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Success and Failure of Chinese Energy Infrastructure Projects in Africa

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Executive Summary

China's lending practices in Africa have been a subject of intense debate, yet their impact on the successful completion of related projects remains underexplored. This study addresses this gap by focusing on Chinese loan-financed energy infrastructure projects from 2000 to 2021. Specifically, it builds on the contentious issues surrounding the opacity of Chinese lending and the allocation of Chinese concessional loans in Africa. According to the transparency proposition, Chinese opaque lending practices are shaped by both supply- and demand-side factors, with loans issued under opaque terms being more common in less transparent countries. Consequently, this study examined the role of government corruption in project completion, considering the widely recognized relationship between low official transparency and high government corruption. The binary logistic regression analysis reveals that Chinese-financed energy projects are more likely to be completed in less corrupt, and therefore more transparent, environments. Regarding the allocation of Chinese concessional loans, it is argued that their concessionality is strategically used as an incentive for borrowing under opaque terms, often accompanied by conditions designed to maximize China's economic benefits. These conditions include contracting Chinese firms and labour, using Chinese materials, and disbursing project funds directly to Chinese contractors. The findings indicate that Chinese financing through concessional loans improves project completion rates, the implementation and fund disbursement conditions tied to these loans do not. This highlights the lack of mutual benefit in China's strategy of leveraging concessional loans to secure contracts, jobs, and markets for its firms while regaining full control of project funds, without significantly contributing to the successful completion of the projects. Lastly, the model's predictions for incomplete projects suggest that 57 per cent (equivalent to USD 57.86 billion) of Chinese loan commitments to African energy infrastructure projects during the study period are at risk of not being completed. Projects exceeding a scale of USD 1.5 billion are particularly vulnerable. The paper provides detailed information on these projects and their respective completion probabilities.

Content

Introduction

Since 2000, Chinese loans have been pivotal in Africa's financial landscape, providing significant funding for energy, transport, and Information and Communications Technology (ICT) infrastructure projects.[1] Between 2000 and 2022, the volume of Chinese loans to Africa totaled USD 170.08 billion – equivalent to 64 per cent of the World Bank's USD 264.15 billion and nearly five times the African Development Bank's (AfDB) USD 36.85 billion in sovereign loans during the same period.[2] Analysis of the Boston University Global Development Policy Center's dataset on Chinese loans to Africa (CLA) from 2000 to 2022 reveals a two-phase trend: an initial surge in loan commitments from less than USD 1 billion in 2000 to a peak of USD 28.45 billion in 2016, followed by a sharp decline to below USD 1 billion in 2022. This pattern was primarily driven by energy sector loans, which rose from less than USD 1 billion in 2000 to USD 17.66 billion in 2016, before dropping to zero in 2022.

Various factors have been proposed to explain this downturn, including high default rates, lending practices, the COVID-19 pandemic, a strategic pause, and China's decreasing demand for natural resources. While the pandemic may have exacerbated the decline, it cannot be the primary cause, as the trend began before 2019. Drawing on the "Angola model," in which China's loans to resource-rich African countries were tied to natural resource extraction, the drop in loan commitments is linked to China's reduced demand for raw materials due to slowing economic growth.[3] Additionally, the empirical work of Franz, Horn, Parks, Reinhart, and Trebesch (2024) disputes the default narrative, showing that Chinese creditor losses in defaults are negligible, indicating that most loans were repaid on time.[4] Moses et al. (2023) suggest that the decline is particularly pronounced in the energy sector, where loan commitments dropped to zero between 2021 and 2022. This may reflect a strategic shift from financing non-renewable energy projects toward greener initiatives. However, while Chinese energy-sector loans have declined significantly since 2016, the rationale for this perceived pivot remains unclear.

One possible explanation lies in the establishment of the China-Africa Environmental Cooperation Centre, conceived in 2015 and officially launched in 2018 under the UN Environment Programme. The center was intended to enhance environmental collaboration between China and Africa and promote green investments. Yet, by 2022 – four years after its launch – the center had made limited progress toward advancing Africa's green energy initiatives in alignment with Sustainable Development Goal (SDG) 7. Another contributing factor could be the growing awareness among African governments of China's opaque lending practices. Studies highlight the lack of transparency in Chinese loans, including confidentiality clauses in agreements that conceal key terms.[5] Gelpern et al. (2021) revealed these clauses in

[1] Wenjie Chen, Michele Fornino, and Henry Rawlings, 'Navigating the Evolving Landscape between China and Africa's Economic Engagements', *IMF Working Papers* 2024, no. 037 (23 February 2024).
[2] Oyintarelado Moses et al., 'A New State of Lending', *Boston University Global Development Policy Center*, GCI Policy Brief, no. 019 (2023): 31.
[3] Chen, Fornino, and Rawlings, 'Navigating the Evolving Landscape between China and Africa's Economic Engagements'.
[4] Lukas Franz et al., 'The Financial Returns on China's Belt and Road'.
[5] Kathleen J. Brown, 'Why Hide? Africa's Unreported Debt to China', *The Review of International Organizations*, 16 October 2023; Ben Cormier, 'Chinese or Western Finance? Transparency, Official Credit Flows, and the International Political Economy of Development', *The Review of International Organizations* 18, no. 2 (1 April 2023): 297–328; Axel Dreher et al., 'Apples and Dragon Fruits: The Determinants of Aid and Other Forms of State Financing from China to

loan contracts, prompting China to issue a rebuttal criticizing the study's sample selection. While some argue that these clauses serve as a competitive strategy to outmanoeuvre Western financiers, they raise legitimate concerns about the mutuality of such lending practices.

The existing discourse on Chinese lending practices focuses on revealing[6] and scrutinizing[7] their characteristics, differences from Western lending models[8], and their impact on default risks in already vulnerable African economies. This discourse forms the basis for the current study, which seeks to address a key question: *How do Chinese lending practices affect the completion of the related projects*? This study is the first to establish a link between Chinese lending practices and project completion rates, a critical aspect in evaluating whether these practices adhere to the principle of mutuality or are pragmatically designed to maximize China's economic benefits at Africa's expense.

To address this question, the study draws on data from Custer et al. (2023) and Dreher et al. (2022) on Chinese lending practices from 2000 to 2021. Two primary objectives guide the analysis. The first is to identify the specific lending practices that influence the likelihood of project completion in China-financed infrastructure projects in Africa from 2000 to 2021. The second is to estimate the completion probabilities of unfinished or ongoing projects based on these lending practices, as well as other factors such as project scale, complexity, and lead time. The study focuses on energy infrastructure projects because they account for a significant share (35%) of Chinese loans to Africa during the study period, compared to transport (29%), ICT (8%), financial services (6%), and industry, trade, and services (5%), with the remaining 17 per cent distributed across other sectors.[9] This focus is also vital for evaluating how China's financing aligns with SDG 7, which aims to achieve "affordable, reliable, sustainable, and modern energy for all"[10] by 2030.

The study is organized into six sections. The next section provides an overview of the stylized facts about Chinese financing of energy infrastructure projects in Africa. Section 3 presents the theoretical propositions underpinning the research. Section 4 outlines the empirical strategy, while Section 5 presents and discusses the findings. Finally, Section 6 concludes the study.

Africa', *International Studies Quarterly* 62, no. 1 (1 March 2018): 182–94; Anna Gelpern et al., 'How China Lends: A Rare Look into 100 Debt Contracts with Foreign Governments', *Center For Global Development*, 2021, 85.

[6] Samantha Custer et al., 'Tracking Chinese Development Finance: An Application of AidData's TUFF 3.0 Methodology', 2023; Axel Dreher et al., 'Banking on Beijing: The Aims and Impacts of China's Overseas Development Program', *Cambridge University Press*, 2022; Gelpern et al., 'How China Lends: A Rare Look into 100 Debt Contracts with Foreign Governments'.

[7] Brown, 'Why Hide?'; Dreher et al., 'Apples and Dragon Fruits'; Sebastian Horn, Carmen M. Reinhart, and Christoph Trebesch, 'China's Overseas Lending', *Journal of International Economics* 133 (1 November 2021): 103539.

[8] Chen, Fornino, and Rawlings, 'Navigating the Evolving Landscape between China and Africa's Economic Engagements'; Cormier, 'Chinese or Western Finance?'; Scott Morris, Brad Parks, and Alysha Gardner, 'Chinese and World Bank Lending Terms: A Systematic Comparison Across 157 Countries and 15 Years', *Center For Global Development*, no. 170 (04 2020): 53.

[9] Moses et al., 'A New State of Lending'.

