



PEKING UNIVERSITY
Institute of New Structural Economics

A Study on the Effectiveness of China's Sovereign Financing in Africa

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Department of International Development Cooperation
Institute of New Structural Economics at Peking University



Table of contents

Chapter 1.	Introduction	2
Section 1.	Global Policy Background and Theoretical Framework	2
Section 2.	The History of Sovereign Financing	4
Section 3.	The Definition of Sovereign Financing in This Study	6
Chapter 2.	China's Financing System in Africa	7
Section 1.	Current Situation of Sovereign Financing in Africa	7
Section 2.	China's Financing Structure in Africa	10
Chapter 3.	Empirical Analysis of the Effectiveness of China's Financing in Africa	15
Section 1.	Literature Review	15
Section 2.	Research Questions and Hypotheses	17
Section 3.	Regression Model	17
Section 4.	Empirical Results	21
Chapter 4.	Cases on the Effectiveness of China's Financing in Africa	33
Section 1.	Transportation	35
Section 2.	Energy	37
Section 3.	Digitalization	40
Section 4.	Benefiting People's Livelihood	42
Chapter 5.	Summary of Main Findings and Policy Recommendations	45
Section 1.	Summary of Main Findings	45
Section 2.	Policy Recommendations	48
Annex		52
References		63



Chapter 1. Introduction

Section 1. Global Policy Background and Theoretical Framework

In 1944, the international community established a post-war reconstruction and economic cooperation mechanism with the World Bank and the International Monetary Fund as the core. Since 1973, the World Bank has proposed the ‘twin goals’ of eradicating global extreme poverty and promoting shared prosperity. During this period, China achieved great economic development results. In 1978, China’s per capita GDP (current US\$156.4) was less than one-third that of Sub-Saharan Africa (current US\$507.5). By 2022, China’s per capita GDP reached current US\$ 12,720.2, making it an upper-middle income country. Most countries in Africa are in a stage of low savings and low taxes and have low income levels with limited fiscal capacity. Since 2000, China has provided and gradually increased financing for Africa’s economic structural transformation, supporting the development of various fields including infrastructure, economic and social development, and debt sustainability. China’s financial support to Africa has promoted the realization of global mainstream development policy goals and is an important component and a new force of the existing development financing system. With China’s infrastructure construction in Africa, traditional industrialized countries have also increased their attention to the field of infrastructure construction in Africa, for instance, Japan’s support for ‘high-quality infrastructure’ in Africa. During the G7 summit in May 2023, the United States announced the financing and construction of the Lobito Atlantic Railway Corridor in West Africa, demonstrating the influence of China and Africa on the development concepts to the global community.

Except for a few economies such as China and the Four Asian Tigers, there are very few economies that have successfully achieved economic catch-up. According to the structuralism advocated by mainstream economics from the 1950s to the 1970s, and the neoliberalism from the late 1980s to the present, the role of the government in shaping efficient markets has been eliminated. As a result, economic transformation has almost completely failed (Lin and Wang, 2020). Policy practitioners and scholars in various countries are trying to dispel the myth of effective growth. Infrastructure construction is a successful experience for many East Asian countries in achieving rapid catch-up. It is widely known in China that if you want to get rich, you need to build roads first. After the war, the World Bank also focused on supporting infrastructure construction in Europe, Japan and China in the early 1990s. However, under neoliberalism, international policies advocate leaving infrastructure problems to the market, which often leads to unprofitable projects and bankruptcy, the lack of sufficient construction funds, and the neglect of the role of the government.

New structural economics is a structural revolution in modern economics. It is an original theory based on the observation of successful and failed economic development experiences. It advocates the combination of promising government and effective markets. Infrastructure requires a large amount of capital investment, and due to its positive externality attributes, it requires the support of government funds. In the early industrialization period, the governments of many developing countries face a shortage of funds and require external financing. Therefore, support from



international development funds is needed for developing countries. From the perspective of new structural economics, China's financing in Africa helps strengthen Africa's infrastructure construction, thereby reducing transaction costs. China's funding for Africa is an unprecedented force that vigorously promotes infrastructure construction in Africa. For African countries, borrowing countries need to further develop industries, which are consistent with their potential comparative advantages based on factor endowments, transform potential competitiveness into actual comparative advantages, promote growth, boost exports, create foreign exchange, and repay debts that fundamentally achieve debt sustainability (Lin, 2023). New structural economics believe that the factor endowments and industrial structures of developed and developing countries are different. The factor endowments of an economy at a specific time are given, including the relative abundance of labor, natural resources, human capital and physical capital. Therefore, the industrial structure adapted to each economy, such as industrial capital intensity, optimal enterprise size, market scope, transaction complexity, etc., are all different. In order to achieve an optimal industrial structure, supporting infrastructure is needed to reduce operating and transaction costs. Economic development is essentially a process of continuous technological and industrial innovation and structural changes (Lin, 2011). In the process of industrial development, factor endowments will continue to change. The government promotes the improvement of infrastructure, helps coordinate and optimize resource allocation, and further supports the continuous upgrading of economic structure.

In order to achieve debt sustainability, the debt use structure needs to be refined in the loan process. It is not only necessary to analyze it from a macro budget perspective, but also to pay attention to the cash flow and the public assets formed from the project level. China's financing loans to Africa are project-based. At the project level, they have the basis of debt sustainability. In terms of debt repayment, since most of Africa's sovereign debts are currently dominated by US dollars, the cash flow of many infrastructure projects is in local currency and cannot be directly used for debt repayment. Therefore, Africa develops industries based on its comparative advantages, and its fundamental ability to earn foreign exchange from exports is crucial to debt sustainability. At present, China's financing in Africa is mainly focused on infrastructure construction, which is the basis for starting a virtuous debt cycle, for generating self-growing capacities. Issues such as industrial development, market economic vitality, and exports require a package of solutions, which cannot be undertaken by one single financing institution. In contrast, they require the participation of many enterprises, forming a closed loop of debt and development interaction in Africa.

Due to changes in the international environment, US dollar interest rate increases have aggravated the debt burden. The current debt repayment environment of African countries has deteriorated, and the timing is not conducive to the debt repayment of African countries. China has implemented a series of debt suspension plans to create favorable conditions for Africa's debt sustainability and further contribute to the effectiveness of long-term financing in Africa. However, in the absence of an effective debt management mechanism in the international community and the external impact of the COVID-19 pandemic, many African countries have fallen into a liquidity crisis. In order to manage debt pressure, the international community also restricts financing. From the perspective of new structural economics, we should pay attention to the infrastructure and production-oriented projects that can generate growth capacities, and focus on the debt use structure rather than restricting financing.



China's financing in Africa mainly involves sovereign loans to Africa from Chinese development financing institutions and commercial institutions. In the 'Decision of the State Council on Financial System Reform' issued in 1993, China proposed the establishment of policy banks to separate policy financing from commercial practices. In 1994, China established policy banks to implement policy goals and development issues. Since 2000, as Chinese enterprises 'going abroad', African countries have sought financing support from China through sovereign credit. This coincides with the market-oriented fund-raising reform of China's policy financing institutions, shifting from the administrative bond distribution led by the central bank to the market-oriented financing. Furthermore, the increase in the capital pool of China's policy financing institutions enhanced the capacity and supply of loans to Africa.

In addition to China, funding for African countries come from various sources. The largest category of foreign debt is multilateral institutions, while other creditors include governments and commercial banks. Due to the heterogeneity of creditors, data availability, and legal issues, there is currently no systematic research on the benefits of each creditor's financing and whether it promotes Africa's development. As an emerging economy, China provides financing to developing countries under various bilateral and multilateral mechanisms, including its contribution to the World Bank, to promote the United Nations Sustainable Development Goals. China and the African continent are the cornerstones of South-South cooperation in a community with a shared future for mankind. Issues such as the effectiveness, the development methods, and the policy orientation of China's financing in Africa need to be further analyzed. This not only has policy research value for China, but also has important reference significance for South-South cooperation and the international sovereign debt market mechanism.

Therefore, this study focuses on the overall effect of China's financing cooperation in Africa, and discusses the effectiveness of China's financing cooperation in Africa from the perspectives of economic benefits, social benefits, and debt sustainability. Due to the difficulties in data collection for African projects, this study adopts quantitative analysis and case studies through publicly available project-level contract commitment loan data collected by a third party.

Section 2. The History of Sovereign Financing

Government borrowing is very important for macroeconomic and fiscal management. The purpose of financing reflects the main development goals of the government and society. In the 1260s, the Italian popes made initial attempts to borrow money; to finance wars, sovereign lending was further developed in medieval Europe (Eichengreen et al, 2018). In the 19th century, European countries borrowed heavily for industrial infrastructure construction and production. In modern times, debt borrowing in Europe turned to the issue of national post-war reconstruction after World War I and World War II. Sovereign financing is divided into external financing and domestic debt. In the stage of low income, when a country's domestic market financing capacity is limited, foreign debt can increase fiscal sources. While borrowing externally, a country will also establish independent Development Financing Institutions (DFI) to promote its policy goals. Developed countries have completed industrialization, and their policy and financial institutions attach more attention to public issues such as economic crisis management, social welfare, and climate change.



The vast number of developing countries are at different stages of structural transformation and upgrading. According to statistics from the development financing project of the Institute of New Structural Economics at Peking University¹, the institutional mission of DFIs in low- and middle-income countries focuses on infrastructure construction. Most of the missions of DFIs in low-income countries are not specifically targeted at one sector that allow them to support a wide range of fields. Development goals are endogenous to the stage of economic development. In terms of the average number of DFIs per country, low-income countries only have an average of 0.9 such institution, while middle-income and high-income countries have an average of about 2 development financing institutions. Most African countries are low-income or low-middle-income economies with limited domestic sources of funds and need to seek external financing. Most of China's financing projects in Africa are concentrated in the field of infrastructure construction, which is consistent with the development needs of its income level stage. Those projects are growth-oriented. Hence, they greatly supplement the lack of development financing capabilities of African countries at this stage. African borrowing was a structural feature of early industrialized societies.

Africa has extensively experimented sovereign borrowing in the international market, and the International Monetary Fund (IMF) has used multiple indicators to form guidance on its debt situation. These indicators include exports, the ratio of debt stock to GDP, etc. (IMF, 2005). In 2018, IMF's research further calculated the overall asset and liability situation of many countries, providing more perspectives for exploring debt sustainability issues (IMF, 2018). In addition to increasing debt, borrowing to build infrastructure projects also forms a country's fixed assets. In previous studies, we focused too much on liabilities and ignored national assets formation (Wang and Xu, 2023). There are currently no universal statistics on the public assets of African countries. Some scholars suggest that by focusing on national assets formed by debt, we can measure the country's development potential and better understand debt sustainability issues. At the same time, the national assets formed by infrastructure construction can also be used for refinancing, such as providing equity financing, or even conducting open market transactions. Listing and holding through public funds will benefit the people, improve asset liquidity, and form a new perspective in managing infrastructure-debt-development issues. China has already tried this measure, such as the launch of the Beijing-Shanghai high-speed rail in 2020(Wang and Xu, 2023). The key to debt is whether it can be used to drive development, support viable projects, and improve long-term sustainability.

