mobilisation, including Broccolini et al. (2021), Gurara et al. (2020), and Basílio (2014), which implicitly assume that large sample sizes and robustness checks sufficiently reduce coverage concerns. Whilst it is still possible that the results are compromised by missing transactions, within the constraints of time, the unique validation exercise mitigates the possibility that it affects the majority of the data.

Table 1 provides an example of the type of analysis that was covered, whereby Brazilian electricity generation

[10]Some examples include EPE (2022), Bakici and Akin (2011), Road Transport and Highways (2018).

projects had substantial coverage, whereas Malaysian channel dredging projects, a subset of port projects, had significant gaps, with the latter being dropped from the analysis.[11]

Table 1: Illustrative Data Coverage

Country	Infrastructure Type	Capacity/Number of Projects Across Sample	Total Coverage (%)	Total Capacity Added in Sample (2012-2022)	Coverage of 2012-2022 Change (%)
Brazil	Electricity Generation	140731.73	77.4912	53762.93	89
Malaysia	Channel Dredging (Ports)	9	38.3211	0	0

For each project, the sample includes data on transaction size, financial close year, commercial details (e.g. size, PPP structure, revenue stream, degree of privatisation), and financing information, such as the number of development finance institutions, commercial foreign banks, and local banks. The key outcome variables used in the empirical analysis include: 1) the number of foreign, commercial banks participating in the country sector; 2) the total number of transactions as a measure of investment activity; 3) the number of privately financed projects with at least one commercial, foreign bank; 4) the number of projects entirely financed by foreign, commercial banks.Due to data limitations on investment size, composition, and revenue structure, the analysis is restricted to extensive margin analysis of private finance participation. This data is available for syndicated loans and sovereign lending but limited for project finance transactions and public-private partnerships, indicating future scope for intensive margin analysis and an impetus for DFIs to record data to facilitate further research.

The analysis focuses on commercial foreign banks, given the dual-financing gaps require levels of institutional capital that exist beyond what is available in financing markets of developing countries. Moreover, domestic private financiers possess knowledge of internal country and sector-level risks, such that the demonstration effects from DFI participation are less relevant. Moreover, domestic project banks are often confined to projects within country of operation, which have to make geographic trade-offs on financing projects.[12]

The final data consideration pertinent for the validity of the results is the possibility that the panel is unbalanced for a systematic reason that would bias estimates (i.e. systematic attrition). For instance, it is possible that specific country-sectors drop out of the panel due to insufficient investment traction, or changes in disclosure norms that reduce reporting. In the case of this analysis, the issue of missing time observations is not terminal. First, the possibility of a large number of missing transactions that are relevant to the parameters of DFI participation likely under estimate of DFI participation of private mobilisation effects, given the nature of data focuses on DFI participation, and missing observations are likely to be concentrated among project sponsors and private financiers that are constrained by commercial sensitivities. Second, many of the reasons for possible systematic attrition are simultaneously reasons for limited financing and project activity. The prevalence of conflict, lacking disclosure requirements, and high reporting costs, are all reasons why there may be gaps in the data, but also reasons why financing activity may be limited. Finally, it is likely that any dataset of infrastructure projects suffers from gaps in coverage, but a combination of the data validation exercise and the credibility of the datasets used, limits the impact of systematic attrition. As such, this analysis should be seen as providing insight into a crucial area of development finance research within the constraints of project data availability.

[11] **Table 7** in Addendum A.2 provides the outcomes of the validation exercise across project-types. In the end, 716 projects are dropped from the final analysis due to insufficient coverage across geographic and time dimensions.

[12] As such, the local branches of commercial, foreign banks are included in the dependent variable analysis, given, in general, local branches loan books and capital allowances are influenced by the global shareholders and executives of the bank.

4. Empirical Strategy

In order to analyse the effect of DFI participation on extensive margin indirect mobilisation effects, we leverage our data into an Interactive Fixed Effects estimator, which allows us to saturate the model with a rich set of fixed effects to control for substantial unobserved heterogeneity. This empirical specification will attempt to provide insight on *Proposition 1* as outlined in the theoretical framework.

Adapting the Broccolini et al. (2021) approach, the following Interactive Fixed Effects Estimator is used to estimate the measures of private participation:

$$y_{cs,t} = \sum_{k=0}^{2} \beta_k DFI_{cs,t-k} + \sum_{j=0}^{2} \beta_j PProj_{cs,t-j} + \delta_{c,t} + \vartheta_{s,t} + \alpha_{cs} + \epsilon_{cs,t}, \tag{11}$$

where $DFI_{cs,t}$, a dummy variable for whether there is at least one project with DFI participation, in Country-Sector cs, at time t. $\sum_{k=0}^{2} \beta_k DFI_{cs,t-k}$ represents the cumulative effect of DFI participation, aggregating the effect of contemporaneous participation, $DFI_{cs,t}$ and two lags, $DFI_{cs,t-1}$, $DFI_{cs,t-2}$.[13] Lags are implemented to allow for the possibility that the mobilisation effects are delayed, particularly for large-scale infrastructure with longer time-horizons.

This is supplemented by a control for the cumulative effect of entirely privately financed projects in the previous two periods, $\sum_{j=0}^{2} \beta_j PProj_{cs,t-j}$, motivated by the theoretical model, whereby previous privately financed projects may provide an independent signal of risk. Finally, the model is saturated with three interactive fixed effects to reduce the threat of omitted variable bias by absorbing variation that may correlate with the regressors, with the mild assumption that unobservable heterogeneity does not systematically change over time[14], which would threaten the validity of estimates. Country and Sector Time-Varying Fixed Effects, $\delta_{c,t}$ and $\vartheta_{s,t}$ respectively, are used to absorb global shocks, and relevant dynamics (e.g. credit market availability, cost of technology) that may vary with DFI and Private Finance participation. Time-Invariant Country-Sector Fixed Effects, α_{cs}, are used to control for dynamics that are constant over time that may affect the estimation (e.g. solar irradiance, geography).[15] In the context of country-sector level variation, we are interested in unobserved variation that may correlate with DFI participation and Private Projects within each unit of analysis, which non-interactive fixed effects may be unable to capture. Relevantly, "under both large N and large T, the estimator is shown to be $\sqrt{NT}$ consistent, which is valid in the presence of correlations and heteroskedasticities of unknown form in both dimensions" (Bai 2009).

Following the procedure outlined for standard error clustering in Abadie et al. (2023), standard errors are clustered at the Country-level in line with the conservative assumption made in Broccolini et al. (2021), that decisions over the allocation of DFI capital are made at a Country-level. Section 6 features a robustness check which clusters at a Country-Sector level to assess whether the results hold up under the plausible assumption that DFI capital is allocated at the Country-Sector level. Robust-Cluster standard errors are used to overcome possible problems of serial correlation in the transient error term, and possible heteroskedasticity.

Finally, we run unit root and cross-sectional dependence tests to ensure the validity of tests. The presence of

[13] Based on the Akaike Information Criteria (AIC), which balances the additional information derived from each additional lag with the simplicity in representing the underlying data-generating-process.

[14] The Hausman (1978) Test is run to whether the Fixed Effects estimator is more appropriate than the Random Effects estimator. We fail to reject the null hypothesis, which is that the Fixed Effects estimator is consistent and more efficient.

[15] In order to test the intuition that time fixed effects are required, a Honda Test (Honda 1985) is run, and we reject the null hypothesis on the need for the range of fixed effects at 1% level, for the inclusion of each interactive fixed effects.

a unit root can create spurious correlations (Wooldridge and White 1988), which can be assessed with a unit root test. Testing for Cross-Sectional Dependence is contextually important, given the increased probability of dependence with large T, and specifically in infrastructure as a unit of analysis. Running the Levin et al. (2002) test, we find that we are able to reject the null that there is a unit root that affects any of the key dependent variables of interest, all at 1% levels. Implementing the Pesaran (2004) test[16] for dependence, we cannot reject the independence null hypothesis.

