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Greenfield project finance loan maturity and the role of multilateral development banks in developing countries

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ABSTRACT

This paper is intended to provide empirical evidence for the financial additionality of multilateral development banks (MDBs) in private sector infrastructure projects. To validate MDBs' financial additionality, this study uses IJGlobal's project finance database to examine whether the loan tenor of MDBs' project finance loans is significantly longer than the average loan tenor extended by commercial banks, using ordinary least squares (OLS) and Poisson Pseudo Maximum Likelihood (PPML) estimations. The result of the empirical analysis shows that project finance loans involving MDBs have significantly longer loan maturity than average loans in lower-middle-income and upper-middle-income countries, while projects in low-income countries and Sub-Saharan Africa do not have such a tendency. Furthermore, in host countries where government effectiveness is underdeveloped, the coefficient of project finance loans provided by MDBs is negative with statistical significance. As a policy implication, these findings indicate that for MDBs to ascertain financial additionality in countries where government effectiveness is weak, additional measures such as capacity building of the host government and additional financial intervention are needed.

Contribution/Originality: This study provides evidence of MDBs' tenor-lengthening effect on Greenfield project finance loans for private sector infrastructure projects in developing countries. The evidence enriches the existing literature on MDBs' additionality, as existing literature has not used Greenfield project finance loan data in this field.

1. INTRODUCTION

The member countries of the United Nations adopted Sustainable Development Goals (SDGs) in September 2015, and the Addis Ababa Action Agenda of the Third International Conference on Financing for Development (the Addis Agenda) has provided a framework for financing sustainable development. In terms of infrastructure investment, the Addis Agenda describes that "investing in sustainable and resilient infrastructure, including transport, energy, water, and sanitation for all, is a pre-requisite for achieving many of our goals (SDGs)" (United Nations, 2015). The agenda estimates that there would be a $1 trillion to $1.5 trillion infrastructure gap annually in developing countries. The agenda also mentions that "we recognize that both public and private investment have key roles to play in infrastructure financing, including through development banks, development finance institutions, and tools and mechanisms such as public-private partnerships, blended finance, which combines concessional public finance with non-concessional private finance and expertise from the public and private sector, special-purpose vehicles, non-recourse project financing, risk mitigation instruments, and pooled funding structures" (United

Nations, 2015). In this context, MDBs are regarded as key institutions that catalyze private sector finance to bridge the gap and cope with large infrastructure investment demand. In response to the SDGs, World Bank Group (WBG), InterAmerican Development Bank Group (IDBG), the African Development Bank (AfDB), Asian Development Bank (AsDB), European Bank for Reconstruction and Development (EBRD), and European Investment Bank (EIB), together defined as multilateral development banks (MDBs), presented a joint vision to show how MDBs could finance the achievement of the SDGs (From Billions to Trillions: MDB Contributions to MDB (2015)). Their vision advocates that "drawing in private sector business and investment will be key to reaching the trillions needed to achieve the SDGs. At the interface of the public and private sectors, we are ready to play a catalytic role to unlock the potential of private finance" (From Billions to Trillions: MDB Contributions to MDB (2015)).

The Global Infrastructure Hub (GI Hub), created by the Group of Twenty (G20) to advance its infrastructure agenda, published the Global Infrastructure Outlook in 2017. The outlook projected that "global infrastructure investment demand will reach 94 trillion US dollars by 2040" (Global Infrastructure Hub, 2017), and the outlook also estimated that "the estimated global investment need between 2016 and 2030 would be $3.5 trillion higher if it included the cost of meeting the SDGs for universal access to water and electricity" (Global Infrastructure Hub, 2017).

Although the outlook of the GI Hub is on a global scale, regarding infrastructure demand in developing countries, Rozenberg and Fay (2019) estimate that "new infrastructure could cost low- and middle-income countries anywhere between 2 and 8.2 percent of gross domestic product (GDP) per year to 2030 and that investments of 4.5 percent of GDP would enable them to achieve the infrastructure-related SDGs" (Rozenberg & Fay, 2019). The estimate was made before the COVID-19 pandemic.

Owing to the spread of the pandemic from 2020 to 2022, the recent Ukrainian crisis, and the acute rise of global food commodity prices and US dollar interest rates, developing countries are facing multiple severe challenges. According to the OECD (2018), "Since the outbreak of the pandemic, the Sustainable Development Goals (SDGs) financing gap has widened from USD 2.5 trillion to at least USD 3.9 trillion per year and is estimated to increase by USD 400 billion per year in 2020 to 2025"(OECD, 2022).

The GI Hub estimates that "the G20 central governments budgeted almost 1 trillion US dollars for infrastructure investment in 2022, equivalent to around 1% of total G20 GDP or 4.6% of total G20 central government budget expenditure, and 71% of the 1 trillion US dollars is in advanced G20 economies and 29% in emerging G20 economies" (Global Infrastructure Hub, 2023). Based on these estimates, it is likely that the budget figures of the G20 governments would be insufficient to cope with investment demand for the SDGs, including infrastructure investment demand. Therefore, the role of private sector finance for infrastructure projects in developing countries has become critical to achieving the SDGs and economic recovery in those countries.

