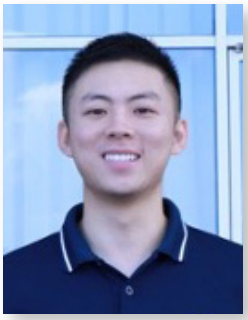
BU Global Development Policy Center

GCI WORKING PAPER 053 • 06/2026





Congyi Dai *is a Global China Pre-doctoral Research Fellow at the Boston University Global Development Policy Center and a doctoral candidate in Environment and Sustainability at the University of Michigan, Ann Arbor. With a background in economics and public policy, his research investigates how China shapes energy access in Africa using quantitative methods. Specifically, he focuses on the relationship between China's development finance and mine acquisitions in Africa, as well as the impacts of Chinese-invested energy infrastructure projects. He has previously worked with the United Nations Development Programme in Mauritius and the World Bank in Washington, D.C.*

Development Quid Pro Quo

CHINESE FINANCE AND CRITICAL MINERAL[1] ACCESS IN AFRICA

BY CONGYI DAI[2]

ABSTRACT

The impact of China's engagement in Africa has drawn much attention in scholarly debates. Some critics view China's interest in Africa as a form of neocolonialism, arguing that China is extracting natural resources for its own state interests. China has been involved in numerous mining activities across the continent, gaining access to critical minerals such as cobalt and copper, which are strategically important for national energy security. At the same time, China has also financed many development projects to help African countries address pressing development challenges. This paper explores whether China's development finance agenda is motivated by its global quest for natural resources, facilitating mine acquisitions in Africa. Multiple datasets on development finance and mining are aggregated and analyzed to examine whether China's development finance coincides with its mine acquisitions in 54 African countries. The results show that minerals needed for clean energy technologies such as copper, cobalt, nickel, and platinum group metals are associated with Chinese loan commitments to recipient countries. Specifically, uranium is the mineral most strongly linked to Chinese development projects, particularly those including a substantial grant component and highly concessional repayment terms. In addition, Chinese finance exhibits a high-risk tolerance in the context of mineral extraction. This paper carries significant policy implications for global energy transitions, critical mineral supply chains, and development finance by revealing how various financial instruments are used to secure access to minerals and by highlighting the need for more transparent development practices.

[1] The study defines "critical minerals" as minerals that are essential to the economy and security of the nation and are vulnerable to supply chain disruption. The full list of critical minerals used in the analysis comes from the International Energy Agency and the U.S Geological Survey. It is not limited to the list of transition minerals which the GDP Center typically focuses on.

[2] Comments and suggestions can be sent to the corresponding author, Congyi Dai, at cydai@umich.edu.



Keywords: Belt and Road Initiative, critical minerals, energy transitions, China in Africa, development finance

INTRODUCTION

Transitioning to clean energy sources and away from fossil fuels is essential to curb global warming (IPCC 2023) and can reduce fossil fuel dependence to support long-term economic growth (Fulghum et al. 2026). Countries like China and the European Union (EU) are leading global energy transitions with a significant emphasis on clean energy technologies such as electric vehicles (EV), battery storage, solar photovoltaic panels, and wind turbines (IEA 2024). As global demand for clean energy continues to rise, demand for the critical minerals needed for clean energy technologies is projected to increase at least threefold by 2030 (IEA 2021; IEA 2023). For example, batteries, one of the most important components of an EV, require critical minerals such as copper, graphite, cobalt, and lithium for production. China alone produces three-quarters of all lithium-ion batteries and has 70 percent of global production capacity for cathodes and 85 percent for anodes in the world—the two ends of a battery that allows electricity to flow (IEA 2022a). In terms of solar panels, China's share of all manufacturing stages exceeded 80 percent in 2022 (IEA 2022b).

To accommodate increasing demand for critical energy transition minerals, securing and maintaining access to mines becomes essential for a state's national and energy security. However, many minerals are geographically concentrated in a few countries, presenting significant supply chain risks. For example, the Democratic Republic of the Congo (DRC) produced 39 percent and 70 percent of tantalum and cobalt, respectively, while South Africa produced 72 percent of platinum and 41 percent of chromium (USGS 2020). To mitigate risks and get ahead in the race to produce and use clean energy technologies, countries, especially large and emerging economies like China, the EU, and the US, are increasingly competing for access to mineral resources. However, the strategies used to engage with resource-rich countries to secure access to mineral resources might look vastly different depending on the motivation and leverage of different resource-seeking states.

China's use of development finance—public and publicly guaranteed finance from China Development Bank and Export-Import Bank of China to sovereign foreign entities—is increasingly viewed as a Chinese approach to engaging with developing states. According to China's Overseas Development Finance database from the Boston University Global Development Center, China's development finance to other countries has reached $472 billion since 2008, representing a key part of China's Belt and Road Initiative (BRI) (National Development and Reform Commission 2015)—a strategic plan to strengthen regional economic cooperation covering regions in Asia, Europe, and Africa—and making China the world's largest bilateral lender. Empirical evidence shows that Chinese development finance institutions are willing to lend concessionally to achieve strategic policy goals over financial returns (Zou et al. 2026).

China's overseas infrastructure loans are often provided to countries facing debt distress, and the terms of Chinese infrastructure lending are not typically disclosed to the public. This has raised concerns over whether China is using development finance to "debt trap" vulnerable countries by offering loans they cannot repay in exchange for the seizure of assets, such as mines. Additionally, existing literature shows cases of resource-backed lending where natural resource revenues or concessions are embedded as collateral or repayment terms of loan agreements (Bräutigam and Gallagher 2014; Odoom 2017). While China has not presented patterns of asset seizure (Acker et al. 2020; Moses et al. 2023), much of the existing debate regarding its motivation for providing development finance in Africa has centered on using case studies to infer whether its development



finance is linked to natural resources in recipient countries. However, there remains limited empirical and systematic evidence on whether China leverages development finance in Africa to secure access to mineral and natural resources.

To address this gap, this paper uses four data sources to examine whether Chinese development finance is tied to the pursuit of critical minerals. Specifically, it examines whether Chinese development finance is associated with mineral extraction, whether financial instruments vary across mineral types, and whether these relationships are conditioned by recipient-country political stability. It also explores whether recipient-country political instability is less likely to deter Chinese engagement when strategically important minerals are involved. These questions carry significant implications for both the global mineral supply chain and the future of international development.

LITERATURE REVIEW

Chinese Development Finance Approach in Africa

Unlike many Western donors that historically attached policy conditionalities such as structural adjustment and governance reforms to development assistance (Dickovick 2014; Heidhues and Obare 2011; Summers and Pritchett 1993), China's development finance has emphasized non-interference and infrastructure-focused cooperation. China's active engagement with Africa generally traces back to the late 1950s and early 1960s, initially driven by political solidarity and diplomatic recognition among newly independent states (Eisenman 2018; Shinn 2019). The largest development project was the TAZARA railway construction from 1970 to 1975, which connected the port of Dar es Salaam in Tanzania to the landlocked country of Zambia. This project allowed then newly independent Zambia to access international trade routes to transport resources in and out of the country without passing through the white-minority-ruled territories in the south (Monson 2009). This politically driven engagement eventually shifted toward commercial interests. However, since the early 2000s, Chinese development finance has increasingly reflected commercial interests as it seeks to channel its industrial overcapacity into larger untapped markets (Dreher et al. 2022).

To pursue its commercial interests, the Chinese government relies on financial tools including grants, export credits, concessional loans, nonconcessional loans, and aid used to foster Chinese investment (Bräutigam 2011a). The majority of China's officially supported finance does not meet the Official Development Assistance (ODA) definition of aid largely due to the lack of transparency, and China's official aid comes in various forms (Bräutigam 2011a). Interest-free foreign aid loans are normally offered by the central government, while concessional loans, export buyer's credits, and other commercial loans are usually offered by the two policy banks: the China Development Bank and the Export-Import Bank (Acker et al. 2020).

China's development finance is not unconditional. A common practice is to use recipient countries' natural resources as collateral (Odoom 2017). Some perceive China's resource-backed infrastructure investments in Africa as China's distinct approach to development in Africa, but this approach is far from unique. This approach can be traced back to the 1970s when China was trading its natural resources in exchange for modern equipment and technologies needed for development. In 1978, China and Japan signed a long-term trade agreement in which Japan offered to finance the export of USD 10 billion of its modern plants, industrial technology, and materials, and China agreed to repay the equivalent in crude oil and coal (Bräutigam 2011b). Similar deals were signed with the US, Canada, Britain, Australia, Italy, and Brazil. China perceived these agreements as a "win-win" strategy as they provided much-needed industrial equipment and technical expertise for modernization at a discount through resources that China could not yet fully develop, which laid the foundation for China's economic success (Bräutigam 2011b). Drawing on this experience, China employs a similar



strategy in its current foreign aid practices, providing industrial equipment and technical expertise in exchange for natural resources (Bräutigam 2011b).

Another distinct characteristic of China's development finance is its lack of transparency. China rarely discloses the details of its foreign aid, raising concerns over its intentions and ability to deliver effective development solutions in Africa (Naím 2007). Some scholars characterize Chinese development aid as "rogue aid," arguing that Chinese aid disregards recipient countries' needs and instead seeks to gain access to natural resources only (Naím 2007; Woods 2008). This claim has been disputed by Dreher and Fuchs (2015), who empirically test the extent of self-interests that shape China's aid allocation and find that China's aid does not prioritize politics more than Western donors, and that its allocation appears to be largely independent of recipient countries' oil production. This finding also corroborates the findings of Hoeffler and Sterck (2022), who find that, similar to most Western donors, China also committed more aid to poorer countries. Tan-Mullins et al. (2010) find that people who labeled Chinese aid as "rogue" not only overlooked the broader motivations underlying Chinese finance but also failed to recognize the historical Sino-African relationship.