Crucially, this analysis makes no claims of causality, given that a large number of plausible factors affecting DFI participation and private financing are neither captured nor accounted for in the data. Nevertheless, the analysis remains valuable as the combination of fixed effects and previous transactional data accounts for significant heterogeneity to approach a precise estimate of DFI participation. The empirical strategy explains a significant amount of the relevant variation. Moreover, in the context of DFI and infrastructure financing, given the data, commercial, and measurement constraints, an exercise in correlational analysis provides us with valuable insights into the direction and magnitude of intended risk mitigation mechanisms.

5. Results and Robustness

5.1 Main Results

Table 2 presents the results of the Central Specification on our measures of private participation.

Table 2: DFI Mobilisation Effects

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{cs,t}$	1.212***	2.112**	0.4601***	-0.0228
	(0.2309)	(0.8278)	(0.0599)	(0.0252)
$DFI_{cs,t-1}$	0.1705	1.547**	0.0908**	0.0148
	(0.1079)	(0.7189)	(0.0444)	(0.0299)
$DFI_{cs,t-2}$	-0.3066	1.302*	-0.0856	-0.0352
	(0.1912)	(0.7812)	(0.0600)	(0.0237)
$PProj_{cs,t-1}$	0.0979*	0.6277***	0.0523***	0.0047
	(0.0505)	(0.1248)	(0.0151)	(0.0040)
$PProj_{cs,t-2}$	0.0347	-0.1157	0.0163	-0.0046
	(0.0600)	(0.2493)	(0.0244)	(0.0045)
$\sum_{\mathbf{k=0}}^{\mathbf{2}} \beta_{\mathbf{k}} \mathbf{DFI_{cs,t-k}}$	1.076***	4.9611**	0.4653***	-0.0432
	(0.2686)	(2.2624)	(0.0953)	(0.0599)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	4,376	4,376	4,376	4,376
R^2	0.59778	0.70113	0.68109	0.58078
Within R^2	0.47538	0.58034	0.48929	0.39291

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

First, the cumulative effect of DFI participation with the inclusion of two lags and contemporaneous participation is associated with a 1.076 increase in the number of commercial foreign banks, largely driven by the contemporaneous effect, based on Specification (1). This effect is statistically significant at a 1% level. We may worry about reverse causality given the composition of the result, whereby DFIs follow private finance activity, but we test for anticipation effects of DFI participation in the following subsection and find limited evidence.

[16] The test exploits pairwise correlation coefficients of the residuals to test whether there is cross-sectional dependence between units.

Second, using the number of projects as a gauge of transactional and financing activity, Specification (2) demonstrates that the cumulative effect of DFI participation is associated with a 4.961 increase in the overall number of projects, which is significant at a 5% level. In contrast to the previous dependent variable, this effect is driven by all three periods of DFI participation.

Third, as per Specification (3), cumulative participation is associated with a 0.4653 increase in the number of privately financed projects with at least one commercial foreign financier, which is significant at a 1% level. The result is driven by both the contemporaneous and lagged effect of participation.[17]

Finally, we evaluate the correlational relationship between DFI participation and the number of projects that are entirely financed by commercial, foreign financiers. The result suggests that there is no statistically significant effect and that there is little evidence for DFI participation sufficiently reducing the perceived risk from allocating finance for Country-Sectors, such that these institutions are willing to provide finance without the presence of other DFIs or domestic banks.

The result of Specification (4) is important, implying that the effect, based on the correlational evidence, seemingly does not facilitate an increase in projects that can self-sufficiently raise foreign private capital. Moreover, given the results of Specifications (1) and (3), where foreign, commercial participation is increasing, this suggests that the private financing activity is catalysed in the form of transactions alongside domestic banks, rather than through sole financing or a syndicate of commercial, foreign banks.

Incorporating scores from the State Fragility Index (SFI) to evaluate the effects across countries fragility as a dimension, the results are largely driven by countries in the middle two quartiles of fragility,[18] across all outcomes. This is consistent with the theoretical analysis in Section 2, where fragile countries still exhibit excessive levels of fundamental risk for private financing, and countries with previous private financing do not benefit from the reduction of the signal.

It is important not to misinterpret this as evidence of direct mobilisation, whereby DFIs directly crowd in private financiers into the same transaction, given DFIs and private financiers often participate in different projects within the same time period. In fact, only 17% of projects in the sample have both DFI and commercial foreign banks involved in the same project. The time variable used is the year of financial close, which is the culmination of a lengthy process and not necessarily the event generating the signalling effect for private financiers. However, the contemporaneous effect should still be considered a measure of indirect mobilisation, as the knowledge that a project will likely reach financial close may be enough of a signal.

5.2 Controlling for Lagged Dependent Variables and Evaluating Amplification Effects

Theoretically, it is possible that private finance participation itself catalyses further mobilisation. Omitted variable bias driven by not accounting for the effect of private finance participation in the previous period may threaten the robustness of the DFI participation estimates. Moreover, the specification we are estimating may follow an autoregressive process which threatens the validity of our estimates found in Section 5.1.

[17]Notably, unlike the other dependent variables, the composition of this effect is heterogeneous across different infrastructure types. All periods are positive and significant for certain energy generation infrastructure (specifically natural gas, hydro and coal), as well as road infrastructure. There is no effect, time-lagged or contemporaneous for waste and water infrastructure, ports, and airports – which is plausibly driven by a lack of "bankable" projects for private financing.

[18]The middle two quartiles are largely comprised of countries from Sub-Saharan Africa, and parts of South Asia and the Middle East.

As such, leveraging the Blundell and Bond (1998) System Generalised Methods of Moments (SGMM) estimator, we can account for the effect of the specific measure of private finance participation in the previous period. In this context, the Fixed Effect Estimator suffers from Dynamic Panel Bias (Nickell 1981), whereby the lagged dependent variable, $y_{cs,t-1}$, correlates with the transient error term used in the estimation, $\epsilon_{cs,t}$. This bias may be decreasing with the number of time periods in a panel, but in the case of our unbalanced panel, there are a number of observations with Small T.

In brief, compared to the Difference GMM (Arellano and Bond 1991), the SGMM transforms instruments such that they are exogenous to the fixed effects (i.e. $\mathbb{E}[\Delta y_{cs,t}\alpha_{cs}] = 0$) (Roodman 2009a), for all cs and t, unlocking the use of differences as instruments for levels.[19] This is more efficient as a result of the additional moment conditions, by leveraging levels and differences as instruments. The orthogonality of the difference instruments for the lagged dependent variable is a plausible assumption in the context of *differences* in extensive margin measures of private participation being uncorrelated with Country-Sector and Time Fixed Effects, given the long-run time-horizon of infrastructure projects.

In estimating the effect of DFI participation the following is estimated:

$$y_{cs,t} = \rho y_{cs,t-1} + \sum_{k=0}^{2} \beta_k DFI_{cs,t-k} + \sum_{j=0}^{2} \beta_j PProj_{cs,t-j} + \delta_{c,t} + \vartheta_{s,t} + \alpha_{cs} + \epsilon_{cs,t} \tag{12}$$

Here, the majority of the specification is the same as the Central Specification in its composition, with the addition of a single lag of the dependent variable $y_{cs,t-1}$, and imposition of $\delta_{c,t}$, $\vartheta_{s,t}$, and α_{cs} which represent country-sector, country-time and sector-time fixed effects respectively, as above. The two-step GMM is implemented given it optimally determines the weighting matrix to insulate from heteroskedasticity and autocorrelation, with an imposition of the Windmeijer (2005) correction to ensure against the SGMM's susceptibility to downward biased standard errors in finite samples.

The results of the SGMM, with implicit Country-Sector and Time fixed effects are reported in **Table 3**. The results are valid under the (Arellano and Bond 1991) AR tests for serial correlation, and the Hansen (1982) over-identification test for the exogeneiety of instruments.[20] Given instrument proliferation weakens the Hansen test, we account for different instrument sets, and are unable to reject the null hypothesis of valid over-identifying restrictions.