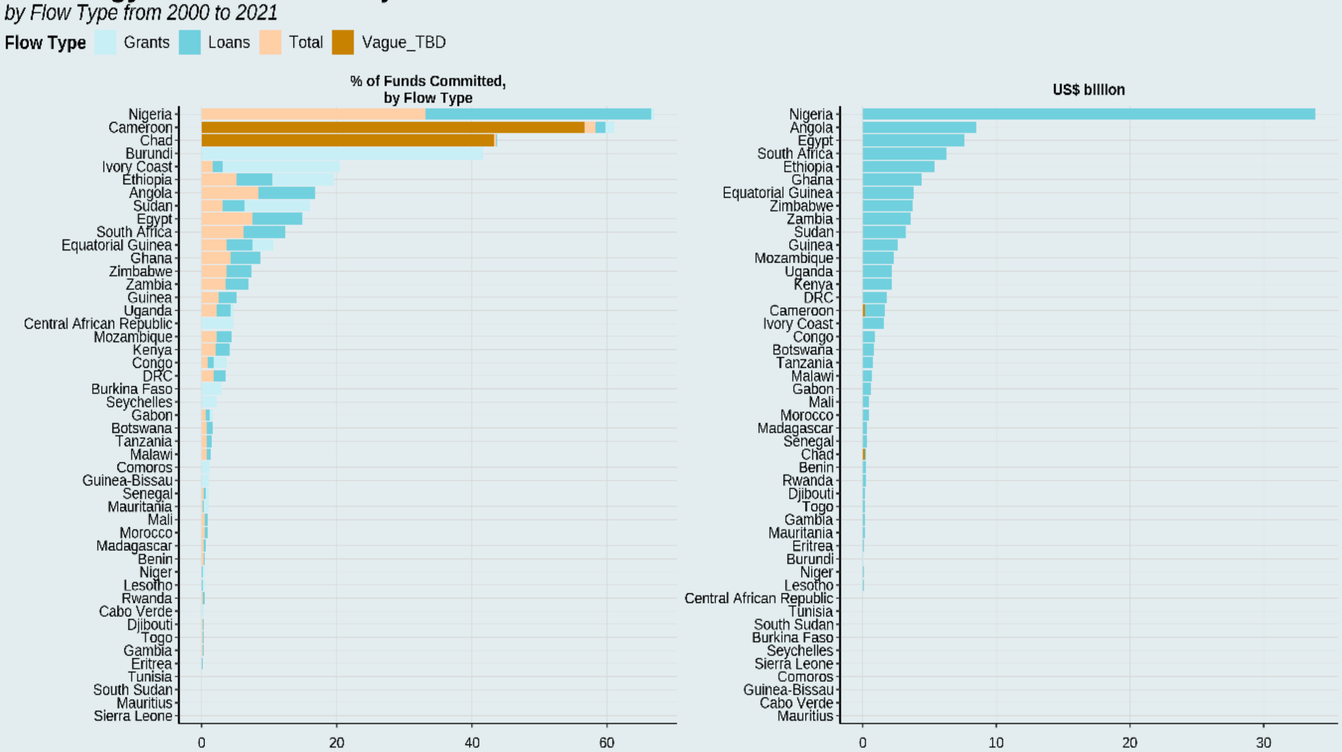
[10] "Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all ", *The United Nations*, accessed June 11, 2025.

Key Points on Chinese Financing for Energy Infrastructure in Africa

A comparison of the primary datasets on Chinese loans to African countries – CLA and AidData's Global Chinese Development Finance Dataset, Version 3.0, compiled by Custer et al. (2023) and Dreher et al. (2022) – reveals a similar overall trend in Chinese loans to Africa from 2000 to 2021, but with notable differences. Several loan commitments included in the AidData dataset are absent from the CLA dataset, suggesting that the CLA dataset may underestimate Chinese loan commitments to African countries. Consequently, my analysis is based on the AidData dataset.

Loans constitute the main form of Chinese funding for African energy infrastructure projects. Nevertheless, this section takes into account all types of financial flows, including grants, and unspecified flows, also referred to as “Vague TBD” by Custer et al. (2023) and Dreher et al. (2022). According to these studies, Chinese financing for energy infrastructure in Africa totaled USD 102.13 billion between 2000 and 2021. Loans account for 99.5 per cent of this financing (USD 101.59 billion), with the balance divided between grants (0.20%) and unspecified flows (0.33%). All funding agencies are Chinese state-owned institutions, with the Export-Import Bank of China (Exim Bank) and the China Development Bank (CDB) providing the bulk of the funding. The geographical distribution of these finances is provided in Figure 1 below.

Figure 1: Recipients of Chinese Financing for Energy Infrastructure Projects
by Flow Type from 2000 to 2021



Source: Author’s compilation based on AidData's Global Chinese Development Finance Dataset

Figure 1 illustrates how Chinese financial flows for energy infrastructure were distributed across 47 African countries from 2000 to 2021, with Nigeria receiving the largest share. The distribution narrows with the flow type. Loan distribution closely mirrors the overall financial flows. This trend is apparent in the plot left of Figure 1, where grants and vague TBD flows become obscured when stacked with loans in the countries to which they were committed, and in the right plot, where the country's proportion of loans is almost the same as that of total flows.

Burundi, Burkina Faso, Cabo Verde, Comoros, Guinea-Bissau, Mauritius, and Seychelles received only grants. These are mostly small countries possessing small Chinese loan portfolios, which often get converted into grants during diplomatic visits.[11] Burundi was the largest recipient of Chinese grants in Africa. Unspecified allocations (Vague TBD flows) were distributed solely in Cameroon and Chad.

Approximately 79 per cent of Chinese financing for energy infrastructure projects in Africa from 2000 to 2021 was committed to only ten African countries, with Nigeria receiving 33 per cent of the funding (right plot of Figure 1). Nigeria's leading position is primarily due to a USD 23 billion loan pledged in 2010 for the construction of three oil refineries in the states of Bayelsa, Kogi, and Lagos, as well as one fuel complex/petrochemical plant. The project was scheduled for completion in 2015; however, as of that year, it was stalled and remained unimplemented until 2023. Another vital insight from Figure 1 is that more than half (54%) of Chinese funding for energy infrastructure in Africa was concentrated in just four countries: Nigeria (33%), Angola (8%), Egypt (7%), and South Africa (6%).

The distribution illustrated above can be attributed to one or both of the following explanations. First, Chinese loans are often directed toward countries that offer economic or geopolitical benefits to China.[12] For example, South Africa, Nigeria, and Egypt are among the leading African markets for Chinese goods, while Angola is the continent's top exporter to China, primarily supplying oil, according to data from the China Africa Research Initiative (CARI) 2023. Overall, the CARI dataset on China-Africa trade suggests that countries receiving the most Chinese loans are also China's key trade partners in Africa. Second, as noted by Cormier (2023), Chinese lenders appear to favour less transparent borrowers to avoid scrutiny of their opaque lending practices. This preference results in higher loan volumes for countries with lower transparency levels. Supporting Cormier's claim, the 2022 Ibrahim Index of African Governance (IIAG) reveals that as of 2021, only South Africa (80) and Ghana (65) had accountability and transparency scores above the average of 50, ranking in the top ten. In contrast, Egypt (17), Sudan (14), and Equatorial Guinea (7) were among the bottom ten, while Nigeria, Ethiopia, Zambia, Zimbabwe, and Angola scored 47, 41, 40, 36, and 28, respectively.[13]

Figure 1 also shows that, among the principal recipients of loans, only Ethiopia, Equatorial Guinea, and Sudan were awarded grants. Burundi received the highest proportion of grants at 42 per cent, while Cameroon accounted for 57 per cent of the unspecified allocations, with the remainder going to Chad. The subsequent sub-section tracks the distribution of Chinese financing for energy infrastructure in Africa, categorized by energy type.

[11] Franz et al., 'The Financial Returns on China's Belt and Road'.
[12] Franz et al.
[13] 'Ibrahim Index of African Governance (IIAG) Data Portal | Mo Ibrahim Foundation', accessed 4 February 2025.

Distribution of Chinese Financing for Energy Infrastructure by Energy Type

Analysing the types of energy infrastructure in Africa funded by China is vital to evaluate how Chinese financing for energy infrastructure contributes to Africa's advancement towards SDG 7. This goal strives for "affordable, reliable, sustainable, and modern energy for all"[14] by 2030. Hence, in this analysis, commitments to hydropower are recorded distinctly from other renewable sources such as wind and solar. This distinction is made to determine if China is backing Africa's strategy to diversify its renewable energy portfolio beyond hydropower. Although hydropower is a prevalent source of renewable energy in Africa, Falchetta, Gernaat, Hunt, and Sterl (2019) argue that the energy source is highly susceptible to climate-related risks. [15] The argument is valid in light of the erratic rainfall that has affected the majority of African countries over the last decade.

