

Assessing infrastructure projects funded by World Bank and Chinese financial institutions: A case study of Sri Lanka

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Abstract

Purpose: This study uses Sri Lanka as a case study to explore and compare the outcomes of projects funded by both the World Bank and Chinese financial institutions.

Approach and Methods: By constructing a distinctive metric and rubric-based framework for data analysis and empirical evaluation, the research employs statistical tools such as the two-sample *t*-test, Mann–Whitney *U* test, and probit regression to examine the effectiveness of these projects. This innovative approach enables a comprehensive assessment of project performance, offering critical insights into overall impact and efficiency.

Findings: The findings suggest that World Bank-funded projects, especially loans, are more effective than those financed by Chinese institutions, probably due to the latter's higher levels of opacity. Adherence to the original budget and timeframe of projects also contributes significantly to project effectiveness.

Policy Implications: The results of this analysis offer insights into key factors relating to the effectiveness of infrastructure projects. This study also underlines the importance of the project implementation process, which has valuable implications for other nations and international development institutions in terms of improving project outcomes.

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KEYWORDS

Chinese financial institutions, development institutions, effectiveness, infrastructure projects, Sri Lanka, World Bank

1 | INTRODUCTION

Five centuries after it began to open up to the outside world, China's open policy has entered a new phase. China is now striving to transform its economic structure and expand its investments in other countries. It is also committed to the international administration of multilateral regimes. In 2013, President Xi Jinping launched the China Dream of Grand Rejuvenation initiative (Ohashi, 2018). To achieve this dream, the Central Committee of the Communist Party of China (CCP) presented the idea of the Belt and Road Initiative (BRI) in 2013, and it was approved in 2015. The main objective of the BRI programme is to establish a vast infrastructure network to enable the Chinese renminbi to be used outside China (McBride et al., 2023). China has launched a number of financial institutions, both unilateral and multilateral, to achieve this (Haga, 2021).

The World Bank (WB) is another renowned institution that provides financial support for infrastructure projects. It aims to help low- and middle-income countries (LMICs) achieve sustainable development and works with various agencies and organizations to support LMICs in their efforts to improve their economic development (Tien et al., 2019).

There has been considerable research into China's adoption of "economic statecraft" to achieve political and strategic objectives (Goldstein, 2020; Haga, 2021; Wong, 2023). By the same token, the United States and its allies have been exerting global financial influence since the establishment of the WB after the Second World War (Haga, 2021). The provision of public infrastructure is a crucial element of economic statecraft and is a key driver of development, economic growth, and the reduction of inequalities. According to Miyamoto et al. (2020), good quality infrastructure affects economic growth through two different channels: productivity and efficiency.

Good quality infrastructure can be achieved when it is well implemented, well planned, sustainable, and resilient. However, creating quality infrastructure has often been challenging. Almost all countries have major investments that have never delivered on their initial promise and yield negative social returns (Schwartz et al., 2020).

Despite recent attention, few empirical studies have explored the potential divergences in outcomes arising from infrastructure projects executed by distinct development institutions. Theoretical and empirical research (Ciminello, 2019; Proag, 2021; Korshunov, 2022) has underlined the critical role of infrastructure in stimulating economic growth. Some studies, such as Kang et al. (2022), have argued that the contribution of international institutions in facilitating economic growth in LMICs is indispensable. Other scholars have identified specific factors in the success of development projects implemented by the WB (Chasanah et al., 2023; Ilka, 2015; Kilby, 2000; Shin et al., 2017; Xu, 2020). However, there is a knowledge gap concerning the critical distinctions in project characteristics between various financial institutions, extending beyond those exclusively associated with the WB.

This study aims to ascertain whether the outcomes of projects exhibit variation based on the financing institution, with a focus on infrastructure projects in Sri Lanka. The decision to focus on Sri Lanka is primarily driven by China's emergence as the primary provider of foreign investment and loans to the country, surpassing long-standing contributors such as Japan and India, and the fact that Sri Lanka is strategically significant within China's Maritime Silk Road initiative, resulting in substantial economic advantages for the country (Choudhury, 2023). The study also seeks to discern whether WB-funded projects demonstrate a higher likelihood of success than those executed by other institutions, particularly Chinese financial entities. Furthermore, the article offers insights into the correlation between project success and adherence to the original agreements.

This study uses information from 68 infrastructure projects sourced from the WB database and additional secondary sources like AidData. The collected data undergoes analysis and is subject to a scoring process, using a multi-criteria approach to construct ranking rubrics and a benchmark designed for the quantification of opacity analysis. After scoring the data, empirical investigation is implemented through a two-sample t-test, the Mann–Whitney U test, and probit regression. The systematic assessment of these projects is based on the findings of previous research (Chasanah et al., 2023; Ilka, 2015; Kilby, 2000; Liu et al., 2021; Shields et al., 2003).

This study finds that WB-financed projects demonstrate greater effectiveness than those financed by Chinese financial institutions. This is primarily due to higher levels of opacity in WB projects, favourable outcomes in the targeted society, and adherence to originally approved funding and duration.

The probit regression analysis reveals that projects adhering to original funding agreements tend to exhibit acceptable levels of opacity, with results indicating significantly that WB projects are more transparent than those funded by Chinese institutions. Additionally, projects with higher funding scores and adherence to original agreements positively impact the target population, with WB projects showing more favourable outcomes than Chinese-funded ones. Moreover, the analysis of the economic internal rate of return (EIRR) ratio indicates that projects staying on schedule generally have higher economic impacts.

Lastly, the results show that loan-funded projects consistently demonstrate greater effectiveness, transparency, and positive societal impact, highlighting their effectiveness as a financing mechanism for infrastructure and social development.

This is a pioneering study in its examination of the diversity of outcomes in development projects financed by various multilateral institutions. It is also one of the few studies to employ scoring and ranking systems to evaluate the effectiveness of development projects. Additionally, it draws on Sri Lankan projects, which have been little studied hitherto. These results add to the existing research and provide valuable information to policy-makers on how to develop infrastructure projects for optimal outcomes.

The article is structured as follows. Section 2 offers a review of the literature on infrastructure projects and international financial institutions, and their impact on economic development, in addition to some insights into China's involvement in Sri Lanka. Section 3 details data collection and methodological design. Following this, Section 4 presents the findings of the study. Lastly, Section 5 concludes and provides recommendations for future research.