The estimate of our SGMM of the cumulative and per-period effect are similar to Table 2, in both direction and magnitude. This suggests that the Central Specification is able to isolate the correlational relationships without the need to control for the lagged dependent variable as a possible confounder. This result is intuitive given the sufficiently small correlation of the $DFI_{cs,t}$ lags with $y_{cs,t-1}$, insulating the results from collinearity issues and lending credence to the Central Specification. To the extent that correlation does exist, this result suggests that each affects measures of private finance participation distinctly.

It is important to note that the imposition of the lagged dependent variable has a strong, statistically significant effect across all the dependent variables of interest and that the effect of DFI participation survives. The implication of this result is that DFI participation may be able to amplify private financing and activity beyond its own indirect effect through a further private participation signal. For instance, if DFI participation

[19] If true, then $\Delta y_{cs,t-1}$ and earlier realisations of Δy_{cs} become valid instruments for the lagged dependent variable in levels.

[20] We fail to reject the null for the Hansen J-Test and the AR(2) Serial Correlation Test ($p = 0.5421$ and $p = 0.2927$ respectively), whilst rejecting for the AR(1) Test ($p = 0.0021$). Up to 7 instruments are used in-line with the performance across tests, whilst avoiding problems of instrument proliferation (Roodman 2009b).

Table 3: Controlling for Lagged Dependent Variables and Evaluating Amplification Effects

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{cs,t}$	1.2208***	2.103**	0.4575***	0.0088
	(0.2153)	(0.4278)	(0.0352)	(0.02313)
$DFI_{cs,t-1}$	0.1781	1.611**	0.0871**	0.0416
	(0.1071)	(0.8189)	(0.1347)	(0.02542)
$DFI_{cs,t-2}$	-0.3350	1.365*	-0.0356	0.0044
	(0.2912)	(0.4812)	(0.0813)	(0.02156)
$PProj_{cs,t-1}$	0.0979*	0.6277***	0.0622**	0.0104*
	(0.0434)	(0.1248)	(0.0030)	(0.0060)
$PProj_{cs,t-2}$	0.0753	-0.1157	0.0388*	0.0082
	(0.12630)	(0.2493)	(0.0622)	(0.0025)
$y_{cs,t-1}$	0.2639*	0.8027***	0.2010**	0.1760**
	(0.0027)	(0.049816)	(0.0685)	(0.0679)
$\sum_{\mathbf{k=0}}^{\mathbf{2}} \beta_{\mathbf{k}} \mathbf{DFI}_{\mathbf{cs,t-k}}$	1.0699***	5.090**	0.4653***	-0.0548
	(0.2034)	(3.1638)	(0.1353)	(0.0612)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	4,376	4,376	4,376	4,376

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

affects the number of commercial foreign banks, the increased presence of commercial foreign banks itself amplifies the effect in the next period, and the same logic applies to the number of transactions. The persistence of mobilisation effects after controlling for lagged private participation correlationally suggests that the risk reduction signals from both DFI and private participation, as discussed in the theoretical framework, are contemporaneous.

5.3 Robustness

5.3.1 Controlling for Relevant Confounders

Chinese Development Finance: The explosion in Chinese development finance flows provided through state-owned enterprises and Chinese DFIs may be uniquely associated with an increase in private finance participation, despite differences in financing approaches to other DFIs. Dreher et al. (2021) suggest that Chinese development financial flows are strongly correlated with higher economic growth, but lowers the effectiveness of US aid and development finance. The first dynamic suggests that Chinese Development Finance may itself crowd in private finance, and the second implies that the effect of DFI participation may be smaller after accounting for Chinese Development Finance. Therefore, the absence of Chinese Development Finance would confound our estimate for DFI participation. On the contrary, as forwarded by Chen (2020), Chinese Development Finance flows operate on cost of capital and transactional structures that are markedly different to conventional private financing structures of public-private partnerships, project finance and sponsor-level loans, and therefore, the strength of the demonstration effect for private financiers is weak.

Incorporating data from projects with China's two largest development finance institutions[21] (excluding projects in China), and projects explicitly labelled by Fitch Connect as Belt and Road Initiative (BRI) projects,[22] we impose a dummy into the Central Specification for whether a country received Chinese

[21]The Export-Import Bank of China (CHEXIM) and the Chinese Development Bank (CDB) are the two largest banks leveraged for the analysis.

[22]The Fitch methodology labels BRI projects based on the involvement of key Chinese financiers, Chinese supported-project sponsors and state owned enterprises, that receive Chinese Development Finance. Asian Infrastructure Investment Bank (AIIB)

Development Finance in the last two years. The results can be found in Addendum A.3.

The results, outlined in Addendum A.3, show that the association with the number of commercial foreign banks remains similar in magnitude and significance to the Central Specification, and Chinese Development Finance does not have a statistically significant association. While Chinese Development Finance is positively and statistically significant in its association with the number of projects, the estimate for DFI participation remains positive and significant. The effect of DFI participation on the number of entirely foreign-financed transactions remains insignificant, and Chinese Development Finance does not have a strong association. Thus, controlling for Chinese Development Finance flows does not detract from the association found in the Central Specification.

Controlling for other confounders: We attempt to impose set of controls, from a range of credible datasets, relevant to financing of infrastructure, including measures of macroeconomic performance, state stability, receipt of ODA, contracting and regulatory quality, policy infrastructure policy and pre-existing stock.[23] When implemented with the set of fixed effects, the majority of added controls were found to be collinear with a combination of the interactive fixed effects, or to have provided very little explanatory power whilst leaving the estimates of Table 2 largely unaffected. The same holds for the imposition of controls for the Cross-Border, Cross-Sector and SGMM specifications. This suggests that the original specifications successfully capture much of the unobserved variation at levels of country, sector and time, which these controls would attempt to capture.

5.3.2 Anticipation Effects

The correlational evidence presented in Section 4 may suffer from reverse causality, whereby DFIs provide financing to projects in countries that are already subject to private finance participation. Therefore, we test for the possibility of anticipation effects, by introducing two years' worth of leads, $DFI_{cs,t+1}$ and $DFI_{cs,t+2}$, to assess whether these are statistically different from zero. This directly tests the association between the measures of private finance measures with the forward activity of DFIs in that country-sector.

We apply the Broccolini et al. (2021) test for anticipation effects, by estimating the following variation of the Central Specification:

$$y_{cs,t} = \sum_{k=-2}^{+2} \beta_k DFI_{cs,t-k} + \sum_{j=0}^{2} \beta_j PProj_{cs,t-j} + \delta_{c,t} + \vartheta_{s,t} + \alpha_{cs} + \epsilon_{cs,t} \tag{13}$$

Here, the model is identical to the Central Specification, with the addition of the leads mentioned above. As outlined in Addendum A.3, the results for the original coefficients testing for mobilisation effects are stable with leads.

However, for the number of projects and the number of foreign projects, leads of DFI participation are statistically significant. This suggests that even though DFIs are not evidently preempting private financing activity in the sector, they may be allocating capital in anticipation of an increase in the number of projects and commercial, foreign financing allocated to a Country-Sector. Whilst this evidence does not undermine

are excluded from the Chinese Development Finance dummy, acting more like a conventional DFI, often investing alongside the ADB and the WB.

[23] Data was leveraged from a combination of the World Development (World Bank 2022b) and Governance Indicators (World Bank 2023), Ease of Doing Business Index (World Bank 2019), Fitch Risk Ratings, OECD Development Finance Data (OECD 2022b), and IMF Infrastructure Investment and Capital Stock data (IMF 2022b).

the rationale of DFI participation from a private finance mobilisation perspective, it creates complications in concluding that the effect of participation drives an increase in financing activity.