At a practical level, a package of solutions is needed from the financing, infrastructure construction to industrial viability building. New structural economics believe that if the government does not have the ability to upgrade infrastructure on a large scale, it can meet the infrastructure conditions required for business operations on a small scale, such as at the industrial park level, and develop industries that are in line with the nations' comparative advantages. At the same time, improving the infrastructure development of the industrial park can also bring a certain amount of cash flow, creating a virtuous cycle starting from the local area, and further upgrading the industry and improving infrastructure conditions in a snowballing manner. Since debts need to be repaid in U.S. dollars, the industrial park also

¹ Data source: Development Financing Database of Peking University Institute of New Structural Economics. Xu, Jiajun, Régis Marodon, Xinchun Ru, Xiaomeng Ren, and Xinyue Wu. 2021. 'What are Public Development Banks and Development Financing Institutions? — Qualification Criteria, Stylized Facts and Development Trends'. *China Economic Quarterly International*, volume 1, issue 4: 271- 294. Website: <http://www.dfidatabase.pku.edu.cn/zh/sjksh/index.htm>



needs to cultivate export-earning industries to promote debt sustainability. In terms of industrial policy, if the development field is too advanced or does not match the comparative advantage, it will lead to the inability to repay debts. If debt is used in non-productive sectors and does not directly promote structural transformation, such as investing in education, medical care, etc., and does not directly create foreign exchange, it will generate debt pressure and affect debt sustainability (Lin, 2023). International mechanisms also need to make more efforts, such as playing a greater role in providing liquidity and responding to debt crises. At the same time, in the context of the increasing role of creditors in developing countries, they need to make innovations in public utilities and seek systemic change (Xu and Carey, 2016).

Section 3. The Definition of Sovereign Financing in This Study

The category of financing in Africa that this study focuses on is sovereign loans to Africa. International standards refer to the World Bank’s definition of public and publicly guaranteed debt, and China adopts the definition of the Ministry of Finance. Both parties have similar connotations and understandings of sovereign loans, that is, they clearly cover debts of the broad public sector, including debts for which a country provides its sovereign guarantee. Detailed definitions are showed in Table 1 below.

Table 1: Definition of Sovereign Debt

Main body	Source	Original
Chinese government	‘Debt Sustainability Framework for Participating Countries of the Belt and Road Initiative’ (BRI-DSF) of the Ministry of Finance of China	The BRI-DSF defines the debt coverage as the future payments of interest and/or principal that are required from the public debtor to the creditor, including debt securities, loans and other accounts payable. Public sector, in its broadest definition, comprises several different sub-sectors. These include the general government (comprising the central, the state, and the local governments, social security funds, and extra-budgetary funds); financial and nonfinancial public enterprises; central bank.
World Bank	WDI-Data Bank Metadata Glossary, PPG; (See the definition of External debt stocks, public and publicly guaranteed (PPG) for details)	Public and publicly guaranteed debt comprises long-term external obligations of public debtors, including the national government, Public Corporations, State Owned Enterprises, Development Banks and Other Mixed Enterprises, political subdivisions (or an agency of either), autonomous public bodies, and external obligations of private debtors that are guaranteed for repayment by a public entity.



After clarifying the research category, Chapter 2 analyzes China's financing situation in Africa, including debt structure, business field distribution, financing methods, policy concepts, development trends and other issues. By further understanding the African sovereign debt market, the mechanisms and the characteristics of each creditor, we can better understand the role of China's financing in Africa. Chapter 3 reviews the literature and comprehensively evaluates China's financing projects in Africa from 2000 to 2020 through an econometric regression model. It uses the Chinese Loans to Africa Database (CLA) to evaluate the sustainability of relevant economic, social development and African debt. Considering endogeneity issues and heterogeneous characteristics such as creditors and financing sectors, it also observes the effectiveness characteristics of financing in Africa. Chapter 4, at the micro level of the project, uses cases to show how China's financing in Africa shapes the public goods of the African continent. Focusing on the role of financing in promoting debt sustainability and increasing foreign exchange, it also analyzes Africa's development conditions, endowment advantages, development stages, and development needs, as well as the importance of a facilitating government and an effective market. Chapter 5 summarizes the main findings and puts forward corresponding policy recommendations to further promote the effectiveness of financing in Africa in the future.

Chapter 2. China's Financing System in Africa

Section 1. Current Situation of Sovereign Financing in Africa

According to the International Debt Statistics (IDS) released by the World Bank in 2022, as of 2021, the largest source of external debt for African sovereign financing is multilateral institutions, accounting for 33%. Following this, international market supported commercial bonds constitute 30% of the debt (Wang and Xu, 2023). African governments have diverse sources of financing, involving various market entities and official organizations, and exhibit high heterogeneity in the regulations, the funding purposes, and the supported sectors.

1.1 Sources of Sovereign Financing in Africa

Creditor entities can be categorized into multilateral, bilateral, and commercial/private sector creditors. Among these, multilateral and bilateral credits fall under the official creditor category, with sovereign credit support. Multilateral creditors have super-sovereign credit. Common examples of multilateral creditors include multilateral development banks (MDBs), such as the World Bank and the African Development Bank, established with sovereign credit support from member countries. Bilateral creditors consist of sovereign governments, banks, and other types of financial institutions. Countries with lower income, due to limited capabilities for commercial credit, exhibit a greater demand for official credits. Different funding sources enjoy variations in repayment priority and negotiation power during debt restructuring. Contrary to the conventional belief that official creditors are more favorable in safeguarding their interests, some research suggests that in actual debt restructuring, debtor countries often tend to default on official creditors (Wright et al., 2019). In 1996, among the 37 developing countries participating in the Heavily Indebted Poor Countries Initiative, commercial credits accounted for only 10% (Xu Qiyuan et al., 2023). Over the past 40 years, the composition of the creditor structure in developing countries has changed significantly, with a substantial increase in the proportion of private/commercial credits, intensifying the competitiveness of the sovereign financing market and the complicating coordination efforts related to debt issues.



1.2 Cost Differences in African Sovereign Financing

Regarding the cost of funds, official creditors, due to their sovereign credit support or fiscal subsidies, can provide concessional loans at lower interest rate levels. Multilateral creditors, benefiting from super-sovereign credit and having core shareholder countries with excellent creditworthiness, enjoy extremely low financing costs and can provide subsidies to alleviate the debt burden of borrowing countries. Commercial creditors typically offer interest rates at market levels. Certain multilateral development financing institutions, exemplified by the World Bank, set loan rate standards based on the income levels of the borrowing economy, designating different categories. Lower-income countries are eligible for more favorable loan terms, while countries that achieve a certain income standard graduate from lower-cost categories into higher-cost ones. According to the International Monetary Fund for 2023, there are currently 33 out of 85 Highly Indebted Poor Countries (HIPC) in Africa, all in Sub-Sahara Africa². However, in terms of commercial financing practice, the lower income economies, the less developed markets, and the scarcer capital often correspond to higher borrowing interest rates, aiming to compensate for the associated investment risks. Official creditors and commercial creditors have significantly different considerations regarding costs and risks, reflecting their distinct requirements for the effectiveness adoptions.

1.3 Preferences for the Effectiveness

When it comes to defining effectiveness, African countries lack a theoretical framework for their own recognition of the effectiveness of international development funds. There is generally a lack of the systematic tracking, evaluation, and data collection for development projects. The concept of effectiveness in international development financing is more commonly associated with the policy ideology under the neoliberalism. The majority of core shareholder countries at the World Bank are traditional industrial donor countries, and they play a dominant role in directing the use of funds, rather than the borrowing countries guiding policy directions. Financing and debt are two sides of the same coin in fund utilization. International organizations' assessments are based on the national-level debt management rather than the project-level sustainability. In addition, infrastructure projects may have service lifecycles of up to 50 to 100 years, and the timing of the assessments can attribute to a different view of the result. Evaluating debt management at a particular moment at the national level and assessing the effectiveness of infrastructure at the project level can yield different results. Financing may create debt pressure in the short term, while the effective operation brings about development effectiveness in the long term. Infrastructure project financing does not result in a trap but cultivates future development. Multilateral institutions excel in debt management for borrowing countries, while China's strength lies in the project formation to enhance growth. The two can complement each other effectively, as such by the World Bank subsidizing developing countries to reduce debt pressure. China can finance the project to initiate growth. China's support is based on the needs of African countries. The projects are carried out under the national plans of these countries. In recent years, many African countries have depicted China- financed infrastructure on their national currency, demonstrating the recognition of the project. This study focuses on the effectiveness, observing China's financing impact on African countries' socio-economic development indicators. It seeks to

² Refer to the International Monetary Fund HIPC list, which can be found at <https://www.imf.org/en/About/Factsheets/Sheets/2023/Debt-relief-under-the-heavily-indebted-poor-countries-initiative-HIPC>. Accessed on July 18, 2023.



determine whether these funds contribute to achieving the global Sustainable Development Goals, which are universally recognized development results.

We can see that the creditors have a dominance in their conceptualization of the effectiveness. Official creditors have clear policy preferences in the use of development financing. Multilateral, bilateral, and commercial creditors have differences in the purposes of the fund utilization and their policy space, as shown in Table 2. These differences among various creditors can be utilized to better promote financing cooperation in Africa.

Table 2: Preferences of Various Financing Sources and Creditors for the Effectiveness Objectives

Creditors type	Financial return	Development benefits	Policy Ideas
Multilateral	Secondary	Prioritized	Prioritized
Official Bilateral	Secondary	Prioritized	Developed countries lead the policy guidance for borrowing countries and often act jointly with the multilateral banks; developing countries have limited influence on borrowing countries' policies but are gradually strengthening their influence.
Private /Commercial	Prioritized	Limited consideration	Limited consideration

(1). Multilateral Creditors Leading Development Policies

Multilateral banks, with member governments as shareholders, engage in policy dialogue with borrowing countries. They make lending's with policy directions in African countries. Their assessment mechanisms are well established, with very good documentations and data records. World Bank's policy objectives for Africa explicitly state the need to enhance the effectiveness of African government institutions, 'Making Institutions More Efficient and Accountable'³. The Design & Monitoring Framework (DMF) serves as a tool for managing the effectiveness. The Asian Development Bank (ADB) establishes the DMF at the planning stage, mapping out dimensions such as the project finance and the macroeconomic performance. Typically, there are three assessments conducted: first, the executing entity of the borrowing country conducts a self-assessment; second, the ADB conducts an evaluation at the bank level; and finally, ADB conducts a third-party evaluation, involving the design and analysis of indicators for individual projects by external scholars and experts, with all evaluation results available online. The procedures are identical for both the ADB and the World Bank.

Multilateral institutions engage in policy coordination with host governments to ensure the operational effectiveness of projects, such as setting electricity prices, which can have a significant impact on the viability and debt collection of projects in the power sector. Sovereign financing involving various creditors. Multilateral banks conduct coordination meetings with the borrowing country's other creditors to discuss policies, development concepts, so as to

³ For the World Bank's policy on Africa, please refer to the document 'Supporting Africa's Transformation - World Bank Africa Strategy for 2019-2023'.



ensure a common ground for development. Multilateral development banks, primarily initiated and led by developed countries, generally adhere to the Washington Consensus and follow theoretical guidance provided by the Western academia. China, and other emerging economies like India, are gradually adding a developing country perspective to the international development policy.