2 | LITERATURE REVIEW

2.1 | Infrastructure and economic development

Infrastructure and economic development have been linked to each other since 1958. It started with Hirschman's concept of social overhead capital (infrastructure), where he elaborated on the positive relationship between infrastructure investment and the development of LMICs (Hirschman, 1958). This concept was later developed through Rostow's theory of stages of growth, where he considered that investment in infrastructure is a precondition for take-off into self-sustained growth (Rostow, 1960).

To date, research has focused mainly on the importance of implementing infrastructure projects and their impact on economic development. Esfahani and Ramirez (2003) find that infrastructure services have a positive impact on gross domestic product (GDP), generally surpassing the associated costs of provision. Lee (2011) draws upon the Malaysian context, arguing that the infrastructure sector plays a critical role in facilitating modern commerce and contributing to economic development. Rao and Srinivasu (2013) contend that improved access to education, health services, water and sanitation, road networks, and electricity are vital to achieve equitable development, social empowerment, and increased productivity.

Recent studies such as Ciminello (2019) underscore the crucial role of infrastructure in fostering sustainable growth and inclusive development within LMICs. Similarly, Proag (2021) and Kurshunov (2022) show that the

attainment of sustainable economic growth is dependent on the ability to furnish superior infrastructure services at reasonable cost.

From another perspective, the allocation and adequacy of project resources, alongside considerations of project size and duration, emerge as influential elements for the success of development projects (Chasanah et al., 2023). Additionally, there is a positive relationship between WB supervision and the level of success of related projects (Ilka, 2015; Kilby, 2000).

2.2 | International institutions and economic development

LMICs generally receive funding from a range of bilateral and multilateral institutions to carry out infrastructure projects. International financial institutions such as the International Monetary Fund (IMF), WB, Asian Development Bank (ADB) and the Asian Infrastructure Investment Bank (AIIB) play a crucial role in supporting the growth of LMICs through grants, loans, and technical assistance. These institutions, though subject to criticism, have made significant contributions to international peace, financial architecture, and the growth of LMICs (Acharya, 2018). In this sense, Kang et al. (2022) recommend that LMICs improve access to financial institutions, as accessibility, the depth of services offered, and the effectiveness of fund allocation by these institutions are positively correlated with LMIC economic growth.

In addition, according to Xu (2020), the WB and the AIIB exhibit analogous lending agreements and comparable structures. However, the AIIB provides customizable repayment plans, comprehensive economic and environmental analyses, and a reduced insistence on economic deregulation and liberalization.

According to Bulman et al. (2015), project outcomes for both the WB and the ADB show greater variation within countries than between countries, with country-level characteristics accounting for only 10%–25% of the differences in project success. The study also highlights that shorter project durations and additional financing are positively associated with better project outcomes. In particular, the relationship between these factors and project outcomes does not show significant differences between WB and ADB (Bulman et al., 2015).

From another perspective, Tien et al. (2019) view the AIIB as a competitor to the IMF and the WB. While the AIIB is smaller, it challenges the dominance of these Bretton Woods institutions. Unlike the IMF, the AIIB does not impose austerity policies, making it an appealing option for some countries outside Asia, including parts of eastern Europe (Tien et al., 2019).

Similarly, China's large-scale domestic initiatives, such as poverty resettlement, reflect its approach to mobilizing significant resources for strategic objectives. Rogers et al. (2020) describe how China's poverty alleviation efforts involved relocating millions of people, showcasing a model of state-driven resource allocation that parallels China's approach to foreign aid and infrastructure investments. However, Chinese foreign aid has been criticized for having strategic motivations and leading to unintended consequences (Dreher et al., 2022). Similarly, Atitianti (2022) finds that Chinese aid projects in sub-Saharan Africa reduce trust in government, largely due to poor assessment of government performance and perceptions of corruption. The study also indicates that WB-funded projects have similar effects, suggesting that both sources of aid can unintentionally undermine public trust in government.

2.3 | Involvement of China and World Bank in Sri Lanka

Sri Lanka's strategic positioning as a pivotal location in China's Maritime Silk Road initiative and the associated string of pearls concept has translated into substantial economic advantages.¹ China's is a crucial export market, a

¹The string of pearls concept refers to China's increasing strategic interests over countries in the Indian ocean region to build a civilian maritime infrastructure (Uluwaduge, 2022).

significant source of foreign direct investment, a supplier of low-cost imports, a catalyst for extensive infrastructure development, and a keystone of Sri Lanka's growing tourism industry. Moreover, China has become a central provider of military and diplomatic support for Sri Lanka (Uluwaduge, 2022). China has also become the main provider of official development assistance to Sri Lanka in recent years. The relationship between these economies has reached unprecedented levels, particularly with Sri Lanka participating in the BRI. Under this initiative, Sri Lanka has secured a substantial amount of Chinese funds, although at considerably higher interest rates compared to loans from multilateral agencies (Choudhury, 2023).

The strong ties between China and Sri Lanka have been extensively analysed (Nugroho, 2023; Senaratane & Melegoda, 2022; Uluwaduge, 2022). However, Sri Lanka's economic engagement with China, while presenting noteworthy opportunities, also introduces a set of issues. The involvement of China raises diplomatic and economic considerations. Additional challenges manifest themselves in a negative trade balance, substantial indebtedness, and relatively modest returns on investment, collectively representing significant areas where Sri Lanka confronts complexities in its economic ties with China (Choudhury, 2023; Nugroho, 2023). Moreover, the magnitude of the funds provided by China to Sri Lanka exceed the repayment capacity of the island. The Chinese-backed projects and loans allocated for infrastructure development became a subject of extensive global debate and criticism after Sri Lanka, facing financial constraints, had to cede ownership of Hambantota Port to China due to its inability to meet loan repayment obligations. This 2018 incident triggered widespread scrutiny and criticism of BRI (Choudhury, 2023).