Despite extensive debate over whether Chinese development finance is politically or commercially motivated, the literature rarely connects these flows to patterns of Chinese ownership in strategic sectors such as mining. Development finance and extractive investment are typically studied in isolation, leaving it unclear whether they are empirically linked. This disconnect limits understanding of how state-backed finance may relate to access to natural resources in Africa.

Chinese Mining in Africa

As global demand for clean energy continues to rise, securing access to critical minerals is a priority for many countries. Definitions of "critical" minerals vary across jurisdictions, reflecting national economic and security concerns. In the United States, the Energy Act of 2020 defined minerals as critical if they fit the following criteria: (1) the mineral must be essential to the country's economic and national security; (2) it must serve an essential function in the manufacturing of a product without which the country's economic and national security would face significant consequences; and (3) it must have a supply chain that is vulnerable to disruption (US Department of Energy n.d.). The US Geological Survey (USGS) issues a list of critical minerals, which is revised every three years. In China's case, China's National Plan for Mineral Resources (2016-2020) created a strategic mineral catalogue that lists important minerals grouped into energy, ferrous, and nonferrous minerals.[3] In a study that evaluates the importance of different critical minerals for China, nickel received the highest overall score, likely due to growing global demand for battery materials (Ren et al. 2025), while tin, cobalt, chromium, and nickel were identified as high risk in terms of supply vulnerability (Zhou et al. 2019). Although China controls a relatively modest share of global mine production value overall—estimated at roughly 3 percent (Ericsson et al. 2020)—its overseas footprint in mineral extraction has expanded significantly over the past two decades.

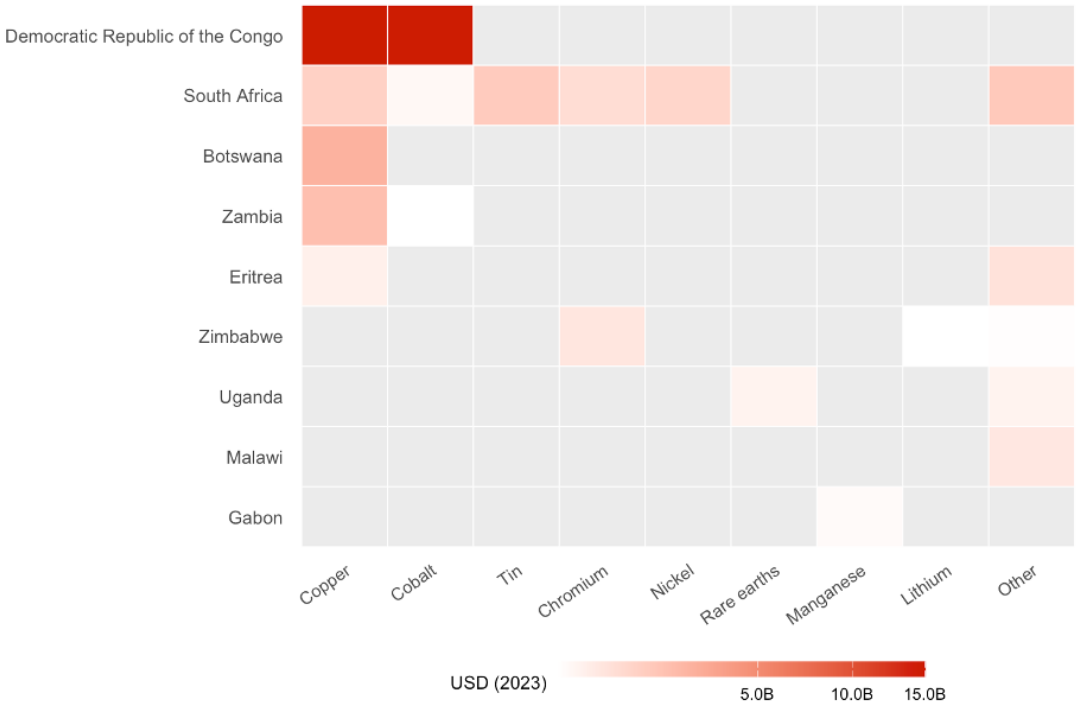
Africa has been central to this expansion. The number of major mining projects by Chinese companies in Africa grew from less than five in 2006 to over 120 in 2015 with a wider geographical spread, including a broad range of minerals such as chrome, copper, iron ore, nickel, platinum, and uranium (Sautman and Yan 2019). Figure 1, constructed using AidData's Chinese Financing for Transition Minerals Dataset (Walsh et al. 2025), illustrates the distribution of Chinese financing commitments for mineral operations across African countries and mineral categories. Financing is heavily concentrated in resource-rich countries such as the DRC, which has received over USD 15

[3] Energy minerals: oil, gas, shale gas, coal, coal bed methane, and uranium; ferrous minerals: iron, chromium, copper, aluminum, gold, nickel, tungsten, tin, molybdenum, antimony, cobalt, lithium, rare earths, and zirconium; nonferrous minerals: phosphorus, potash, crystalline graphite, and fluorite.



billion in commitments related to cobalt and copper projects. These patterns highlight the strategic importance of African mineral endowments within China's broader resource engagement.

Figure 1: Chinese Financing for Critical Minerals in Africa by Country and Mineral Group



Source: Tracking China's Transition Mineral Financing: Methodology and Approach, Version 1.0., AidData (2025).

China's involvement in African mining dates back to the late 1990s, beginning with Sinosteel's acquisition of the Dilokong chromite mine in South Africa in 1997 (Ericsson et al. 2020). Since then, Chinese firms have expanded their presence across the continent, generating substantial debate over labor practices, expatriate employment, and environmental governance (Cooke et al. 2015; Kara 2023; Owusu et al. 2025; Wegenast et al. 2019). While the literature documents important socioeconomic and environmental consequences of Chinese mining in Africa, it largely focuses on the impacts of mining operations rather than on the financial mechanisms through which China gains access to mineral assets in the first place. Less attention has been paid to whether and how state-backed development finance facilitates Chinese mine acquisitions at scale—the question this paper directly addresses.

Connecting Development Finance to Natural Resources

While bilateral development finance is generally seen as reciprocal, reciprocity does not always result in narrowly material or immediately transactional terms. Benabdallah (2022) argues for a relational approach that accounts for nonmaterial gifts to better understand the reciprocity of foreign aid, especially in contexts outside Eurocentric frameworks. Nevertheless, development finance typically reflects underlying state interests, whether in the form of resource extraction, international market expansion, or relationship building. Reciprocity may therefore operate through economic channels that unfold over time through implicit conditionality.

Research on Chinese outward investment supports this view. Empirical studies show that Chinese overseas foreign direct investment is associated with host-country natural resource endowments,



market size, and political alignment, suggesting that investment decisions reflect a combination of commercial and strategic considerations (Dreher et al. 2022; Kolstad and Wiig 2012; Ramasamy et al. 2012; Zhao et al. 2025). Yet this literature largely examines investment flows in isolation from development finance and rarely differentiates across specific mineral endowments. Parallel scholarship on commodity-backed lending and state-backed credit emphasizes that financing structures shape ownership, bargaining power, and long-term control within host-country sectors (Bräutigam and Gallagher 2014; Lee 2018). From this perspective, finance is not merely capital provision but a governance mechanism that structures economic relationships.

Despite these insights, systematic empirical evidence linking Chinese development finance to mineral sector engagement remains limited. Existing work tends to analyze aid allocation patterns or extractive investment separately, leaving open the question of whether development finance and mineral access are empirically connected at scale. If development finance functions as part of a broader strategic configuration, one would expect observable associations between financial flows and mineral resource activity, particularly in sectors critical to industrial upgrading and energy transitions.

This paper advances a development quid pro quo framework that conceptualizes development finance and mineral engagement as potentially complementary components of state strategy. The argument does not assume direct conditional exchange but rather posits that development finance may align with access to strategic resources. Given China's prominent role in renewable energy technologies and battery manufacturing and the increasing strategic salience of energy transition minerals, the relationship between finance and mineral extraction warrants systematic examination. Moreover, because different minerals occupy distinct positions within global supply chains, patterns of financial engagement may vary across mineral types. Political stability may further condition these relationships by affecting perceived investment risk, contract enforcement, and long-term project viability.

Three institutional channels plausibly connect development finance to mineral access. The most direct is resource-backed lending, in which natural resource revenues or concessions are embedded as collateral or repayment terms within loan agreements—a practice documented in Chinese infrastructure deals across sub-Saharan Africa (Bräutigam and Gallagher 2014; Odoom 2017). A second channel operates through parallel deal structures: because China's policy banks and state-owned enterprises frequently act in coordination, infrastructure financing and mining concessions may be negotiated simultaneously as components of a broader bilateral package, even without explicit written conditionality (Dreher et al. 2022). A third, softer channel is diplomatic reciprocity, whereby development assistance builds political goodwill that host governments translate into favorable conditions for Chinese mining firms (Benabdallah 2022). These channels are not mutually exclusive, and the data cannot adjudicate between them. However, the heterogeneity of findings across financial instruments is consistent with different mechanisms operating for different resource types, with more strategically sensitive minerals more likely to be pursued through instruments that minimize formal conditionality and maximize diplomatic cover.