(2). The Policy Objectives of the Bilateral Official Creditors

Bilateral official creditors exhibit significant heterogeneity in their policy objectives. Each country has its own policy preferences, while the financial returns are not their primary objective. Developed industrialized countries place greater emphasis on sectors as education, health, gender equality, biodiversity, and addressing historical issues. The United Kingdom, for example, has been aiding Africa since 1929. A former UK Prime Minister mentioned Africa as ‘a scar on the conscience of the world’. UK conducted international development policies for the historical compensation and is also motivated by a few other factors, such as for the commercial interests, diplomacy, security, and poverty reduction in developing countries (Hudson, 2006). In addition to addressing climate change and social development, China’s engagement with Africa is particularly highlighted in the field of infrastructure development. Different countries have varying policy priorities.

The cost of funds and lending capacity of the official bilateral creditors are influenced by the development level of their financial markets. There are various forms of financing, including grants, interest-free loans, concessional loans, and financing with market standard. There are also significant operational differences among creditors in terms of project management, the communication with its domestic residents, and information disclosure. Since the world war two, bilateral official creditors have been primarily composed of developed and industrialized countries, who are major shareholders in multilateral banks. In recent years, with the development of emerging economies, including China, official creditors from developing countries have played an increasingly prominent role, providing greater support for various global development issues. China supporting both the bilateral and multilateral systems has a significant impact on the global development.

(3). Private/Commercial Creditors Motivated by Profit Maximization

From the perspective of commercial creditors, project effectiveness is how it can maximize the return on investment. Unlike official creditors who focus on development effectiveness, the private/commercial creditors are more concerned with financial metrics. African countries have accumulated some high-cost debt, with very close mature year and no specific targeting project. The investment demand of funds in developed countries contributing to the aggressive lending behavior of the African nations, encouraging them to issue Eurobonds, which is not conducive to the sustainable development of Africa. For example, in recent years, promoted by the international financial markets, Zambia issued international bonds which fostered its debt pressure and liquidity risks (Tang, 2022).

Section 2. China’s Financing Structure in Africa

2.1 Trends of China’s Financing to Africa



We can classify China's creditors into two groups, the official and the non-official creditors. China's official creditors join the debt relief of the borrowing countries. We apply the definition to the various creditor disclosed in the database. Following this definition, Chinese official creditors are the Export Import Bank of China, China International Development Cooperation Agency (CIDCA), the central bank, and creditors labeled as government institutions in the database. The others are the non-official creditors, among which China Development Bank is the development finance creditor, with the remaining commercial creditors. The database we use is the Chinese Loans to Africa Database (CLA) managed by the Global Development Policy Center at Boston University, which tracks the loan commitment. From 2000 to 2020, China's sovereign financing to Africa was primarily conducted by its official creditors, accounting for 56%. The lending experienced slow growth in the early 2000s. Around 2010, China's loans to Africa entered a period of rapid growth, with a richer composition of financing, and both the development finance and commercial loans have become more active. In recent years, the international market is becoming uncertain, leading to a decrease in African countries' borrowing wills, while China's new loans to Africa have decreased. Post pandemic the international travel recovered, various investment and financing activities worldwide have resumed. In the first half of 2023 alone, China's new direct investment in Africa reached \$1.82 billion, with a year-on-year increase of 4.4%. In August 2023, China announced an 'Initiative in Support of Africa's Industrialization', committed the \$10 billion investment in Africa and the \$10 billion in credit lines to support small and medium-sized enterprises. China's investment and financing activities in Africa are expected to resurge. In terms of national distribution, China's financing for Africa is concentrated in low-income and lower-middle-income African countries, accounting for over 90% of the total funding and 87% of the total number of projects. China's financing for Africa targets the most sluggish areas of development, addressing bottlenecks in African countries (Wang and Xu, 2023).

2.2 Policy Framework and Evolution

China's financing for Africa follows China's policy guidance. In 2000, the Forum on China-Africa Cooperation (FOCAC) was established, serving as a platform to articulate China's financing philosophy for Africa. FOCAC holds ministerial-level meetings every three years, where the Chinese government collaboratively discusses policy directions with African nations. Since its inception in 2000, China's financing for Africa has been evolving. Infrastructure development has been a crucial experience for East Asian countries in achieving economic structural transformation. Due to limited space for China to support African infrastructure through multilateral mechanisms, in 2013, China introduced the 'Belt and Road Initiative' (BRI) to enhance financing support for developing countries, in particular for infrastructure development. This initiative led to increased activity in both development finance and commercial lending compared to previous years.

In 2016, the Johannesburg Summit of the FOCAC introduced the 'Ten Major Cooperation Plans' which further emphasized the industrialization goal of Africa, aiming to support African Union's 'Agenda 2063'. The objective is to have the manufacturing sector contributing to more than 50% of Africa's GDP by 2063. China's financing for Africa primarily encompasses infrastructure development, such as transportation, energy, telecommunications, and water supply, accounting for approximately 67.7%, as shown in Table 3. In addition to infrastructure support, China's financing for Africa also extends to social sectors, including healthcare, medical services, and food security.



China's support for Africa aligns closely with the United Nations Sustainable Development Goals (SDGs). The SDGs encompass a total of 17 sub-goals. China's support for infrastructure and industrial production projects in Africa contributes to the achievement of several SDGs, including SDG 1 No Poverty, SDG 8 Decent Work and Economic Growth, and SDG 9 Industry, Innovation, and Infrastructure. Projects related to food security directly contribute to SDG 2 Zero Hunger. Water supply projects help improve SDG 6 Clean Water and Sanitation. Educational initiatives contribute to the realization of SDG 4 Quality Education. Projects in the healthcare sector support SDG 3 Good Health and Well-being. Energy projects, particularly those focused on clean energy that unleash the endowment of Africa's natural resources, contributing to the SDG 7 Affordable and Clean Energy and SDG 13 Climate Action.

China has gradually been advancing project management. Around 2015, China began to promote the concept of the 'integration of investment, construction and operation integration', placing greater emphasis on the post-construction operation which ensure the success of the projects. China encouraged its enterprises to maintain a long-term focus of the host countries as development partners. Currently, all projects supported by China's official creditors will ensure the assistance in training local personnel. Some projects even develop a one to three-year operation contract, with China helping in operations to share management know-how. The adoption follows China's philosophy of 'teaching to fish' in addition to giving a fish approach.

China's policy direction aligns with international agendas. In 2015, the 21st United Nations Climate Change Conference (COP21) adopted the Paris Agreement, calling for global cooperation among governments to address the challenges of climate change. In 2021, China made a commitment to the international community to support green and low-carbon energy development in developing countries and cease the financing of new overseas coal-fired power projects⁴. China was the first developing country to make such a commitment. China has deepened cooperation in the field of green energy, promoting various projects such as hydropower and wind farm, based on the comparative advantages of host countries. China also pays attention to the development of the grid, addressing power bottlenecks and improving the last-mile delivery to households. For example, Zimbabwe and Côte d'Ivoire, with financing from China, constructed hydropower stations, earning foreign exchange for their electricity exports. These projects improved their fiscal development capacity and contributed to debt sustainability.

In 2017, the finance ministries of 26 countries, including China, jointly approved the 'Guiding Principles on Financing the Development of the Belt and Road', encouraging cooperation between policy banks, DFIs, and export credit agencies of various countries, especially in promoting infrastructure development. In 2018, following the 7th FOCAC Beijing Summit, the 'Eight Major Initiatives' was established, initiating the joint development of the 'China-Africa Infrastructure Cooperation Plan' with the African Union. The plan covers a wide range of fields, including energy, transportation, ICTs, water resources, and the Africa's issuance of bonds in China. The goal is to encourage Africa to make better use of resources from China.

⁴ Refer to President Xi Jinping's speech at the 76th United Nations General Assembly on September 21, 2021.



In 2021, following the 8th FOCAC, the ‘Nine Programs’ were introduced, emphasizing a more diversified scope of cooperation with Africa. This includes digital innovation, green development, poverty reduction, agriculture, trade promotion, healthcare, capacity building, and many more. In terms of the supporting entities and institutional mechanisms, China’s financing for Africa continues to innovate. Since the BRI, African countries can leverage newly established multilateral resources in which China actively participates, such as the Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB). In terms of bilateral resources, China is gradually enriching its financing platforms for Africa, establishing numerous funds, expanding equity financing, and enhancing financing for production-oriented industries, as indicated in Table 4. Chinese government recognized the strength of both the private and state-owned enterprises. Chinese government hopes to advocate Chinese private enterprises to invest in Africa. The goal is to promote Africa’s self-growing capacities, achieving a virtuous cycle of infrastructure development, industrial growth, and debt payment. Additionally, private enterprises in China often have faster decision-making processes and engage in labor-intensive manufacturing industries that favors Africa’s large population and low labor costs. This can lead to job creation on the African continent without exerting pressure on sovereign debt. According to Chinese government statistics as of the end of 2020, private enterprises have become the main force in China’s investments in Africa, employing 80% of local staff and creating millions of jobs (Information Office of the State Council of China, 2021). In 2023, the Belt and Road Initiative celebrates its tenth anniversary. Over the past decade of the BRI, according to available data (as of 2020), China’s sovereign financing commitment for Africa amounted to USD 106 billion, supporting a cumulative total of 510 projects. The primary financing sectors include transportation, energy, mining, telecommunications, and more, as the following:

Table 3: China’s Financing to Africa by Sector (2000-2020)

Sector	Million USD	Percentage
Transportation	48661	34%
Energy	20705	16%
ICT	8582	12%
Water Supply	6410	10%
Education	965	2%
Health	253	1%

Data source: CLA Database

Table 4: Diverse China-Africa Financing Platforms

Name	Establishment Year	Contributor/Shareholder	Size	Investments Completed
China-Africa Development Fund	2006	China Development Bank	\$10 billion USD	\$5.5 billion USD
Africa Growing Together Fund	2014	People’s Bank of China and African Development Bank	\$2 billion USD	36 projects; \$1.14 billion USD



Silk Road Fund	2014	Foreign Exchange Reserves, China Investment Corporation, China Development Bank, The Exim Import Bank of China	\$40 billion USD and 1 trillion RMB	Over \$20 billion USD (as of the end of 2022)
China-Africa Production Capacity Cooperation Fund	2015	The Exim Import Bank of China	\$10 billion USD	22 projects
Africa Import-Export Trade Financing Special Fund	2018	The Exim Import Bank of China	\$5 billion USD	\$5 billion USD

Source: Information obtained from the State Council Information Office of the People's Republic of China, 'China-Africa Cooperation in the New Era', November 2021; The Silk Road Fund official website.