Sri Lanka, according to the WB, has opportunities to build upon its past successes through an ambitious development vision to promote a globally competitive private sector economy, with a strong emphasis on job creation and social inclusion. Sri Lanka stands as a notable development success story on various fronts. The Country Partnership Framework (CPF) lays out specific objectives geared toward supporting the government in realizing its development trajectory (Dinelka, 2016). The support provided by the WB to Sri Lanka has been widely studied, broadly highlighting the success of WB programmes in strengthening the economic conditions of rural communities and fostering shared prosperity (Samaraweera, 2010; Mimrose et al., 2012). There is a contrasting school of thought, exemplified by Kumarasiri and Dissanayake (2021), which highlights the misappropriation of funds allocated for waste-to-energy projects for personal gain, resulting in diminished government support and impediments to project implementation. Additionally, Perera (2021) criticizes the restrictive terms attached to WB loans.

In light of these considerations, this research seeks to elucidate the potential difference between the outcomes of the infrastructure projects implemented by the WB and Chinese financial institutions, using Sri Lanka as a paradigmatic case study. The primary objective is to examine whether there is a relationship between the nature of the authority overseeing the projects and their overall success. More precisely, this research suggests the following hypothesis regarding the differences in outcomes of projects implemented by the WB and Chinese financial institutions.

Hypothesis 1. WB projects implemented in Sri Lanka have a higher level of effectiveness than projects implemented by Chinese financial institutions.

Infrastructure projects are at the forefront of economic recovery investments, both on a domestic and international scale, serving as a key driver of growth within the construction industry today. Regrettably, a significant number of these projects face challenges and ultimately fail, primarily due to inadequate early project planning. Recognizing the paramount importance of mitigating these challenges, front end planning (FEP) emerges as a critical process. FEP addresses the challenges faced by infrastructure projects in terms of avoiding cost overruns and project delays. As such, FEP plays a central role in unveiling project unknowns, fostering the development of precise scope definitions, and establishing a well-structured approach to the project execution process (Ferrer Rivero, 2021). The effectiveness of projects lies in the identification and mitigation of various issues, ranging from right-of-way concerns and utility adjustments to environmental hazards, logistic challenges, and project-specific

requirements such as regulatory compliance and environmental approvals (Mustapa et al., 2018). In other words, projects that adhere to their original plan have higher success rates than projects that fail to do so. As such, this study posits the following hypothesis:

Hypothesis 2. WB and Chinese projects that adhere to their original loan agreements are more likely to be more effective than those that do not.

3 | DATABASE AND METHODOLOGY

3.1 | Database

A wide range of quantitative and qualitative data have been combined to address the hypotheses posited in this study. This dataset pertains specifically to projects funded by various Chinese institutions, such as the Export-Import Bank of China (China Exim Bank) and China Development Bank (CBD), within Sri Lanka. Additional research into projects undertaken by the WB in Sri Lanka is also included.

To gather the necessary data, an extensive analysis of over 150 documents, including audit reports and press releases, was conducted. These documents were obtained from various secondary sources. Microvariables related to WB projects were mainly extracted from the bank's official database (World Bank, n.d.). Audit reports for WB projects were obtained from the WB independent evaluation group database. Variables associated with Chinese financial institutions were sourced from AidData, a comprehensive database developed at William and Mary University (AidData, n.d.). Audit reports for projects implemented by Chinese financial institutions were retrieved from the website of Sri Lanka's National Audit Office (NAO, n.d.). When information was not available through these sources, supplementary data searches were conducted using Google Scholar and press releases.

A total of 68 infrastructure projects were examined for the period 2013 to 2020. The starting year was chosen as it is the year that BRI began (McBride et al., 2023). The concluding year is the deadline for projects that remained unfinished at the time of the last data update.

3.2 | Scoring methodology

The evaluation of the socioeconomic impact of infrastructure projects is necessary to give financial institutions a benchmark for measuring project performance and to inspire them to higher-ranking outcomes. Some standard methods used to evaluate infrastructure projects include analytical hierarchy process (AHP) analysis; strengths, weaknesses, opportunities, threats (SWOT) analysis; and scoring techniques.

Metric and score-driven analysis involves using quantitative measures (such as cost and schedule adherence) and qualitative assessments (such as quality and socioeconomic impact) to evaluate the effectiveness of infrastructure projects. Metrics quantify qualitative measures (e.g., performance, progress, or quality of a particular project), while scoring involves assigning numerical values to various attributes to evaluate, rank, or classify entities based on their performance (Honell et al., 2023). Previous studies have developed multidimensional metrics to assess infrastructure project outcomes, construction success, and sustainability (Liu et al., 2021; Mekovec & Kelemen, 2012; Shields et al., 2003).

The literature supports the use of rubrics in performance evaluations. Îsasimatis et al. (2019) emphasize that using a rubric as an instrument of assessment technique would bring clarity and consistency to project evaluations. Additionally, Liu et al. (2021) provide a solid foundation for our methodology and the generalizability of rubric-based evaluations across different contexts, such as educational settings, healthcare projects, and public infrastructure.

Shields et al. (2003) provide a metric for the measurement of the success of a construction phase, incorporating critical components covering cost, schedule, quality, and safety. This approach integrates most, if not all, of the essential facets of project performance. Liu et al. (2021) designed a system that measures infrastructure sustainability in environmental, social, economic, and managerial dimensions. These multidimensional metrics are helpful for understanding the overall perspective of project outcomes and ensuring their proper evaluation (Liu et al., 2021).

To achieve a comprehensive analysis of infrastructure projects, our study includes a scoring rubric that benchmarks projects sponsored by the WB and Chinese financial institutions in Sri Lanka. Table 1 compares the evaluation criteria used in our study with those of Liu et al. (2021) and Shields et al. (2003), highlighting how our methodology aligns with and builds upon established approaches.

The scores are divided into three categories: high scores for projects with a value of 30, medium scores for projects with a value of 15, and low scores for projects with a value of 0. This scoring is built on Jönsson's (2022) technique, which advocates using a simple scale to analyse infrastructure projects where data collection is highly complex, as in our study.

The initial assessment of the effectiveness of the project compares the approved and the actual durations and the approved versus spent amounts (OECD, 2020). Ika and Donnelly (2017) emphasize that project success requires strong commitment, collaboration, and alignment with agreements. In cases of changes, shorter durations and increased financing are preferred over extensions or reduced disbursements, or discontinuation (Bulman et al., 2015). Projects with no changes in duration or financial disbursements receive a score of 30, shortened durations score 15, and other cases score zero.