MDBs provide financial and technical assistance to governments of developing countries (referred to as "sovereign operations"); some MDBs focus more on providing loans and equity to the private sector in developing countries (hereinafter referred to as "private sector operations"). This study focuses on MDBs' role in private sector operations.

An important principle for MDBs' involvement in private sector operations is "additionality": "MDB support of the private sector should make a contribution that is beyond what is available or that is otherwise absent from the market and should not crowd out the private sector."(Multilateral Development Bank Principles to Support Sustainable Private Sector Operations, p3). MDBs formed the MDB Task Force to create a harmonized framework of "additionality". In the Task Force report in 2018, MDBs defined "financial and non-financial additionality" and described that meaningfully "extended tenor" compared to the tenor available by private financial institutions as one of the examples of financial additionality by MDBs (MDB Task Force (2018) see Table 1).

Table 1. MDB additionality in private sector operation.

Category	Type
Financial additionality	Financing structure: MDBs provide financing that is not available in the market from commercial sources on reasonable terms and conditions. This includes local currency financing, increased amounts, an extended term, or a grace period.
	Innovative financing structures and/or Instruments: DBs provide clients and partners with innovative financing structures that (i) add value by lowering the cost of capital or by better addressing risks and (ii) are not available in the market at a reasonable cost. It is understood that innovation is market specific; a structure could be considered innovative if it is new to a market, even if it may already exist in more developed markets.
	MDBs' own account equity: MDBs provide equity that is not available in the market in a way that strengthens the financial soundness, creditworthiness, and/or governance of the client. Equity is a vehicle for additionality, as it often strengthens the client's ability to take risks, leverage resources, and improve corporate governance.
	Resource mobilization: MDBs are involved in mobilization of resources from private sources; that is, there is a verifiable role played by MDBs in mobilizing financing on commercial terms from an institutional or private financier.
Non-financial additionality	Risk mitigation: MDBs provide comfort to clients and investors by mitigating non-financial risks, such as country, regulatory, project, economic cycle, or political risk. Such comfort is often due to MDBs' reputation in the market, role as honest brokers,
	Policy, Sector, Institutional, or Regulatory change: MDBs' involvement in a project is considered MDBs' involvement in a project is considered a change in the policy, sector, institutional, or regulatory framework, or an enhancement of practices at the sector or country level.
	Standard setting: Helping Projects and Clients Achieve Higher Standards MDBs promote improved policies (for example, gender equality) and provide expertise in environmental, social, and governance standards (ESG) and on integrity and procurement best practice.
	Knowledge, Innovation, and Capacity Building: MDBs provide expertise, innovation, knowledge, and/or capabilities that are material to the timely realization of the project's anticipated development impact, including support to strengthen the capacity of the client. Capacity-building support may be provided either in-house or by external experts.

Source: MDB Task Force (2018).

Existing literature examines MDB's financial additionality, focusing on the mobilization effect of private capital using syndication loan databases, and there is a research gap in terms of MDB's role in Greenfield project finance loans in private sector infrastructure projects. This study is intended to verify MDBs' financial additionality in private sector infrastructure projects in terms of providing financing that is not available in the market from private financial institutions and to shed light on MDBs' tenor-lengthening effect on project finance loans, as limited empirical studies have focused on this aspect in the literature.

To validate MDBs' financial additionality, this study uses *Project Finance and Infrastructure Journal's* (IJGlobal's) project finance database to examine whether the maturity of MDBs' Greenfield project finance loan is significantly longer than the average project finance loan tenor in the market. According to the Bank for International Settlements (BIS), project finance is defined as "the method of funding in which the lender looks primarily to the revenues generated by a single project, both as the source of repayment and as security for the loan. This type of financing is usually for large, complex, and expensive installations such as power plants, chemical processing plants, mines, transportation infrastructure, environment, media, and telecoms" (BIS, 2017). For project finance loans, lenders are exposed to project-specific risk, including the political risk associated with the country where such projects are located. In other words, the tenor of project finance loans at financial close indicates the direct risk appetite of lenders

towards the concerned sector and market. As Arezki, Bolton, Peters, Samama, and Stiglitz (2017) have discussed, the risks for greenfield and brownfield infrastructure projects have different magnitudes. Greenfield infrastructure assumes construction risk and the early stages of operation and maintenance risk. In other words, Greenfield project finance loans would shoulder higher risk from lenders compared with brownfield project finance loans. Therefore, extended tenor, a longer tenor than what private financial institutions could offer, would be interpreted as clear evidence of MDBs' financial additionality, especially in Greenfield project finance loans where lenders need to take direct project risk.

The structure of this paper is as follows: Section 2 reviews the literature on the roles of MDBs in the private sector and project financing in developing countries. The contributions that this study produced are described in Section 3. Section 4 presents the data that were used in the empirical investigation. Section 5 outlines the methodology and results of the analysis. Section 6 provides an overview of the findings and policy implications.