From this framework, this study proposes three hypotheses:

Hypothesis 1: China's development finance in Africa is positively associated with mineral resource extraction, particularly with respect to critical energy transition minerals.

Hypothesis 2: The financial instruments employed by China vary systematically across mineral types, with strategically important minerals associated with more favorable lending conditions.



Hypothesis 3: Recipient-country political stability conditions the relationship between development finance and mineral engagement.

By testing these hypotheses across African countries, this study moves beyond case-based narratives and contributes systematic evidence on whether state-backed finance aligns with strategic resource engagement. It adds to the growing literature on the influence of China in Africa by providing empirical evidence on the links between China's development finance and mine acquisitions, examining how different financial instruments are used to engage with African countries in the pursuit of different minerals, and offering valuable insights on global resource governance.

DATA AND METHODS

Data

To test the hypotheses, this paper constructs a country-level panel dataset covering 54 African countries from 2000 to 2023 by integrating four complementary data sources. The resulting dataset combines publicly available development finance records with proprietary mining ownership data, allowing the analysis to systematically track both Chinese overseas finance and the timing of Chinese mineral acquisition events. By linking financial flows to changes in mine ownership at the country level, the dataset enables a dynamic assessment of whether development finance is associated with access to strategic mineral assets. Table 1 summarizes the datasets.

Table 1: Description of Datasets Included in the Main Analysis

Dataset	Unit of Analysis	Spatial Coverage	Temporal Coverage	Data Source	Publicly Available
Chinese Loans to Africa	Country-level loan amount	49 African countries	2000-2023	Boston University Global Development Policy Center	Yes
Global Chinese Development Finance	Country-level count of development projects	Global	2000-2021	AidData	Yes
SNL Mining & Metals	Mine-level binary data	Global	2000-2023	S&P Global Market Intelligence	No
Worldwide Governance Indicators	Country-level score	Global	2000-2023	World Bank Group	Yes

CHINESE LOANS TO AFRICA DATABASE

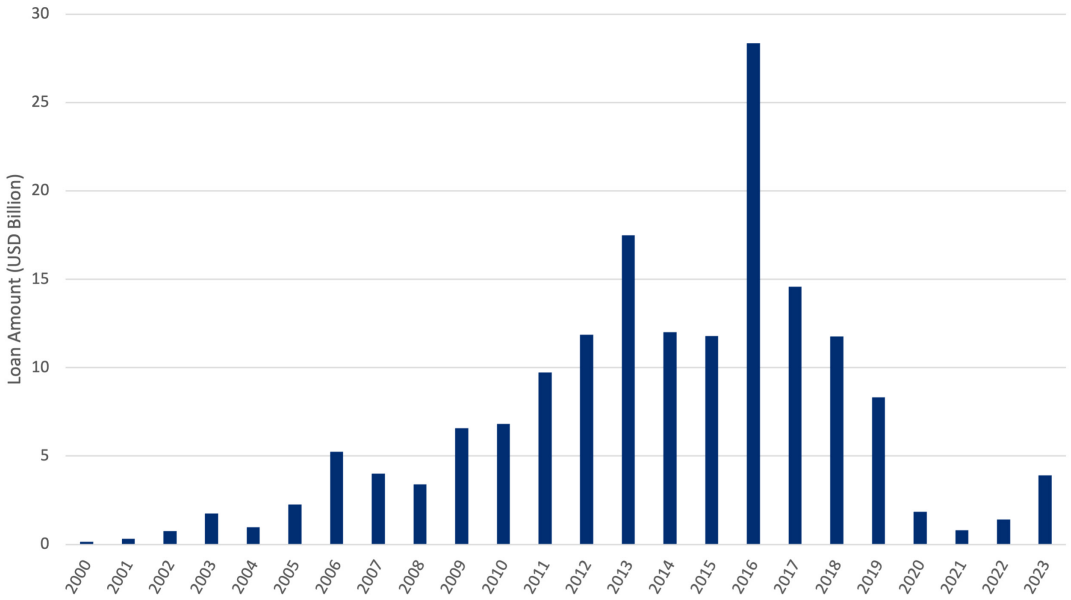
The Chinese Loans to Africa (CLA) Database is compiled and maintained by the Boston University Global Development Policy Center. The CLA data track loan commitments from Chinese development finance institutions, commercial banks, government entities, and companies to African governments, state-owned enterprises, and regional multilateral institutions from 2000 to 2023. The key variable in this dataset is the USD value of committed loans, which serves as the dependent variable in the models. Using commitments rather than actual disbursements provides a better basis for estimation because disbursements may be delayed for various reasons



and thereby bias the estimates. However, given the opaque nature of Chinese overseas finance, many loan commitments may be missing from the dataset.

Figure 2 uses the CLA data to illustrate trends in Chinese loan commitments to Africa between 2000 and 2016. Loan amounts increased between 2000 and 2016 before declining sharply after 2019, potentially reflecting the effects of COVID-19.

Figure 2: Chinese Loans to Africa from 2000 to 2023 (USD Billion)



Source: Chinese Loans to Africa Database, Boston University Global Development Policy Center.

GLOBAL CHINESE DEVELOPMENT FINANCE DATASET

The second dataset is the Global Chinese Development Finance (GCDF) dataset from AidData (Custer et al. 2023). The GCDF tracks Chinese development aid activities from 2000 to 2021 across various sectors such as energy, education, and healthcare, covering 148 countries. This dataset includes information such as sector, financial flow class (ODA or other official flows [OOF]),[4] funding amount, implementing partners, and commitment/completion year. The GCDF complements the CLA data by capturing additional streams of development finance that might not come in the form of loan commitments. Although this dataset includes aid activities through various channels, about half of the projects in Africa are missing funding amounts as China does not always disclose them.

Given the large number of observations presented in the data (over 20,000 records) and the missing information on specific funding amounts, the analysis employs project counts (the number of projects received by a country) as the dependent variable, using only the commitment year to calculate project counts, as implementation timelines vary across projects. The analysis also draws on the financial flow class category for heterogeneity analyses to identify which types of development

[4] Each project was assigned a financial flow class based on its concessionality. According to the Organisation for Economic Co-operation and Development's (OECD) ODA concessionality threshold, projects issued between 2000 and 2017 were subject to a 25 percent. This means that projects with a grant equivalent component of 25 percent or higher were coded as "ODA-like," while those with a grant equivalent component below 25 percent were coded as "OOF-like"; all others were classified as "vague." For projects issued from 2018 onward, the definition was updated based on the recipient country's income level. The specifics can be found on the OECD website: https://www.oecd.org/en/topics/policy-issues/official-development-assistance-oda.html or in the AidData handbook: https://www.aiddata.org/data/aiddatas-geospatial-global-chinese-development-finance-dataset-version-3-0.



projects are more strongly associated with specific minerals. Table 2 presents descriptive statistics for the data, showing that 77.6 percent of projects in Africa are classified as ODA.

Table 2: Descriptive Statistics of GCDF Data

Total projects		20,985
Variable	**Count**	**% of Total Projects in Africa**
Projects in Africa	9,219	-
ODA Projects	7,155	77.61
Health Sector	2,026	21.97
Education Sector	1,247	13.53
Government & Civil Society Sector	864	9.37
Transport and Storage Sector	718	7.79
Energy Sector	473	5.13
Other	3,891	42.21

Source: Global Chinese Development Finance, AidData

SNL METALS & MINING DATASET

The third dataset comes from S&P Global Market Intelligence's SNL Metals & Mining (SNL) database, which provides asset-level details—such as general mine location, ownership structure, mineral type, and operational status—for more than 35,000 mines worldwide. The SNL data are integrated with the development finance datasets to construct a country-level panel dataset. To align with the timeframe of the CLA data (2000–2023), the analysis restricts the SNL data to the same period.

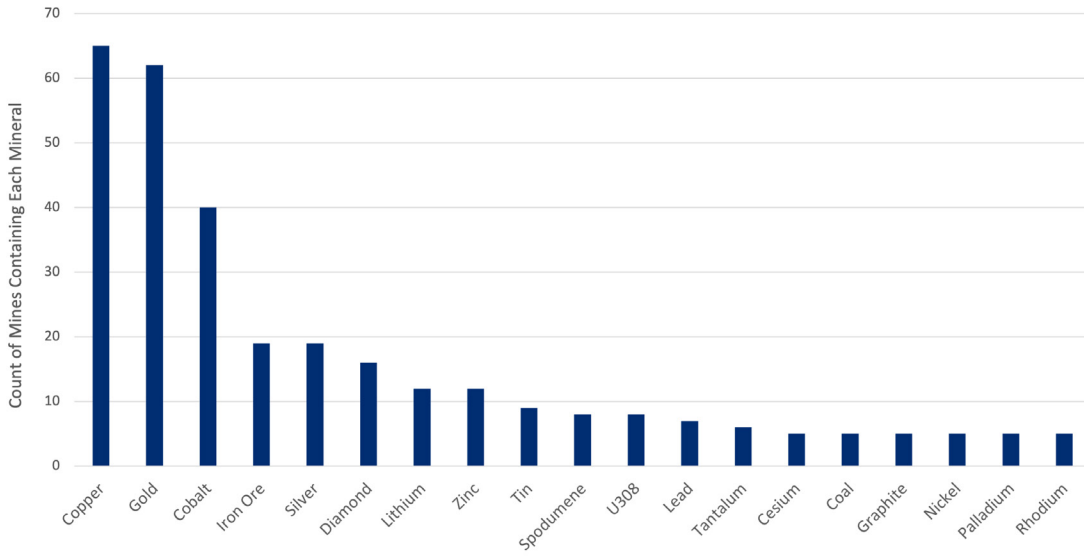
The dataset identifies mines in which Chinese companies hold a majority stake (defined as 50 percent or more ownership) and records the year the ownership shifted to Chinese control. For example, if a Chinese company acquired majority ownership of mine A in 2010, each mineral contained in mine A is coded as 0 from 2000 to 2009 and as 1 from 2010 to 2023, assuming no subsequent ownership changes. This coding allows the analysis to capture the coincidence of mineral access acquisition and development finance. The dataset does not distinguish between brownfield (existing) and greenfield (new) investments, meaning that greenfield investments by Chinese companies are coded as 1 beginning in the first year of mine operation. In addition, the effects might vary depending on the previous ownership structure, as mines with state ownership may be more likely to be associated with China's quid pro quo approach.