Moreover, to further evaluate the duration and funding, the difference between approved and revised or actual values is calculated and divided by the originally approved amount to account for the level of relative variation.

An additional cost assessment is conducted by calculating the cost efficiency score, which is derived by dividing the benchmark cost; the average cost of similar projects funded by international financial institutions (e.g., WB, IMF) in Sri Lanka; by the actual cost, measured as the observed cost per beneficiary for Chinese-funded projects. This approach follows the methodology outlined by Herrera and Pang (2008).

TABLE 1 Comparison of evaluation criteria from Shields et al. (2003) and Liu et al. (2021).

Evaluation Criteria	Our Study	Shields et al. (2003)	Liu et al. (2021)
Implementation duration	1. Approved schedule compared to actual duration 2. Relative Duration Variation = $(\text{Approved Duration} - \text{Actual Duration}) / \text{Approved Duration}$	Schedule adherence (Actual construction duration - Initial construction duration) / Initial predicted duration	Not specifically addressed
Cost efficiency	1. Actual expenditure vs. approved budget. 2. Relative funding variation = $(\text{Approved Funding} - \text{Actual Funding}) / \text{Approved funding}$. 3. Cost Efficiency Score (CES) = $\frac{\text{Benchmark cost}}{\text{Actual cost}}$	Financial management (Actual cost - Initial cost) / Initial predicted cost	Economic costs like direct cost of the project, indirect costs like social costs and environmental costs
Economic impact	Economic internal rate of return (EIRR)	Not specifically addressed	Economic dimension like employment growth.
Social impact	Direct and Indirect Impact on Society (e.g., job opportunities, pollution, displacement, traffic...)	Not specifically addressed	Social dimension: external costs incurred by those impacted by the projects such as environmental damage and compensation for demolition.
Project opacity	Transparency factors (e.g., bribery, audit reports, procurement type)	Inspection costs (indirectly related)	Not specifically addressed.

Secondly, in evaluating the economic impacts of the projects, a metric is applied using the EIRR. This is a widely recognized metric for assessing the economic impact of infrastructure projects. By calculating the rate at which the net present value of a project's benefits equals its costs, EIRR provides a comprehensive measure of a project's overall economic efficiency (ADB, 2017). Within this framework, for projects with a ratio that exceeds the average value of all ratios, a score of 30 is assigned. Conversely, if the project ratio falls below the average value, a score of 0 is ascribed.

Thirdly, the projects are examined on the basis of their social impact, as delineated by the Organisation for Economic Co-operation and Development (OECD, 1991). The success of development projects is highly correlated with factors of human development (Chasanah et al., 2023). Within this scope, the social scoring methodology for the projects was based on two categories: direct social impact and indirect social impact. Each category was scored on a scale of 0 to 15. A score of 15 was given if the project had a clearly positive impact, such as improving access to services, creating jobs, or improving health outcomes. A score of 5 was assigned if the project had both positive and negative effects, such as mixed results in employment or health. A score of 0 was given if the project had a negative or no measurable impact, such as worsening conditions or failing to provide benefits.

Furthermore, additional assessment of the data is performed by considering the flow type of the projects as a dummy variable and analysing it as follows: in cases where the flow type is a loan, a value of one is assigned and a value of zero otherwise.

Finally, the evaluation of the outcomes of the projects is conducted using an opacity benchmark, which systematically incorporates considerations such as bribery allegations, the accessibility of audit reports, the precision of reported data, type of procurement and the appropriate utilization of funds (Büchner et al., 2008; Kenny, 2006; UNODC, 2018). Kenny (2006) suggests that anti-corruption research activities should be prioritized. In this context, projects involving allegations of bribery warrant the assignment of a score of zero. Conversely, active projects free from accusations of bribery are assigned a score of 6. The public availability of audit reports results in a score of an additional 6, while the absence of such reports results in a score of zero. Also, if the provided data demonstrate accuracy, an additional score of 6 is bestowed; conversely, inaccuracies result in a score of zero. If the funds are being used effectively, the project is also assigned a score of 6, otherwise it is given a score of zero. Lastly, if the process of procurement follows competitive bidding, a score of 6 is allocated and zero otherwise.

On the one hand, the implementation success of the project is analysed using the duration-based score and the score based on funding. On the other hand, to analyse the overall performance of a project, the total scores are calculated by adding up the scores based on opacity, social impact, and EIRR. Projects are ranked accordingly from highest to lowest, then the scores are compared to assess the efficiency of the projects, considering the ones with the highest score to be more efficient than those with the lowest score. In all cases, projects with insufficient information or data are assigned a score of zero, and they are placed at the bottom of the list. The scoring guideline is presented in Table 2.

3.3 | Empirical model

The first hypothesis is assessed to establish whether there exist discernible differences in outcomes between WB projects and those implemented by Chinese financial institutions, and to determine the relative effectiveness of projects implemented by the WB compared to those by Chinese financial institutions. The suitability of employing either equal variance or unequal variance t-tests hinges on the normal distribution of the dataset. Conversely, datasets deviating from normality require alternative approaches such as the Mann-Whitney U for analysis (Emerson, 2023). Moreover, to assess the differences in the overall distributions of the two samples, the Kolmogorov-Smirnov test is applied (Baumgartner & Kolassa, 2021). This test assesses the hypothesis that two given samples come from the same population, so if we reject this hypothesis, we can conclude that WB project outcomes differ from the outcomes of projects funded by Chinese financial institutions.

TABLE 2 Scoring guideline.

Criterion	Explanation	Score
Implementation duration	No change in implementation duration	30
	Decrease in implementation duration	15
	Extension in project implementation or discontinuation	0
Cost	The actual amount spent is equivalent to the approved or revised amount	30
	The actual amount spent is greater than the approved or revised amount	15
	The actual amount spent is less than the approved or revised amount.	0
	CES above average CES	30
	CES below average CES	0
Economic impact	EIRR of the particular project is greater than EIRR of all projects	30
	EIRR of the particular project is lower than EIRR of all projects	0
Social impact	Direct Social Impact (job creation, direct benefits of the project, such as access to water, medical services or roads): 15 (Positive), 5 (Positive and Negative), 0 (Negative or No Impact)	30
	Indirect Social Impact (less or more pollution, displacement of people, time saving...): 15 (Positive), 5 (Positive and Negative), 0 (Negative or No Impact)	
Opacity	Are there any allegations of bribery? 0 Yes, 6 No	30
	Is there an audit report for the project? 0 No, 6 Yes	
	Are values being reported accurately? 0 No, 6 Yes	
	Are funds being used efficiently? 0 No, 6 Yes	
	Is the procurement competitive? 0 No, 6 Yes	
	No information 0	
Flow type	If the funding is a loan, it takes a value of 1 and zero otherwise.	