2. LITERATURE REVIEW

This section provides a literature review with regard to (i) MDBs' role in private sector operations and (ii) project finance in developing countries.

As for (i) MDBs' additionality in private sector operations, several recent studies have focused on MDBs' role in syndicated lending operations. Gurara, Presbitero, and Sarmiento (2020) showed that longer maturity and higher borrowing costs are associated with MDBs' involvement in syndicated loans, which could be interpreted as an intension by MDBs to provide financing towards high-risk projects that may not be supported by private financial institutions. In addition, the study identified that MDBs have a greater likelihood of providing loans to borrowers located in high-risk countries, while there was "limited to no evidence that MDBs are more likely than commercial banks to lend to risky borrowers" (Gurara et al., 2020).

Using loan-level syndication data, Broccolini, Lotti, Maffioli, Presbitero, and Stucchi (2020) discovered that MDBs have a positive and statistically significant effect on the flow of private capital into investments in developing countries. In particular, the study found that "MDB participation in the infrastructure sector of a country increases the average maturity of syndicated loans by 0.81 years, and the effects are substantial even in subsequent years" (Broccolini et al., 2020). Another insight from the study is that the mobilization effect of MDB lending in syndicated loan markets could be less effective in low-income countries.

Following a similar approach to that of Broccolini et al. (2020) and Avellán, Galindo, Lotti, and Rodriguez (2021) focused on MDBs' role in mobilization within the infrastructure sector, using the IJGlobal database. The study found that the presence of MDBs would mobilize third-party financing resources directly and indirectly; the mobilization multiplier in a three-year span is 4.4, while mobilization effects are lower where government effectiveness is low.

Although their focus was not on MDBs, Hu, Schclarek, Xu, and Yan (2022) studied national development banks (NDBs) and their role in providing long-term loans. The study found the role of NDBs in lengthening the loan maturity. Although NDBs and MDBs differ, their maturity-lengthening role could be a common feature of these institutions.

In terms of the non-financial additionality in Table 1, Arezki et al. (2017) argued that MDBs' role in providing technical expertise and governance standards, such as anti-corruption standards, in infrastructure investment.

Regarding (ii) project finance in developing countries, Hainz and Kleimeier (2012) argued that the involvement of development banks in loan syndication for non-recourse project finance loans would help mitigate political risk. Thierie and De Moor (2019) study looked at the main things that affect the maturity of loans in infrastructure projects. It included developed and developing countries around the world. They found that the following things affect the maturity of project finance loans: political risk and regulatory risk, the type of deal (Greenfield or brownfield), the revenue scheme, the participation of multilateral financial institutions and export credit agencies, and the execution.

3. CONTRIBUTIONS

The contributions of this study to the literature are twofold. First, the existing literature on the additionality of MDBs has examined MDBs' role using a broader syndication loan database, not limited to Greenfield project finance loan-level data. Broccolini et al. (2020) showed that the involvement of MDBs in the infrastructure sector provides longer loan maturities, which could be treated as a proof of MDBs' financial additionality. This study expands on Broccolini et al. (2020) research by verifying only greenfield project finance loans with MDBs support and sheds light on MDBs' effect on the loan tenor of project finance loans, as limited empirical studies have focused on this aspect in the literature. Sorge (2004) defined "project finance loan" as "limited or non-recourse financing for a new project through the establishment of a vehicle company". Lenders of Greenfield project finance loans are directly exposed to project-specific risk, including construction and political risk associated with the country where such projects are located. In other words, the tenors of project finance loans at financial close for Greenfield projects indicate the direct risk appetite of lenders towards the concerned sector and market. Therefore, by focusing on Greenfield project finance loans, this study may well capture the financial additionality of MDBs. Second, existing literature on project finance has focused on either the determinant factor of loan spread or the coverage of studies that include developed markets rather than developing countries. This study focuses on the maturity of Greenfield project finance loans in developing countries and enriches evidence of MDBs' financial additionality in the literature.

4. DATA

For empirical analysis, the main source of data was the *Project Finance & Infrastructure Journal* (IJGlobal). The data from IJGlobal is one of the most comprehensive project-level databases in the industry. IJGlobal also manages project-level data for the PPI Database of the World Bank.

From IJGlobal's database, the main data for the analysis were extracted based on several conditions: finance type as project finance, transaction type as primary financing, transaction stage as financial close, and transaction currency as USD. With these conditions, the scope of the analysis was narrowed down to Greenfield project finance transactions in USD. In addition, projects located in developed countries were excluded from the main data. As a result of data cleaning, the total transaction number became 3,413, of which 221 projects had MDBs, accounting for 6.5 percent of the total projects. The average loan maturity with MDBs' participation was 15.1 years, while loan maturity without MDBs was 12.1 years Table 2.

Regarding country classification, this study adopted the World Bank country classification, which uses the host country's income level (low-, lower-middle-, upper-middle-, and high-income countries). The average loan tenor of project finance loans with MDBs was longer than the average of total transactions by more than 25%, except for low-income countries. In low-income countries, the average loan tenor of total transactions was longer than that of transactions with MDBs, although the total number of transactions with MDBs was only 16. This may indicate that MDBs' participation in project finance transactions in low-income countries is limited, and there may be a way to increase their shares.