5.3.3 Sensitivity to Specification and Clustering

As flagged in Section 4, the Central Specification makes the assumption that DFI capital budgets are determined at the Country-level, which is the basis for clustering standard errors. Per Abadie et al. (2023), if allocations are actually determined at a Country-Sector level, we would need to cluster at the Country-Sector level. This alternative assumption on the level of treatment is plausible given DFIs tend to pursue “bankable” projects in geographies of operation, rather than originating projects from scratch (Nassiry 2016). As per Addendum A.3, the results found in the Central Specification are robust in changes in the level of clustering. Moreover, the results are robust to non-interactive fixed effects, if we believe that the Central Specification over-absorbs the variation relevant within each country sector, albeit explaining less variation.[24]

6. Extensions

6.1 Cross-Segment Mobilisation Effects

We now provide an empirical attempt to test for the possibility of cross-sector mobilisation effects, as per *Proposition 2* in the Theoretical Framework. One of the key questions when evaluating the capacity of DFI financing to mitigate the dual-financing gap, is whether it is able to crowd in private capital in related infrastructure, beyond the project type that was initially invested in. Using the subset of the data that relates to energy generation, transmission, and distribution infrastructure, we can examine whether the evidence for indirect mobilisation extends to other segments of the energy infrastructure market. As discussed in Section 1, in the context of the demanding global targets under the Paris Agreement, there is a pressing need for private financing for renewable energy generation and electricity transmission infrastructure.

First, we assess intra-segment mobilisation effects. Specifically, we analyse whether there is evidence of a relationship between DFI participation in renewable and non-renewable energy generation projects, and private mobilisation effects in other projects in the segment. For instance, if DFI financing is provided to solar projects, we assess whether mobilisation effects extend to wind and hydro projects within the same country. It is possible that the demonstration effect extends within the same segment, given these projects share project characteristics and contracting similarities (e.g. high capital costs or hold-up type dynamics present in most renewables projects). Importantly, this is not a complete test of the full set of mobilisation effects that may occur in adjacent and complementary sectors, as outlined in the theoretical framework rather it is a test for catalysation within the segment.[25] We test for the following specification:

$$y_{ai,s,t} = \sum_{n=1}^{2} \beta_n DFI_{aj,s,t-n} + \sum_{j=0}^{2} \beta_j PProj_{ai,s,t-j} + \sum_{k=0}^{2} \beta_k DFI_{ai,s,t-k} + \delta_{a,t} + \vartheta_{i,t} + \alpha_{ai} + \epsilon_{ai,s,t}, i \neq j \quad (14)$$

In this analysis, we extend on the Central Specification to estimate the effect on measures of private finance in country a, sector i, segment s, at time t, where the first set of distributed lag coefficients are the effect of DFI participation, which is a dummy as previously, in the same country a and segment s, but in all sectors

[24]Results from the non-interactive fixed effects specification are available as a supplement on request.
[25]Lanzalot et al. (2018) for instance, provide novel evidence at a project-level of catalysation effects across sectors.

within that segment not including i. We retain the core of the Central Specification to control for any effects of previous past private projects and DFI participation within sector i.

Table 4: Cross-Segment Mobilisation Effects (Within Energy Clusters)

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{aj,t-1}$	-0.1925	-0.4189	0.0104	-0.0248
	(0.2682)	(0.3639)	(0.0714)	(0.0474)
$DFI_{aj,t-2}$	0.2451	0.5278*	0.0507	0.0809
	(0.2359)	(0.2951)	(0.1043)	(0.0617)
$DFI_{ai,t}$	1.883***	2.516***	0.0840	-0.0102
	(0.4568)	(0.6423)	(0.0664)	(0.0565)
$DFI_{ai,t-1}$	0.3594	1.242**	0.1727***	0.0569
	(0.2445)	(0.4830)	(0.0588)	(0.0544)
$DFI_{ai,t-2}$	-0.3586	0.6241	-0.0811	-0.0191
	(0.3236)	(0.6683)	(0.0768)	(0.0492)
$PProj_{ai,t-1}$	0.1458***	0.3892***	0.0510***	0.0053
	(0.0398)	(0.0636)	(0.0107)	(0.0060)
$PProj_{ai,t-2}$	0.0840	0.1944	0.0551**	-0.0042
	(0.0654)	(0.1208)	(0.0223)	(0.0112)
$\sum_{n=1}^{2} \beta_n \mathbf{DFI_{aj,s,t-n}}$	0.0526	0.1089	0.0611	0.0561
	(0.1723)	(0.2213)	(0.0495)	(0.0341)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	1,964	1,964	1,964	1,964
R^2	0.72788	0.80498	0.76747	0.68586
Within R^2	0.53168	0.6446	0.5964	0.4121

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

As **Table 4** suggests there is limited evidence of cross-segment mobilisation, whilst the coefficients estimating the within Country-Sector mobilisation effects are similar in direction to the Central Specification.

Second, we evaluate the effect of DFI financing for Energy Generation projects on measures of private finance for Electricity Transmission and Distribution Infrastructure. The underlying rationale for this test is that an increase in energy generation capacity should create an organic necessity for investments in transmission and distribution infrastructure. The results of **Table 5** below do not provide evidence for such an effect, with weak correlational evidence for mobilisation across all measures of private finance participation.

The results of cross-segment analysis suggest that the catalysation is limited to the infrastructure type as the original project, and as such, allocations of DFI capital that attempt to unlock segments for investment are unlikely to be successful. DFI capital according to these results, should be allocated to infrastructure types with high potential for investment, rather than in anticipation of possible spillovers to other segments, which is particularly relevant for the green energy transition.

6.2 Cross-Border Mobilisation Effects

State fragility is a key determinant of private financing for infrastructure, given its impacts on the contracting environment, implications for land tenure stability, and the possibility of damage or negligence (PPPLRC 2022). In the DFI context, fragility as a distinction between states for the purposes of financing has received increasing traction (IFC 2015; Safran 2013).

Given the paucity of bankable projects in fragile and conflict-afflicted states, the possibility that DFI demonstration effects may inspire private financing in other fragile states within the same region is theoretically a powerful mechanism, in-line with *Proposition 3* of the theoretical framework. It seems however, there is

Table 5: Cross-Segment Mobilisation Effects (Electricity Transmission and Distribution)

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{aj,t-1}$	-0.1448	0.3538	-0.0666**	-0.0270
	(0.0925)	(0.5275)	(0.0307)	(0.0274)
$DFI_{aj,t-2}$	0.1183	-0.4455	0.0584	0.0156
	(0.1253)	(0.6931)	(0.0583)	(0.0213)
$DFI_{ai,t}$	0.3357	0.7755	0.0415	-0.0918
	(0.2387)	(0.7271)	(0.1235)	(0.0677)
$DFI_{ai,t-1}$	0.2335	0.8171	0.1642	0.0150
	(0.1980)	(0.6885)	(0.1005)	(0.0696)
$DFI_{ai,t-2}$	0.2362	1.124	0.2519	0.0471
	(0.2247)	(0.6847)	(0.1528)	(0.0907)
$PProj_{ai,t-1}$	0.2179***	0.4236***	0.1004***	-0.0071
	(0.0571)	(0.1285)	(0.0183)	(0.0078)
$PProj_{ai,t-2}$	0.3744***	0.1001	0.1479***	0.0160*
	(0.0577)	(0.1093)	(0.0174)	(0.0089)
$\sum_{\mathbf{n=1}}^{\mathbf{2}} \beta_{\mathbf{n}} \mathbf{DFI_{aj,s,t-n}}$	-0.0266	-0.0917	-0.0082	-0.0114
	(0.0621)	(0.2336)	(0.0378)	(0.0185)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	334	334	334	334
R^2	0.84554	0.63142	0.85144	0.67275
Within R^2	0.60795	0.05778	0.53880	0.02703

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

little evidence of such an effect. Similarly, the possibility that demonstration effects may spillover across borders, to unlock synergies in regional energy generation would also open a range of financing and grid possibilities. As such, we test whether there are mobilisation effects across borders, for countries within the same region and with similar levels of fragility, based on SFI score, using the following specification:

$$y_{ai,r,t} = \sum_{n=1}^{2} \beta_n DFI_{bi,r,t-n} + \sum_{k=0}^{2} \beta_k DFI_{ai,r,t-k} + \sum_{j=0}^{2} \beta_j PProj_{ai,r,t-j} + \delta_{a,t} + \vartheta_{i,t} + \alpha_{ai} + \epsilon_{ai,r,t}, a \neq b, \quad (15)$$

where $y_{ai,r,t}$ represent measures of private participation for Country a, Sector i, in regional cluster of countries, r, and $\sum_{n=1}^{2} \beta_n DFI_{bi,r,t-n}$, which reflects the aggregate effect of DFI participation in all countries in the Cluster r, except Country a.