Source: Authors' own elaboration.

The second hypothesis posits that projects that adhere closely to their original loan agreements tend to be more successful than those that do not. In other words, our second analysis shows the relationship between execution scores—i.e., scores based on duration and scores based on funding—and the outcome scores based on opacity, impacted people, and economic impact. This hypothesis is tested through probit regression analysis by considering three models: Model 1 where the opacity score is the dependent variable, Model 2 where the impact on people is the dependent variable, and Model 3 where the EIRR is the dependent variable. For all models, scores based on duration, allocated funding, relative duration variation, relative funding variation, flow type, and funding entity identity are the independent variables.

The use of probit regressions follows the methodology applied by different scholars in the context of evaluating socioeconomic factors and infrastructure projects (Faust et al., 2013; Mittal & Mehar, 2016). Finally, we use McFadden's (1974) pseudo R^2 to analyse the goodness-of-fit of our models, as recommended by Veall and Zimmermann (1996), considering a value of 0.2 to be acceptable.

The following equations summarize the models under analysis:

$$Y_i = \beta_{10} + \beta_{11}FS_i + \beta_{12}DS_i + \beta_{13}CES_i + \beta_{14}FT_i + \beta_{15}ID_i + \varepsilon_{1i} \quad (\text{Equation 1})$$

$$Y_i = \beta_{20} + \beta_{21}FS1_i + \beta_{22}FS2_i + \beta_{23}DS1_i + \beta_{24}DS2_i + \beta_{25}CES1_i + \beta_{26}CES2_i + \beta_{27}FT_i + \beta_{28}ID_i + \varepsilon_{2i} \quad (\text{Equation 2})$$

$$Y_i = \beta_{30} + \beta_{31}RFV_i + \beta_{32}RDV_i + \beta_{33}FT_i + \beta_{34}ID_i + \varepsilon_{3i} \quad (\text{Equation 3})$$

Y represents the dependent variables, a set of proxies measuring the effectiveness of project “i”. The dependent variables are as follows: *OS* (score based on opacity), *SI* (score based on social impact), and *EIRR* (scores based on economic internal rate of return). *OS* are divided into three categories: *OS1*, *OS2*, and *OS3*. *OS1* represents projects with a high level of opacity (i.e. with an *OS* value of 22.5 or 30), *OS2* represents projects with a medium level of opacity (i.e. with an *OS* value of 7.5, 10, or 15), and *OS3* represents projects with a low level of opacity (i.e. with an *OS* of zero). *SI* are divided into three groups: *SI1*, *SI2*, and *SI3*. *SI1* denotes projects with a positive impact on society (i.e. *SI* equal to 30), *SI2* denotes projects with an *SI* value of 20 and 25, and *SI3* depicts projects with an *IP* value of 15, 10, 5, and zero. Finally, β_0 represents the intercept, β_{11} to β_{34} are the coefficients of the independent variables and ε is the error term.

The independent variables are *FS* (Funding Score); *DS* (Scores Based on Duration); *RDV* (Relative Duration Variation), *RFV* (Relative Funding Variation), and *CES* (Cost Efficiency Score). In equation 2, *FS* and *DS* are sorted into two different levels to provide more evidence for the results observed in the first equation and to capture potential threshold effects, where the variables may influence the outcomes differently at higher or lower levels: *FS1* and *FS2*, *DS1* and *DS2*, *CES1* and *CES2*. *FS1*, *DS1*, and *CES1* represent projects with a high level of *FS*, *DS*, and *CES* respectively (i.e. projects scoring a value of 30), and *FS2*, *DS2*, and *CES2* represent projects with a low level of *FS*, *DS*, and *CES* respectively (i.e. projects scoring a value of 15 or below). Additionally, *FT* refers to flow type that takes a value of 1 if the flow is a loan and 0 otherwise, and *ID* stands for identity and takes a value of 1 if the project is funded by the WB and 0 if it is funded by China.

This procedure is performed using Stata software version 18 (StataCorp, 2023). The input diagnosis is conducted using the Pearson correlation, indicating that a significant correlation value higher than 0.8 is an alert for the existence of multicollinearity (Gujarati, 2003).

4 | RESULTS

This section provides the findings from this research. The analysis begins by testing the first hypothesis to assess whether WB projects demonstrate greater effectiveness than those funded by Chinese institutions. Subsequently, the second hypothesis is examined to determine whether projects that adhere closely to their original loan agreements tend to exhibit higher levels of effectiveness.

4.1 | Comparative evidence

The first hypothesis posits that WB projects are more effective than Chinese projects implemented in Sri Lanka. Before conducting the two-sample t-test for efficacy assessment, a normality test is performed to ascertain the assumption of normal distribution in the data. Predicted upon the Shapiro–Wilk test, skewness and kurtosis, and omnibus tests, our findings on scores based on opacity (*OS*) for Chinese projects and WB data delineate normality. However, other metrics such as total scores, duration, funding, *EIRR*, social impact, flow type, and opacity scores do not exhibit normal distribution, necessitating the application of the Wilcoxon rank-sum test instead of the two-sample t-test (Emerson, 2023).

Table 3 presents the results of the equal variance and unequal variance t-test for opacity score. It reveals a mean difference of 9.836 for scores based on opacity between the two populations, signifying a lower mean for Chinese projects significant at 1%, 5%, and 10%, indicating that WB projects exhibit a more favourable outcome. The Aspin-Welch unequal variance t-test confirmed these findings. Therefore, based on these results, we accept the first hypothesis, indicating that in Sri Lanka WB projects are more effective than Chinese projects in terms of

TABLE 3 T-test.