To analyze the political risk of the host countries, this study used the government effectiveness index (*gve*), which was extracted from the Worldwide Governance Indicators (WGI) of the World Bank. The WGI is shown in numbers between approximately -2.5 (low) and 2.5 (high). The index is defined in the database as "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies." (World Banks, 2022).

The figure in Table 2 shows that a longer loan tenor is associated with the higher index, and the magnitude of MDBs' involvement is also clearly shown: 34% longer in $gve > 0$, 19% longer where gve is above -1 and below 0, and 13% longer where *gve* is less than -1. The interesting point is that in the low-end of the index ($gve < -1$), the average loan tenor was significantly shorter than it was in the other categories, and there was a smaller gap in the average

loan tenor between the projects with MDBs and the total average ones. In addition, the number of transactions with MDBs was only 8. These factors imply that the possibility for MDBs to participate in project finance transactions would improve if the host country's government effectiveness were enhanced. As described above, the political risk of the host countries would influence project finance transactions. Since MDBs also must maintain financial soundness to secure AAA ratings from external rating agencies, their risk tolerance is capped (Boosting MDBs' Investing Capacity, 2022). This trend indicates that for countries with low government effectiveness, technical assistance to improve host governments' capacity building to handle private sector infrastructure projects should be prioritized.

Table 2. Overview of greenfield project finance transactions in developing countries.

	Total projects		Projects with MDBs		c/a	d/b
	Numbers	Average Tenor (years)	Numbers of projects with MDBs	Average tenor (years)		
	(a)	(b)	(c)	(d)		
Total	3,413	12.1	221	15.1	6.5%	1.25
[Host country's income levels]						
Low	230	13.4	16	11.4	7.0%	0.85
Lower middle	1,577	12.2	123	15.8	7.8%	1.30
Upper middle	1,289	11.6	70	14.6	5.4%	1.26
High	317	12.8	12	16.1	3.8%	1.25
[Host country's government effectiveness (GVE)]						
gve<-1	236	8.5	8	9.6	3.4%	1.13
-1<gve<0	1,870	12.5	150	14.9	8.0%	1.19
gve>0	1,307	12.3	63	16.4	4.8%	1.34
[Host country's regions]						
Asia and Pacific	1,090	13	53	16.0	4.9%	1.24
MENA	210	16	54	19.1	25.7%	1.18
Sub-Saharan Africa	578	11	29	12.1	5.0%	1.13
Latin America	1494	12	79	13	5.3%	1.13
Europe	41	8	6	12.0	5.0%	1.56
[Projects' sectors]						
Oil& gas	1,230	10.6	27	9.3	2.2%	0.88
Mining	356	7.9	11	10.3	3.1%	1.31
Renewable	639	14.8	115	17.5	18.0%	1.18
Power	707	14.6	36	15.0	5.1%	1.03
Social	29	13.3	0	0.0	0.0%	0.00
Telecom	65	9.9	3	9.9	4.6%	1.00
Transport	370	12.2	26	13.5	7.0%	1.10
Water	17	13	3	15	17.6%	1.14

In terms of regional classification, the Asia-Pacific region and Latin America account for 32% and 44% of the total number of transactions, respectively. On the other hand, MDBs' participation in these two regions was 4.9 percent and 5.3%, respectively, while MDBs' involvement in transactions in the Middle East and North Africa was 25.7 percent. Egypt, Jordan, and Morocco are countries in the Middle East and North Africa where MDBs participated in project finance transactions, and those countries have medium or high government effectiveness index scores.

In the sectoral classification, the power and renewable sectors had a relatively longer average tenor of 14.6 years and 14.8 years, respectively, and transactions with MDBs in the renewable sector had the longest average tenor of 17.5 years among all sectors. Furthermore, the number of transactions with MDBs in the renewable sector was 115 out of 221. In other words, 52% of loans with MDBs were allocated to the renewable sector. This may indicate MDBs' strong emphasis on tackling climate change.

The findings mentioned above are based on a mere observation of the IJGlobal project finance transaction database. However, year-fixed effects also influence the maturity of project finance loans, such as time-varying

country-specific factors and world economic conditions. In the next section, this study applied an econometric methodology to control these effects and verify the effect of MDBs on the maturity of project finance loans by MDBs.

5. ECONOMETRIC ESTIMATIONS

This section details the econometric analysis that was conducted to validate MDBs' tenor lengthening effect on Greenfield project finance loans.

5.1. Variables and Data

Table 3 lists the variables used for the analysis. The estimation equation consists of one dependent variable (loan maturity) and five independent variables to control year fixed effects and dummy variables for transactions with MDBs and for categorizing the transactions by host country's income levels, government effectiveness, regions in the host country, and sectors in the projects. The variables for macroeconomic conditions were adopted from the related literature (Banerjee, Oetzel, & Ranganathan, 2006; Basilio, 2011). Table 4 provides the descriptive statistics of the variables. The explanation of each variable is as follows:

Table 3. List of variables.