In Table 1, non-renewable energy sources account for the majority (51%) of Chinese energy infrastructure financing in Africa, followed by hydropower (32%). Commitments to other renewable energy sources such as solar and wind constitute 10 per cent, while 7 per cent of the funds were not explicitly allocated to any category (unspecified allocations).[16] This distribution is heavily influenced by loan flows, further demonstrating the centrality of loans in Chinese financing for African energy infrastructure. Accordingly, the current study focuses on loans; however, without disregarding the vitality of other types of financial flows. Table 1 breaks down Chinese loan financing for energy infrastructure in Africa by energy type.

Table 1: Breakdown of Chinese Financing by Flow Type and Energy Category

Flow type	*Hydro*	*Renewable*	*Non-Renewable*	*Unspecified*	*Total*
	USD billion (% of flow type)	USD billion (% of flow type)	USD billion (% of flow type)	USD billion (% of flow type)	USD billion
Loans	$32.00 (32%)	$9.96 (10%)	$52.06 (51%)	$7.57 (7%)	$101.59
Grants	$0.12 (59%)	$0.03 (13%)	$0.02 (10%)	$0.04 (18%)	$0.20
Vague TBD	$0.19 (57%)	$0.15 (43%)	$0.34		
Total	$32.31 (32%)	$9.99 (10%)	$52.22 (51%)	$7.61 (7%)	$102.13

Source: Author's estimation based on AidData's Global Chinese Development Finance Dataset

Although non-renewable energy accounts for a larger share of Chinese loan commitments for energy infrastructure, as shown in Table 1, its geographic distribution is narrow compared to hydropower and almost on par with that of renewable energy. Of the 40 countries that received Chinese loan commitments for energy infrastructure, only Botswana, Chad, Djibouti, Eritrea, Morocco, South Africa, Lesotho, Niger, Gambia, and Tunisia did not receive financing for hydropower projects. This is most likely because they do not have hydropower, except for

[14] "Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all".
[15] Giacomo Falchetta et al., 'Hydropower Dependency and Climate Change in Sub-Saharan Africa: A Nexus Framework and Evidence-Based Review', *Journal of Cleaner Production* 231 (10 September 2019): 1399–1417.
[16] These unspecified commitments are mainly designated for electrification initiatives powered by existing energy sources, the majority of which are hydro and non-renewable.

Morocco and Tunisia. It is therefore reasonable to assert that China primarily supports existing power sources, the majority of which are hydropower and non-renewable.

Angola is the largest beneficiary of Chinese loans for hydro energy infrastructure, receiving 16 per cent, while Nigeria is the leading recipient for both renewable and non-renewable energy infrastructure projects, with 16 per cent and 50 per cent respectively. Kenya received the majority of electrification projects (unspecified allocations) at 16 per cent. In terms of grants, Burundi obtained 71 per cent for hydropower infrastructure, Burkina Faso obtained 24 per cent for renewable energy, Sudan was allocated 94 per cent for non-renewable energy, and Ivory Coast received 96 per cent of unspecified allocations. Vague TBD allocations are divided between Cameroon, with 57 per cent for hydropower infrastructure, and Chad, with 43 per cent for non-renewable energy infrastructure.

In summary, this section highlights two main points. First, Chinese financing for African energy infrastructure projects largely consists of loans, accounting for 99.5 per cent of the funding. Almost 80 per cent of these loans are concentrated in just 10 countries, which are also China's top trading partners. Second, the majority of Chinese loan commitments for energy infrastructure in Africa support existing power sources, with non-renewable sources receiving 51 per cent and hydropower projects 32 per cent of the funding. Support for energy diversification beyond hydro and non-renewable sources is limited, with solar and wind energy projects accounting for only 10 per cent of the loans. The remaining 7 per cent is allocated to support electrification initiatives that are powered by existing energy sources, which are predominantly hydro and non-renewable. In the next section, I outline the theoretical propositions underpinning the study.

Theoretical Underpinning

This study draws from recent political economy empirical findings regarding Chinese lending. Precisely, it is underpinned by the transparency proposition of Cormier (2023) and the allocation of the concessional finance proposition of Dreher et al. (2018). The study also considers various common factors and lending practices that are deemed to influence the completion of loan-financed infrastructure projects in general.

Transparency Proposition

Cormier (2023) found that Chinese opaque lending practices are influenced by both supply- and demand-side dynamics. On the supply side, Chinese lending agencies prefer providing loans to less transparent countries because this allows them to shield their lending activities from external scrutiny. On the demand side, less transparent countries favour Chinese financiers to avoid the strict transparency and accountability requirements of Western lenders and international financial institutions (IFIs). Brown (2023) further argues that such countries intentionally seek loans under Chinese opaque conditions to circumvent penalties tied to World Bank debt sustainability thresholds. Consequently, Chinese loans are disproportionately directed to less transparent countries compared to their more transparent counterparts.

Transparency – defined as the condition where information about decision-making processes is publicly accessible and verifiable, including rules and the identities of decision-makers – is widely recognized as a mechanism for detecting corruption.[17] Therefore, it is logical to associate lower transparency with higher levels of corruption. As of 2021, only South Africa and Ghana, among the top ten recipients of Chinese loans for energy infrastructure, scored above average on accountability and transparency metrics [18]. Furthermore, none of these countries achieved an above-average score on the Corruption Perception Index (CPI), where 0 represents a highly corrupt government and 10 represents a very clean government.[19] In fact, across all 40 recipients of Chinese energy infrastructure loans, only Botswana and Rwanda recorded average CPI scores above 5 between 2000 and 2021, underscoring the prevalence of corruption in Africa.

Brazys et al. (2017) and Isaksson and Kotsadam (2018) found a correlation between the high volume of Chinese-financed projects and increased domestic corruption experiences in Africa. This aligns with the hypothesis that, although countries with lower transparency levels attract more Chinese loans, the prevalence of corruption in these countries hinders the successful completion of related projects. This is further supported by Bong and Premaratne (2019) and Olamide and Maredza (2023), who argue that government corruption, particularly in the form of

[17] Samuel Brazys, Johan A. Elkink, and Gina Kelly, 'Bad Neighbors? How Co-Located Chinese and World Bank Development Projects Impact Local Corruption in Tanzania', *The Review of International Organizations* 12, no. 2 (1 June 2017): 227–53; Alina Mungiu-Pippidi, 'Transparency and Corruption: Measuring Real Transparency by a New Index', *Regulation & Governance* 17, no. 4 (2023): 1094–1113; Ann-Sofie Isaksson and Andreas Kotsadam, 'Chinese Aid and Local Corruption', *Journal of Public Economics* 159 (1 March 2018): 146–59; UNODC, 'Module 6 Detecting and Investigating Corruption UNODC Module Series on Anti-Corruption', in *Knowledge Tools for Academics and Professionals* (Vienna: United Nations Office on Drugs and Crime, n.d.), 44.

[18] 'Ibrahim Index of African Governance (IIAG) Data Portal | Mo Ibrahim Foundation'.

[19] '2023 Corruption Perceptions Index: Explore the Results', Transparency International, 30 January 2024.

public debt mismanagement, undermines the potential benefits of public debt financing.[20] As a result, I hypothesize that:

$\boldsymbol{H_1}$**:** *Reduced corruption within African governments increases the likelihood of completing Chinese loan-financed energy infrastructure projects.*

The Allocation of Concessional Finance Proposition

According to Dreher et al. (2018), China's strategic foreign policy and economic interests influence the allocation of its concessional finances. The majority of Chinese loans exhibit some degree of concessionality when evaluated against the OECD Official Development Assistance (ODA)'s concessionality threshold of 25 per cent.[21] This suggests that China holds economic interests in African countries. For instance, Section 2 demonstrates that the top four recipients of Chinese loans for energy projects in Africa, accounting for over half (54 %) of these commitments from 2000 to 2021, are also Africa's top trading partners with China. Be that as it may, concessional loans, in theory, can improve the financial sustainability of projects, particularly those that may struggle to secure private-sector financing due to perceived risks or long conception periods. Concessional loans offer more favourable interest rates, terms, and grace periods than commercial loans, making projects economically viable. Therefore, I hypothesize that:

$\boldsymbol{H_2}$**:** *Energy infrastructure projects financed with concessional (OECD-ODA) loans have higher completion chances than those financed with non-concessional loans.*

However, the concessionality of Chinese loans is often used strategically as an incentive to borrow under opaque terms, yet coupled with conditions designed to maximize China's economic payoff benefits. For example, many projects funded by concessional Chinese loans require the use of Chinese contractors, labour, and input materials.[22] While this condition displaces domestic firms, labour, and material in these projects, I hypothesize that projects undertaken by Chinese contractors are more likely to be completed quicker due to their comparatively superior expertise and consistent supply of sophisticated materials.

$\boldsymbol{H_3}$**:** *Projects implemented by Chinese contractors have a better chance of completion than those implemented by African state-owned vendors*.