Group 1 variables: WB Projects, Group 2 variables: Chinese Projects							
Alternative Hypothesis: $\mu_1-\mu_2 \neq 0$, Null Hypothesis: $\mu_1-\mu_2=0$							
Equal variance results for score based on opacity				Aspin-Welch test for score based on opacity			
Mean difference	Standard error	T-statistic	DF	Mean difference	Standard error	T-statistic	DF
9.836	1.983	4.960***	66	9.836	1.985	4.954***	58.01

Note: Significant results are marked in bold. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively, two-tail tests. DF: Degree of Freedom.

opacity. These outcomes are consistent with previous conclusions that indicated the existence of a positive relationship between WB supervision and the level of success of its projects (Ilka, 2015; Kilby, 2000).

For non-normally distributed data, the Mann–Whitney U or Wilcoxon rank-sum tests are used. Table 4 summarizes the outcomes, indicating higher values of Mann–Whitney U for WB in terms of total score, scores based on duration, flow type, and cost efficiency, all significant at 1%. These results confirm the hypothesis that WB projects have better outcomes than Chinese projects in terms of duration, cost efficiency, and flow type.

Overall, the outcomes from various statistical tests support the conclusion that WB projects are more effective than Chinese projects in Sri Lanka, and this is particularly attributed to higher opacity levels, adherence to approved duration and efficient cost relative to local norms. These results align with the conclusions of Schwartz et al. (2020) that corruption is directly linked to poor infrastructure governance. These empirical observations lend credence to the initial hypothesis favouring WB projects over those carried out by Chinese financial institutions.

The Kolmogorov–Smirnov test was used to test the first hypothesis further. Table 5 shows that there is a significant difference between projects funded by WB and Chinese financial institutions in terms of adherence to approved duration, opacity, cost efficiency and flow type.

4.2 | Evidence of effectiveness

The second hypothesis focuses on the impact of adhering to original loan agreements on opacity, the affected population, and the investment-to-GDP ratio. This hypothesis is evaluated using probit regression models across three main empirical frameworks.

4.2.1 | Evidence on opacity

Table 6 presents a detailed analysis of the probit regression results for Model 1, applied across all datasets to examine the influence of independent variables on opacity levels. The results of Model 1 are derived from nine estimations, each incorporating different sets of independent variables.

Estimates 1, 2, and 3 evaluate the influence of FS (Funding Score), DS (Duration Score), FT (Flow Type), CES (Cost Efficiency Score) and ID (Funding Agency Identity) on OS1 (High Opacity Score) OS2 (Medium Opacity Score), and OS3 (Low Opacity Score), respectively. Estimates 4, 5, and 6 assess the impact of FS1 (High Funding Score), FS2 (Low Funding Score), DS1 (High Duration Score), DS2 (Low Duration Score), CES1 (High-Cost Efficiency Score), CES2 (Low Cost Efficiency Score) FT, and ID on OS1, OS2, and OS3, respectively. Finally, estimates 7, 8,

TABLE 4 Mann–Whitney U or Wilcoxon rank-sum tests for the difference in location.

Variable	Score based on											
	Total Score		Duration		Funding		Social Impact		EIRR		Flow type	
	China	WB	China	WB	China	WB	China	WB	China	WB	China	WB
Mann–Whitney U	273	847	385.5	734.5	558.5	561.5	302	818	594	626	356	764
Sum of Ranks (W)	1093	1253	1205.5	1140.5	1378.5	967.5	1122	1224	1314	1032	1176	1170
Test Type: Alternative Hypothesis: Location	Z-value		Z-value		Z-value		Z-value		Z-value		Z-value	
Diff. #0												
Normal approximation	3.580^{***}		2.513^{**}		0.020		3.298^{***}		0.960		3.389^{***}	
Normal approximation with C.C.	3.574^{***}		2.506^{**}		0.014		3.292^{**}		0.953		3.381^{***}	

Note: Significant results are marked in bold. ^{***}, ^{**}, ^{*} denote significance at the 1%, 5%, and 10% levels, respectively, two-tail tests. C.C.: Continuity Correction.

TABLE 5 Kolmogorov–Smirnov Test for comparing distributions.

TS	DS	FS	OS	SI	EIRR	FT	CES
0.404**	1.247*	0.072	0.546***	0.439***	0.118	0.364**	0.435**

Note: Significant results are marked in bold. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively, two-tail tests.

and 9 investigate the effects of RDV (Relative Duration Variation), RFV (Relative Funding Variation), FT, CES, and ID on OS1, OS2, and OS3, respectively.

Key findings from estimates 1, 2, 4, 5, and 9 indicate that projects that adhere to their original funding agreements exhibit moderate opacity levels. Notably, the second and fifth estimates reveal that projects with high funding scores and a medium cost efficiency score are associated with medium levels of opacity. This result confirms the idea that adherence to the original agreement helps to reveal project unknowns and establish a well-structured approach to the project execution process (Gaventa & McGee, 2013; Ferrer Rivero, 2021).

In addition, the first and fourth estimates demonstrate a negative relation between high funding scores and high levels of opacity. This outcome underlines the need for a deeper exploration of these relationships and offers valuable insights for future research in this area.

Furthermore, the results of estimates 2, 5, 8, and 9 indicate that projects funded through loans are often more transparent because lenders monitor them closely, set clear conditions, and ensure funds are used properly to guarantee repayment, unlike grants, which may have less oversight (Dreher et al., 2018; Horn et al., 2021).

Our analysis indicates that Chinese financial institutions are generally less transparent than the WB, as evidenced by the significant results for ID in the first, third, fourth, and sixth estimates. This outcome provides additional evidence for our first hypothesis delineating that WB-funded projects are more effective than those funded by Chinese financial institutions. Furthermore, our results indicate why Chinese-backed projects and loans allocated for infrastructure development became the subject of extensive global debate and criticism (Choudhury, 2023). Limited operational transparency and government management, as seen in Chinese international volunteer programs, contribute to the inconsistencies in project outcomes and alignment with local needs, highlighting how state-driven goals in development can impact effectiveness and foster uncertainty in recipient countries (Zhang et al., 2021).

Looking at the goodness-of-fit of our regressions, estimates 1, 4, 5, 6, and 9 hold acceptable values of Pseudo R2, which are approximately greater than 0.2. This means that they have a strong fit and provide a viable explanation of our results.