Variables	Description	Data sources
Dependent variables		
Maturity	Project finance loan maturity(years)	IJGlobal
Explanatory variables: Host country's macroeconomic conditions		
gdp	Gross Domestic product [current USD, log terms, lagged]	IMF_WEO
ypc	GDP per capita [current USD, log term, lagged]	
inf	Inflation, consumer prices [annual%, lagged]	
exr	National Currency per USD[period average, log term, lagged]	
gbl	General government net lending/borrowing [percent of GDP, lagged]	
Explanatory variables: Dummy variables [d_x=1, otherwise 0]		
d_mdb	Transactions with MDBs' participation	IJGlobal
<Host country's income levels>		
d_low	Low income	WB_CL
d_lmid	Lower middle income	
d_umid	Upper middle income	
<Host country's government effectiveness(gve)>		
d_gvel	gve<-1	WB_WGI
d_gvem	-1<gve0	
d_gveh	gve>0	
<Host country's regions>		
d_Asia	Asia and pacific	IJGlobal
d_Mena	Middle East and North Africa	
d_Africa	Sub-Saharan Africa	
d_Latam	Latin America	
<Projects' sectors>		
d_Power	Power (non-renewable)	IJGlobal
d_Renewable	Renewable energy	
d_Transport	Transport	
d_Mining	Mining	
d_oil	Oil&Gas	
d_others	Others (Water, ICT, Telecom, Social & Defense)	

Notes: IJGlobal: Project Finance & Infrastructure Journal (IJGlobal) database.
IMF_WEO: World Economic Outlook Database, International Monetary Fund.
WB_CL: Country Classification, World Bank.
WB_WGI: Worldwide Governance Indicators, World Bank.

Table 4. Descriptive statistics.

Variables	Obs.	Mean	Median	Std. dev.	Min.	Max.
Maturity	3,413	12	12	5	2	40
D_MDB	3,413	0	0	0	0	1
EXR	3,413	958	19	2,037	0	7,505
GBL	3,413	-3.54	-3.16	3.74	-19.79	17
GDP	3,413	642.66	303.09	904.63	0.18	17,745
INF	3,413	7.28	4.52	25.55	-72.73	557
LNGDP	3,413	5.56	5.71	1.61	-1.69	10
YPC	3,413	5,714	4,144	4,300	429	18,431

The maturity of each Greenfield project finance loan was extracted from the IJGlobal project finance database and expressed in year terms. In terms of the variables for macroeconomic indicators, the following five indicators were applied for the estimation: inflation (*inf*), GDP per capita (*ypc*), gross domestic product (GDP) (*gdp*), government budget balance (*gbl*), and exchange rate (*exr*). These macroeconomic data were retrieved from the World Economic Outlook Databases of the International Monetary Fund. Following Rao, Gatti, and Casalini (2023), this study included GDP as an instrument to measure purchasing power and the market size of host countries. The inflation rate would influence lenders' behavior since it relates to their funding cost. General government net lending measures the possibility of sovereign defaults, and the exchange rate indicates the macroeconomic risk of the host countries.

As for dummy variables, the independent variable for the estimation was the dummy for projects with MDBs' involvement (*d_mdb*). The financial additionality of MDBs could be verified when the coefficient of the dummy was positive with statistical significance. In addition, four other dummy variables were included in the estimation: income level, government effectiveness, regions, and sectors. These dummies were used to examine potential selection biases. For example, when loans with MDBs were concentrated heavily on specific sectors and regions, the result of the analysis might lose its validity to verify MDBs' financial additionality. Only when the exceedance of loan maturity with MDBs is identified in any component of any category can the financial additionality of MDBs be verified. For this reason, the analysis included a cross-term of dummies. The details of dummy variables are presented in Table 3.

With these variables, the study built an unstructured dataset with 3,413 Greenfield project finance projects for 2001–2021, including 62 countries for the subsequent estimation.

5.2. Methodologies

The equations for the analysis were as follows: For simple estimation of the total projects:

$$Maturity_{itk} = \beta * E_{it} + \mu * d\_mdb_k + \nu_t + \varepsilon_{itk} \quad (1)$$

$$Maturity_{itk} = exp\,[\beta * E_{it} + \mu * d\_mdb_k) + \nu_t\,] + \varepsilon_{itk} \quad (2)$$

For the estimation considering five categories of the projects:

$$Maturity_{itk} = \beta * E_{it} + \gamma * D_j + \mu * (d\_mdb_k * D_j) + \nu_t + \varepsilon_{itk} \quad (3)$$

$$Maturity_{itk} = exp\,[\beta * E_{it} + \gamma * D_j + \mu * (d\_mdb_k * D_j) + \nu_t\,] + \varepsilon_{itk} \quad (4)$$

Ordinary least squares (OLS) estimations are applied in Equations 1 and 3, and Poisson Pseudo Maximum Likelihood (PPML) estimations are used in Equations 2 and 4. The subscripts *i*, *t*, and *k* denote host countries (the 62 countries), years (2001–2021), and project number (3,413 Greenfield project finance projects), respectively; *E* is the variable for country-specific, time-varying macroeconomic conditions; ν denotes year-fixed effects; ε represents error terms; β, γ, and μ are parameters of variables; and D_j represents the dummy variables. The most meaningful parameter in particular is μ (the coefficient of a dummy for MDBs involvement times a dummy of each of the four categories) in Equations 3 and 4: a positive coefficient with statistical significance in any component of any category would indicate MDBs' lengthening effect on tenors for project finance loans in developing countries.