Custer et al. (2023) and Dreher et al. (2022) reveal that, in some instances, Chinese contractors receive project funds directly from Chinese lending agencies, though typically these funds are

[20] Angkeara Bong and Gamini Premaratne, 'The Impact of Financial Integration on Economic Growth in Southeast Asia', *The Journal of Asian Finance, Economics and Business* 6, no. 1 (2019): 107–19; Ebenezer Gbenga Olamide and Andrew Maredza, 'Pre-COVID-19 Evaluation of External Debt, Corruption and Economic Growth in South Africa', *Review of Economics and Political Science* 8, no. 1 (5 January 2023): 19–36.
[21] Custer et al., 'Tracking Chinese Development Finance: An Application of AidData's TUFF 3.0 Methodology'; Dreher et al., '(PDF) Banking on Beijing'; Morris, Parks, and Gardner, 'Chinese and World Bank Lending Terms: A Systematic Comparison Across 157 Countries and 15 Years'.
[22] Bunte, J.B. (2019). Raise the Debt: How Developing Countries Choose Their Creditors. Oxford Academic: New York.

disbursed to the respective African governments. The criteria for direct disbursement of project funds to Chinese contractors or African governments remain unclear, but I assume that such direct payment to Chinese contractors might be another condition attached to Chinese concessional loans. This allows China greater control over the funds than if they were paid to African governments. Nevertheless, considering the transparency and corruption issues prevalent in many African governments, I hypothesize that Chinese loans disbursed directly to African governments are more susceptible to misuse, reducing the likelihood of completing the intended project. [23]

$\boldsymbol{H_4}$*: Energy infrastructure projects funded by Chinese loans through the respective African government are less likely to be completed than those financed through Chinese contractors*.

Basic Lending Practices

Basic lending practices include providing collateral security and a loan guarantor.[24] Chinese loans for energy projects in Africa are typically either state-guaranteed and secured by significant government assets or not secured and guaranteed at all.[25] I argue that governments can expedite the completion of collateralized and guaranteed loans, anticipating additional revenue from the project to boost repayment sources, thus mitigating the risk of their assets being confiscated in the event of default.

$\boldsymbol{H_5}$*: Chinese-led energy infrastructure projects financed using collateralized and guaranteed loans have relatively better chances of completion than those financed with uncollateralized and unguaranteed loans*.

Standard Determinants of Energy Infrastructure Project Completion

Infrastructure project completion generally depends on factors such as scale, complexity, agency, and lead time. Large-scale and complex projects may take longer to complete, even if initiated earlier, due to the challenges posed by their size and intricacy, as well as occasional issues with agency. Nevertheless, projects that are committed earlier are typically prioritized for completion, allowing resources to be reallocated to newer projects. While detailed data on the lead time of Chinese-financed energy infrastructure projects in Africa is currently scarce, this study draws on evidence from Clapin and Longden (2024), who found that in Australia, solar

[23] '2023 Corruption Perceptions Index'; 'Ibrahim Index of African Governance (IIAG) Data Portal | Mo Ibrahim Foundation'.
[24] A loan guarantee is a third-party commitment to assume the borrower's debt obligation if they default. Often, this third party is a government agency that purchases the debt from the lending institution and assumes responsibility for the loan.
Dreher et al., '(PDF) Banking on Beijing'.
[25] Custer et al., 'Tracking Chinese Development Finance: An Application of AidData's TUFF 3.0 Methodology'.

energy projects committed before 2010 had an average lead time of 83 months, which decreased post-2010 due to accumulated experience and advancements in technology.[26]

Given that Australia is a developed country, it is reasonable to assume a longer lead time—approximately 10 years (120 months)—for solar and wind energy projects initiated from scratch in developing African countries. This assumption is further justified by the relatively smaller scale of Chinese-financed solar and wind projects in Africa compared to those in developed countries. The proposed 10-year lead time is also considered appropriate for hydropower and non-renewable energy projects, as most of these projects involved rehabilitation and expansion rather than entirely new construction. Additionally, this estimate aligns with the timeline of Africa's largest Chinese-financed project—a USD 28 billion commitment to Nigeria in 2010, which was expected to be completed by 2015.

Based on this reasoning, and considering the study period of 2000-2021, I hypothesize that: $\boldsymbol{H_6}$: *Chinese loan-financed energy projects committed in 2010 or earlier have a higher likelihood of completion than those committed after 2010.*

In terms of size, large-scale project completion rates are generally low, with project selection, constraints, leadership, complexity, and management all playing important roles. Furthermore, large projects are known to be delivered behind schedule and over budget, with an average one-year delay and a 30 per cent cost overrun for projects exceeding USD 1 billion.[27]

These studies suggest that large projects succeed less than 15 per cent of the time. In this regard, I hypothesize a negative relationship between project completion and scale, implying that the likelihood of completion decreases as the project size increases.

$\boldsymbol{H_7}$**:** *The likelihood of completing Chinese loan-financed energy infrastructure projects in Africa decreases as their size increases*.

Finally, the study also considers the types, intricacies, and agency of Chinese loan-financed energy infrastructure projects in Africa. According to Custer et al. (2023) and Dreher et al. (2022), these loans are allocated to wind, solar, hydro, and several non-renewable energy sources. They also support electrification initiatives powered by the existing energy sources which are predominantly hydropower and non-renewable energy. In this regard, I hypothesize that the complexity of a project, particularly the type of energy it involves, affects its likelihood of completion. Wind and solar projects are posited to have higher completion rates due to their relative affordability, ease of implementation, and alignment with SDG 7, thus serving as a benchmark category.

$\boldsymbol{H_8}$: *Chinese loan-financed energy infrastructure projects involving solar and wind power generally have a higher likelihood of completion than projects involving other energy sources*.

[26] Lachlan Clapin and Thomas Longden, 'Waiting to Generate: An Analysis of Onshore Wind and Solar PV Project Development Lead-Times in Australia', *Energy Economics* 131 (1 March 2024): 107337.

[27] A. Aljohani, 'Construction Projects Cost Overrun: What Does the Literature Tell Us?', *International Journal of Innovation, Management and Technology* Volume 8, no. 2 (2017): pp.137-143; Bertram I. Steininger, Martin Groth, and Brigitte L. Weber, 'Cost Overruns and Delays in Infrastructure Projects: The Case of Stuttgart 21', *Journal of Property Investment & Finance* 39, no. 3 (2021): 256–82.

Empirical Strategy and Data

These hypotheses are empirically tested using a binary logistic regression model because our outcome variable (y) which captures the completion status of the Chinese loan-financed energy infrastructure project in Africa, is binary, with a value of 1 if the project is completed and 0 otherwise. Consequently, the following equation provides the probability that the outcome variable is 1 for given values of the factors (X) highlighted from H_1 to H_8:

$$P(y = 1|X_1, \dots, X_n) = \frac{1}{1+e^{-(\alpha+\beta_1 X_1+\cdots+\beta_k X_k)}} \quad (1)$$

where α is the constant and β is the logistic regression coefficient associated with the predictor variable (X). The mathematical decomposition of Equation (1) is thoroughly detailed in various literature, including Gasso (2023) and The Pennsylvania State University.[28] Table 2 describes all the variables, pairing each one with its corresponding hypothesis.

[28] Gilles Gasso, 'Logistic Regression'; The Pennsylvania State University, 'Lesson 12.1 Logistic Regression | STAT 462', PennState Eberly College of Science, *STAT 462* (blog), accessed 4 February 2025.

Table 2: Variables Description

Hypothesis	*Variable*	*Description*
Outcome variable	Project success	A binary variable is used, where 1 represents projects completed as per the completion status in Custer et al. (2023) and Dreher et al. (2022), and 0 otherwise.
1	Corruption Perception Index (CPI)	The CPI is an index that scores countries on the perceived levels of government corruption. The scores range from 0 to 10, with 0 indicating a highly corrupt government and 10 indicating a very clean government.[29] As a result, we expect an increase in the CPI to have a positive impact on the completion of Chinese loan-financed energy projects in Africa.
2	Concessionality	0 for non-concessional loans, 1 if the loan meets the OECD-ODA's concessionality threshold of 25%, and 2 if the loan meets the IMF-World Bank (WB)'s concessionality threshold of 35%.
3	Implementing Agencies	1 if the project is implemented by the African government vendors, and 0 if it is the Chinese contractor.
4	Direct funds recipients	1 if the loans are paid directly to the African government; 0 if the Chinese contractors directly receive the funds from the lending agencies.
5	Collateral security	1 if the loan commitment is collateralized, and 0 otherwise.
5	Loan guarantor	1 if the guarantor is provided, and 0 otherwise.
6	Project lead time	0 if the project was committed on or before 2010 1 if the project was committed after 2010
7	Project size	The nominal value of the loan committed by China for a specific energy infrastructure project in an African country, in United States dollars (USD).
8	Energy type	1- If the loan commitment is associated with a renewable energy project, 2- If the loan commitment is connected to a hydropower project, 3- If the loan commitment is related to a non-renewable energy project, and 4- If the loan commitment does not specify the targeted energy type.