4.2.2 | Social impact

Table 7 presents the probit regression results assessing the influence of various independent variables on SI (Social Impact) across nine distinct estimations. The first three estimates evaluate the impact of FS, DS, FT, CES and ID on SI1 (Positive Social Impact), SI2 (Positive and Negative Social Impact), and SI3 (Negative or No Social Impact), respectively. Estimates 4, 5, and 6 examine the effects of FS1, FS2, DS1, DS2, CES1, CES2, FT and ID on SI1, SI2, and SI3, respectively. Estimates 7, 8, and 9 explore the influence of RDV, RFV, FT, and ID on SI1, SI2, and SI3, respectively.

The comprehensive analysis across most estimates robustly supports the notion that projects adhering to their originally allocated funding and duration yield superior outcomes for the impacted society. For instance, estimate 1 demonstrates that a higher funding score is associated with an increased SI1 (highest social score). Similarly, Estimate 6 shows that projects with a low cost efficiency score tend to have low social impact. This result is confirmed through estimates 2, 5, and 7 showing that adherence to original funding and duration agreements

TABLE 6 Model 1 – Effects of the funding score, duration score, cost efficiency score, and flow type on opacity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	OS1	OS2	OS3	OS1	OS2	OS3	OS1	OS2	OS3
FS	−0.033* (0.018)	0.027** (0.012)	−0.013 (0.013)						
DS	−0.003 (0.017)	−0.013 (0.012)	0.016 (0.013)						
CES	−0.025 (0.020)	−0.004 (0.013)	0.018 (0.014)						
FS1				−1.324** (0.625)	1.092*** (0.405)	−0.519 (0.396)			
FS2				−0.125 (0.657)	0.039 (0.473)	0.046 (0.501)			
DS1				0.179 (0.568)	−0.509 (0.382)	0.527 (0.397)			
DS2				Omitted -	−0.552 (1.032)	1.007 (0.944)			
CES1				−0.611 (0.597)	−0.196 (0.403)	0.595 (0.426)			
CES2				Omitted -	1.257** (0.635)	−0.523 (0.632)			
RFV							0.753 (1.048)	0.908 (0.748)	−1.612* (0.833)
RDV							−0.040 (0.437)	0.467 (0.380)	−0.578 (0.427)
ID	1.540** (0.742)	0.091 (0.432)	−0.898* (0.482)	1.446** (0.736)	0.220 (0.448)	−0.979** (0.492)	0.782 (0.604)	−0.217 (0.440)	−0.347 (0.505)
FT	−0.506 (0.797)	0.729* (0.437)	−0.529 (0.428)	−0.687 (0.858)	1.057** (0.484)	−0.721 (0.453)	−0.143 (0.726)	0.976* (0.514)	−1.044* (0.538)
Constant	−0.740 (0.690)	−0.655 (0.454)	−0.037 (0.461)	−0.598 (0.751)	−1.064** (0.530)	0.166 (0.508)	−1.363** (0.545)	−0.432 (0.417)	0.249 (0.413)
Observations	68	68	68	59	68	68	57	57	57
LR χ^2	11.15	8.581	10.18	12.40	14.67	12.92	3.236	7.671	12.27
Prob > χ^2	0.049	0.127	0.070	0.054	0.066	0.114	0.519	0.104	0.016
Pseudo R ²	0.2	0.1	0.1	0.3	0.2	0.2	0.1	0.1	0.2

Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

yields better social impact. This outcome supports the notion that the success of development projects is highly correlated with human development factors (Chasanah et al., 2023).

Additionally, estimates 2, 3, and 6 show that projects funded through loans tend to have a positive social impact, as they require stronger accountability, encourage efficient resource allocation, and promote long-term sustainability, ensuring that funds are used effectively to benefit society (Collier & Dollar, 2002; Dreher et al., 2018).

TABLE 7 Model 2—Effect of funding score, duration score, cost efficiency score and flow type on society.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	SI1	SI2	SI3	SI1	SI2	SI3	SI1	SI2	SI3
FS	0.062*** (0.022)	0.118*** (0.044)	−0.083*** (0.019)						
DS	0.008 (0.019)	0.077*** (0.029)	−0.042*** (0.016)						
CES	0.020 (0.024)	0.026 (0.022)	−0.026 (0.017)						
FS1				6.268 (468.4)	7.548 (903.0)	−3.046*** (0.787)			
FS2				5.276 (468.4)	6.125 (903.0)	−1.895** (0.781)			
DS1				0.075 (0.744)	2.188** (0.864)	−1.230** (0.494)			
DS2				Omitted -	5.623 (771.3)	−1.255 (1.378)			
CES1				0.768 (0.898)	0.729 (0.672)	−0.778 (0.542)			
CES2				6.880 (468.4)	0.554 (1.244)	−1.450* (0.803)			
RFV							4.046** (1.718)	2.180 (2.068)	−3.107** (1.353)
RDV							−2.425 (1.528)	−0.245 (0.265)	0.319 (0.261)
FT	Omitted -	1.242* (0.676)	−1.080* (0.571)	Omitted -	1.277 (0.794)	−1.410** (0.640)	Omitted -	0.609 (0.521)	−0.649 (0.525)
ID	1.749** (0.737)	−4.079*** (1.178)	0.282 (0.552)	1.931** (0.829)	−3.887*** (1.187)	0.249 (0.578)	Omitted -	−1.768*** (0.598)	−0.163 (0.440)
Constant	−3.569*** (0.877)	−5.016*** (1.625)	3.558*** (0.777)	−8.151 (468.4)	−9.095 (903.0)	4.452*** (1.090)	0.433 (0.334)	−0.584 (0.411)	0.560 (0.413)
Observations	52	68	68	50	68	68	28	57	57
LR χ^2	27.42	36.66	43.27	32.10	37.66	45.91	9.281	13.23	12.58
Prob > χ^2	1.630	7.000	3.260	1.560	8.680	2.470	0.010	0.010	0.014
Pseudo R ²	0.453	0.552	0.474	0.541	0.568	0.503	0.240	0.237	0.162

Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Furthermore, our findings indicate that the WB-funded projects have a more favourable impact on society than those funded by Chinese financial institutions, as evidenced by the significant *ID* results across most estimates.

Moreover, following pseudo R^2 , a value greater than 0.2 provides further evidence on the viability of our results, which is applicable in estimates 1, 2, and 6.