The PPML estimator is used in Equations 2 and 4 along with the OLS analysis in Equations 1 and 3. Since the variables used in the estimation are from developing countries and the discrepancy in the data could be high, standard

errors may not follow a normal distribution. For this reason, the log-linear OLS estimator may lead to inconsistency and bias in its estimate due to the heteroskedasticity issue. To cope with this concern, as Silva and Tenreyro (2006) advocate, the PPML estimator accounts for heteroskedasticity. This study conducted both the OLS and the PPML as a robustness check.

5.3. Estimation Outcomes and Discussions

Table 4 shows the descriptive statistics of the variables. To examine multicollinearity among the variables, the bivariate correlations and variance inflation factors (VIF) are presented in Table 5. The correlations and VIF index suggest that there is no noteworthy concern about the multicollinearity among the explanatory variables.

Table 5. Correlation matrix and variance inflation factors.

	EXR	GBL	LNGDP	INF
EXR	1.000	0.034	0.065	-0.032
GBL	0.034	1.000	-0.137	0.014
LNGDP	0.065	-0.137	1.000	-0.075
INF	-0.032	0.014	-0.075	1.000
VIF	1.477	1.404	1.198	1.052

Table 6 and 7 provide the results of OLS estimation and PPML estimation, respectively. Column (a) reports the result of the estimation on total projects in Equations 1 and 2, and columns (b) to (e) present the results of the estimation on the projects, including four categories in Equations 3 and 4.

Table 6. OLS estimation results.

	(a)	(b)	(c)	(d)	(e)
gdp	-0.345 (-5.598)	-0.223*** (-3.431)	-0.345*** (-5.6769)	-0.441*** (-7.713)	-0.321*** (-5.004)
ypc	0.524** (-2.145)	-0.612 (-1.1439)	-0.827*** -2.798	-0.069 (-0.267)	-0.705** (-1.835)
inf	$3*10^{-4}$ (-0.084)	$-6.69*10^{-5}$ (-0.019)	$5.3*10^{-3}$ (-1.462)	$-2.63*10^{-3}$ (-0.796)	$-7*10^{-4}$ (-0.198)
exr	5.87×10^{-4}*** (11.995)	6.31×10^{-4}*** (-11.988)	4.64×10^{-4}*** (-9.367)	5.79×10^{-4}*** (-12.486)	5.67×10^{-4}*** (-10.38)
gbl	-0.003 (-0.135)	-0.013 (-0.509)	0.029 (-1.134)	-0.067 (-2.857)	0.101*** (-3.878)
d_mdb	2.985*** (8.532)				
d_low		0.088 (0.111)			
d_lmid		-1.667*** (-3.158)			
d_umid		-0.862** (-2.442)			
d_mdb x d_low		-1.098 (-0.856)			
d_mdb x d_lmid		4.006*** (8.474)			
d_mdb x d_umid		2.548*** (4.199)			
d_gvel			-4.728*** (-10.465)		

	(a)	(b)	(c)	(d)	(e)
d_gvem			-0.125 (-0.628)		
d_mdb x d_gvel			0.224 (0.127)		
d_mdb x d_gvem			2.637*** (6.291)		
d_power				1.704*** (3.555)	
d_renewable				1.694*** (3.435)	
d_transport				0.326 (0.646)	
d_mining				-5.090*** (-9.899)	
d_oil				-1.848*** (-3.956)	
d_mdb x d_power				0.878 (1.140)	
d_mdb x d_renewable				3.005*** (6.460)	
d_mdb x d_transport				1.157 (1.275)	
d_mdb x d_mining				1.888 (1.354)	
d_mdb x d_oil				-1.764** (-2.012)	
d_Asia					2.110*** (2.922)
d_Africa					1.162 (1.578)
d_Mena					6.534*** (8.201)
d_Latam					2.670*** (3.861)
d_mdb x d_Asia					3.742*** (5.468)
d_mdb x d_Africa					0.962 (1.042)
d_mdb x d_Mena					2.850*** (3.684)
d_mdb x d_Latam					1.463*** (2.576)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
R-squared	0.157	0.170	0.186	0.315	0.206
Adjusted R-squared	0.151	0.162	0.179	0.308	0.198
Observation	3,413	3,413	3,413	3,413	3,413

Note: ***, **, and * denote rejection of the null hypothesis at the 99%, 95%, and 90% levels of significance, respectively. The figure in () denotes the t-value. The coefficients of the time dummy are omitted here due to space limitations.