Table 6 outlines the average relationship across the sample.[26] The analysis, even if performed on subsets of the data based on fragility, suggests that there is no evidence of cross-border mobilisation across categorisations of fragility. This insignificance suggests reasonably strict geographic limitations on any mobilisation effects.

[26]Standard Errors are clustered at a Region-level, given the level of any cross-border spillover would be regional. The insignificance of the results does not change with the level of clustering.

Table 6: Cross-Border Mobilisation Effects

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{bi,r,t-1}$	0.0464	0.0202	0.0032	0.0012
	(0.0324)	(0.0801)	(0.0065)	(0.0080)
$DFI_{bi,r,t-2}$	0.0028	0.0666	0.0183	-0.0011
	(0.0440)	(0.0951)	(0.0097)	(0.0078)
$DFI_{ai,r,t}$	0.9174**	0.7304	-0.0521*	-0.0299
	(0.3241)	(0.4150)	(0.0241)	(0.0155)
$DFI_{ai,r,t-1}$	0.2700	0.7511	0.0947**	0.0290*
	(0.1738)	(0.5467)	(0.0364)	(0.0127)
$DFI_{ai,r,t-2}$	-0.0012	0.2319	-0.0142	-0.0103
	(0.0936)	(0.2250)	(0.0600)	(0.0201)
$PProj_{ai,r,t-1}$	0.1783*	0.9231***	0.0788**	0.0107**
	(0.0812)	(0.1727)	(0.0261)	(0.0036)
$PProj_{ai,r,t-2}$	0.1015	0.2037	0.0566**	0.0058
	(0.0538)	(0.2448)	(0.0207)	(0.0053)
$\sum_{\mathbf{n=1}}^{\mathbf{2}} \beta_{\mathbf{n}} \mathbf{DFI_{bi,r,t-n}}$	0.0493	0.0868	0.021434	0.0001
	(0.0337)	(0.0961)	(0.0088)	(0.0041)
Fixed-effects				
Region-Year	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Region-Sector	Yes	Yes	Yes	Yes
Fit statistics				
Observations	3,441	3,441	3,441	3,441
R^2	0.60782	0.64411	0.70085	0.50051
Within R^2	0.29681	0.32439	0.48023	0.321536

Clustered (Region) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

7. Conclusion

The novel theoretical framework in Section 2 explores how DFI participation can reduce the perceived risk of financing infrastructure in developing countries. The subsequent analysis demonstrates that, once controlling for significant variation, DFI participation is strongly associated with a range of extensive margin private finance outcomes, consistent with indirect mobilisation. The Central Specification, controlling for fixed effects and prior signals from privately financed projects, shows that this association holds for the number of foreign commercial financiers, the number of transactions with at least one foreign commercial financier, and the total number of projects. Testing for the effect in the presence of signals of private participation from a previous period, this mobilisation effect survives, lending credence to the possibility of an amplification effect, whereby the total effect exceeds the direct channel of participation. Further analysis reveals that mobilisation effects are confined to specific Country-Sectors for all measures of private participation.

A combination of the main findings, robustness checks and extensions presents three implications. First, DFI participation acts as a blunt signal in indirectly mobilising private finance, whereby private financiers perceive a reduced risk in the Country-Sector that received development finance, and not other countries and sectors that may share similar risk characteristics. Second, the limited mobilisation effects of Chinese development finance are pertinent in the context of rapidly rising flows from China to infrastructure in developing countries. The differential effect of Chinese development finance may be driven by perceptions of Chinese projects as generating lower returns, given underlying lower costs of financing and alternative project structures which permit returns below a commercial financier's hurdle rate. This effect could also be explained by higher barriers to entry, driven by bankable projects being captured by Chinese financiers. Finally, the heterogenous effect of DFI participation across levels of fragility implies that DFI participation is unable to overcome entrenched priors of high risk in the most fragile countries, and that there is no corresponding increase in the number of bankable projects which could receive private finance.

Therefore, DFI capital should target infrastructure in countries with potential for sector growth, in projects that resemble the financing structures of future projects that may receive private finance, whilst creating a pipeline of bankable projects. The results for highly fragile states necessitate alternative financing instruments, such as aid and grant funding, and programs that increase the number of bankable projects. Further research could explore whether these approaches can catalyse private finance in these countries. The evidence that mobilisation effects persist independently after DFI participation, propagated through induced private activity, suggests that the case for sustained DFI participation is limited. In the context of constrained DFI resources, amplification effects imply that DFI should target a wide range of country-sectors rather than concentrating capital allocations. Finally, capital deployment strategies relying on spillovers across infrastructure segments and borders are unlikely to crowd in additional private capital and should not be the focus of scarce development finance. Immediate policy implications for DFIs include the establishment of best-practice, replicable project structures for future private financiers, and improving data reporting on current and future projects to bolster demonstration effects.

However, there are limitations to the methodology and conclusions of the empirical analysis. First, the robustness checks reduce the possibility of endogeneity in the effect of DFI participation, but there is still the possibility that there is some endogenous variation that cannot be controlled for (e.g. the strategic objectives of DFI participation) which prevents causal inference. Second, as discussed in Section 3, missing transactions may compromise the results by misestimating the effect of DFI and private participation which otherwise would have been captured by other transactions in a Country-Sector. Ultimately, the analysis only examines indirect mobilisation; there is scope for further research on direct and intensive-margin effects.

Climate Change and persistent underdevelopment require solutions that effectively catalyse trillions of dollars in private capital, in large part through DFI participation. Within the constraints of data, this analysis has attempted to provide unique theoretical and empirical insight into the current state of mobilisation.

A. Addendum

A.1 Derivations for the Theoretical Framework

First, we want to derive the result found in Equation **(10)**. Starting with the break-even condition for financing, we can solve in terms of $n_{cs,t}^{DFI}$, such that:

$$\mathbb{E}\left[\pi_{cs,t}\right] = \left(1 - R_{cs,t}\left[C_{cs,t}(\cdot), S_{cs,t}(\cdot)\right]\right) Y - F = H, \tag{16}$$

$$R_{cs,t}(\cdot) = 1 - \frac{F+H}{Y}, \tag{17}$$

Implementing the constituent parts of $R_{cs,t}(\cdot)$, this becomes (for $P(\cdot) > 0$):

$$\frac{1}{3}\left[C_{cs,t}(\cdot) + S_{cs,t}(\cdot) + P_{cs,t}(\cdot)\right] = 1 - \frac{F+H}{Y}, \tag{18}$$

$$P_{cs,t}(\cdot) = 3 - 3\left(\frac{F+H}{Y}\right) - C_{cs,t}(\cdot) - S_{cs,t}(\cdot), \tag{19}$$

Finally, we implement the complete form of $P(\cdot)$ and $\delta(\cdot)$,to solve:

$$P_{cs,t}\left[\delta\left(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}\right), \epsilon_{cs,t}\right] = \left(1 - \delta\left(n_{cs,t}^{DFI}, n_{cs,t}^{PProj}\right) \cdot \epsilon_{cs,t}\right) = 3 - 3\left(\frac{F+H}{Y}\right) - C_{cs,t}(\cdot) - S_{cs,t}(\cdot) \tag{20}$$

$$\gamma\left(\sum_{\tau=t}^{\infty} \alpha^{t-\tau} \cdot n_{cs,\tau}^{DFI} + \sum_{\tau=t}^{\infty} \mu^{t-\tau} n_{cs,\tau}^{PProj}\right) = \frac{1}{\epsilon_{cs,t}}\left[3\left(\frac{F+H}{Y}\right) + C_{cs,t}(\cdot) + S_{cs,t}(\cdot) - 2\right], \tag{21}$$

$$n_{cs,t}^{DFI} = \frac{x}{1-\alpha} \tag{22}$$

Where $x = \gamma^{-1}\left\{\frac{1}{\epsilon_{cs,t}}\left[3\left(\frac{F+H}{Y}\right) + C_{cs,t}(\cdot) + S_{cs,t}(\cdot) - 2\right]\right\} - \sum_{\tau=t}^{\infty} \mu^{t-\tau} n_{cs,t}^{PProj}$, as outlined in Section 2.