This dataset records mines globally and is coupled with corporate data and financial metrics for publicly listed companies. Although comprehensive, the dataset is likely skewed toward larger mines and excludes much artisanal and small-scale mining because ownership information for smaller mines is often difficult to obtain. In addition, most mineral reserve and annual production data are missing, making it difficult to weight minerals appropriately.

Figure 3 presents the top 20 minerals identified in mines owned by Chinese firms. Out of the 3,901 mines in Africa recorded in the dataset, 186 were identified as Chinese-owned. Copper, gold, and cobalt are the top three minerals acquired by China. Note that cobalt is primarily mined as a byproduct of copper or nickel.



Figure 3: Top Minerals Acquired by Chinese Firms in Africa from 2000 to 2023 (N=186)



Source: Metals & Mining, S&P Global Market Intelligence.

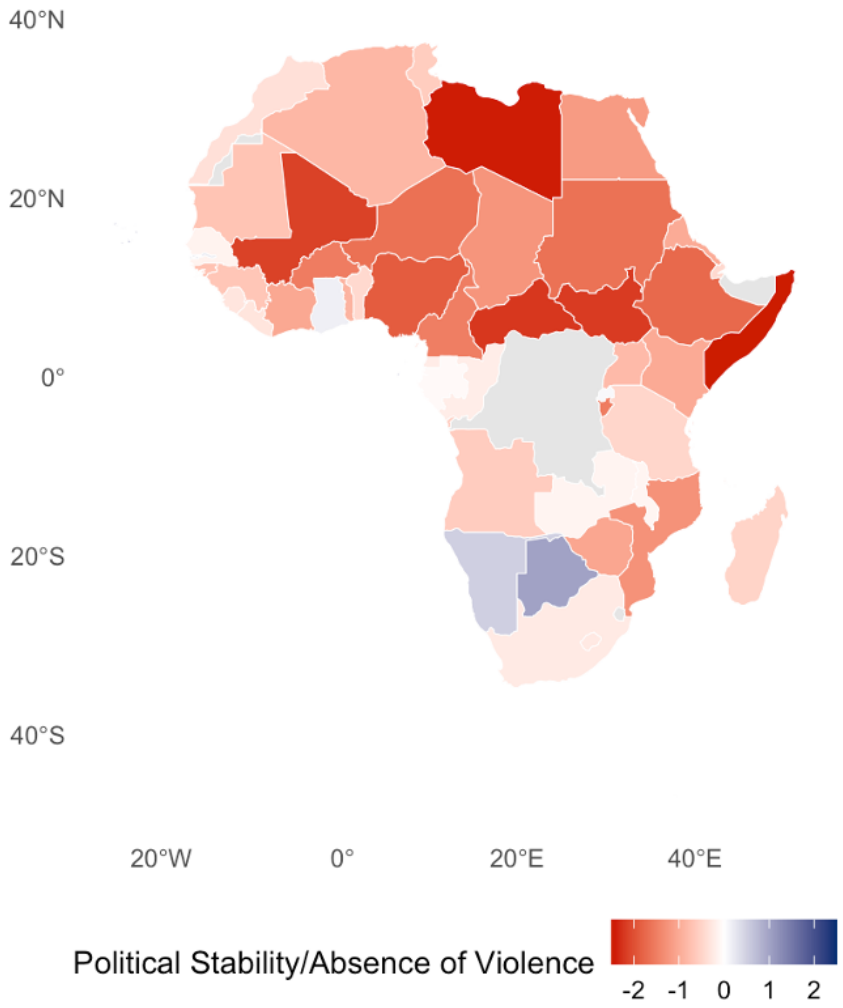
WORLDWIDE GOVERNANCE INDICATORS DATASET

This paper also explores whether the development quid pro quo is more pronounced in countries with higher levels of political stability. To do so, it incorporates Worldwide Governance Indicators (WGI) data from the World Bank that measure governance through six dimensions: Voice and Accountability, Regulatory Quality, Political Stability and Absence of Violence/Terrorism (PV), Rule of Law, Government Effectiveness, and Control of Corruption. For this analysis, the focus is on PV, which measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism, on a scale ranging from -2.5 (politically unstable) to 2.5 (politically stable). PV is used because political instability is often a key deterrent to international development finance. Although other measures of governance may also influence financing decisions, they are highly correlated with PV, which is expected to capture similar patterns. Because WGI data for 2001 are missing, values from 2000 are used as substitutes.

The WGI data provide a standardized measure of host-country political stability that enables cross-country comparisons. However, the indicators remain too coarse and may not fully capture within-country political dynamics or sudden changes in governance conditions. Figure 4 illustrates PV scores across African countries in 2020.



Figure 4: PV Scores Across African Countries in 2020



Source: Worldwide Governance Indicators, World Bank Group.



Research Design

This paper employs a two-way fixed effects (TWFE) model to leverage the panel structure of the data and examine whether Chinese development finance coincides with mineral acquisitions in Africa. To do so, it constructs a country-level panel dataset by merging four sources: (1) the SNL data, which provide asset-level information on mine ownership, acquisition year, and mineral type; (2) the CLA data, which contain loan amounts to Africa; (3) the GCDF data, which provide project-level information on Chinese development finance, including recipient country, year, sector, and financial flow class; and (4) the WGI data, which provide PV scores for each country.

The analysis begins by identifying mines with majority Chinese ownership (≥ 50 percent) and the year in which ownership shifted to a Chinese enterprise, including both state-owned enterprises and private firms. Because these mines often contain multiple minerals (e.g., copper, cobalt, lithium), a binary variable is created for the presence of each mineral in a given country-year. The number of Chinese development finance projects per country-year is then aggregated and serves as one of the main dependent variables. The second dependent variable is the log-transformed loan amount each country receives from China based on the CLA data. Using two dependent variables enables assessment of whether China uses different financial instruments for different mineral acquisitions.

To explore potential mechanisms and heterogeneity, the analysis draws on the detailed coding in the GCDF data, which includes information on financial flow class (ODA, OOF, or vague). This allows the effects to be disaggregated by financial terms and project purpose, contributing to the testing of hypothesis 2. The analysis also investigates whether these relationships are moderated by recipient-country political stability by incorporating PV scores from the WGI data as interaction terms with the mineral variables. This enables assessment of whether China's resource-seeking behavior is more pronounced in politically stable countries.

The models include country and year fixed effects to control for unobserved time-invariant country characteristics and global temporal shocks.

Econometric Models

For the main analysis, this paper draws on the data's country-level panel structure by employing TWFE models. The model specification is

$$DF_{ct} = \alpha_c + \delta_t + \beta_i M_{ict} + \epsilon_{ct}, \quad (1)$$

where DF_{ct} represents the development finance outcome variable. Specifically, it denotes the amount of loans received or the number of development projects country c received from China in year t. Country fixed effects are denoted as α_c, while year fixed effects are δ_t. M_{ict} represents the acquisition of mineral i in country c in year t, and β_i represents the coefficient for mineral i.

To test the hypothesis regarding whether a recipient country's level of PV affects China's engagement pattern, an interaction term between PV and M is included. The model specification is

$$DF_{ct} = \alpha_c + \delta_t + \beta_i PV_{ct} * M_{ict} + \epsilon_{ct}, \quad (2)$$

where PV_{ct} indicates the PV score for country c in year t, and β_i denotes the interaction coefficient for mineral i.



RESULTS

Critical Mineral Acquisitions and Chinese Loans to Africa

To test the first hypothesis that Chinese development finance is associated with critical mineral acquisitions, the analysis uses the log-transformed loan amount variable from the CLA data as the dependent variable. Separate regression models are estimated for each of the top 20 minerals identified in Figure 3.

Table 3 reports the coefficients for 80 regression models (20 minerals × 4 model specifications), including pooled OLS, random effects, fixed effects, and TWFE models. The pooled OLS models serve as baseline estimates without accounting for the panel structure of the data. Given the opaque nature of Chinese engagement in Africa and the presence of unobserved country-specific factors that may influence development finance patterns, both random effects and fixed effects models are reported for comparison. The TWFE models additionally control for both country and year fixed effects, accounting for time-invariant country characteristics and global temporal shocks.