Table 7. PPML estimation results.

	(a)	(b)	(c)	(d)	(e)
gdp	-0.029***	-0.019***	-0.029***	-0.037***	-0.027***
	(-7.916)	(-4.869)	(-7.789)	(-9.775)	(-6.804)
ypc	0.039**	-0.049	-0.066***	-0.011	-0.066***
	(2.408)	(-1.501)	(-3.736)	(-0.662)	(-2.774)
inf	1.99×10^{-5}	-5.68×10^{-6}	5.27×10^{-4}***	-2.18×10^{-4}	-3.71×10^{-5}
	(0.090)	(-0.025)	(2.418)	(-0.970)	(-0.165)
exr	4.37×10^{-5}***	4.77×10^{-5}***	3.36×10^{-5}***	4.28×10^{-5}***	4.22×10^{-5}***
	(16.246)	(16.253)	(12.175)	(15.457)	(13.544)
gbl	2×10^{-4}	-7.33×10^{-4}	2.72×10^{-3}	-5.84×10^{-3}***	8.69×10^{-3}***
	(0.118)	(-0.473)	(1.756)	(-3.671)	(5.450)
d_mdb	0.223***				
	(11.976)				
d_low		$9.32*10^{-4}$			
		(-0.020)			
d_lmid		-0.138***			
		(-4.382)			
d_umid		-0.071***			
		(-3.427)			
d_mdb x d_low		-0.083			
		(-1.075)			
d_mdb x d_lmid		0.296***			
		(11.865)			
d_mdb x d_umid		0.193***			
		(5.886)			
d_gvel			-0.444***		
			(-14.882)		
d_gvem			-0.008		
			(-0.664)		
d_mdb x d_gvel			0.063		
			(0.532)		
d_mdb x d_gvem			0.196***		
			(8.584)		
d_power				0.117***	
				(3.699)	
d_renewable				0.120***	
				(3.698)	
d_transport				0.021	
				(0.626)	
d_mining				-0.510***	
				(-14.077)	
d_oil				-0.174***	
				(-5.540)	
d_mdb x d_power				0.064	
				(1.422)	
d_mdb x d_renewable				0.182***	
				(7.059)	
d_mdb x d_transport				0.093*	
				(1.651)	
d_mdb x d_mining				0.211**	
				(2.138)	
d_mdb x d_oil				-0.157**	
				(-2.432)	

	(a)	(b)	(c)	(d)	(e)
d_Asia					0.213*** (4.274)
d_Africa					0.125** (2.453)
d_Mena					0.549*** (10.423)
d_Latam					0.263*** (5.447)
d_mdb x d_Asia					0.268*** (7.393)
d_mdb x d_Africa					0.09 (1.608)
d_mdb x d_Mena					0.144*** (3.743)
d_mdb x d_Latam					0.120*** 3.644
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Observation	3,413	3,413	3,413	3,413	3,413

Note: ***, **, * denote rejection of null hypothesis at the 99%, 95% and 90% level of significance, respectively. The figure in () denotes t-value. The coefficients of the time dummy are omitted here owing to space limitations.

OLS estimation in Table 6 and PPML estimation in Table 7 report similar outcomes regarding statistical significance and the sign of each coefficient. By reviewing the estimation results in Column (a), the coefficients of the dummy for MDB-involved projects (*d_mdb*) are 2.985 in Table 6 and exp. (0.223) = 1.249 in Table 7. Given that the average loan maturity of projects with MDBs is longer than that of total average projects by 25%, as explained in Section 4, the PPML estimation in Table 7 appears to provide a reasonable result.

As for macroeconomic variables, Columns (a) to (e) showed that the coefficients of GDP (*gdp*) were negative and the coefficients of exchange rate (*exr*) were significantly positive. This may indicate that the role of MDBs in high-GDP markets would be diminished, while MDBs would take deeper risks in terms of macroeconomic risk.

In addition, the government budget balance (*gbl*) coefficient was negative, although the figures were mostly not statistically significant. The coefficients of inflation (*inf*) and GDP per capita (*ypc*) were mostly not statistically significant, which may indicate that stability of price and market size are not meaningful factors in greenfield project finance transactions.

The estimation results on the category of income levels of the host country in Column (b) denote that the coefficients of the cross terms of the dummies *d_mdb* times *d_lmid* and *d_umid* are both positive with statistical significance. On the other hand, the cross-term of the dummies *d_mdb* time's *d_low* had a negative coefficient and was not statistically significant. This result indicates that MDBs' involvement in Greenfield project finance transactions in low-income countries has not been effective in lengthening loan tenor.

Regarding the category of government effectiveness, the coefficients of the cross-term of the dummies *d_mdb* times *d_gvel* were statistically insignificant, while the cross-term of the dummies *d_mdb* times *d_gvem* were positive with statistical significance. This indicates that MDBs' participation in project finance loans would not be effective in lengthening loan tenors in the host countries where the government effectiveness index is low by *gve* < -1; therefore, additional policy measures such as capacity building of the host government and nonconventional additional financial intervention would be needed in these countries in order for MDBs' financial additionality to function properly.