Notes: The categorization of energy types is not included in Custer et al. (2023) and Dreher et al. (2022); instead, it was derived from the project descriptions. Loan commitments that do not specify the targeted energy source are primarily intended to support electrification initiatives powered by existing power sources, which are predominantly hydro and non-renewable energy. It was assumed that the government vendors carried out any project without a specified implementing agency.
Source: Author's compilation

[29] '2023 Corruption Perceptions Index'.

The regressors outlined in Table 2 comprise two continuous variables, project size, and the CPI, while the remaining are categorical or factor variables. Except for the CPI data obtained from Transparency International (2024), the data for other variables were sourced from AidData's Global Chinese Development Finance Dataset, Version 3.0. The CPI is pertinent to this study as it gauges governmental corruption through various indicators, including access to information on government activities (transparency), bribery, and misappropriation of public funds, among others.[30] Hypotheses 1–4 capture the main variables of interest.

The limitations of Equation (1) include the assumption of a linear relationship between the independent variables and the log odds or model fit, as well as the need for large sample sizes to yield stable estimates. It is also less effective at dealing with multicollinearity and is more susceptible to outliers and influential points. Consequently, the model diagnostics shown in Figure 2 are critical to ensuring the robustness of the model estimates in Table 3, which include verifying the goodness of fit, ensuring no perfect multicollinearity, and detecting the presence of influential observations. In terms of sample size, the study included all 276 Chinese loan-financed energy projects committed to African countries between 2000 and 2021.

[30] The IIAG's accountability and transparency index would have been more appropriate; however, the dataset commences in 2012, while my analysis begins in 2000.

Estimated Results and Discussions

This section is structured into three parts: Descriptive Statistics, Main Results, and Discussions. The descriptive statistics follow.

Descriptive Statistics

The empirical analysis of this study utilizes a sample of all 279 Chinese loan-financed energy infrastructure projects committed in 40 Africa from 2000 to 2021, as shown in Table A1 in the Appendices. Of these 276 projects, 54 per cent have been completed while the remainder are ongoing. The total value of completed projects (USD 28.90 billion) is two and a half times lower than that of unfinished projects (USD 72.69 billion). This could suggest a preference for relatively small-scale projects, or considering the lead time, it could be argued that projects financed in or before 2010 are smaller in scale but large in numbers compared to those financed after 2010. Table A1 also indicates that 81 per cent of the total projects are concentrated in just 15 countries, encompassing all of the top 10 loan recipients depicted in Figure 1. A comparison between Figure 1 and Table A1 typically reveals a relationship where high loan commitments are associated with a high number of projects. However, there are exceptions, such as in Mozambique, South Africa, and Egypt, where a relatively substantial amount of loans was committed to a few large-scale projects, and in Kenya and Cameroon, where relatively smaller loans were distributed across many small-scale projects.

Projects committed between 2011 and 2021 are nearly twice as many as those committed from 2000 to 2010. This is not surprising given the spike in Chinese loan commitments for energy projects in Africa from 2010 to 2016, as documented by both the AidData dataset and the CLA. Approximately 73 per cent of these projects are executed by Chinese contractors, with funding often disbursed directly to African governments and, occasionally, to Chinese contractors. Moreover, almost 90 per cent of these projects are financed by loan commitments that satisfy the OECD-ODA's concessionality threshold of 25 per cent. These statistics confirm Bunte's (2019) and Dreher et al.'s (2018) assertions regarding the project implementation conditions attached to Chinese concessional loans. According to these studies, it is a common condition for Chinese concessional loans that the financed projects be implemented by Chinese contractors using their labour and materials. While this could be viewed as an opportunity for technology and knowledge transfer, it is less likely if domestic labour and firms are not involved in the skill-intensive aspects of the projects. Therefore, it is a fair assessment to say that Chinese loans in Africa provide employment opportunities for Chinese labour and contractors and a market for Chinese industrial materials.

Furthermore, descriptive statistics reveal that 77 per cent and 91 per cent of loans are neither collateralized nor guaranteed, respectively. This is odd given African countries' default record in projects of such magnitude and raises concerns about China's intentions in the event of default.

The number of Chinese loan-financed hydropower and non-renewable energy projects surpasses that of solar and wind projects by more than three times and almost twofold, respectively. Likewise, loan commitments for hydropower and non-renewable projects are, respectively, over three and five times greater than commitments for solar and wind projects (Table 1). This is unexpected in an era where all countries worldwide are increasingly adopting green initiatives in alignment with SDG 7.

Regarding continuous variables, the CPI for African countries averaged 2.8 during the period 2000-2021, ranging from 1.4 to 5.6, with a standard deviation of 0.8. Botswana had the highest CPI (5.6) followed by Rwanda (5.4), while all other countries were below an average score of 5, indicating widespread government corruption in African governments. These statistics underscore apprehensions about African governments' capacity to utilize Chinese loans for their intended purposes without the oversight of an independent project committee.

Finally, the Chinese loan commitments to energy infrastructure projects in Africa averaged USD 368.08 million during the same period, ranging from USD 2 million to USD 23 billion, with a standard deviation of 1.47. The USD 23 billion commitment is significantly off the range as a result, I performed additional descriptive statistics excluding this transaction to observe the changes in the mean, and more importantly to check if the difference between the means of the two samples is worthy of concern. The mean drops to USD 285.78 million, with a range of USD 2 million to USD 4.92 billion and a standard deviation of 0.53. However, the effect size of the difference in samples' means, based on Cohen's *d* statistic, is negligible (-0.15), even if statistically significant at 5 per cent. [31] My robustness check performed in Column 9 of Table 3 also indicates that excluding the USD 23 billion commitment as a potential outlier does not affect the estimates of overall observations.

Main Results

Columns 1-3 of Table 3 present estimates for the standard determinants of energy infrastructure project completion, outlined in Section 3.4. The analysis begins with project lead time as the fundamental determinant and then includes project size in Column 2 and energy type in Column 3. Column 4 incorporates collateral security and guarantee variables as basic lending practices that can influence the completion of a loan-financed project (see Section 3.3). The estimated coefficients of these variables enter the model as expected, albeit statistically insignificant, even when considered individually. In addition to the foregoing, Column 5 introduces the effect of government corruption, as discussed in Section 3.1, and Columns 6–8 introduce the effects of concessionality, as well as the project implementation and fund disbursement conditions associated with Chinese concessional loans, as described in Section 3.2. Column 8 provides baseline estimates for Equation (1) by incorporating all variables. Columns 9–11 are robustness checks for baseline estimates. Precisely, Equation (1) was applied to two subsamples and a specification without statistically insignificant variables to ensure the consistency of the baseline estimates. Column 9 excludes the USD 23 billion project in Nigeria as a potential outlier; Column 10's estimates are derived from a sample of 15 top recipients of Chinese loan-

[31] Jacob Cohen, *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed (Hillsdale, N.J: L. Erlbaum Associates, 1988).

financed energy projects, which account for 81 per cent of all projects; and Column 11 excludes statistically insignificant variables in Column 8. The baseline estimates in Column 8 are also robust to different diagnostics, including posterior predictive checks and binned residual checks to ascertain the model's fits for the data, as well as tests for potential outliers and multicollinearity, as shown in Figure 2.

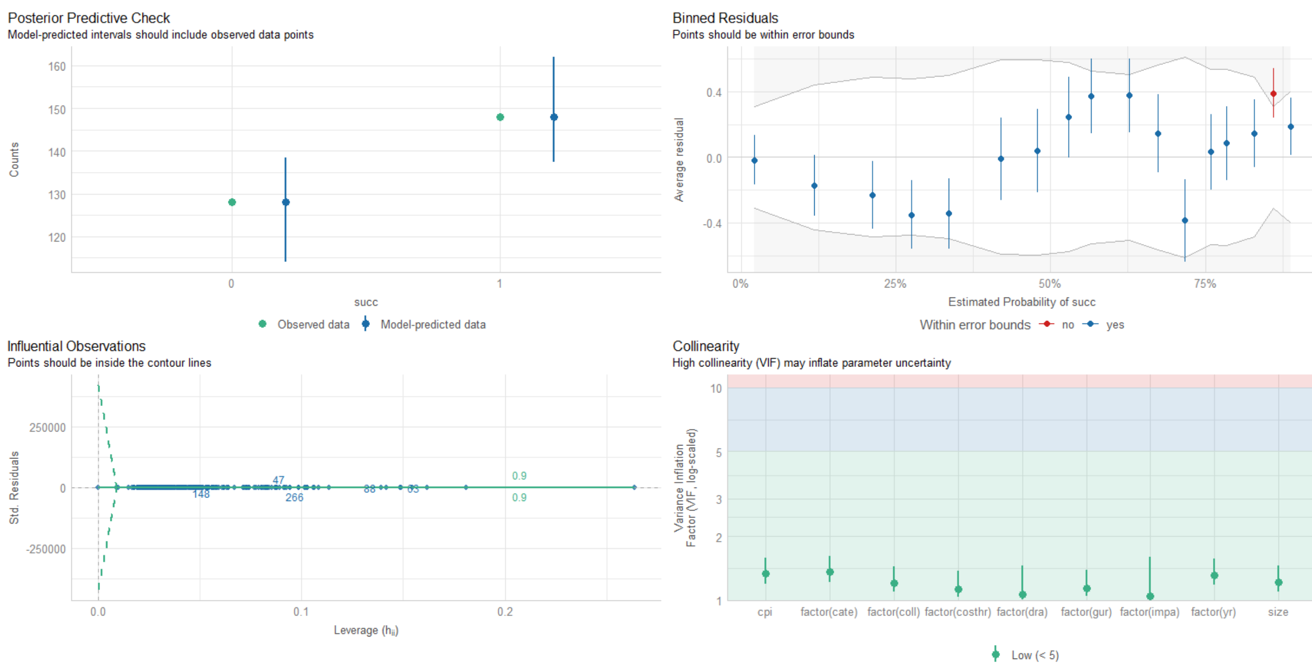
Table 3: Binary Logistic Regression Results