Table 3: Effects of Mineral Acquisitions on Chinese Loans to Africa

	Pooled OLS (1)		Random Effect (2)		Fixed Effect (3)		TWFE (4)	
Mineral	***Coefficient***	***SE***	***Coefficient***	***SE***	***Coefficient***	***SE***	***Coefficient***	***SE***
Critical Minerals[1]								
Cesium	-2.54	(3.47)	-3.95	(3.11)	-4.16	(3.11)	-2.40	(2.95)
Cobalt	**4.14** ***	**(0.77)**	**3.30** ***	**(0.84)**	**3.09** ***	**(0.87)**	**1.81** **	**(0.83)**
Copper	**3.31** ***	**(0.58)**	**2.42** ***	**(0.62)**	**2.20** ***	**(0.65)**	**1.16** *	**(0.62)**
Graphite	-2.54	(2.00)	-2.71	(1.82)	-2.74	(1.82)	-2.92 *	(1.73)
Lithium	-2.55	(1.73)	-3.13 **	(1.55)	-3.22 **	(1.55)	-2.20	(1.49)
Nickel	**4.22** ***	**(1.55)**	**3.21** **	**(1.42)**	**3.05** **	**(1.43)**	**2.66** **	**(1.35)**
PGMs[2]	**3.74** **	**(1.55)**	**3.32** **	**(1.51)**	**3.24** **	**(1.53)**	**3.02** **	**(1.45)**
Tantalum	-2.54	(2.45)	-4.33 **	(2.20)	-4.61 **	(2.20)	-2.91	(2.10)
Tin	2.57 **	(1.31)	1.74	(1.25)	1.60	(1.27)	1.54	(1.20)
U_3O_8	0.35	(1.23)	0.19	(1.11)	0.16	(1.11)	-0.27	(1.06)
Zinc	2.07 **	(1.05)	1.63 *	(0.95)	1.55	(0.96)	0.84	(0.91)
Noncritical Minerals								
Coal	2.89 *	(1.73)	2.43	(1.57)	2.35	(1.57)	1.95	(1.49)
Diamonds	1.99 **	(0.90)	1.21	(0.90)	1.05	(0.91)	1.24	(0.87)
Gold	2.06 ***	(0.61)	1.46 **	(0.57)	1.36 **	(0.57)	0.74	(0.56)
Iron Ore	0.89	(0.87)	0.64	(0.78)	0.60	(0.79)	-0.11	(0.75)
Lead	2.34 *	(1.31)	2.08 *	(1.19)	2.03 *	(1.20)	1.06	(1.14)
Silver	2.97 ***	(0.93)	1.89 **	(0.86)	1.71 **	(0.86)	1.10	(0.83)
Spodumene	-2.54	(2.00)	-3.52 *	(1.79)	-3.66 **	(1.80)	-1.97	(1.73)
Observations	1,247		1,247		1,247		1,247	

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

Note: 1. This paper follows the Final List of Critical Minerals 2022 by the International Energy Agency (IEA) and the 2025 List of Critical Minerals by the USGS. The only difference between the two lists is that uranium was removed from the IEA list and reclassified as a fuel mineral. 2. PGMs—platinum, palladium, and rhodium—are mostly recognized for their use in catalytic converters, which are essential for reducing exhaust emissions from vehicles with internal combustion engines (Gulley et al. 2018). Note that in the mining data, these three minerals were all found in the same mines, resulting in identical coefficients across all subsequent analyses.



Across all four model specifications, copper, cobalt, nickel, and platinum group metals (PGMs) are statistically significant. All four are classified as energy transition minerals. The results support the first hypothesis that Chinese development finance is associated with critical energy transition minerals. Specifically, the TWFE results indicate that Chinese ownership of mines containing copper, cobalt, nickel, and PGMs is associated with increases of 219 percent, 511 percent, 1,330 percent, and 1,949 percent, respectively, in Chinese loan amounts to the corresponding countries. By contrast, the results are not significant for other critical energy transition minerals such as lithium and graphite.

Financial Instruments and Mineral Access

To understand if various financial instruments are used to secure access to minerals, the above analyses are repeated using a dependent variable from the GCDF data. This dataset includes the financing of additional development projects (as indicated in Table 1 that one-third of the projects are in either health or education sectors) to allow the testing of hypothesis 2. The results, presented in Table 4, show that cobalt remains statistically significant across all four models. However, the most striking finding concerns uranium (measured as U_3O_8). One additional acquisition of a mine containing U_3O_8 is associated with 6.43 additional development projects for the corresponding African country—far exceeding the associations for cobalt (4.39) and lead (5.36). This difference is theoretically important: whereas loans are the primary financial instrument for energy transition minerals, development projects (many of which are grants) are more strongly associated with uranium. This suggests that China prioritizes uranium acquisition through instruments it can afford to make concessional, indicating high strategic value. Note that most silver mining deposits are linked to lead-zinc ores (Zhang et al. 2024); one potential interpretation of this is that silver or lead is being accidently picked up while lead or silver is the main mineral related to development projects. As for U_3O_8, as the most stable form of uranium oxide, it is a key material in nuclear power and nuclear security.



Table 4: Effects of Mineral Acquisitions on Chinese Development Projects

	Pooled OLS (1)		Random Effect (2)		Fixed Effect (3)		TWFE (4)	
Mineral	*Coefficient*	*SE*	*Coefficient*	*SE*	*Coefficient*	*SE*	*Coefficient*	*SE*
				Critical Minerals				
Cesium	-1.76	(7.38)	-5.86	(6.87)	-6.86	(6.89)	-7.42	(5.93)
Cobalt	**7.84** ***	**(1.65)**	**7.24** ***	**(1.85)**	**7.00** ***	**(1.97)**	**2.89** *	**(1.72)**
Copper	4.53 ***	(1.24)	3.02 **	(1.39)	2.41	(1.48)	-0.68	(1.29)
Graphite	-1.43	(4.26)	-0.29	(4.02)	-0.02	(4.05)	-3.34	(3.48)
Lithium	0.74	(3.69)	-1.24	(3.44)	-1.73	(3.45)	-2.17	(3.01)
Nickel	6.07 *	(3.30)	2.39	(3.15)	1.35	(3.18)	0.93	(2.73)
PGMs	9.68 ***	(3.29)	6.36 *	(3.33)	5.34	(3.42)	4.87 *	(2.95)
Tantalum	3.24	(5.22)	-0.16	(4.86)	-1.02	(4.88)	-1.51	(4.24)
Tin	7.86 ***	(2.79)	4.21	(2.77)	3.09	(2.83)	2.51	(2.43)
U_3O_8	**8.93** ***	**(2.60)**	**8.24** ***	**(2.44)**	**8.07** ***	**(2.46)**	**6.43** ***	**(2.12)**
Zinc	5.29 **	(2.23)	5.67 ***	(2.10)	5.79 ***	(2.12)	2.59	(1.84)
				Noncritical Minerals				
Coal	5.01	(3.69)	3.46	(3.47)	3.09	(3.49)	1.77	(3.00)
Diamonds	4.57 **	(1.91)	0.77	(1.98)	-0.58	(2.05)	-1.10	(1.77)
Gold	5.12 ***	(1.29)	3.89 ***	(1.27)	3.45 ***	(1.31)	0.38	(1.15)
Iron Ore	3.54 *	(1.85)	2.54	(1.74)	2.29	(1.74)	0.81	(1.51)
Lead[1]	**7.14** **	**(2.79)**	**8.53** ***	**(2.63)**	**8.90** ***	**(2.65)**	**5.36** **	**(2.29)**
Silver[2]	**9.80** ***	**(1.96)**	**8.94** ***	**(1.88)**	**8.73** ***	**(1.90)**	**4.39** ***	**(1.68)**
Spodumene	1.91	(4.26)	-0.20	(3.97)	-0.71	(3.98)	-1.21	(3.50)
Observations	1,052		1,052		1,052		1,052	

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

Note: 1. By the early 2000s, demand for lead in all types of lead-acid storage batteries represented 88 percent of apparent US lead consumption (USGS 2026). 2. Of all metals, pure silver has the whitest color, the highest optical reflectivity, and the highest thermal and electrical conductivity. Additionally, silver halides are photosensitive. Owing to these properties, silver has many industrial applications, such as mirrors, electrical and electronic products, and photography, which is the largest single end use of silver. Silver's catalytic properties also make it ideal for use as a catalyst in oxidation reactions (USGS 2025).



These results confirm Hypothesis 2 that various financial instruments are used for the acquisition of different minerals. Simply speaking, loans are more likely to be used for energy transition minerals, while grant-funded development projects are used to gain access to minerals such as U_3O_8.

Heterogeneity Analysis by Financial Flow Class

To further investigate the mechanisms underlying the associations observed in Table 4, a heterogeneity analysis by financial flow class is conducted using the GCDF data to assess whether the significant results are primarily driven by ODA-like or OOF-like projects. ODA projects are approved on concessional terms and are intended to promote the economic development and welfare of developing countries, whereas OOF projects are provided on nonconcessional terms or do not primarily target the development and welfare objectives.

Table 5 shows that the significant results for cobalt and silver are mainly driven by OOF projects, while the results for U_3O_8 are more evenly distributed between ODA and OOF projects. Lead becomes statistically insignificant in this specification. The results for cobalt and silver suggest that, although these minerals are important to China, access to them is more strongly associated with nonconcessional forms of development finance. The results for U_3O_8, however, are particularly notable because more than half of the observed association is linked to ODA-like development finance, despite such projects generally being intended as development assistance. This may suggest that U_3O_8 holds a higher strategic value for China, to the extent that China is willing to employ more concessional forms of finance to secure access.