Lastly, estimates 7 and 9 provide compelling evidence that when projects deviate from their originally agreed funding amounts, a larger relative funding variation is positively correlated with better social impacts on the targeted population. This is consistent with the study by Bulman et al. (2015), who contend that positive outcomes

TABLE 8 Model 3—Effect of funding score, duration score, cost-efficient score, and flow type on EIRR.

VARIABLES	(1) EIRR	(2) EIRR	(3) EIRR
FS	0.010 (0.012)		
DS	0.023* (0.012)		
CES	0.009 (0.013)		
DS1		0.678* (0.369) (0.369)	
DS2		−0.008	
CES1		0.197 (0.406)	
CES2		1.067* (0.634)	
FT	1.136** (0.447)	1.346*** (0.489)	1.014** (0.508)
ID	−0.405 (0.425)	−0.331 (0.433)	−0.438 (0.446)
RDV			−0.203 (0.278)
RFV			0.518 (0.727)
Constant	−1.112** (0.482)	−1.495*** (0.543)	−0.122 (0.387)
Observations	68	68	57
LR χ^2	10.71	14.68	4.536
Prob > χ^2	0.057	0.066	0.338
Pseudo R ²	0.115	0.158	0.0605

Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

are observed in cases where projects need additional financing. However, based on the goodness-of-fit of these estimates, we cannot definitively confirm this conclusion, as the pseudo R2 values are quite low.

4.2.3 | Evidence on EIRR

Model 3 denotes the impact of the independent variables on EIRR with the results summarized in Table 8. The model is analysed through three estimates. The first depicts the impact of *FS*, *DS*, *FT*, *CES*, *FT*, and *ID* on *EIRR* (Economic Internal Rate of Return). The second studies the impact of *FS1*, *FS2*, *DS1*, *DS2*, *CES1*, *CES2*, *FT*, and *ID* on *EIRR*. The last estimate shows the impact of *RFV*, *RDV*, *CES*, *FT*, and *ID* on *EIRR*.

Our results provide evidence that projects adhering to their original agreement in terms of duration tend to have a higher *EIRR*. In other words, projects that stay on schedule are less likely to incur cost overruns, which can dilute the overall economic benefits. Additionally, delayed projects can face challenges such as reduced efficiency, loss of investor confidence, and missed opportunities to capitalize on economic growth, all of which can diminish their overall impact.

Furthermore, results across all estimates provide evidence that projects funded through loans tend to achieve a higher *EIRR*, as they undergo stricter financial scrutiny, emphasize efficient resource allocation, and prioritize economic viability to ensure repayment, ultimately leading to better project outcomes (IEG, 2010).

Across all models, the remaining results were not statistically significant. This is mainly due to the predominant influence of funding size on the *EIRR*, overshadowing the importance of adhering to the initially allocated amount for the project. In other words, the *EIRR* is primarily influenced by the size of the allocated funding, rather than the score assigned to the project based on the comparison of the approved and spent amounts. Moreover, the low pseudo R^2 values further indicate the model's weak goodness-of-fit.

5 | CONCLUSION

This study addresses a gap in the literature in this field and offer insights into project outcomes facilitated by diverse financial institutions, with a specific focus on the WB and Chinese financial institutions, using Sri Lanka as a case study. In particular, this work is based on comparative evidence from infrastructure projects by focusing on a scoring system to identify the projects with the most and least effective outcomes. Statistical tests, such as two-sample t-tests, Mann–Whitney U and probit regressions, are performed to assess the level of effectiveness of the projects and to compare their outcomes.

Our empirical findings show that projects executed by distinct institutions exhibit discernible variations in their outcomes. Furthermore, an analysis of projects implemented by the WB in Sri Lanka indicates superior results compared to those undertaken by Chinese financial institutions, mainly due to higher level of opacity, adherence to originally approved funding, and the favourable impact on people seen in projects implemented by the WB. This result underscores the importance of considering the supervisory role and project management practices of financing entities in the context of achieving successful outcomes.

Viewed from an alternative perspective, our analysis highlights the importance of adherence to loan agreements in determining project success. Using probit regressions, we find that projects adhering to original funding agreements tend to display moderate levels of opacity, with significant evidence suggesting that WB projects are more transparent than those funded by Chinese institutions. Additionally, projects with higher funding scores and strong adherence to initial agreements have a more positive impact on the target society, with WB projects producing more favourable outcomes than those funded by China. Finally, our analysis of the *EIRR* shows that projects that adhere to schedule generally yield greater economic impacts. Overall, the analysis underscores the advantages of loan-funded projects as a superior financing mechanism for infrastructure development.

Our article incorporates new ways of assessing variables through the scoring framework and provides a more comprehensive explanation of the effectiveness of infrastructure projects. In addition, this article contributes to the methodology by introducing a structured analysis of infrastructure projects through validating data collection by manually evaluating hundreds of legal documents to improve the reliability of the methodology. Moreover, this work contributes to the theoretical framework by addressing existing gaps in the literature. Although previous studies have examined the outcomes of infrastructure projects, few have explored the specific differences between projects funded by different financial institutions within the same geopolitical context.

However, our research is subject to certain minor limitations, notably the scarcity of specific information, particularly evident in the context of Chinese projects. This limitation may introduce some gaps in the analysis

and affect the overall comprehensiveness of the results. However, the application of multiple robustness checks ensures the reliability and validity of our findings.

Nevertheless, our work not only provides valuable insights into the current discourse, it also paves the way for future research into the operations of international institutions, using diverse case studies for a comprehensive understanding. Future research could investigate the analysis of infrastructure projects more deeply and provide a more nuanced understanding of the relationship between financing mechanisms, project governance, and overall project outcomes.

On another level, this research provides insights for policy-makers on how to structure infrastructure projects for optimal outcomes. In addition, this work highlights the experience of Sri Lanka and gives a lesson to other nations, societies, and economies on important factors that influence the effectiveness of infrastructure projects. Additionally, through an in-depth case study, this article sets out the importance of establishing clear channels for stakeholder input during the planning and execution phases of infrastructure projects. Moreover, the results of this research reveal to policy-makers that greater transparency in project funding and implementation processes can help reduce inefficiencies and improve opacity, leading to more effective infrastructure development.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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