Chapter 3. Empirical Analysis of the Effectiveness of China's Financing in Africa

Section 1. Literature Review

Distinguished from traditional creditors of developed industrial nations, China, as a developing country, has garnered considerable attention for providing substantial development funding to the international community. Existing academic research has focused on the question of whether China's financing to African countries is effective. Previous studies have put forth various explanations while also expressing concerns about the growing China-Africa engagement. For instance, think tanks like the U.S. Global Development Center have argued the need to identify African countries at risk of falling into debt distress due to Chinese loans, emphasizing the danger of African countries becoming increasingly dependent on Chinese loans (Onjala, 2018; Were, 2018; Rowley, 2020). At the same time, some scholars argue that Chinese loans come with certain conditions that limit local industries and job creation, such as the requirement to use Chinese contractors and suppliers in infrastructure projects. It has also been noted that Chinese contractors have been accused of importing labor rather than employing local workers (Corkin, 2012; Wegenast et al., 2019; Watkins, 2022). Furthermore, China's debt-financed projects in Africa have been criticized for their environmental impact, leading to deforestation, soil erosion, and pollution (Mandon and Woldemichael, 2023).

On the other hand, existing literature analyzes the effectiveness of China's financing to Africa from different dimensions, including economic, social, and debt-related aspects. In terms of development benefits, a study using the AidData database to analyze Chinese financing projects in Africa built from 2000 to 2017 found that 76.1% of the hard infrastructure projects and 73.4% of the soft infrastructure projects supported by China addressed bottleneck issues in Africa. These bottleneck issues pertain to the slowest developing sectors in the most underdeveloped African countries (Wang and Xu, 2023). Regarding debt benefits, the study reviewed recent views from the International Monetary Fund (IMF) on national assets and liabilities. It discovered that public assets in African countries are not universally accounted for. This study advocates for the international community to pay attention to the asset side of African countries, and innovate financing methods, focusing on the assets formed by completed infrastructure projects in African nations. This approach draws lessons from China's methods of infrastructure refinancing and listing to enhance debt sustainability, benefiting the citizens (Wang and Xu, 2023). Some research has also examined sovereign debt crises over several centuries and found that increasing export growth can reduce the risk of debt default. Additionally, it highlighted significant variations in debt thresholds among different countries (Rong, 2015). This finding further underscores that applying a uniform threshold to all countries in international debt management is unreasonable. Furthermore, research has found that Chinese infrastructure and social service projects have a positive impact on nearby residents in terms of their perception of the country's economic improvement and personal living conditions (Chen, 2022).

This article establishes an analytical framework based on the New Structural Economics theory, focusing on the effectiveness of the debt usage structure on economic growth, social welfare development, and debt sustainability. The structural analysis section primarily examines structural differences in the debt structure concerning creditors' attributes, the income stage of borrowing countries, and the destination sectors. In terms of indicators, it selects metrics



such as infrastructure, education, exports, among others, to incorporate into the regression model, aligning with the development principles advocated by the United Nations Sustainable Development Goals (SDGs) and their measurement dimensions. The analysis aims to assess the impact of Chinese financing in Africa on development. Debt is a necessary component of development, and the African continent is leveraging international funding support to build infrastructure, reduce transaction costs, promote industries consistent with its potential comparative advantages. The financing can nurture competitive edges, and unlock economic growth potential. As an emerging economy, China has both the demand for lending and for international capacity cooperation. Being the largest developing country, China is also a vital component of global governance and development financing, contributing to the achievement of the twin goals⁵ the World Bank and the SDGs. The African continent does not currently have clear policy objectives regarding the effectiveness of international development financing which raised extensive discussions about the effectiveness of China's financing. This article represents the first attempt to analyze the issue of China's financing to Africa using an original theory. Due to the difficulties in data collection and the inability to gather project data and fiscal data from borrowing countries, this article does not intend to comprehensively delineate all the characteristics of Chinese financing projects in Africa. Instead, it takes an initial step by selecting important economic, social, and debt-related indicators for an exploratory investigation. New Structural Economics is an innovative theory in the field of social sciences, and it has been applied in policy practices, offering policy recommendations to countries such as Nigeria, Djibouti, Benin, Senegal, and many others in Africa. It continues to enrich theoretical perspectives through practical applications. This article represents an attempt to research the effectiveness of sovereign financing development and contributes to the efforts in advancing original economic theories and their applications.

For information sharing, China as an emerging creditor is trying a bolder attempt. Several U.S. institutions have compiled data on China's overseas sovereign financing. Widely-used databases by scholars both domestically and internationally include the AidData from the College of William & Mary and the Chinese Loans to Africa (CLA) database operated by the Global Development Policy Center at Boston University. Existing research is primarily based on these databases, although there is still room for improvement in terms of data accuracy. Furthermore, existing studies have often focused on specific indicators, whereas this paper encompasses a broader range of economic and social indicators. Given the dominance of the U.S. dollar in international markets, early sovereign borrowing by developing countries often necessitates the accumulation of U.S. dollars. This paper also underscores the role of export earnings in ensuring debt sustainability.

In the selection of indicators for this paper, publicly available data from the World Bank was utilized, encompassing a total of six major indicators. These indicators include infrastructure improvement, economic growth, and job creation, which are employed to gauge economic performance. Infrastructure development directly reduces transaction costs and provides positive externalities for economic growth. Job creation is a paramount concern in African countries, as per World Bank data indicating that in 2022, the total population of Sub-Saharan African countries is approximately 1.2 billion, with an average population age of less than 20 years. Employment is crucial for the stability of African societies.

⁵ In 2013, the World Bank established the 'twin goals' for poverty reduction, which include the eradication of extreme poverty (to reduce the global proportion of people living in extreme poverty to below 3% by 2030) and the promotion of shared prosperity (to foster income growth among the lowest 40% of the population in each country).



Foreign direct investment inflows were chosen to measure Africa's integration into the global economy, while earnings from commodity exports were selected to assess debt sustainability and the potential for further development of export-oriented economies. Additionally, educational attainment was used as a measure of human capital development and its contribution to improving the well-being of the population. These indicators are also aligned with the content of several United Nations Sustainable Development Goals (SDGs), including SDG Goal 1 No Poverty, SDG Goal 8 Decent Work and Economic Growth, SDG Goal 9 Industry, Innovation, and Infrastructure, SDG Goal 4 Quality Education, SDG Goal 7 Affordable and Clean Energy, among others.

This chapter utilizes data from 49 African countries provided by Boston University for the years 2000 to 2020. While considering the possibility of endogeneity bias, instrumental variable regression methods were employed to estimate the causal relationships between Chinese loans and six dimensions. IV-2SLS estimation results reveal significant and positive impacts of Chinese loans across multiple dimensions. For instance, the contribution of Chinese loans to African growth ranges from 0.176% to 0.300%. This implies that an increase of 1% in loans would contribute to at least a 0.176% increase in growth. The impact on infrastructure improvement falls within the range of 0.027% to 0.084%. Furthermore, the results indicate statistically significant positive effects of Chinese loans on African earnings from exports and foreign direct investment (FDI) inflows. The coefficient for export earnings ranges from 0.244% to 0.330%, suggesting that a 1% increase in Chinese loans would lead to an increase of at least 0.244% in export earnings. Similarly, the significant impact on attracting foreign direct investment inflows ranges from 0.293% to 0.533%, indicating that a 1% increase in Chinese loans would attract at least a 0.293% increase in foreign direct investment inflows. Moreover, Chinese loans also facilitate improvements in Africa's human capital and job creation. Regression results demonstrate that, after controlling for several significant covariates, a 1% increase in loans would lead to an increase of 0.118% to 0.212% in high school enrollment rates and an increase of 0.143% to 0.167% in job creation.

Section 2. Research Questions and Hypotheses

2.1 Research Question

In this chapter, using data obtained from Boston University and other relevant sources, we conduct econometric analysis. Based on panel data models estimated for 49 African countries during the period 2000-2020, we aim to address the following question: Do Chinese loans, specifically sovereign borrowing by African countries corresponding to all financing from China, contribute to economic growth, social development, and debt sustainability in African countries? Additionally, to address potential endogeneity issues, instrumental variable regression analysis will be employed.

2.2 Research Hypotheses

Hypothesis: An increase in the scale of Chinese loans to Africa contributes to promoting economic growth.

Section 3. Regression Model

Building upon Dreher et al. (2021) research on Chinese aid, this paper extends the use of their model as follows.



$$growth_{i,t} = \beta_0 + \beta_1 loan_{i,t-1} + \beta_2 loan_{i,t-1}^2 + \sum_j^J \gamma_j X_{j,i,t} + \eta_i + \tau_t + \mu_{i,t} \quad (1)$$

The variable $growth_{i,t}$ represents the annual average real GDP growth of borrowing country i in year t , used to measure economic performance. Other dependent variables include education level, infrastructure improvement, job creation opportunities, the capacity to integrate into the global economy (captured by Foreign Direct Investment inflows), and debt sustainability (captured by commodity export earnings). In total, there are six key indicators. This paper uses the export-to-GDP ratio as a measure of commodity export earnings because it reflects a country's emphasis on an export-oriented economy and its ability to earn foreign exchange. Higher export levels typically indicate more significant foreign exchange inflows, which can be used to repay external debt while reducing default risk (Cepal, 1999). Additionally, this paper employs the electricity supply coverage rate to characterize the indicator for infrastructure development and improvement. This indicator is not perfect, but a reliable and adequate electricity supply is crucial for various economic activities, including industrial production, services, and technological applications (Ayele and Mutyaba, 2021; Chiyemura et al., 2021). The variable $loan_{i,t-1}$ represents the total amount of financing from China to borrowing countries in the previous period, encompassing all types of financing. Based on data characteristics, this paper defines the lag period as 1-3 years. The model also includes $loan_{i,t-1}^2$, the squared term, to capture potential nonlinear relationships and decreasing loan returns (Dreher and Langlotz, 2020). The regression model incorporates a set of control variables $X'_{i,t}$ commonly used in empirical models that may directly affect African growth and the performance of the other five dimensions. Among these, macro-level variables include inflation, determined by the annual percentage change in the Consumer Price Index (CPI); money supply, represented by the year-on-year percentage change in the M2 money supply (as a percentage of GDP); and government spending. Institutional variables include the rule of law, measured by the rule of law index (degree of enforcement and compliance with the law); corruption control, represented by the corruption control index; government effectiveness; and government stability. Factors endowment variables include gross fixed capital formation (GFCF), measured by the total amount of fixed capital formation—investment in fixed assets such as buildings and machinery (as a percentage of GDP); labor force, represented by the number of people participating in the labor force; population size; and total resource endowment. Geographic factors include landlock, indicating whether a country is landlocked. The variables η_i , τ_t , and $\mu_{i,t}$ represent the borrowing countries fixed effects, year fixed effects, and the error term, respectively. The coefficients of the various variables are presented in Table A1 in the appendix.

3.1 Data Utilization

The data utilized in this study is sourced from the CLA Database compiled by the Global Development Policy (GDP) Center at Boston University (BU, 2023). The selection of sample countries was based on data availability. This database provides comprehensive information on China's loans to African countries from 2000 to 2020, including details on committed loan amounts, loan types, loan project descriptions, and other relevant information. As of 2021, China had provided approximately \$155 billion in loans to African countries, with countries such as Egypt, Ethiopia, Nigeria, Kenya, Zambia, and Angola being the largest recipients (Horn et al., 2021; Carmody and Wainwright, 2022). The database covers 49 countries with varying income levels, and information on the sample countries can be found in



Appendix Table A2. Other key potential variables that may influence economic growth in African countries include inflation, money supply, government total expenditure, rule of law, corruption control, government effectiveness, government stability, capital, labor force, population size, natural resource endowment, and landlocked status. Data sources primarily include the World Development Indicators (WDI), the United Nations Conference on Trade and Development (UNCTAD) database, the Barro-Lee database, the World Steel Association (WSA), the International Monetary Fund (IMF), the Worldwide Governance Indicators (WGI), and the Democracy-Dictatorship database (DD), among others. Descriptive statistics for the variables are provided in Appendix Table A3.