Table 5: Heterogeneity Analysis by Financial Flow Class

	ODA Count TWFE		OOF Count TWFE	
Mineral	***Coefficient***	***SE***	***Coefficient***	***SE***
Cobalt	0.07	(1.14)	2.33 ***	(0.89)
Silver	0.76	(1.14)	2.79 ***	(0.89)
U_3O_8	3.18 **	(1.45)	3.11 ***	(1.14)
Lead	2.46	(1.56)	1.85	(1.23)
Observations	1,247		1,247	

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

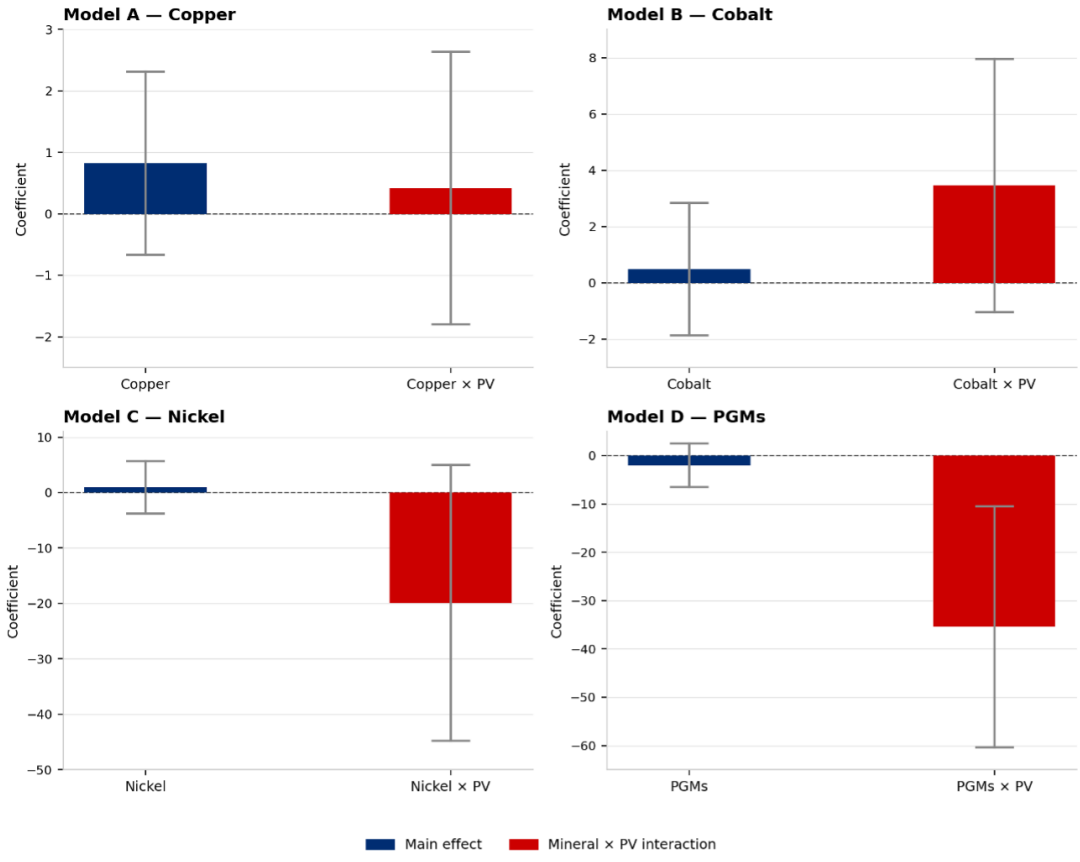


Political Stability and China's Engagement Patterns

To understand whether patterns of development finance and mineral acquisition are influenced by the recipient country's PV level as proposed by hypothesis 3, the analysis includes an interaction term between the binary mineral variable and the PV indicator from the WGI data for minerals with statistically significant results in Table 3. A statistically significant interaction term suggests that the relationship between mineral acquisition and Chinese loans varies according to the recipient country's political environment.

As shown in Figure 5, only the interaction term for PGMs is significant. This finding suggests that the host country's political environment affects the relationship between development finance and PGM acquisition. The negative coefficient indicates that host countries with higher PV scores are associated with fewer PGM-linked loans from China. By contrast, the insignificant interaction terms for copper, cobalt, and nickel suggest that lower PV scores in recipient countries do not affect Chinese loans associated with these minerals, signaling the high perceived value of these resources to China. These results are not consistent with our hypothesis 3, but they corroborate existing literature showing that Chinese finance has a higher tolerance for political risk than Western-backed multilateral development banks (Gallagher et al. 2018; Kaplan 2021). Interestingly, private ODI is more concentrated in politically stable countries (Chen et al. 2016), illustrating the contrast in risk tolerance between state actors and private firms.

Figure 5: Interaction Effects of Political Stability on Mineral-Linked Chinese Loans



Notes: Bars show TWFE coefficients; whiskers are 95% CIs (±1.96 × SE).
Dependent variable: log Chinese loans to Africa. N = 1,194. * p<0.1 ** p<0.05 *** p<0.01

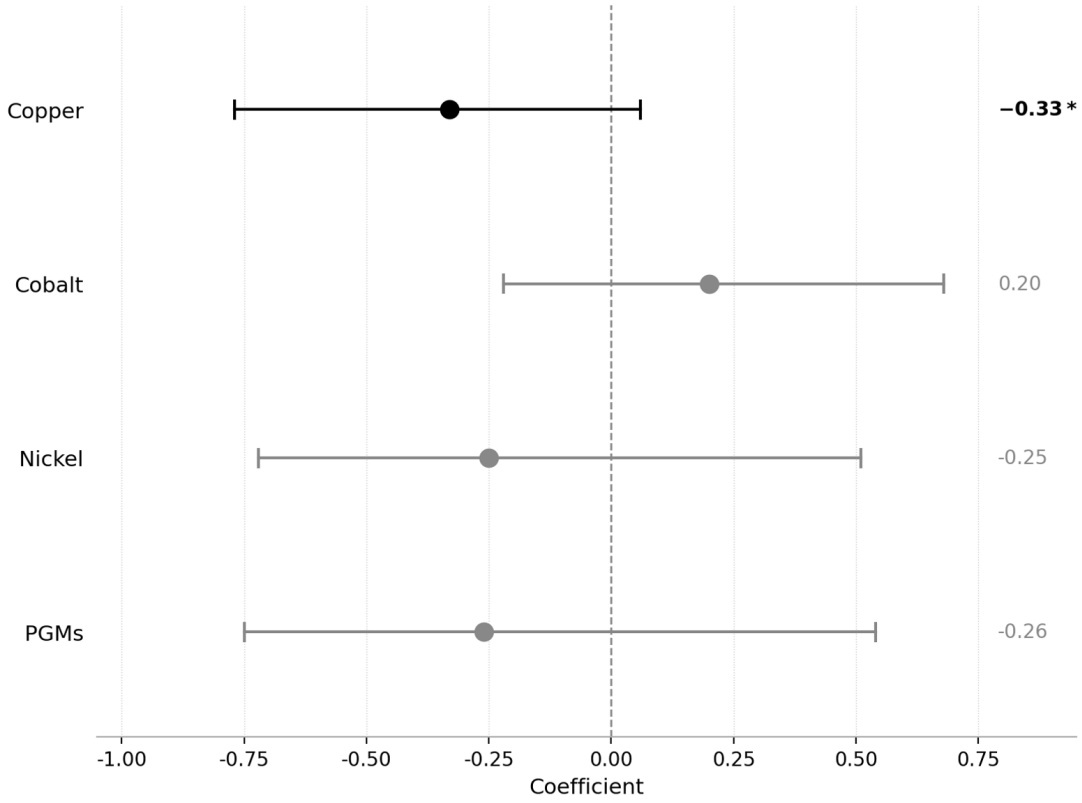


Robustness Check Using US Foreign Assistance Data

To test the robustness of the results, a placebo test is conducted using US foreign assistance data as the dependent variable to examine whether development finance from a non-Chinese bilateral donor predicts Chinese mining acquisitions. In theory, critical minerals linked to Chinese mine acquisitions should not be associated with the amount of foreign assistance received from the US unless the US is also responding to China's mine acquisition patterns.

Figure 6 presents the results of the placebo test using log-transformed foreign assistance amounts from the official US government foreign assistance website (ForeignAssistance.gov n.d.). Almost all critical minerals associated with Chinese loans are insignificant, with only a weakly significant coefficient ($p < 0.1$) for copper. This could either be coincidental or reflect that copper-rich countries required less foreign assistance from the US during the years in which they received more Chinese loans, which would explain the negative coefficient. In general, the placebo test supports the earlier findings that China's development finance is associated with critical transition mineral acquisitions and rejects the claim that resource-rich African countries simply receive more development aid.

Figure 6: Placebo Test Using US Foreign Assistance Data



Notes: TWFE estimates with 95% confidence intervals. N = 1,231.
* p<0.1 ** p<0.05 *** p<0.01



DISCUSSION

The long-standing debate over China's engagement in Africa centers on whether Chinese development finance primarily serves development objectives or strategic interests in natural resource acquisition. This debate is often framed in contrast to traditional Western donors, whose foreign aid is more commonly portrayed as development-oriented and less explicitly reciprocal (Mawdsley 2012). The findings in this paper suggest that these motivations are not mutually exclusive. Instead, Chinese development finance appears to function simultaneously as a tool for infrastructure and development cooperation and as a mechanism for securing access to strategically important minerals.