In terms of regional category, the results of the OLS and PPML estimations show that the cross term of the dummies *d_mdb* times *d_Africa* was statistically not significant, while the cross terms of other areas were significantly

positive. This implies that Greenfield project finance transactions in the Sub-Saharan Africa region would require more than MDBs' conventional financial support.

Regarding sectors, the cross-term of the dummies *d_mdb* times *d_renewable* was statistically significant, and the coefficient was the largest among the sectors in both the OLS and PPML estimations. This result aligns with the above-mentioned descriptive analysis of the data, and it confirms that MDBs are highly prioritizing renewable energy transactions, thereby tackling climate change.

The findings of the above analysis contribute to the existing literature as follows: First, the result of MDBs' participation in greenfield project finance loans extending loan maturity is consistent with seminal works by Gurara et al. (2020) and Broccolini et al. (2020), while data in the previous studies are not limited to greenfield project finance loans but include all types of syndication loans. This study focused on Greenfield project finance loans and identified MDBs' financial additionality to extend longer loan maturity in lower- and upper-middle-income countries in Greenfield project finance transactions where lenders are directly exposed to the project risk and political risk of host countries.

Second, MDBs' financial additionality is influenced by the government effectiveness of the host country, which implies an additional need for MDBs' assistance for capacity building in the host countries and also the need for additional interventions other than ordinary finance operations by MDBs. This finding aligns with Gurara et al. (2020) conclusion that there is "limited to no evidence that MDBs are more likely than commercial banks to lend to risky borrowers" (Gurara et al., 2020). The Addis Agenda recognized the role of blended finance in coping with the limited effectiveness of MDBs' regular private sector finance operations. Blended finance is defined as the "use of public resources to 'crowd in' commercial finance for SDG investments that would otherwise not have materialized (United Nations, 2021). Low-income countries, Sub-Saharan Africa, and countries with low government effectiveness commonly lack a favorable investment climate for private investors, and the risk and return relationship in these markets is often not well adjusted. Blended finance could be an effective tool to unlock private investment in these markets and complement MDBs' financial additionality.

Third, the sector analysis verifies that MDBs show strong financial additionality in the renewable energy sector compared with other sectors. This implies that the climate change agenda is prioritized in MDBs' private sector operations. In fact, MDBs made a joint statement at the United Nations Secretary-General's Climate Action Summit in 2019 to increase climate finance and mobilization of climate investments from private sector investors, with the target of an expected collective total of $50 billion for low- and middle-income economies, at least $65 billion for climate finance globally, and $40 billion for private mobilization. By 2021, MDBs had already surpassed these collective expectations on climate finance (MDB, 2021). The largest positive coefficient numbers with statistical significance for the renewable energy sector in the estimation clearly verify the contribution of MDBs to the climate change agenda.

In sum, the econometric estimation validates MDBs' capacity to provide longer tenor in Greenfield project finance transactions in developing countries compared to the total average loan maturity, except for low-income countries and the Sub-Saharan African region. In host countries where government effectiveness is at the lowest edge, MDBs' financial additionality loses its significance, thereby requiring governance improvement and capacity building in the host countries and innovative blended finance instruments for their financial additionality to function well.

6. CONCLUSION AND IMPLICATIONS

This study provided empirical evidence for demonstrating MDBs' financial additionality in Greenfield project finance transactions regarding financing beyond what is available in the markets. To validate the role of MDBs' financial additionality, this study analyzed whether Greenfield project finance transactions with MDBs' involvement have significantly longer loan maturity than the total average loan maturity using the IJGlobal project finance

database. The major contribution of this study is its quantification of MDBs' financial additionality using project-level data, as limited empirical studies have used Greenfield project finance transaction data in this field.

The main findings from data observation and econometric analysis are summarized as follows:

MDBs' participation in Greenfield project finance loans was associated with longer loan maturity in lower-middle-income and upper-middle-income countries, while projects in low-income countries and in the Sub-Saharan Africa region did not have such a tendency. Furthermore, in host countries where government effectiveness is underdeveloped, the maturity of project finance loans provided by MDBs was negative, with statistical significance. In terms of sectors, MDBs' involvement shows the largest effect for project finance transactions in the renewable energy sector, indicating MDBs' effort to tackle climate change issues as their priority.

These results have implications for policy since they show that extra steps, such enhancing the host government's capacity and stepping up involvement, are required for MDBs to assure the tenor-lengthening effect of project finance loans in nations with ineffective governments. MDBs have recently extended their advisory services to host governments such as transaction advisory work and technical support for enhancing the investment climate. Improved governance and capacity building through such advising initiatives in the host nations, as well as innovative blended finance instruments to address bigger market issues, could be potential facilitators in these markets. Future study should focus on the non-financial additionality that MDBs bring about through their advising work in terms of policy, industry, institutional, or regulatory reforms, as well as the financial additionality that comes from using blended finance instruments to provide creative financing structures.

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