For this result to make sense, we have to demonstrate that the condition found in **2.3.1** on the dynamic of the first derivative holds true.

Exploiting the chain rule:

$$\frac{\partial \mathbb{E}\left[\pi_{cs,t}\right]}{\partial n_{cs,t}^{DFI}} = \frac{\partial \mathbb{E}\left[\pi_{cs,t}\right]}{\partial P_{cs,t}(\cdot)} \cdot \frac{\partial P_{cs,t}(\cdot)}{\partial \delta(\cdot)} \cdot \frac{\partial \delta(\cdot)}{\partial n_{cs,t}^{DFI}} \tag{23}$$

Based on the parameterisation of the model, we have the following:

$$\frac{\partial \mathbb{E}\left[\pi_{cs,t}\right]}{\partial P_{cs,t}(\cdot)} < 0, \frac{\partial P_{cs,t}(\cdot)}{\partial \delta(\cdot)} < 0, \frac{\partial \delta(\cdot)}{\partial n_{cs,t}^{DFI}} > 0 \tag{24}$$

$$\therefore \frac{\partial \mathbb{E}\left[\pi_{cs,t}\right]}{\partial n_{cs,t}^{DFI}} = \frac{\partial \mathbb{E}\left[\pi_{cs,t}\right]}{\partial P_{cs,t}(\cdot)} \cdot \frac{\partial P_{cs,t}(\cdot)}{\partial \delta(\cdot)} \cdot \frac{\partial \delta(\cdot)}{\partial n_{cs,t}^{DFI}} > 0, \tag{25}$$

This is consistent with the result that expected return on financing is increasing in the number of transactions with DFI participation.

A.2 Outcome of the Data Validation Exercise

Table 7: Data Validation Outcomes

Infrastructure Type	Infrastructure Segment	Number of Validation Iterations	Nature of Coverage Gaps	Number of Projects Removed
Airports	-	5	N	0
Biogas	Biofuels	8	A	36
Biomass	Biofuels	5	G	23
Bridges	Bridge and Road Infrastructure	7	T	92
Channel Dredging	Ports	3	A	76
Coal	Energy Generation	6	N	0
Commuter and Light Rail	Railways	5	G	9
Diesel	Energy Generation	6	N	0
Electricity Distribution and Transmission	-	19	G-T	87
Freight Rail	Railways	5	T	16
Geothermal	Energy Generation	4	A	96
Natural Gas	Energy Generation	10	G-T	71
New Ports	Ports	4	N	0
Nuclear	Energy Generation	4	A	16
Roads	Bridge and Road Infrastructure	18	G-T	108
Solar	Energy Generation	8	G	22
Waste Collection Plants	Water, Waste and Treatment	5	A	56
Waste Treatment Plant	Water, Waste and Treatment	7	N	0
Water Treatment Facilities	Water, Waste and Treatment	5	G	8
Wind	Energy Generation	6	N	0
Total				716

Note: The number of iterations is the number of Country-Time periods examined
Legend: A: All Observations, T: Observations from Specific Time Periods, G: Observations from Specific Geographies

A.3 Results from Robustness Checks

Table 8: Controlling for Chinese Development finance

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{cs,t}$	1.204***	2.071**	0.4604***	-0.0230
	(0.2310)	(0.8042)	(0.0605)	(0.0251)
$DFI_{cs,t-1}$	0.1538	1.455**	0.0911**	0.0144
	(0.1094)	(0.6494)	(0.0440)	(0.0303)
$DFI_{cs,t-2}$	-0.2967	1.307*	-0.0780	-0.0340
	(0.1921)	(0.7228)	(0.0600)	(0.0238)
$PProj_{cs,t-1}$	0.0960*	0.6284***	0.0521***	0.0047
	(0.0507)	(0.1217)	(0.0152)	(0.0041)
$PProj_{cs,t-2}$	0.0324	-0.1392	0.0162	-0.0047
	(0.0617)	(0.2526)	(0.0247)	(0.0046)
$China$	0.4136	3.059***	0.1395	0.0354
	(0.3084)	(0.9899)	(0.1003)	(0.0390)
$China_{cs,t-1}$	0.3463	0.7175	-0.1082	-0.0134
	(0.2195)	(0.8757)	(0.0984)	(0.0403)
$China_{cs,t-2}$	-0.1681	1.141	-0.0601	-0.0027
	(0.3443)	(1.169)	(0.1040)	(0.0344)
$\sum_{\mathbf{k=0}}^{\mathbf{2}} \beta_{\mathbf{k}} \mathbf{DFI_{cs,t-k}}$	1.061***	4.8324**	0.4735***	-0.0426
	(0.2776)	(2.1025)	(0.09726)	(0.0601)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	4,376	4,376	4,376	4,376
R^2	0.59916	0.70562	0.68205	0.58103
Within R^2	0.47856	0.59416	0.49202	0.4035

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 9: Controlling for Anticipation Effects

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{cs,t}$	1.211***	2.135**	0.4678***	-0.0197
	(0.2280)	(0.8235)	(0.0601)	(0.0237)
$DFI_{cs,t-1}$	0.1813	1.606**	0.1003**	0.0190
	(0.1107)	(0.7321)	(0.0449)	(0.0291)
$DFI_{cs,t-2}$	-0.2963	1.364*	-0.0751	-0.0307
	(0.1985)	(0.7871)	(0.0597)	(0.0228)
$DFI_{cs,t+1}$	0.1662	0.5737**	0.0456	0.0221
	(0.1401)	(0.2199)	(0.0600)	(0.0231)
$DFI_{cs,t+2}$	0.0228	0.4540	0.1183*	0.0491**
	(0.1694)	(0.3281)	(0.0618)	(0.0240)
$PProj_{cs,t-1}$	0.0958*	0.6162***	0.0504***	0.0039
	(0.0515)	(0.1205)	(0.0152)	(0.0043)
$PProj_{cs,t-2}$	0.0342	-0.1159	0.0165	-0.0045
	(0.0602)	(0.2505)	(0.0249)	(0.0046)
$\sum_{\mathbf{k=0}}^{\mathbf{2}} \beta_{\mathbf{k}} \mathbf{DFI_{cs,t-k}}$	1.0964***	5.1051**	0.4930***	-0.0314
	(0.2838)	(2.2773)	(0.0954)	(0.0555)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	4,376	4,376	4,376	4,376
R^2	0.5982	0.7019	0.6825	0.5823
Within R^2	0.4764	0.59261	0.4932	0.4065

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 10: Clustering at the Country-Sector Level

Dependent Variables:	Number of Commercial Foreign Banks	Number of Transactions	Number of Foreign Projects	Number of Foreign Only Transactions
Model:	(1)	(2)	(3)	(4)
Variables				
$DFI_{cs,t}$	1.212***	2.112***	0.4601***	-0.0228
	(0.2249)	(0.5529)	(0.0725)	(0.0293)
$DFI_{cs,t-1}$	0.1705	1.547**	0.0908	0.0148
	(0.1501)	(0.6236)	(0.0654)	(0.0330)
$DFI_{cs,t-2}$	-0.3066	1.302**	-0.0856	-0.0352
	(0.2490)	(0.6127)	(0.0667)	(0.0328)
$PProj_{cs,t-1}$	0.0979*	0.6277***	0.0523**	0.0047
	(0.0505)	(0.1523)	(0.0206)	(0.0054)
$PProj_{cs,t-2}$	0.0347	-0.1157	0.0163	-0.0046
	(0.0600)	(0.2846)	(0.0255)	(0.0047)
$\sum_{\mathbf{k=0}}^{\mathbf{2}} \beta_{\mathbf{k}} \mathbf{DFI_{cs,t-k}}$	1.076***	4.9611**	0.4653***	-0.0432
	(0.3398)	(1.5058)	(0.1355)	(0.0624)
Fixed-effects				
Country-Sector	Yes	Yes	Yes	Yes
Sector-Year	Yes	Yes	Yes	Yes
Country-Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	4,376	4,376	4,376	4,376
R^2	0.59778	0.70113	0.68109	0.58078
Within R^2	0.47538	0.58034	0.48929	0.38291

Clustered (Country-Sector) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

References

ABADIE, A., **ATHEY, S.**, **IMBENS, G. W.**, and **WOOLDRIDGE, J. M.**, 2023. When should you adjust standard errors for clustering?*. *The Quarterly Journal of Economics* [online], 138 (1), 1–35. Available from: https://doi.org/10.1093/qje/qjac038.