The Quest for Clean Energy Minerals

The results show a consistent association between Chinese loans and acquisitions of copper, cobalt, nickel, and PGMs—minerals that IEA (2021) identifies as critical to the clean energy transition. These resources are heavily used in electric vehicle batteries, hydrogen technologies, and renewable energy infrastructure. For instance, cobalt and nickel are essential in EV battery chemistries, copper is indispensable for electricity networks, and PGMs are central to hydrogen fuel cells. China's domestic demand further reinforces this link: in 2021, Chinese consumers purchased 3.3 million EVs, more than the total global sales of the previous year (IEA 2022a). Demand for these minerals is also rapidly increasing. According to IEA (2021), cobalt, nickel, and graphite may see demand increases of 6 to 30 times by 2040 relative to 2020.

The insignificance of some other critical minerals in the results also highlights the importance of their geographical distribution. China already controls large reserves or production shares of graphite (USGS 2025a), rare earth elements (USGS 2025c), and germanium domestically, while Chile and Australia have the top two lithium reserves, accounting for over 50 percent of global reserves combined (USGS 2025b). In Africa, therefore, Chinese finance is targeted more selectively—toward those minerals where China is import-dependent and where African resources provide a comparative advantage. This geographic differentiation underscores the strategic logic of China's resource-finance nexus: development loans coincide with access to minerals that China cannot easily supply from home or allied sources.

Different Financial Instruments Serving Different Interests

The results also suggest that China deploys different financial instruments for different minerals. Loans are strongly associated with energy transition minerals, while ODA-like project commitments are more likely to accompany U_3O_8, silver, and lead. This distinction matters. Loans are usually commercial in nature and often repayable on nonconcessional terms, meaning that African governments are effectively mortgaging future revenues from transition minerals in exchange for finance. The finding that cobalt and silver are driven by OOF-type flows reinforces this commercial logic.

The case of uranium is more striking. That ODA-like, grant-style projects are linked to U_3O_8 suggests that China is willing to absorb fiscal costs to access nuclear-related minerals. This aligns with the high strategic value of uranium, not only for civil nuclear power but also for national security considerations. In effect, development assistance is serving dual purposes: advancing diplomatic goodwill while enabling access to strategic resources.



This differentiation in instruments also raises questions about African agency. For countries like Niger and Namibia, where uranium access is tied to ODA-like projects, the line between development cooperation and resource extraction becomes blurred. While governments may welcome grants, the long-term implications may include dependency on external financing tied to strategic concessions. For other development partners, these findings highlight the need to offer alternative financing mechanisms so that African states do not need to trade away strategic resources for basic development projects.

Political Stability and Absence of Violence in the Recipient Country

The heterogeneity analysis further suggests that China's engagement is highly risk tolerant but not uniformly so. For copper, cobalt, and nickel, political stability has no significant moderating effect. This means that even fragile states, with weak governance and high levels of violence, remain attractive as long as they hold the minerals that China deems strategically important. This finding confirms prior arguments (Gallagher et al. 2018; Kaplan 2021) that Chinese finance is less risk-averse than traditional lenders but adds nuance by showing that tolerance varies by resource type.

For PGMs, however, political stability does matter: countries with higher levels of stability and lower levels of violence receive fewer mineral-linked loans. This could reflect two dynamics. First, stable countries may already be saturated with existing contracts, reducing the need for additional lending. Second, fragile environments may offer fewer competitors and weaker bargaining positions, making it easier for China to secure favorable terms.

The findings here are sobering. For fragile African states, resource endowments may attract finance even in the absence of stability, but this finance comes with heightened risks of dependency, corruption, and conflict dynamics. For stable states, the diminishing significance of stability in attracting loans suggests that minerals may outweigh governance considerations in shaping development finance patterns.



CONCLUSION AND POLICY IMPLICATIONS

Understanding the costs embedded in international development finance is essential for enhancing transparency and strengthening recipient countries' negotiating power. Although development finance is rarely nonreciprocal, prevailing narratives of advanced economies "helping" less-developed countries often overlook the reciprocal dimensions of these relationships. To capture this reality, this paper introduces the concept of a development quid pro quo, underscoring the reciprocal nature of these development finance flows.

By combining four datasets, this paper examines the relationship between Chinese development and mine acquisitions in Africa. The results show that Chinese loans are significantly associated with copper, cobalt, nickel, and PGMs—critical minerals for the energy transition on which China is more import-dependent. Additionally, when development project counts are used as an alternative financial measure, cobalt, silver, U_3O_8, and lead are significantly associated with Chinese development projects. The disaggregation by financial flow class further shows that cobalt and silver are linked primarily to OOF-like projects, indicating that China deploys more commercial forms of finance to gain access. By contrast, U_3O_8 appears more evenly split between ODA- and OOF-like flows, highlighting China's willingness to absorb greater costs for strategically important resources. Moreover, the findings on political stability suggest that China displays lower levels of risk aversion when targeting critical transition minerals such as copper, cobalt, and nickel.

These results carry substantial policy implications. First, they highlight the vulnerabilities of global mineral supply chains. China's leading role in clean energy technologies, combined with its dominant position in critical mineral processing, places it on a trajectory toward significant influence in the clean energy economy. Second, the concentration of mineral access and processing in a single country poses risks to energy security, industrial competitiveness, and geopolitical balance elsewhere. To mitigate these risks, recipient countries must strengthen resource governance and negotiation capacity, while multilateral development banks and donor institutions can support transparency initiatives and provide alternative financing mechanisms. At the same time, major economies should pursue diversification strategies, including investments in domestic processing and recycling, to reduce overreliance on a single supplier.

Taken together, this study shows that Chinese development finance functions not only as a tool for advancing recipient countries' infrastructure goals but also as a strategic lever for accessing critical minerals. Recognizing this development quid pro quo is vital for policymakers and scholars seeking to understand the broader implications of international finance in an era of energy transition.

This study faces several limitations that warrant caution in interpreting the findings. First, the use of country-level panel data means that the results are based on aggregated indicators, which may mask important within-country heterogeneity and obscure the mechanisms at play. Second, data availability and quality vary across countries and years, leading to potential measurement error and an unbalanced panel structure. Third, although TWFEs absorb time-invariant country characteristics—such as geological endowments, historical Sino-African ties, and baseline governance quality—as well as global temporal shocks, time-varying country-specific confounders cannot be fully ruled out. A bilateral diplomatic agreement or a domestic industrial policy shift in China could independently drive both loan commitments and mine acquisitions in the same country-year, creating a spurious association. However, several features of the analysis suggest that omitted variable bias is unlikely to reverse the core findings. First, country and year fixed effects already remove the most plausible sources of confounding. Second, the placebo test demonstrates that the same minerals are not associated with US foreign assistance, indicating that the pattern is specific to China rather than a general feature of resource-rich countries attracting development finance. Together, these checks provide reassurance that the associations reported here reflect a genuine China-specific finance-mining nexus, even if strong causal claims remain beyond the scope of the current design.



REFERENCES

Acker, Kevin, Deborah Bräutigam, and Yufan Huang. 2020. "Debt Relief with Chinese Characteristics." Working Paper No. 2020/39. China Africa Research Initiative, School of Advanced International Studies, Johns Hopkins University. https://doi.org/10.2139/ssrn.3745021.

Benabdallah, Lina. 2022. "A Relational Approach to Gift-Giving: China's Aid Exchanges in the Global South." *Global Studies Quarterly* 2 (4): ksac071. https://doi.org/10.1093/isagsq/ksac071.

Bräutigam, Deborah. 2011a. "Aid 'with Chinese Characteristics': Chinese Foreign Aid and Development Finance Meet the OECD-DAC Aid Regime." *Journal of International Development* 23 (5): 752–764. https://doi.org/10.1002/jid.1798.

Bräutigam, Deborah. 2011b. *The Dragon's Gift: The Real Story of China in Africa*. Oxford: Oxford University Press.

Bräutigam, Deborah, and Kevin Gallagher. 2014. "Bartering Globalization: China's Commodity-Backed Finance in Africa and Latin America." *Global Policy* 5 (3): 346–352. https://doi.org/10.1111/1758-5899.12138.

Chen, Wenjie, David Dollar, and Heiwai Tang. 2016. "Why Is China Investing in Africa? Evidence from the Firm Level." *The World Bank Economic Review* 32 (3): 610–632. https://doi.org/10.1093/wber/lhw049.

Cooke, Fang Lee, Jue Wang, Xing Yao, Li Xiong, Jiaying Zhang, and Alice Shuaishuai Li. 2015. "Mining with a High-End Strategy: A Study of Chinese Mining Firms in Africa and Human Resources Implications." *The International Journal of Human Resource Management* 26 (21): 2744–2762. https://doi.org/10.1080/09585192.2015.1071863.

Custer, Samantha, Axel Dreher, Thai-Binh Elston, Brooke Escobar, Andreas Fuchs Fedorochko, Siddhartha Ghose, Joyce Jiahui Lin et al. *Tracking Chinese development finance: An application of AidData's TUFF 3.0 Methodology*. Williamsburg, VA: AidData at William & Mary, 2023.

Dickovick, J. Tyler. 2014. "Foreign Aid and Decentralization: Limitations on Impact in Autonomy and Responsiveness." *Public Administration and Development* 34 (3): 194–206. https://doi.org/10.1002/pad.1691.

Dreher, Axel, and Andreas Fuchs. 2015. "Rogue Aid? An Empirical Analysis of China's Aid Allocation." *Canadian Journal of Economics/Revue canadienne d'économique* 48 (3): 988–1023. https://doi.org/10.1111/caje.12166.

Dreher, Axel, Andreas Fuchs, Bradley Parks, Austin Strange, and Michael J. Tierney. 2022. *Banking on Beijing: The Aims and Impacts of China's Overseas Development Program*. Cambridge: Cambridge University Press.