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Intercept	1.113***	1.292***	1.025**	0.840*	0.028	-2.605**	-2.432*	-2.461*	-2.461*	-2.466*	-2.553*
	(0.240)	(0.254)	(0.420)	(0.431)	(0.617)	(1.310)	(1.318)	(1.376)	(1.375)	(1.461)	(1.304)
Project lead time:											
Reference Variable: Projects committed on/before 2010											
Projects committed post-2010	-1.410***	-1.365***	-1.104***	-1.004***	-1.188***	-0.960***	-0.956***	-0.957***	-0.957***	-0.993**	-1.082***
	(0.283)	(0.290)	(0.305)	(0.325)	(0.343)	(0.355)	(0.355)	(0.355)	(0.355)	(0.406)	(0.339)
Project size		-0.730**	-1.141***	-1.321**	-1.319***	-1.339***	-1.291***	-1.293***	-1.293***	-1.270**	-1.262***
		(0.333)	(0.385)	(0.417)	(0.414)	(0.465)	(0.474)	(0.475)	(0.475)	(0.519)	(0.443)
Energy type:											
Reference Variable: Renewable Energy											
Hydropower			0.608	0.574	0.568	0.716	0.734*	0.731*	0.731*	0.936*	
			(0.413)	(0.421)	(0.421)	(0.437)	(0.437)	(0.440)	(440)	(0.497)	
Non-Renewable			0.611	0.597	0.620	0.681	0.657	0.656	0.655	0.725	0.753
			(0.470)	(0.483)	(0.483)	(0.498)	(0.499)	(0.499)	(0.499)	(0.547)	(0.485)
Unspecified allocations			-0.834*	-0.826*	-0.866*	-0.880*	-0.837*	-0.842*	-0.842*	-0.975*	-0.882*
			(0.452)	(0.455)	(0.457)	(0.467)	(0.467)	(0.472)	(0.472)	(0.526)	(0.466)
Collateral security:											
Reference Variable: Uncollaterilized loans											
Collateralized loans				0.470	0.525	0.539	0.489	0.491	0.491	0.517	
				(0.371)	(0.373)	(0.390)	(0.391)	(0.392)	(0.392)	(0.430)	
Guarantee:											
Reference Variable: Unguaranteed loans											
Guaranteed loans				0.843	0.692	0.425	0.466	0.471	0.471	0.657	
				(0.497)	(0.504)	(0.515)	(0.521)	(0.525)	(0.525)	(0.608)	
CPI					0.341*	0.468**	0.425**	0.426**	0.426**	0.554**	0.476**
					(0.188)	(0.204)	(0.206)	(0.207)	(0.207)	(0.236)	(0.198)
Concessionality:											
Reference Variable: Non-concessional loans											
OECD-ODA's concessionality threshold						2.274**	2.320**	2.324**	2.324**	1.959*	2.379**
						(1.104)	(1.107)	(1.109)	(1.108)	(1.169)	(1.106)
IMF-WB's concessionality threshold						-0.237	-0.185	-0.181	-0.181	-0.091	-0.197
						(1.354)	(1.357)	(1.358)	(1.358)	(1.443)	(1.356)
Implementing Agencies:											
Reference Variable: Chinese contractors											
Government Vendors							-0.448	-0.450	-0.450	-0.440	
							(0.327)	(0.329)	(0.329)	(0.366)	
Direct funds recipients:											
Reference Variable: Chinese contractors											
Government/State-Owned Enterprises								0.031	0.031	0.007	

								(0.414)	(0.414)	(0.451)	
No. of Observati-ons	276	276	276	276	276	276	276	276	275	224	276
AIC	357.74	350.6	337.51	336.23	334.83	319.86	319.99	321.98	321.98	259.97	318.94
Likelihood Ration Test (LRT): Pr(>Chi)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pseudo R-squared: McFadden	0.072	0.096	0.146	0.160	0.169	0.219	0.223	0.223	0.220	0.241	0.210

Notes: *, **, and *** represent significance level at 10%, 5%, and 1%, respectively. Standard errors are in parenthesis. Project completion is the outcome variable, with 1 representing projects completed as per the completion status in Custer et al. (2023) and Dreher et al. (2022), and 0 otherwise.
Source: Author's estimations

Figure 2: Diagnostics Test



Notes: 'factor (.)' on the collinearity graph depicts the variables that enter the model as categorical. These are 'cate' for energy type, 'coll' for collateral security, 'costhr' for concessionality, 'dra' for direct funds recipients, 'gur' for guarantee provision, 'impa' for implementing agencies, and 'yr' for project lead time. 'CPI' and 'size' serve as proxies for the CPI variable and project size, respectively. All variables have Variance Inflation Factor (VIF) values below 5, suggesting no potential multicollinearity. The posterior predictive check plot indicates that the observed data points and those predicted by the model are closely aligned, suggesting the model's good fit. This is supported by the binned residual graph, which reveals only one residual outside the error bounds, adhering to the rule of thumb that at least 95per cent of residuals should fall within the error bounds. Additionally, the Standardized Residuals vs. Leverage plot demonstrates that all data points are aligned with the horizontal axis, signifying the absence of influential observations in the sample.
Source: Author's estimations

The relevance of each variable in every specification of Table 3 is indicated by the Akaike Information Criterion (AIC) and Pseudo R-squared statistics, which show improvement as variables are incrementally added from Column 1 to Column 7. Furthermore, each set of estimates underwent a goodness of fit evaluation using the Likelihood Ratio Test (LRT). The LRT's null hypothesis assesses a model's fit based solely on the intercept, positing that a model with only an intercept is adequate. Consequently, a small *p*-value would indicate that a model with only an intercept is insufficient. Table 3 displays very small *p*-values for the LRT across all specifications, suggesting significant differences between intercept-only and the specified models at the 1 per cent significance level. Therefore, the variables included are instrumental in predicting the outcome. However, given that some variables are statistically insignificant, it is preferable to conduct the predictions using estimates from Column 11. This preference is further supported by the Column's AIC statistic, which is the lowest among all other specifications encompassing the full sample. A model with a lower AIC value typically indicates more accurate predictions. As a result, Column 11 is utilized to compute adjusted odds ratios (AORs) in Table 4 and the probabilities of project completion in Section 5.2.1.

Table 4: AORs

	Coefficient	*AOR [95% CI]*	*p-value*
Intercept	-2.553	0.078 [0.006-1.003]	0.050
Project lead time:			
Projects committed on/before 2010	1		
Projects committed post-2010	-1.082	0.339 [0.174-0.659]	0.001
Project size	-1.262	0.283 [0.119-0.675]	0.004
Energy type:			
Renewable	1		
Hydropower	0.792	2.207 [0.945-5.153]	0.067
Non-renewable	0.753	2.123 [0.820-5.498]	0.121
Unspecified allocations	-0.882	0.414 [0.166-1.031]	0.058
CPI	0.476	1.609 [1.092-2.370]	0.016
Concessionality:			
Non-concessional loans	1		
OECD-ODA’s concessionality threshold	2.379	10.789 [1.235-94.275]	0.032
IMF-WB’s concessionality threshold	-0.197	0.821 [0.058-11.706]	0.884

Notes: The abbreviation CI stands for Confidence Interval. An AOR is an odd ratio (OR) that has been adjusted to consider the influence of other predictor variables in a model. In general, odd ratios signify the multiplicative impact of a specific parameter on the outcome. AOR > 1 suggests a higher likelihood of the event occurring with an increase in the predictor, after adjusting for other regressors. Conversely, AOR < 1 suggests a reduced likelihood of the event occurring as the predictor increases, after adjusting for other regressors. All variables that have an AOR of 1 are considered reference variables within that category.
Source: Author’s estimations

Table 4 reveals that Chinese loan-financed energy infrastructure projects committed after 2010 have a 66 per cent lower likelihood of completion (AOR = 0.339, 95% CI: 0.174-0.659) compared to those committed on or before 2010, assuming all other factors remain constant. Additionally, the analysis of project size shows that for every additional USD 1 in Chinese loan financing, the likelihood of completing the project decreases by 72 per cent (AOR = 0.283, 95% CI: 0.119-0.675), after accounting for other variables.