ARELLANO, M., and **BOND, S.**, 1991. Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies* [online], 58 (2), 277. Available from: https://academic.oup.com/restud/article-lookup/doi/10.2307/2297968.

ATTRIDGE, S., and **ENGEN, L.**, 2019. *Blended finance in the poorest countries: The need for a better approach.* London.

BAI, J., 2009. Panel Data Models With Interactive Fixed Effects. *Econometrica* [online], 77 (4), 1229–1279. Available from: https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA6135.

BAKICI, S., and **AKIN, K.**, 2011. *Spatial data infrastructure in turkey and projects* [online]. Istanbul. Available from: https://www.oicrf.org/-/spatial-data-infrastructure-in-turkey-and-projects.

BASÍLIO, M. S., 2014. The Determinants of Multilateral Development Banks' Participation in Infrastructure Projects. *Journal of Infrastructure Development* [online], 6 (2), 83–110. Available from: http://journals.sagepub.com/doi/10.1177/0974930614564991.

BLALOCK, G., and **GERTLER, P. J.**, 2008. Welfare gains from Foreign Direct Investment through technology transfer to local suppliers. *Journal of International Economics* [online], 74 (2), 402–421. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0022199607000980.

BLUNDELL, R., and **BOND, S.**, 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* [online], 87 (1), 115–143. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0304407698000098.

BROCCOLINI, C., **LOTTI, G.**, **MAFFIOLI, A.**, **PRESBITERO, F. A.**, and **STUCCHI, R.**, 2021. Mobilization effects of multilateral development banks. *World Bank Economic Review* [online], 35 (2), 521–543. Available from: https://elibrary.worldbank.org/doi/abs/10.1093/wber/lhz049.

BUITER, W., and **FRIES, S.**, 2002. What should the multilateral development banks do?

BYOUN, S., **KIM, J.**, and **YOO, S. S.**, 2013. Risk Management with Leverage: Evidence from Project Finance. *Journal of Financial and Quantitative Analysis* [online], 48 (2), 549–577. Available from: https://www.cambridge.org/core/product/identifier/S0022109013000082/type/journal_article.

CARTER, P., **VAN DE SIJPE, N.**, and **CALEL, R.**, 2021. The elusive quest for additionality. *World Development* [online], 141, 105393. Available from: https://www.sciencedirect.com/science/article/pii/S0305750X2100005X.

CHELSKY, J., **MOREL, C.**, and **KABIR, M.**, 2013. Investment Financing in the Wake of the Crisis. [online]. Available from: http://hdl.handle.net/10986/22619.

CHEN, M., 2020. State Actors, Market Games: Credit Guarantees and the Funding of China Development Bank. *New Political Economy* [online], 25 (3), 453–468. Available from: https://www.tandfonline.com/doi/full/10.1080/13563467.2019.1613353.

CLEMENS, M. A., 2002. 'World Bank Capital Neither Complements Nor Substitutes for Private Capital'. *SSRN Electronic Journal* [online]. Available from: http://www.ssrn.com/abstract=1107366.

DASGUPTA, D., and **RATHA, D.**, 1999. What Factors Appear to Drive Private Capital Flows to Developing Countries? And How Does Official Lending Respond? *World Bank E-Library* [online]. Available from: http://elibrary.worldbank.org/doi/book/10.1596/1813-9450-2392.

DREHER, A., **FUCHS, A.**, **PARKS, B.**, **STRANGE, A.**, and **TIERNEY, M. J.**, 2021. Aid, China, and Growth: Evidence from a New Global Development Finance Dataset. *American Economic Journal: Economic Policy* [online], 13 (2), 135–174. Available from: https://pubs.aeaweb.org/doi/10.1257/pol.20180631.

EGLI, F., 2020. Renewable energy investment risk: An investigation of changes over time and the underlying drivers. *Energy Policy* [online], 140, 111428. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0301421520301816.

EICHENGREEN, B., and **MODY, A.**, 1998. *What Explains Changing Spreads on Emerging-Market Debt: Fundamentals or Market Sentiment?* [online]. Cambridge, MA. Available from: http://www.nber.org/papers/w6408.pdf.

EIKON, 2023. *Infrastructure project database.*

EPE, E. DE P. E., 2022. *Anuário estatístico de energia elétrica* [online]. Brasília. Available from: https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/anuario-estatistico-de-energia-eletrica.

FITCH CONNECT, 2023. *Fitch connect key infrastructure database.*

GAMSO, J., and **NELSON, R. C.**, 2019. Does partnering with the World Bank shield investors from political risks in less developed countries? *Journal of World Business* [online], 54 (5), 100997. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1090951618304516.

GURARA, D., **PRESBITERO, A.**, and **SARMIENTO, M.**, 2020. Borrowing costs and the role of multilateral development banks: Evidence from cross-border syndicated bank lending. *Journal of International Money and Finance* [online], 100, 102090. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0261560619300476.

HAINZ, C., and **KLEIMEIER, S.**, 2012. Political risk, project finance, and the participation of development banks in syndicated lending. *Journal of Financial Intermediation* [online], 21 (2), 287–314. Available from: https://www.sciencedirect.com/science/article/pii/S1042957311000416.

HANSEN, L. P., 1982. Large sample properties of generalized method of moments estimators. *Econometrica* [online], 50 (4), 1029. Available from: https://www.jstor.org/stable/1912775?origin=crossref.

HAUSMAN, J. A., 1978. Specification tests in econometrics. *Econometrica* [online], 46 (6), 1251. Available from: https://www.jstor.org/stable/1913827?origin=crossref.

IEA, I. E. A., 2021. *Financing clean energy transitions in emerging and developing economies* [online]. Paris. Available from: https://www.iea.org/reports/financing-clean-energy-transitions-in-emerging-and-developing-economies.

IFC, I. F. C., 2015. *Rebuilding for tomorrow: Private sector development in fragile and conflict-afflicted situations in africa* [online]. Washington DC. Available from: https://www.ifc.org/wps/wcm/connect/cf665750-0fc8-4cff-bd71-dc5111122e97/IFC_CASA_SmartLessons_Booklet.pdf?MOD=AJPERES&CVID=kRhr5AZ.

IMF, I. M. F., 2022a. Chapter 2 - SCALING UP PRIVATE CLIMATE FINANCE IN EMERGING MARKET AND DEVELOPING ECONOMIES: CHALLENGES AND OPPORTUNITIES. *Global Financial Stability Report.*

IMF, I. M. F., 2022b. *IMF investment and capital stock dataset, 1960-2019* [online]. Washington DC. Available from: https://data.imf.org/?sk=1CE8A55F-CFA7-4BC0-BCE2-256EE65AC0E4.

JAVORCIK, B. S., 2004. Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages. *American Economic Review* [online], 94 (3), 605–627. Available from: https://pubs.aeaweb.org/doi/10.1257/0002828041464605.

JEE, S. J., and **SRIVASTAV, S.**, 2022. Knowledge Spillovers between Clean and Dirty Technologies.

SSRN Electronic Journal [online]. Available from: https://www.ssrn.com/abstract=4233536.