3.2 Estimation Procedure

The estimation procedure in this study proceeds as follows. First, fixed-effects high-dimensional estimation is applied to all dependent variables related to Chinese loans while controlling for multiple variables and fixed effects of countries and years. Secondly, endogeneity issues are addressed by using instrumental variables (IV) in the estimation. IV-2SLS regression is conducted to reaffirm the causal relationships established in the previous section. Third, this research estimates the impact of Chinese loans based on classifications related to creditor types, borrowing country income level, and the structure of debt usage to identify differences among these characteristics. Fourth, regression analysis is conducted on the loan data by sector.

Figure 2 provides a visual representation of the positive correlation between the average growth rate of Chinese loans and six indicators. These indicators include economic growth, education level, infrastructure improvement, job creation opportunities, the capacity to integrate into the global economy (captured by Foreign Direct Investment inflows), and debt sustainability (captured by the proportion of exports in GDP). The data covers a 20-year period from 2000 to 2020. The data shows a positive correlation between the growth of Chinese loans and all six indicators, suggesting that Chinese loans may have a positive impact on these indicators (Xu et al., 2020; Mlambo, 2022). However, it's important to note that correlation does not imply causation, and other factors such as changes in government policies or natural disasters may also play a role in the observed relationships (Leszczensky and Wolbring, 2022). Additionally, issues of reverse causality may complicate the interpretation of the data. Therefore, to better understand the nature of the relationship between Chinese loans and these six indicators, more precise estimations using statistical methods like Ordinary Least Squares (OLS) regression and Two-Stage Least Squares (2SLS) with instrumental variables are needed. Two-stage regression can help address issues of non-causality and reverse causality, providing a more accurate understanding of the relationship between Chinese loans and these six indicators (Angrist and Krueger, 2001).

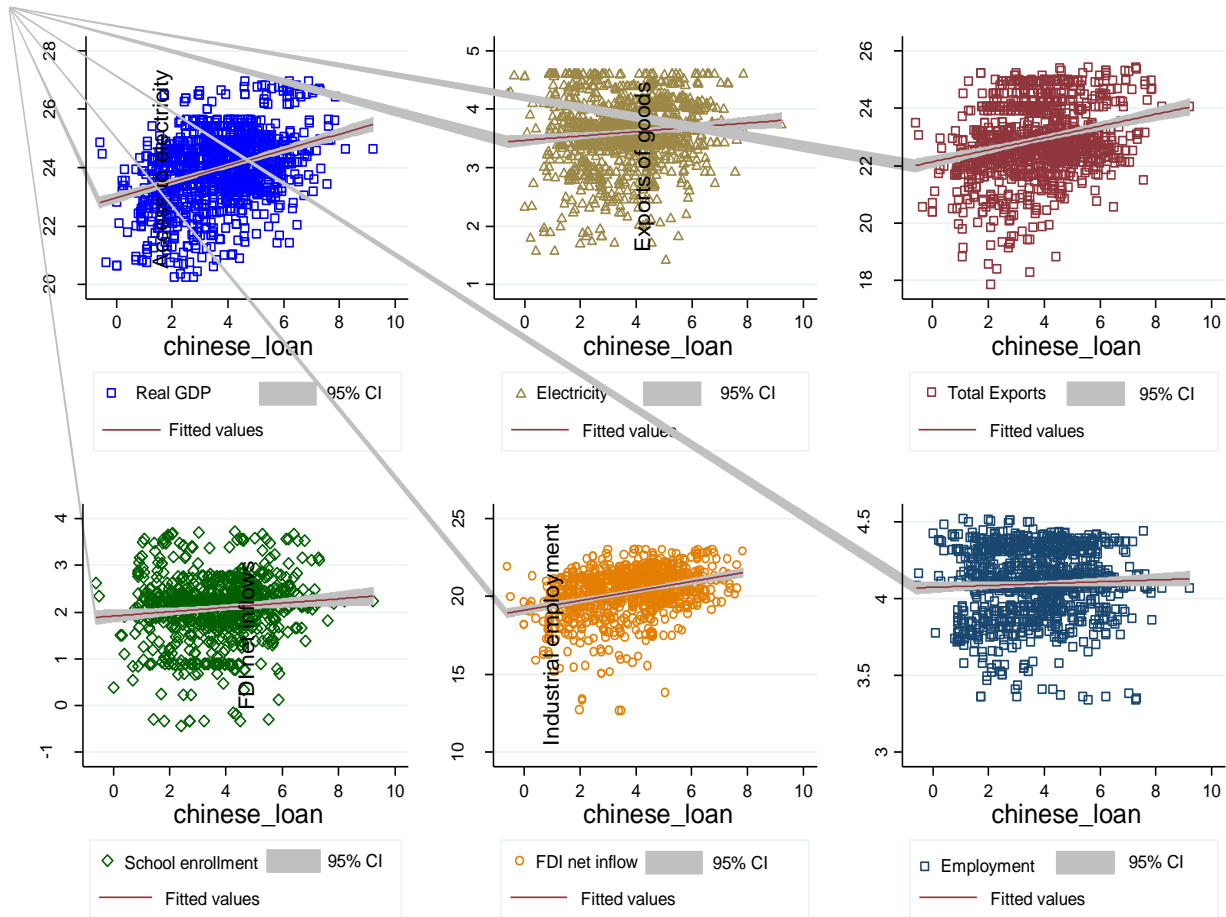


Fig 1: Scatter plot of Chinese loan versus growth and other indicators

Section 4. Empirical Results

4.1 Estimation Results of the Baseline Model

Table 5(a) presents the regression results estimating the impact of Chinese loans on African economic growth from 2000 to 2020 using the fixed effects method. The dependent variable is the annual economic growth rate for each country. This study clusters standard errors at the borrowing country's level and adjusts for heteroskedasticity. The model is estimated with country and year fixed effects to account for variations in loan effects that do not change over time and across different countries. Furthermore, the effects of general loans on economic growth may not be immediately observable but may take some time to manifest prominently. The explanatory variable 'Chinese Loans' is lagged for 1 to 3 years, depending on data characteristics. The lag variable captures delayed effects of loans on economic growth and addresses endogeneity issues. Additionally, variables are log-transformed as needed. The results in Table 5 for Model (5-1-1) show that, measured by the annual growth rate, Chinese loans with a three-year lag have a positive and significant impact on economic growth. Holding other variables constant, a 1 percentage point increase in Chinese loans leads to an average increase of about 0.046 percentage points in Africa's economic growth performance. Given the large economic volume of the entire African continent in the trillion-dollar range, the absolute growth stimulated by this effect is substantial. In Model (5-1-2), additional control variables are introduced, including corruption control, type of government, inflation, money supply, population, government expenditure, total natural resources, government effectiveness, and landlocked status. Each variable exhibits the expected significance and does not have an additional impact on the conclusion regarding the relationship between Chinese loans and economic growth. Overall, after controlling for several covariates, the impact of Chinese loans on growth ranges from 0.025% to 0.046%.

Table 5: Chinese loans and economic performance, infrastructure improvement, and goods exports

Variables	(a)—Dep Var: GDP Growth		(b)—Dep Var: Electricity		(c)—Dep Var: Exports	
	(5-1-1)	(5-1-2)	(5-2-1)	(5-2-2)	(5-3-1)	(5-3-2)
L3.ln(Chinese loan)	0.046*** (0.014)	0.025* (0.012)	0.005** (0.002)	0.004* (0.002)	0.024*** (0.006)	0.014* (0.007)
ln(inflation)		-0.137* (0.076)		0.002 (0.012)		-0.089* (0.051)
ln(gfcf)	0.321 (0.256)	0.649** (0.263)	0.006 (0.044)	0.156** (0.067)		-0.114 (0.144)
ln(Money supply)				0.248*** (0.081)		-0.089 (0.196)
ln(gov't spend)		-2.308*** (0.707)		-0.433** (0.197)		-0.062 (0.468)
ln(total resource)		0.233** (0.108)		0.033 (0.032)		0.315*** (0.062)
ln(population)		-1.004 (2.392)	0.635** (0.246)	-0.087 (0.670)		0.836* (0.465)
regime		-0.209 (0.159)		0.005 (0.064)		-0.151*** (0.032)
Other X _{it}		Yes		Yes		Yes
Constant	0.468 (0.822)	57.602*** (19.737)	-6.631 (4.157)	5.766 (11.373)	3.334*** (0.022)	-1.191 (8.211)
Observations	853	813	852	641	1,010	813
R-squared	0.498	0.622	0.911	0.859	0.856	0.873
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes



Note: Each column represents a regression. Given the data characteristics, this study improves linearity, standardizes distributions, reduces heteroscedasticity, and facilitates coefficient interpretation by calculating percentage changes and using logarithmic transformations. 'ln' denotes a logarithmic transformation. Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.

China's loans have facilitated access to funds for African countries. These loans have been used to finance infrastructure investments in African countries, including the construction of highways, railways, ports, and power plants, improving the country's infrastructure, enhancing productivity, and promoting trade and investment. This result is consistent with many previous studies (Martuscelli, 2020; Xu et al., 2020; Dreher et al., 2021; Mlambo, 2022; Larsen et al., 2023; Mandon and Woldemichael, 2023).

Table 5(b) presents the regression results using the fixed-effects method to estimate the relationship between Chinese loans from 2000 to 2020 and improvements in African infrastructure (measured as the percentage of the population with access to electricity). This analysis further adjusts for various covariates, such as macroeconomic variables, institutional factors, and resource endowments. Due to loan disbursement, project planning, implementation, and impact assessment, the effects of loans on African infrastructure may be delayed. Therefore, the Chinese loan variable is lagged by 1 to 3 years in the adjustments. Models (5-2-1) and (5-2-2) display the estimated impact of Chinese loans on infrastructure improvements in African countries while controlling for other variables. On average, for every 1% increase in Chinese loans to Africa, infrastructure improvements increase by 0.004 to 0.005 percentage points. China is a significant source of financing for large-scale infrastructure projects in Africa, including projects related to power generation, transmission, and distribution, accounting for over 65% of loans in the African infrastructure sector. Additionally, China is a global leader in renewable energy technologies such as solar and wind power. Chinese loans and investments in energy projects may contribute to transferring these technologies and knowledge to African countries, thereby enhancing their capacity to produce and distribute electricity efficiently and sustainably (Yu, 2017; Gallagher et al., 2018; Marchesi et al., 2021; Usman, 2021; Yang et al., 2023).