Eisenman, Joshua. 2018. "Comrades-in-Arms: The Chinese Communist Party's Relations with African Political Organisations in the Mao Era, 1949–76." *Cold War History* 18 (4): 429–445. https://doi.org/10.1080/14682745.2018.1440549.

Ericsson, Magnus, Olof Löf, and Anton Löf. 2020. "Chinese Control over African and Global Mining—Past, Present and Future." *Mineral Economics* 33 (1): 153–181. https://doi.org/10.1007/s13563-020-00233-4.

ForeignAssistance.gov. n.d. "U.S. Foreign Assistance Data" Accessed 2026. https://foreignassistance.gov.



Fulghum, Nicolas, Wilmar Suarez, Katye Altieri, and Kostantsa Rangelova. 2026. *Global Electricity Review* 2026. London: EMBER. https://ember-energy.org/latest-insights/global-electricity-review-2026.

Gallagher, Kevin P., Rohini Kamal, Junda Jin, Yanning Chen, and Xinyue Ma. 2018. "Energizing Development Finance? The Benefits and Risks of China's Development Finance in the Global Energy Sector." *Energy Policy* 122: 313–321. https://doi.org/10.1016/j.enpol.2018.06.009.

Gulley, Andrew, Nedal T. Nassar, and Sean Xun. 2018. "China, the United States, and Competition for Resources That Enable Emerging Technologies." *Proceedings of the National Academy of Sciences* 115 (16): 4111–4115. https://doi.org/10.1073/pnas.1717152115.

Heidhues, Franz, and Gideon A. Obare. 2011. "Lessons from Structural Adjustment Programmes and Their Effects in Africa." *Quarterly Journal of International Agriculture* 50 (1): 55–64. https://doi.org/10.22004/ag.econ.155490.

Hoeffler, Anke, and Olivier Sterck. 2022. "Is Chinese Aid Different?" *World Development* 156: 105908. https://doi.org/10.1016/j.worlddev.2022.105908.

IEA (International Energy Agency). 2021. *The Role of Critical Minerals in Clean Energy Transitions*. Paris: IEA.

IEA. 2022a. *Global Supply Chains of EV Batteries*. Paris: IEA.

IEA. 2022b. *Special Report on Solar PV Global Supply Chains*. Paris: IEA.

IEA. 2023. *World Energy Outlook 2023*. Paris: IEA.

IEA. 2024. Energy Technology Perspectives 2024. Paris: IEA.

IPCC (Intergovernmental Panel on Climate Change). 2023. *Climate Change 2021: The Physical Science Basis*. 1st ed. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781009157896.

Kaplan, Stephen B. 2021. *Globalizing Patient Capital: The Political Economy of Chinese Finance in the Americas*. Cambridge: Cambridge University Press.

Kara, Siddharth. 2023. *Cobalt Red: How the Blood of the Congo Powers Our Lives*. New York: St. Martin's Press.

Kolstad, Ivar, and Arne Wiig. 2012. "What Determines Chinese Outward FDI?" *Journal of World Business* 47 (1): 26–34. https://doi.org/10.1016/j.jwb.2010.10.017.

Lee, Ching Kwan. 2018. *The Specter of Global China: Politics, Labor, and Foreign Investment in Africa*. Chicago: University of Chicago Press.

Mawdsley, Emma. 2012. "The Changing Geographies of Foreign Aid and Development Cooperation: Contributions from Gift Theory." *Transactions of the Institute of British Geographers* 37 (2): 256–272. https://doi.org/10.1111/j.1475-5661.2011.00467.x.

Monson, Jamie. 2009. *Africa's Freedom Railway: How a Chinese Development Project Changed Lives and Livelihoods in Tanzania*. Bloomington: Indiana University Press.

Moses, Oyintarelado, Cecilia Springer, and Kevin P. Gallagher. 2023. "Demystifying Chinese Overseas Lending and Development Finance." GCI Policy Brief No. 018. Boston University Global Development Policy Center.

Naím, Moisés. 2007. "Rogue Aid." Foreign Policy 159: 95–96. https://www.jstor.org/stable/25462153.

National Development and Reform Commission. 2015. *Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road*. March. https://web.archive.org/web/20181127225143/http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html.



Odoom, Isaac. 2017. "Dam In, Cocoa Out; Pipes In, Oil Out: China's Engagement in Ghana's Energy Sector." *Journal of Asian and African Studies* 52 (5): 598–620. https://doi.org/10.1177/0021909615599419.

Owusu, Solomon, Keyi Tang, and Gideon Ndubuisi. 2025. "Chinese Ties and Low Carbon Industrialization in Africa." *Energy Economics* 144: 108352. https://doi.org/10.1016/j.eneco.2025.108352.

Ramasamy, Bala, Matthew Yeung, and Sylvie Laforet. 2012. "China's Outward Foreign Direct Investment: Location Choice and Firm Ownership." *Journal of World Business* 47 (1): 17–25. https://doi.org/10.1016/j.jwb.2010.10.016.

Ren, Xiaojuan, Fengyan Fan, Qunyi Liu, and Yan Lv. 2025. "Evaluation of the Importance of Critical Minerals in China." *Frontiers in Earth Science* 13: 1491360. https://doi.org/10.3389/feart.2025.1491360.

Sautman, Barry, and Yan Hairong. 2019. "Chinese Mining in Africa and Its Global Controversy." In *Africa's Mineral Fortune*, edited by Saleem H. Ali, Kathryn Sturman, and Nina Collins, 45–62. London: Routledge.

Shinn, David H. 2019. "China–Africa Ties in Historical Context." In *China–Africa and an Economic Transformation*, edited by Arkebe Oqubay and Justin Yifu, 61–83. Oxford: Oxford University Press.

Summers, Lawrence H., and Lant H. Pritchett. 1993. "The Structural-Adjustment Debate." *The American Economic Review* 83 (2): 383–389.

Tan-Mullins, May, Giles Mohan, and Marcus Power. 2010. "Redefining 'Aid' in the China–Africa Context." *Development and Change* 41 (5): 857–881. https://doi.org/10.1111/j.1467-7660.2010.01662.x.

US Department of Energy. n.d. "What Are Critical Materials and Critical Minerals?" Accessed 2026. https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals.

USGS (US Geological Survey). 2020. "Mineral Supply Chain Risk Methodology." February 21. https://www.usgs.gov/media/images/mineral-supply-chain-risk-methodology.

USGS. 2025a. "Graphite." *Mineral Commodity Summaries* 2025. https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-graphite.pdf.

USGS. 2025b. "Lithium." *Mineral Commodity Summaries 2025*. https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-lithium.pdf.

USGS. 2025c. "Rare Earths." *Mineral Commodity Summaries* 2025. https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-rare-earths.pdf.

Walsh, K., S. Zhang, A. Malik, B. Escobar, and J. Zimmerman. "Tracking China's Transition Mineral Financing: Methodology and Approach, Version 1.0." *Williamsburg, VA: AidData at William & Mary 1* (2025).

Wegenast, Tim, Mario Krauser, Georg Strüver, and Juliane Giesen. 2019. "At Africa's Expense? Disaggregating the Employment Effects of Chinese Mining Operations in Sub-Saharan Africa." *World Development* 118: 39–51. https://doi.org/10.1016/j.worlddev.2019.02.007.

Woods, Ngaire. 2008. "Whose Aid? Whose Influence? China, Emerging Donors and the Silent Revolution in Development Assistance." *International Affairs* 84 (6): 1205–1221. https://doi.org/10.1111/j.1468-2346.2008.00765.x.

Zhang, Hongliang, Heng Yu, Wei Sun, Shangyong Lin, and Chenyang Zhang. 2024. "Beneficiation of Silver and Silver-Bearing Lead–Zinc Ores: A Review." *Minerals Engineering* 208: 108608. https://doi.org/10.1016/j.mineng.2024.108608.



Zhao, Jinjing, Yunfan Gao, Qihang Lang, Chenlu Gao, and Miao Su. 2025. "Technology Transfer and Political Alignment: New Evidence from China's Outward Foreign Direct Investment (OFDI) in Africa." *Humanities and Social Sciences Communications* 12 (1): 1690. https://doi.org/10.1057/s41599-025-05964-9.

Zhou, Yanjing, Jianwu Li, Gaoshang Wang, Shouyu Chen, Wanli Xing, and Tianjiao Li. 2019. "Assessing the Short- to Medium-Term Supply Risks of Clean Energy Minerals for China." *Journal of Cleaner Production* 215: 217–225. https://doi.org/10.1016/j.jclepro.2019.01.064.

Zou, Yang, Jiajun Xu, and Ugo Panizza. 2026. "Comparing Financial Returns: National Development Banks vs Commercial Banks." *Pacific-Basin Finance Journal* 98: 103171. https://doi.org/10.1016/j.pacfin.2026.103171.



BU Global Development Policy Center

Boston University
53 Bay State Road
Boston, MA 02215

gdp@bu.edu
@GDP_Center
bu.edu/gdp



The Global China Initiative (GCI) is a research inititiative at Boston University Global Development Policy Center. The GDP Center is a University wide center in partnership with the Frederick S. Pardee School for Global Studies. The Center's mission is to advance policy-oriented research for financial stability, human wellbeing, and environmental sustainability.

www.bu.edu/gdp

The views expressed in this Working Paper are strictly those of the author(s) and do not represent the position of Boston University, or the Global Development Policy Center.