JOSKOW, P. L., 1985. Vertical Integration and Long-term Contracts: The Case of Coal-burning Electric Generating Plants. *The Journal of Law, Economics, and Organization* [online]. Available from: https://academic.oup.com/jleo/article/1/1/33/952058/Vertical-Integration-and-Longterm-Contracts-The.

KOMENDANTOVA, N., **SCHINKO, T.**, and **PATT, A.**, 2019. De-risking policies as a substantial determinant of climate change mitigation costs in developing countries: Case study of the Middle East and North African region. *Energy Policy* [online], 127, 404–411. Available from: https://linkinghub.elsevier.com/retrieve/pii/S030142151830822X.

KOTCHEN, M. J., and **NEGI, N. K.**, 2019. Cofinancing in environment and development: Evidence from the global environment facility. *World Bank Economic Review* [online], 33 (1), 41–62. Available from: https://elibrary.worldbank.org/doi/10.1093/wber/lhw048.

LANZALOT, M. L., **MAFFIOLI, A.**, **STUCCHI, R.**, and **YANEZ-PAGANS, P.**, 2018. Infrastructure Investments and Private Investment Catalyzation: The Case of the Panama Canal Expansion. *IDB Invest*.

LEVIN, A., **LIN, C.-F.**, and **JAMES CHU, C.-S.**, 2002. Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics* [online], 108 (1), 1–24. Available from: https://www.sciencedirect.com/science/article/pii/S0304407601000987.

MARKUSEN, J. R., and **VENABLES, A. J.**, 1999. Foreign direct investment as a catalyst for industrial development. *European Economic Review* [online], 43 (2), 335–356. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0014292198000488.

MAZZUCATO, M., and **SEMIENIUK, G.**, 2018. Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting and Social Change* [online], 127, 8–22. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0040162517306820.

MCHUGH, C. A., 2023. Competitive conditions in development finance. *Journal of International Financial Markets, Institutions and Money* [online], 83, 101741. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1042443123000094.

MDB TFM, 2021. Mobilization of private finance 2019. [online]. Available from: http://hdl.handle.net/10986/35616.

MORALES, L., and **ANDREOSSO-O'CALLAGHAN, B.**, 2012. The current global financial crisis: Do Asian stock markets show contagion or interdependence effects? *Journal of Asian Economics* [online], 23 (6), 616–626. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1049007812000863.

NASSIRY, D., 2016. Finding the pipeline: Project preparation for sustainable development. [online]. Available from: https://odi.org/en/publications/finding-the-pipeline-project-preparation-for-sustainable-development/.

NICKELL, S., 1981. Biases in dynamic models with fixed effects. *Econometrica* [online], 49 (6), 1417. Available from: https://www.jstor.org/stable/1911408?origin=crossref.

OECD, 2022a. *Global Outlook on Financing for Sustainable Development 2023: No Sustainability Without Equity* [online]. OECD. Available from: https://www.oecd-ilibrary.org/finance-and-investment/global-outlook-on-financing-for-sustainable-development-2023_fcbe6ce9-en.

OECD, 2022b. *Development finance data - OECD* [online]. Available from: https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/.

PESARAN, M. H., 2004. General Diagnostic Tests for Cross Section Dependence in Panels. [online]. Available from: https://www.repository.cam.ac.uk/handle/1810/446.

PPPLRC, W. B., 2022. Models for Private Sector Engagement in FCS. [online]. Available from: https:

//ppp.worldbank.org/public-private-partnership/.

PROBST, B., **WESTERMANN, L.**, **ANADÓN, L. D.**, and **KONTOLEON, A.**, 2021. Leveraging private investment to expand renewable power generation: Evidence on financial additionality and productivity gains from Uganda. *World Development* [online], 140, 105347. Available from: https://www.sciencedirect.com/science/article/pii/S0305750X20304757.

RATHA, D., 2001. Complementarity between Multilateral Lending and Private Flows to Developing Countries : Some Empirical Results. [online]. Available from: http://hdl.handle.net/10986/19337.

ROAD TRANSPORT, M. OF, and **HIGHWAYS**, 2018. *Basic road statistics of india (2000-2018)* [online]. New Delhi. Available from: https://morth.nic.in/basic-road-statistics-india.

RODRIK, D., 1995. *Why is there Multilateral Lending?* [online]. Cambridge, MA. Available from: http://www.nber.org/papers/w5160.pdf.

ROODMAN, D., 2009a. How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal: Promoting communications on statistics and Stata* [online], 9 (1), 86–136. Available from: http://journals.sagepub.com/doi/10.1177/1536867X0900900106.

ROODMAN, D., 2009b. A Note on the Theme of Too Many Instruments*. *Oxford Bulletin of Economics and Statistics* [online], 71 (1), 135–158. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-0084.2008.00542.x.

RYAN, N., 2021. Holding Up Green Energy. *NBER Working Paper* [online], w29154. Available from: http://www.nber.org/papers/w29154.pdf.

SAFRAN, P., 2013. Infrastructure development in fragile states: Is it worth it? | asian development blog. [online]. Available from: https://blogs.adb.org/blog/infrastructure-development-fragile-states-it-worth-it.

SAWANT, R. J., 2010. Emerging Market Infrastructure Project Bonds: *Their Risks and Returns*. *The Journal of Structured Finance* [online], 15 (4), 75–83. Available from: http://jsf.pm-research.com/lookup/doi/10.3905/JSF.2010.15.4.075.

STIGLITZ, J. E., 1993. The Role of the State in Financial Markets. *The World Bank Economic Review* [online], 7 (suppl 1), 19–52. Available from: https://academic.oup.com/wber/article-lookup/doi/10.1093/wber/7.suppl_1.19.

UNFCCC, U. N. F. C. ON C. C., 2015. *Paris agreement* [online]. Available from: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

VIVIESCAS, C., **LIMA, L.**, **DIUANA, F. A.**, **VASQUEZ, E.**, **LUDOVIQUE, C.**, **SILVA, G. N.**, **HUBACK, V.**, **MAGALAR, L.**, **SZKLO, A.**, **LUCENA, A. F. P.**, **SCHAEFFER, R.**, and **PAREDES, J. R.**, 2019. Contribution of Variable Renewable Energy to increase energy security in Latin America: Complementarity and climate change impacts on wind and solar resources. *Renewable and Sustainable Energy Reviews* [online], 113, 109232. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1364032119304320.

WANG, M., **KELLER, C.**, and **SIEGRIST, M.**, 2011. The less you know, the more you are afraid of—a survey on risk perceptions of investment products. *Journal of Behavioral Finance* [online], 12 (1), 9–19. Available from: https://doi.org/10.1080/15427560.2011.548760.

WINDMEIJER, F., 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics* [online], 126 (1), 25–51. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0304407604000387.

WOOLDRIDGE, J. M., and **WHITE, H.**, 1988. Some Invariance Principles and Central Limit Theorems for Dependent Heterogeneous Processes. *Econometric Theory* [online], 4 (2), 210–230. Available from:

https://www.cambridge.org/core/journals/econometric-theory/article/some-invariance-principles-and-central-limit-theorems-for-dependent-heterogeneous-processes/1C82B5A046CB8C4DC2C6BC7A6C6D1C12.

WORLD BANK, 2019. *Ease of doing business* [online]. Available from: https://archive.doingbusiness.org/en/rankings.

WORLD BANK, 2022a. *Private participation in infrastructure projects database* [online]. Available from: https://ppi.worldbank.org/.

WORLD BANK, 2022b. World development indicators | DataBank. [online]. Available from: https://databank.worldbank.org/source/world-development-indicators.

WORLD BANK, 2023. *Worldwide governance indicators | DataBank* [online]. Available from: https://databank.worldbank.org/source/worldwide-governance-indicators.

YEE, K. K., 2004. Interim Reporting Frequency and Financial Analysts' Expenditures. *Journal of Business Finance & Accounting* [online], 31 (1-2), 167–198. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.0306-686X.2004.00005.x.