Table 5(c) presents the regression results of the impact of Chinese loans on the debt sustainability of African countries, measured using merchandise export earnings as an indicator. The use of merchandise export earnings serves as an indicator of debt sustainability. Models (5-3-1) and (5-3-2) in Table 5(c) reveal a substantial positive impact of Chinese loans on the merchandise exports of African countries. The baseline model indicates that a 1% increase in loans (lagged by 3 years) drives export growth by 0.024%. While the magnitude of the impact varies slightly with the introduction of other covariates, the overall relationship between loans and the capacity for merchandise export earnings remains consistent. These results align with existing research. For example, studies by Savin et al. (2020) and Xu et al. (2022) suggest that Chinese financing effectively promotes value-added exports in recipient countries, especially to China and Europe. Additionally, there is research indicating that Chinese financing projects, including aid from China, benefit recipient countries in terms of exporting to China, helping them enhance their development and earnings capacity while meeting China's domestic consumption demands (Hongrong et al., 2021).

In addition, the study also analyzed the role of Chinese loans in improving human capital in Africa. Chinese loans may directly or indirectly impact human capital in Africa. For example, some projects have been invested in improving human capital sectors, including vocational training. Furthermore, Chinese financing in various sectors such as



manufacturing, construction, clean energy, information and communication technology, business, hospitality, agriculture, and food industries may lead to increased demand for skilled labor, thereby compelling governments to allocate more budget to education and training. Column (a) in Table 6 demonstrates that loans from China significantly affect human capital in Africa, with the dependent variable being the secondary school enrollment rate provided by WDI. Under otherwise similar conditions, models (6-1-1) and (6-1-2) show that a 1% increase in loans results in an increase in enrollment rates ranging from 0.006% to 0.007%. The introduction of control variables does not alter the impact of loans on secondary school enrollment rates in Africa. The results of this study are consistent with previous research, including Martorano et al. (2020), who investigated the impact of Chinese financing projects on Sub-Saharan African countries and found that these projects had a positive effect on education. However, other factors such as natural resource endowments, capital, and institutional factors may also positively influence enrollment rates in education.

Table 6(b) presents the regression results estimating the impact of Chinese loans on job creation in Africa using the fixed-effects method. The dependent variable is the employment figures in the industrial and agricultural sectors provided by the World Development Indicators (WDI). Models (6-2-1) and (6-2-2) estimate the effect of Chinese loans on industrial employment, with controls for country and year fixed effects. The results show that Chinese loans have a statistically significant positive impact on job creation in the industrial sectors of African countries. This suggests that the availability of Chinese loans promotes industrial development in African nations, leading to increased employment opportunities. On average, for every 1% increase in Chinese loans to Africa, industrial employment increases by 0.003%. Furthermore, the introduction of control variables indicates that an increase in capital and natural resource endowments leads to an increase in job creation, while government expenditure does not have a positive and significant impact on employment in the industrial sectors. This may require further investigation. Therefore, the presence of Chinese debt is expected to help break the ‘deindustrialization’ trap in Africa (Rodrik, 2016). However, loans targeted at agricultural-related sectors are limited, resulting in insufficient employment impact in these sectors (Bluhm et al., 2018; Guo et al., 2022).

Column (c) of Table 6 demonstrates that the ability of African countries to integrate into the global economy can be attributed to the contributions of Chinese loans. Economic integration and interdependence among nations are at the core of globalization, and foreign direct investment (FDI) inflows are a critical indicator of a country’s ability to integrate into the global economy. Each model in Table 6(c) is estimated by controlling for country and year fixed effects, with standard errors clustered at the country level to account for heteroskedasticity. Models (6-3-1) and (6-3-2) show that Chinese loans have a positive impact on FDI inflows ranging from 0.047% to 0.049%. This implies that, in the long run, for every 1% increase in Chinese loans, foreign direct investment flowing into Africa increases by approximately 0.047%. This finding aligns with previous research, including Wang and Xu (2023), Zhang et al. (2023), Gemueva (2018), and Xu and Zhang (2020), which suggest that Chinese financing promotes infrastructure improvements, attracting foreign investment inflows and increasing exports. The findings suggest that Chinese loans may facilitate the development of infrastructure such as transportation networks and telecommunications systems, reducing transaction costs, improving efficiency, enhancing the attractiveness of these countries as investment destinations, and thus promoting foreign investment in African nations. Additionally, Chinese loans can foster the



development of trade and investment ties between China and African countries, driving the market access for foreign investors in these countries. This not only enhances potential investment returns but also encourages greater inflows of foreign direct investment (Manasseh et al., 2022). However, the above estimates do not account for endogeneity issues. The next section will estimate the effects while considering endogeneity.

Table 6: Chinese loans and educational improvement, job creation, and FDI inflows

Variables	(a)—Dep Var: Enrollment Rate		(b)—Dep Var: Industrial/Agri Employ			(c)—Dep Var: FDI Inflows	
	(6-1-1)	(6-1-2)	(6-2-1)	(6-2-2)	(6-2-3)	(6-3-1)	(6-3-2)
L3.ln(Chinese loan)	0.006*	0.007*	0.007**	0.003*	-0.002	0.049***	0.047**
	(0.003)	(0.004)	(0.003)	(0.002)	(0.001)	(0.017)	(0.017)
ln(gfcf)		0.055		0.159***	-0.028	0.523***	0.842**
		(0.058)		(0.046)	(0.044)	(0.188)	(0.397)
rule of law		0.002		0.001	0.000		-0.007
		(0.003)		(0.002)	(0.001)		(0.016)
ln(inflation)		0.008		0.027**	-0.018		0.032
		(0.010)		(0.012)	(0.011)		(0.103)
ln(total resource)		0.064***		0.060***	-0.008		-0.174
		(0.019)		(0.020)	(0.016)		(0.181)
ln(GDP growth)		-0.001		0.001	-0.004**		
		(0.015)		(0.002)	(0.001)		
ln(gov't spend)		-0.068		-0.003**	0.001		
		(0.187)		(0.001)	(0.001)		
ln(population)	1.327***	-0.007		0.563**	1.111***		-2.438
	(0.158)	(0.363)		(0.241)	(0.263)		(3.379)
regime	0.114***	0.115***		-0.063***	0.116***		0.233
	(0.022)	(0.039)		(0.023)	(0.034)		(0.187)
Other X_{it}		Yes		Yes	Yes		Yes
Constant	-18.283***	3.306	2.339***	-7.330*	-14.805***	-0.740	46.558
	(2.577)	(6.023)	(0.011)	(3.995)	(4.315)	(0.610)	(36.515)
Observations	630	403	1,058	792	792	827	466
R-squared	0.950	0.976	0.967	0.986	0.990	0.655	0.735
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively. Model (6-2-3) has agricultural employment as the dependent variable.

4. 2 Endogeneity Issues

It should be noted that the estimates in this study may be influenced by endogeneity issues that have not been fully addressed, potentially leading to biased estimation results. Endogeneity is a critical concern in causal inference, with omitted variables, reverse causality, and the possibility of measurement errors in variables due to limited information availability being reasons that can result in biased OLS estimates. Endogeneity bias in the empirical models of this chapter may exist because a borrowing country's loans and economic growth performance are jointly determined by many variables that this study cannot control for. Additionally, the economic characteristics of borrowing countries may affect the size of Chinese loans, as the Chinese government may be more inclined to provide more favorable loans to countries with lower economic growth to ensure that its loans reach relatively lower-income countries, aiming for shared development. On the other hand, the Chinese government may also be more inclined to provide more loans to countries with relatively faster economic growth because fast-growing borrowing countries can offer more attractive



business opportunities. All these possibilities would result in African countries affecting Chinese loans rather than the reverse. Therefore, to address this issue, this chapter employs Instrumental Variable (IV) estimation to test the causal effect of Chinese loans on African economic performance. IV estimation should use variables that are correlated with the endogenous variable but unrelated to the error term (Angrist and Krueger, 2001; Roberts and Whited, 2013; Chen and Lin, 2014).

To better understand, biased estimates can be observed in the simplest simultaneous equation model: $growth = \gamma_1 loan + u$, denoted as (5e); $loan = \gamma_2 growth + e$, represented by (6e). The OLS estimator or the probability limit γ_1 in equation (5e) can be expressed as $\gamma_1^{OLS} = \gamma_1 + \frac{cov(loan, u)}{var(loan)}$, as shown in (7e). Substituting equation (5e) into (6e) and rearranging again produces the balance condition: $loan = \frac{1}{1-\gamma_1\gamma_2}(\gamma_2 u + e)$, denoted as (8e). Thus, substituting equation (8e) into (7e) yields: $\gamma_1^{OLS} = \gamma_1 + \frac{\gamma_2}{1-\gamma_1\gamma_2} \frac{var(u)}{var(loan)} + \frac{1}{1-\gamma_1\gamma_2} \frac{cov(e, u)}{var(loan)}$, expressed as (9e). In this expression, the second term on the right-hand side of equation (9e) captures simultaneity bias that arises when $\gamma_2 \neq 0$ in equation (6e), and the third term captures omitted variable bias. To examine whether the third term in equation (9e) contains omitted variables, this study sets $\gamma_2 = 0$. In this case, $loan = u$, resulting in the OLS estimator's probability limit $\gamma_1 + \frac{cov(loan, e)}{var(loan)}$. To overcome reverse causality, this study employs the instrumental variable method (IV-2SLS) for estimation. This study defines Z as the endogenous instrument for $loan$, such that $cov(Z, loan) \neq 0$ and $cov(Z, u) = 0$. Therefore, the following IV-2SLS estimator can be derived: $\gamma_1^{IV} = \gamma_1 + \frac{cov(Z, u)}{var(Z, loan)}$, aimed at generating relatively unbiased regression results. The first-stage equation for this study's instrumental variable regression is specified as follows:

$$loan_{i,t-1} = \pi_1 material_{i,t-1} \times p_c + \pi_2 FR_{i,t-1} \times p_c + \sum_j \gamma_j X_{j,i,t} + \delta_i + \theta_t + \varepsilon_{it} \quad (2)$$

Where $loan_{i,t-1}$ is the endogenous variable representing China's credit to Africa in the previous period, the variables $material_{i,t-1}$ and $FR_{i,t-1}$ are instrumental variables representing exogenous changes in China's loans to Africa, representing steel production or other building materials and China's foreign exchange reserves, respectively. p_c represents the probability of obtaining loans from China. $X'_{i,t}$ is a set of control variables, and ε_{it} is the error term. The instrumental variables—steel production and foreign exchange reserves—should be correlated with $loan_{i,t-1}$ in equation (2) but uncorrelated with the error term $\varepsilon_{i,t}$. The methods to address endogeneity bias are twofold. Firstly, to account for unobservable omitted variables, additional control variables such as geographical features, institutional variables, etc., are included in the model. Additionally, this study incorporates time fixed effects and allows for appropriate time lags in endogenous variables to account for the cross-sectional dependence of the data on the baseline model.