When examining energy types, hydropower projects funded by Chinese loans are 2.2 times more likely to be completed than other renewable energy projects, such as wind and solar (AOR = 2.200, 95% CI: 0.945-5.153), after controlling for additional factors. Conversely, Chinese loans allocated to energy infrastructure projects with unspecified purposes show a 59 per cent reduction in the likelihood of completion (AOR = 0.414, 95% CI: 0.166-1.031) compared to wind and solar projects. Since these unspecified loans typically fund electrification initiatives powered by existing hydro and non-renewable energy sources, the findings suggest that wind and solar projects achieve higher completion rates than these electrification initiatives.
The results also highlight a significant impact of the CPI: a one-unit increase in CPI correlates with a 1.6 times higher likelihood of completing a Chinese loan-financed energy project (AOR = 1.609, 95% CI: 1.092-2.370), after adjusting for other covariates.

Finally, energy infrastructure projects financed through Chinese concessional loans (OECD-ODA) are 10.8 times more likely to be completed (AOR = 10.800, 95% CI: 1.235-94.275) compared to projects funded by non-concessional loans, holding other variables constant. While this 10.8 factor might seem high, it aligns with the observed difference in project quantity and completion rates. Over 90 per cent of these projects are funded through concessional loans, of which 53 per cent are completed, whereas non-concessional loans account for only 6 per cent of projects, with a completion rate of just 0.4 per cent (Section 5.1).

Predictions of Project Completion Probabilities

The computation of project completion probabilities is made after evaluating the model's performance using the receiver operating characteristics (ROC) curve, which considers the true positive rate (TPR) plotted on the vertical axis (sensitivity) against the false positive rate (FPR) on the horizontal axis (specificity). The area under the curve (AUC) quantifies the prediction effectiveness of the model. An AUC close to 1 indicates a high level of model performance, while an AUC of 0.5 suggests no discriminative power. I derived an AUC of 0.79, indicating that the model has excellent discrimination capabilities. Precisely, it suggests that the model has a high level of accuracy in predicting whether the project will succeed (completed) or fail.

This study adopts a standard framework for evaluating project risk in project management, categorizing event occurrence probabilities into five distinct groups: $(0 \leq p < 0.2)$, $(0.2 \leq p < 0.4)$, $(0.4 \leq p < 0.6)$, $(0.6 \leq p < 0.8)$, and $(0.8 \leq p < 1)$.[32] These categories represent projects that are 'very unlikely', 'unlikely', 'possible', 'probable', and 'very likely' to be completed, respectively. Of all the completed projects (148), the model predicted that 31 per cent were very likely to be completed, 34 per cent had a good chance (probable), 26 per cent were toss-ups (possible), 7 per cent were unlikely, and 2 per cent were very unlikely to be completed. The details of these projects along with their estimated probabilities can be made available on

[32] Agnieszka Sienkiewicz, 'Project Risk Assessment: An Example with a Risk Matrix Template', BigPicture, 20 2022.

request. Overall, 91 per cent of completed projects were determined to have some chance of completion based on the model's predictions, confirming its excellent predictive accuracy as indicated by the ROC curve.

Figures 3 and 4 present predictions for the projects of interest. These are 128 unfinished or ongoing Chinese loan-financed energy projects in Africa, totalling loan commitments of USD 72.69 billion. Fifty-three percent (53%) of these projects, representing loan commitments of USD 57.86 billion, are at risk of remaining unfinished (Figure 3), while the rest, accounting for USD 15.10 billion in loan commitments, could be completed (Figure 4). Africa's largest USD 23 billion project, pledged to Nigeria in 2010, is among the projects at risk and is highly unlikely to be completed based on the model's predictions. Assuming this project did not exist, the value of the risky projects would still be almost two times greater than the value of those that could be completed. Overall, projects that account for 57 per cent of the Chinese loan commitments for energy infrastructure in Africa between 2000 and 2021 are at risk of not reaching completion. This indicates the magnitude of loss that Africa is likely to encounter. The burden is typically passed on to taxpayers, further straining their already limited income brackets. Another critical finding from Figures 3-4 is that all projects financed by loans exceeding USD 1.5 billion are considerably risky.

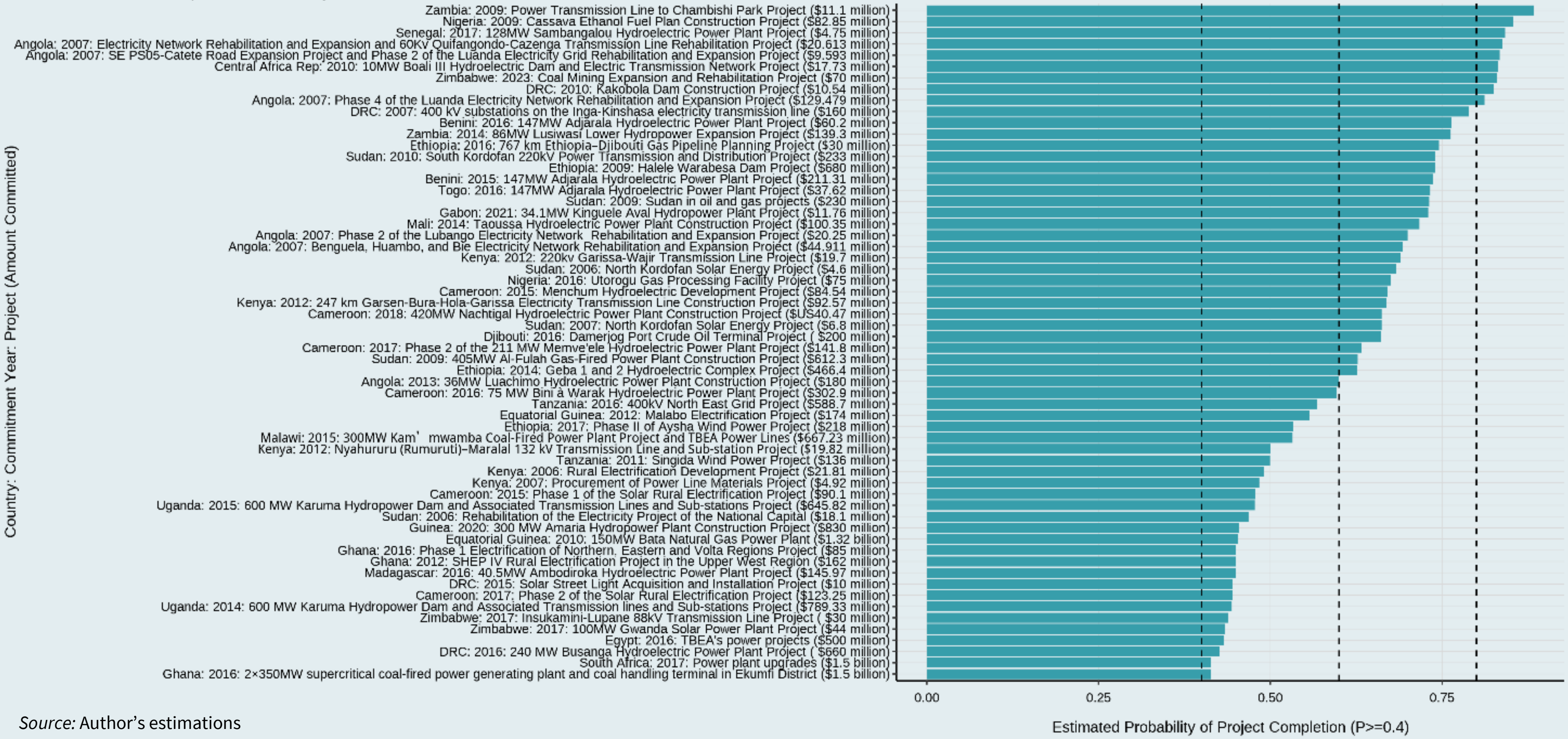
Figure 3: Ongoing Chinese Loan-Financed Energy Projects

With an Estimated Completion Probability of at Most 40 Per Cent

Source: Author's estimations

Figure 4: Ongoing Chinese Loan-Financed Energy Projects

With an Estimated Completion Probability of at Least 40 Per Cent



Source: Author's estimations

Discussion of the Findings

The results in Table 4 lend credence to hypotheses 1, 2, 6, and 7, while hypothesis 8 is partially supported. These findings indicate that the prioritization of Chinese loan-financed projects generally aligns with their commitment periods, with projects pledged on or before 2010 receiving higher priority for completion compared to those committed after 2010. Furthermore, the likelihood of project completion improves with a reduction in government corruption in Africa and is higher for projects funded by concessional loans meeting OECD-ODA criteria compared to non-concessional loans. Conversely, the probability of project completion decreases as project size increases, with loans exceeding USD 1.5 billion being less likely to result in completed projects (Figures 3-4). This outcome aligns with the assertions of Aljohani (2017) and Steininger et al. (2021) that large-scale projects are more prone to delays. Additionally, Figures 3-4 suggest that 57 per cent of loan commitments made between 2000 and 2021 are at risk of not reaching completion.