Furthermore, to address the issue of reverse causality, this study employs Chinese steel production as an instrumental variable for providing loans to African countries because it is highly correlated with China's loans to Africa but is unlikely to be correlated with the error term. This study uses IV estimation to assess the causal effect of Chinese loans

on African economic performance, thereby mitigating endogeneity bias. Additionally, for the same purpose, this study considers China’s foreign exchange reserves as a potential instrumental variable along with steel production, which represents China’s financial and material supply capabilities as well as its ability to extend loans to other countries. Dreher et al. (2021) have also confirmed that higher levels of foreign exchange reserves and construction material production indicate China’s ability to provide loans to other countries, reflecting the stability and credibility of China’s financial system, which could influence borrowing behavior. Moreover, not all countries receive loans every year. Therefore, the subsequent IV estimation is calculated by multiplying each IV by the probability of receiving a loan. To determine the probability of receiving Chinese loans, this study calculates the number of years a country received at least one Chinese loan project between 2000 and 2020. The probability of receiving a loan is defined as $p_c = \frac{\sum_{t=2000}^{2020} \beta_{c,t}}{m}$, where $m = 20$, $\beta_{c,t}$ is a dummy variable representing receiving a loan as 1 and not receiving a loan as 0. However, the effectiveness of foreign exchange reserves and steel production as instrumental variables depends on their strength of correlation with the endogenous variable and the exclusion restriction assumption, i.e., that they affect Chinese loan supply only through influencing borrowing behavior in no other way (Dreher et al., 2021; Appiah-Kubi and Jarrett, 2023; Atitianti, 2023).

4.3 IV-2SLS Estimation Results

Table 7 presents the results obtained using the Two-Stage Least Squares (IV-2SLS) estimation method. Similarly, to address the issue of heteroskedasticity, estimates in each model are clustered by the standard deviation of observations at the country level. In columns (a) and (b) of Table 7, the dependent variables are GDP growth rate and the percentage of electrification, respectively. As mentioned earlier, the Chinese loan variable may be endogenous and influenced by Chinese steel production and foreign exchange reserves. The estimated results indicate that Chinese loan projects contribute to Africa’ GDP growth rate and infrastructure improvement, consistent with the trends observed in the previous OLS estimates. Additionally, this study introduces a range of control variables in the analysis, including institutional, macro-level, and factor endowment variables, and they do not alter the main findings of this study, aligning with the aforementioned findings.

Table 7: The impact of Chinese loans on growth, infrastructure, and human capital improvement

Variables	(a)—Dep Var: GDP Growth		(b)—Dep Var: Electricity		(c)—Dep Var: Enrollment Rate	
	(7-1-1)	(91-2)	(7-2-1)	(7-2-2)	(7-3-1)	(7-3-2)
L3.ln(Chinese loan)	0.176*** (0.068)	0.300*** (0.058)	0.027* (0.014)	0.084** (0.040)	0.212*** (0.066)	0.118* (0.067)
ln(labor)	0.604*** (0.042)	0.725*** (0.041)		0.918*** (0.304)		
ln(gfcf)		0.160 (0.141)		0.163*** (0.050)	-0.100 (0.113)	-0.113 (0.137)
ln(total resource)		-0.034 (0.029)		-0.002 (0.024)	-0.240*** (0.038)	-0.146** (0.065)
ln(inflation)		0.060* (0.033)		-0.006 (0.010)		-0.117*** (0.034)
ln(Money supply)		0.016*** (0.002)		0.004*** (0.002)		0.021*** (0.003)
ln(gov’t spend)		-0.024*** (0.003)		-0.325*** (0.098)		0.488 (0.361)
rule of law		-0.004		0.006***		



regime		(0.004) 0.207***		(0.002) -0.045*		0.503***
Other X _{it}		(0.077) Yes		(0.024) Yes		(0.111) Yes
Constant	14.066*** (0.590)	13.215*** (0.961)			1.726** (0.840)	-0.329 (1.975)
Observations	1,016	902	1,027	899	690	566
R-squared	0.520	0.726	0.446	0.294	0.174	0.582
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.

Compared to the OLS results, IV-2SLS provides more accurate estimates by addressing endogeneity issues. The coefficients of the endogenous variables in the instrumental variable estimation are more significant than the corresponding variable coefficients in the OLS estimation with country and time fixed effects, indicating a potential downward bias in OLS regression estimates. For example, the impact of Chinese loans on economic growth ranges from 0.176% to 0.300%. This means that a 1% increase in loans would lead to at least a 0.176% increase in economic growth. The effect on electricity supply ranges from 0.027% to 0.084%. The reason for the higher estimates in the instrumental variable method is straightforward. As mentioned in the previous section, when China maintains a large foreign exchange reserve and steel production meets domestic consumption and export demands, it may have the capacity to provide more loans to African countries. An increase in the factors determining Chinese loans would result in a higher loan amount, thus increasing the coefficients in the IV estimates.

Next, this study employs the IV-2SLS method to assess the impact of Chinese loans on the improvement of human capital in Africa, with the dependent variable being the high school enrollment rate. The results in Table 7(c) demonstrate significant and positive outcomes at the 5% and 10% levels in both models, indicating that Chinese loans contribute to the enhancement of human capital in Africa. In other words, after controlling for several important covariates, a 1% increase in loans leads to a 0.118% increase in the high school enrollment rate.

Table 8: The impact of Chinese loans on employment, globalization - exports and FDI inflows, and exports

Variables	(a)— Dep Var: Exports		(b)— Dep Var: FDI Inflows		(c)— Dep Var: Industrial/Agri employ		
	(8-1-1)	(8-1-2)	(8-2-1)	(8-2-2)	(8-3-1)	(8-3-1)	(8-3-3)
L3.ln(Chinese loan)	0.330*** (0.099)	0.244*** (0.071)	0.293** (0.118)	0.533** (0.264)	0.143** (0.068)	0.167** (0.066)	-0.117*** (0.041)
ln(inflation)	-0.156 (0.103)	-0.065* (0.036)	-0.014 (0.067)	-0.052 (0.070)	-0.138*** (0.046)	-0.124*** (0.044)	0.030 (0.027)
ln(Money supply)	0.211* (0.114)	0.771*** (0.194)	0.037 (0.298)	0.193 (0.553)	0.143 (0.125)	0.010*** (0.004)	-0.012*** (0.004)
ln(gov't spend)		-1.646*** (0.394)		0.228 (1.063)		-0.076 (0.473)	1.220*** (0.436)
ln(total resource)		0.315*** (0.116)		0.029 (0.173)		0.086 (0.085)	0.024 (0.047)
ln(labor)		1.263 (1.481)		2.897 (2.888)		-0.087 (0.054)	0.041 (0.048)
ln(gfcf)		0.312** (0.150)		0.972** (0.395)		0.053 (0.170)	0.034 (0.092)
rule of law		-0.017** (0.007)		-0.012 (0.024)		-0.009* (0.005)	0.008* (0.004)



regime	-0.021 (0.073)		0.145 (0.289)		0.185* (0.099)	-0.110 (0.072)	
Other X_{it}	Yes		Yes		Yes	Yes	
Constant	20.620*** (0.449)	16.424 (10.855)	18.483*** (0.779)	50.832 (34.736)	1.606*** (0.524)	3.117 (2.128)	-1.985 (1.600)
Observations	904	875	694	665	858	835	835
R-squared	0.822	0.903	0.708	0.560	0.204	0.290	0.531
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively. The dependent variable in Model (8-3-3) is employment in the agricultural sector.

Table 8 employs the instrumental variable method and controls for annual and country fixed effects to present regression estimates of the relationship between African commodity exports (column (a)) and FDI inflows (column (b)) with Chinese loans. The results indicate statistically significant positive effects of Chinese loans on African commodity exports and FDI inflows. The coefficient for commodity exports ranges from 0.244% to 0.330%, suggesting that a 1% increase in Chinese loans leads to an increase in exports of at least 0.244%. This generally signifies a greater foreign exchange generation capacity that can be used for debt repayment while enhancing the debt-servicing capacity of African countries. Similarly, the coefficients for FDI inflows range from 0.293 to 0.533, indicating that a 1% increase in Chinese loans results in an increase in FDI inflows of at least 0.293%. As expected, the IV-2SLS method yields larger estimated effects, indicating a more substantial impact of loans on commodity exports and FDI inflows. Additionally, in Table 8, Model (8-3-3) considers employment in the agricultural sector as the dependent variable. The impact of Chinese loans on agricultural sector employment is statistically negative, though significant, but the magnitude of this effect is minimal compared to the positive impact of Chinese loans on industrial sector employment. This suggests that Chinese loans in Africa tend to focus on large infrastructure and industrial development projects, which are typically concentrated in urban areas. This can explain the positive effect of Chinese loans on industrial sector employment, driven by growth in manufacturing and other industries in areas where these projects are located. In contrast, the statistically negative impact on agricultural sector employment may be due to structural transformation, with populations shifting from traditional agriculture to industry, reducing the labor force in agriculture.

4.4 Structural Analysis

This section conducts an in-depth analysis of the debt structure. It observes the effectiveness on the development of African countries based on characteristics such as creditor types, borrowing country income levels, and the purpose of debt usage.

(1). Classification of Creditors

Chinese creditors in Africa are categorized into two groups: PPG-Official creditors and PPG-Non-official creditors. These creditor types may have significantly different impacts on economic growth. PPG-Official creditors include entities like the Export-Import Bank of China, the China Development Bank, the People's Bank of China, and other entities labeled as Chinese government institutions in the database. On the other hand, PPG-Non-official creditors consist of other lending institutions listed in the database. Official creditors generally offer loans or aid packages with more favorable terms, including lower interest rates and longer repayment periods. They often serve as a source of



patient capital and market incubation. Common unofficial creditors include China's private and commercial banks. Examining the structural effects of different creditors can provide insights into how different types of creditors influence economic growth through African debt. The loan data reveals that in the dataset spanning the past two decades, there are a total of 1169 projects, with 869 projects (74.34%) categorized as PPG-Official creditors and 297 projects (25.41%) categorized as PPG-Non-official creditors.

Appendix Table A4 displays the impact of projects funded by PPG-Official and PPG-Non-official creditors within Chinese loans on economic growth, FDI inflows, export earnings, and infrastructure improvement. The results indicate that, under the support of PPG-Official creditors, all four indicators exhibit positive effects. However, loans from PPG-Non-official creditors have a statistically significant positive impact on infrastructure improvement and the promotion of exports but lack statistical significance in other aspects. The limited positive spillover effects of loans from PPG-Non-official creditors on the economy may be due to their primary focus on profit maximization. Overall, these results demonstrate that Chinese lenders from all categories, whether official creditors or private commercial entities, have played a positive role in fostering beneficial development, such as infrastructure development and exports, contributing to sustainable debt practices in Africa.

Furthermore, Appendix Table A5 illustrates the impact of projects funded by PPG-Official and PPG-Non-official creditors within Chinese loans on human capital improvement and job creation. Appendix Table A5 reveals that Chinese loans from PPG-Official creditors have a positive effect on the high school enrollment rate and employment in the industrial sector of African countries. This could be attributed to the allocation of funds from PPG-Official creditors towards improving living and working conditions, making education more accessible. In contrast, loans from PPG-Non-official creditors exhibit a statistically negative impact on enrollment rates, warranting further investigation into the underlying reasons. This may be because loans from PPG-Official creditors could be directed towards education and human development projects, such as school construction, teacher training, and student scholarships, which can contribute to higher enrollment rates. On the other hand, PPG-Non-official creditors might be more interested in financing projects with anticipated maximum profitability and high returns.