Regarding project complexity and agency, as represented by the energy types discussed in hypothesis 8, the analysis shows that electrification projects financed by Chinese loans and powered by existing energy sources, particularly hydro and non-renewable energy, are less likely to be completed compared to wind and solar-powered projects. Contrary to expectations, however, Chinese-financed energy infrastructure projects in Africa appear more likely to succeed when associated with hydropower than with wind or solar energy. I argue that this outcome reflects a prioritization strategy rather than a reflection of complexity, suggesting that, within the renewable energy domain, China places greater emphasis on supporting hydropower projects over wind and solar projects. This conclusion is consistent with the statistics in Table 1 and descriptive analysis in Section 5.1, which reveal that the volume of loan commitments for hydropower (Table 1) and the number of hydropower projects (Section 5.1) are more than three times higher than those for wind and solar projects. Additionally, the number of completed hydropower projects is nearly four times greater than that of solar and wind projects (Section 5.1).

The statistically insignificant findings related to hypotheses 3 and 4 (Table 3), combined with the fact that over 70 per cent of these projects are carried out by Chinese contractors (Section 5.1), highlight the inequitable nature of project implementation conditions tied to Chinese concessional loans. These conditions heavily favour China by creating jobs for Chinese contractors and workers and securing markets for Chinese industrial materials33, often at the expense of local firms, labour, and materials. 34 Ideally, Chinese contractors should contribute significantly more to the successful completion of projects than local vendors, as initially hypothesized. Regarding fund disbursement, the results indicate that neither African governments nor Chinese contractors have a distinct advantage in managing funds to improve project completion rates. Direct allocation of funds to either party introduces considerable challenges in tracking and monitoring project expenditures, especially in a context where transparency is a critical issue.

[33] Bunte, Raise the Debt: How Developing Countries Choose Their Creditors.
[34] Dreher et al., ‘Apples and Dragon Fruits’.

The findings related to hypothesis 5 indicate that collateral security and loan guarantors have no significant impact on project completion (Table 3). Descriptive analysis in Section 5.1 further shows that 77 per cent and 91 per cent of Chinese loans for energy infrastructure projects in Africa are issued without collateral or guarantees, respectively. Considering the scale of these projects and the history of loan defaults by African countries, this raises concerns about China's motives in the event of a default. The use of significant government assets as collateral is particularly troubling, especially when the terms of such agreements are not disclosed.[35] Pledging key state assets as collateral can place fiscal pressure on governments, potentially resulting in higher electricity tariffs and taxes for citizens. While these measures are intended to ensure repayment and mitigate default risks, they often come at a significant cost to the public. The risk of default becomes even more concerning when considering the ambiguous and generally less favourable terms of Chinese concessional loans compared to those from institutions like the World Bank. Morris et al. (2020) observe that Chinese concessional loans typically feature higher interest rates, shorter maturities, and shorter grace periods than World Bank loans. This aligns with the descriptive analysis in Section 5.1, which reveal that the majority (89%) of projects are financed by concessional loans meeting the OECD-ODA's 25 per cent concessionality threshold, while only a small proportion (5%) are funded by concessional loans meeting the World Bank-IMF's 35 per cent concessionality criterion.

[35] Dreher et al., 'Banking on Beijing'; Custer et al., 'Tracking Chinese Development Finance: An Application of AidData's TUFF 3.0 Methodology'.

Conclusion

This study examined the impact of Chinese lending practices on the successful completion of related projects, an area that has received limited attention in discussions surrounding Chinese loans. It specifically addressed the contentious issues of transparency in Chinese lending, as well as the project implementation and fund disbursement conditions linked to Chinese concessional loans. Exploring these issues is essential for promoting fairness in Chinese lending practices. The research focused on energy infrastructure projects for two key reasons: first, between 2000 and 2021, the energy sector accounted for the largest share of Chinese loan commitments; second, Africa faces a significant energy infrastructure deficit, particularly in green energy. The study aimed to assess how China is supporting African countries in achieving SDG 7 by 2030. Utilizing AidData's Global Chinese Development Finance Dataset, Version 3.0, compiled by Custer et al. (2023) and Dreher et al. (2022), the analysis covered a sample of 276 Chinese-financed energy projects across 40 African countries from 2000 to 2021 and employed a binary logistic regression model. Four critical findings emerged:

Government Corruption and Project Completion: The findings suggest that reducing government corruption improves project completion rates. In the context of Chinese lending, where transparency is often lacking, this finding highlights the negative impact of opaque lending terms on project outcomes. Specifically, Chinese-financed energy projects in Africa are more likely to succeed in less corrupt, and consequently more transparent, environments.

Limitations of Chinese Concessional Loans: While Chinese concessional loans contribute to project completion, the associated implementation and fund disbursement conditions do not. The study underscores the inequity of China's approach to tying concessional loans to conditions that primarily benefit Chinese contractors, labour, and markets, without making meaningful contributions to project success. Moreover, the practice of disbursing funds directly to Chinese contractors to retain control over project finances appears unfair, as it does not significantly enhance project completion.

Preference for Hydropower over Solar and Wind Energy: China prioritizes hydropower over solar and wind energy, despite hydropower's vulnerability to climate change risks. The United Nations has emphasized the need for Africa to diversify its renewable energy sources, advocating for increased investment in solar and wind energy as part of SDG 7. While China claims to support Africa's development goals, this preference for hydropower suggests a focus on economic gains rather than aligning with Africa's broader developmental priorities. Furthermore, the study found that financing solar and wind energy projects is more effective than supporting electrification initiatives reliant on existing hydropower or non-renewable energy sources.

Risks to Project Completion: Of the USD 101.59 billion in Chinese loans committed to energy infrastructure projects in Africa from 2000 to 2021, projects worth USD 57.86 billion are at risk of not being completed. This represents significant potential losses for Africa. Additionally, energy infrastructure projects financed with Chinese loans exceeding USD 1.5 billion carry substantial risks of non-completion.

In a nutshell, the deteriorating institutional quality of African countries has limited their access to credible and fair development funding sources, leaving them vulnerable to opaque Chinese lending terms. Unfortunately, little can be done about loans that have already been disbursed. However, moving forward, African governments should focus on implementing institutional reforms as part of the African Union Agenda 2063. Such reforms would not only enhance the success rates of debt-financed infrastructure projects and other developmental initiatives but also restore access to more credible funding sources. Specifically, these improvements would increase their eligibility for concessional loans from institutions like the World Bank and the IMF, which offer more favourable, transparent, and realistic lending terms compared to China.

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Appendix

Table A1: Recipients of Chinese loan-financed energy projects from 2000 to 2021

Country	*Uncompleted Projects*	*Complete Projects*	*Total*
Angola	16	20	36
Ethiopia	11	22	33
Zambia	7	14	21
Kenya	12	8	20
Sudan	6	13	19
Nigeria	12	4	16
Equatorial Guinea	5	9	14
Ghana	4	10	14
Cameroon	7	2	9
Zimbabwe	6	2	8
DRC	6	1	7
Egypt	3	4	7
Guinea	2	5	7
South Africa	3	4	7
Senegal	1	5	6
Cote d'Ivoire	2	3	5
Gabon	2	3	5
Togo	3	2	5
Uganda	4	1	5
Congo	0	4	4
Mali	1	2	3
Tanzania	3	0	3
Benin	2	0	2
Madagascar	2	0	2
Malawi	1	1	2
Morocco	0	2	2
Botswana	0	1	1
Central African Republic	1	0	1
Chad	0	1	1
Djibouti	1	0	1
Eritrea	0	1	1
Gambia	1	0	1
Lesotho	1	0	1
Mauritania	0	1	1
Mozambique	1	0	1
Niger	0	1	1
Rwanda	1	0	1
Sierra Leone	0	1	1
South Sudan	0	1	1
Tunisia	1	0	1
Total	128	148	276

Note: These countries are ranked in descending order by the total number of projects committed.
Source: Author’s compilation based on AidData's Global Chinese Development Finance Dataset

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