(2). Classification by Borrowing Country Income Level

The impact of Chinese loans may vary significantly across countries with different income levels, as each country may face distinct economic challenges and policy priorities. To gain a better understanding of the relationship between Chinese loans and all the indicators across various income levels, it is essential to conduct an analysis based on income classification. The income classification is based on the World Bank's categorization⁶. The loan data encompass 1,169 projects over the past two decades. Among these, there are 6 projects (accounting for 0.51% of the total) in the high-income category, 412 projects (35.24% of the total) in the low-income category, 617 projects (52.78% of the total) in the lower-middle-income category, and 134 projects (11.46% of the total) in the upper-middle-income category. Appendix Table A6 presents the IV-2SLS regression estimates of the impact of Chinese loans on human capital improvement, infrastructure improvement, and FDI inflows. Due to the limited number of observations in the first and

⁶ The World Bank's classification of income levels can be found at: <https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023>, accessed in May 2023.



fourth categories, the estimation results include only the low-income and lower-middle-income categories (the second and third categories). In Appendix Table A6(a), the impact of Chinese loans on human capital improvement in Africa, measured by enrollment rates in junior high school and high school, is displayed. Models A6-1-1 and A6-1-2 show the regression results for enrollment rates in junior high school, while models A6-1-3 and A6-1-4 present the results for high school enrollment rates. The results indicate that the positive impact of Chinese loans on school enrollment rates is more substantial in higher-income African countries than in lower-income ones. An increase of 1% in loans leads to an increase in enrollment rates for the lower-middle-income group of 0.045% in junior high school and 0.218% in high school. This could be attributed to the fact that higher-income countries generally have more comprehensive education systems and institutions, stable political and economic environments, and diversified economies compared to lower-income African countries. These factors result in a higher demand for skilled labor, promoting industrial structural transformation. As a result, Chinese loans can be more effectively utilized to increase school enrollment rates and enhance the educational outcomes in these countries.

Furthermore, Appendix Table A6(b) demonstrates a positive and significant impact of Chinese loans on infrastructure improvement in low-income and lower-middle-income African countries. Specifically, for every 1% increase in Chinese loans, it drives infrastructure improvement by 0.135% and 0.099%, respectively. Chinese loans are primarily directed towards infrastructure improvement projects, especially in lower-income countries, with a focus on sectors like transportation and energy infrastructure. In terms of infrastructure development, such as hydropower stations, power grids, roads, ports, and bridges, China has a comparative advantage, and these are essential needs for both low-income and lower-middle-income countries. This result aligns with findings from Wang and Xu (2023), Horn et al. (2021), and Dollar (2019), which suggest that a significant portion of China's infrastructure loan projects is concentrated in countries with relatively lower incomes. Infrastructure investments can generate income, create job opportunities, promote economic growth, foster manufacturing, reduce poverty, and, thus, contribute to development.

On the other hand, Appendix Table A6(c) indicates that compared to higher-income African countries, Chinese loans have a more positive impact on FDI inflows in lower-income African countries. Chinese loans are typically used for infrastructure improvement projects in lower-income African countries, reducing operational costs and making foreign investors more willing to enter the market.

Appendix Table A7 presents instrumental variable regression estimates of the impact of Chinese loans on African economic growth, job creation, and commodity exports, controlling for a set of covariates mentioned in the previous section. Appendix Table A7(a) indicates that compared to higher-income African countries, Chinese loans have a more significant positive impact on economic growth in lower-income African countries. This can be attributed to the higher development needs of lower-income African countries compared to higher-income ones. Additionally, Appendix Table A7(b) shows that Chinese loans have a positive impact on industrial employment in low-income and lower-middle-income African countries. Appendix Table A7(c) demonstrates that Chinese loans have a positive impact on the ability of both low-income and high-income African countries to generate income through commodity exports. An increase of 1% in loans leads to a 0.122% and 0.061% increase in commodity export earnings for low-income and lower-middle-income countries, respectively. Chinese financing can be used to fund infrastructure improvement projects in relatively



lower-income countries, especially in transportation and energy infrastructure, reducing transportation costs and improving the efficiency of export activities, thus boosting commodity exports.

(3). Loan Purpose- Sector Variability

Chinese financing to Africa may have different impacts depending on the industry and development sectors to which it flows, based on the purpose of the debt (Guillon and Mathonnat, 2020). This paper categorizes loans into two types based on data characteristics. The first category includes loans related to infrastructure, such as transportation, energy, information and communication technology, and water supply. The second category encompasses loans related to production and social aspects, such as productive industry, mining, banking, trade, food, agriculture, environment, healthcare, education, and other social sectors. Using this classification, Appendix Tables A8 and A9 present instrumental variable regression estimates that take industry heterogeneity into account.

The results indicate that the impact of Chinese loans in the first category related to infrastructure has a more significant effect on Africa's economic growth compared to loans in the second category related to production and social aspects. Holding other conditions constant, a 1% increase in infrastructure-related loans is associated with a 0.307% increase in economic growth. Appendix Table A8(b) demonstrates that the impact of Chinese loans in the infrastructure-related sector on Africa's power supply is greater than that of loans in the production and social-related sectors. Appendix Table A8(c) shows that Chinese loans in the infrastructure sector have a stronger positive impact on industrial employment in Africa compared to loans in the production and social sectors.

Different purposes of debt have varying impacts on export earnings, FDI inflows, and human capital improvement. The regression estimates presented in Appendix Table A9 demonstrate that, concerning exports, both the first and second categories of industries have a positive impact, but loans in the first category related to infrastructure-related industries have a more significant effect. This result may be explained by loans for infrastructure investment, which can lower the cost of exported goods by improving transportation and logistics. Regarding FDI inflows, Appendix Table A9(b) shows that Chinese loans have a positive impact on FDI inflows, with loans in the second category of industries having a more significant effect than the first category. This may be because loans in the production sector enhance foreign capital inflows, promoting industrial clustering and facilitating the establishment or expansion of local production facilities, enabling firms to compete in the global value chain. Therefore, FDI inflows may provide positive feedback to loans in the production sector. Regarding the impact on human capital improvement (measured by secondary school enrollment rates), specifically, loans in the infrastructure-related category have a positive impact on enrollment rates. In contrast, loans in the production and social welfare category have a statistically negative impact, which requires further analysis, as shown in the regression estimates in Appendix Table A9(c). The positive impact of infrastructure loans on enrollment rates can be attributed to investments in infrastructure such as roads, electricity, and water supply. These investments improve transportation convenience and enhance living conditions, reducing the necessary costs for basic household activities, thus increasing educational opportunities. For example, projects like well construction in Senegal saved residents a significant amount of time previously spent fetching water, encouraging citizens to pursue education. Additionally, industrial upgrades can also elevate educational levels. On the other hand, investments in a broad range of social sectors may promote employment growth but may not directly contribute to



educational development.

4.5 Robustness Tests

In this section, we re-estimate the models using merged summation functions. The original loan data is provided at the country, project, and yearly level, and in this section, we present the data in a country-year format by summing projects for the same year. The advantage of using merged country-year panel data is that it can improve efficiency, reduce multicollinearity issues, and simplify the analysis. However, a potential drawback is a reduction in the number of sample observations. We maintain the same estimation methods as before, controlling for important covariates and including country and year fixed effects. Standard errors are clustered at the country level to account for heteroskedasticity. Appendix Table A10 presents estimates of the impact of Chinese loans on overall levels of economic growth, school enrollment rates, and infrastructure improvement in African countries. The results show, as expected, that Chinese loans continue to have a significantly positive impact on economic growth, school enrollment rates, and infrastructure improvement at the overall level in Africa.

Additionally, to investigate potential temporal effects, this section introduces a time-period variable and interactions between loans and time periods to determine whether the positive effects of Chinese loans on the six dimensions diminish over time. The results indicate that the interaction between Chinese loans and time periods is negative, suggesting a potential weakening of the impact of Chinese loans on African economic growth over time. However, this result is not statistically significant and can be disregarded. The results for the loan squared terms in the models in Appendix Table A10 are all not significant, implying a linear relationship between Chinese loans and economic growth, infrastructure improvement, and human capital improvement, with proportional increases and no diminishing effects. Nevertheless, in the model in Appendix Table A10(c), the coefficient of the interaction term is negative, indicating a potential decrease in the positive impact of Chinese loans on enrollment rates over time.

Appendix Table A11 employs the same estimation method to illustrate the impact of Chinese loans on FDI inflows, commodity export earnings, and employment creation at the aggregate level, using lagged Chinese loans and their squared terms for lags of 1 to 3 years. The results in each column regarding FDI inflows, commodity export earnings, and industrial employment creation are consistent with the findings we obtained in the previous chapters. In other words, Chinese loans stimulate the growth of FDI inflows, commodity export earnings, and employment creation in Africa.

The squared terms in each column do not exhibit statistical significance, indicating that the model follows a linear rather than nonlinear relationship and does not show diminishing returns. On the other hand, the interaction terms in models A11-1-1 and A11-2-1 are both negative and significant, suggesting that the contribution of Chinese loans to FDI inflows and merchandise exports is constrained by time, meaning their impact diminishes over time, but it does not imply that Chinese debt has a negative effect on FDI inflows and merchandise exports in African countries. Additionally, in model A11-3-2 of Appendix Table A11, where the dependent variable is the number of jobs in the agricultural sector, the results show that Chinese loans do not have a positive impact on agricultural employment. This finding also suggests that Chinese loans may be facilitating structural transformation, even if it means a shift in



employment from the agricultural sector to the industrial sector.

Chapter 4. Cases on the Effectiveness of China's financing in Africa

China's financing in Africa involves a substantial array of regional public goods, such as airports, railways, and ports, which constitute public sector assets. China also financed the social sector of Africa, promoting the human capital development. In terms of development objectives, China's financing in Africa contributes to the realization of the World Bank's twin goals and the United Nations Sustainable Development Goals. In the realm of development philosophy, China's financing in Africa focuses on the comparative advantages of African countries. In the energy sector, starting from the endowment of natural resources, it has developed projects such as a wind farm in Ethiopia and a hydropower plant in Côte d'Ivoire. These projects fully utilize Africa's renewable and clean energy resources, assisting Africa in addressing electricity bottlenecks and confronting the global climate change challenge. In terms of collaboration principles, China places emphasis on the expression of Africa's own development voice, prioritizing African countries' needs rather than determining the development areas and directions for these nations. Consequently, we can also observe that the projects in these cases are primarily guided by the host country's strategic planning, instilling self-confidence in African development.

Apart from provide financing support, China also shared development experiences and management know-how to African countries for the operation of the projects, indicating China's responsibility for introducing project financing. In contrast to the World Bank Development Policy Financing (DPF) that tries to impact the institutional framework and development policy of the borrowing nations, China does not have this type of flow, and performed technical assistance in those infrastructure projects. Such cases can be found in the first toll road of Kenya, constructed and financed by the Chinese. In 2022, the road is opened to business, connecting the Jomo Kenyatta International Airport of Nairobi and the city travel. The goal is to improve city transportation efficiency. The program also introduced the ETC system, which allows cars to pass without stop and fulfill auto payment, which is widespread adopted in China. The program has reduced the travel time from 2 hours to 20 minutes and this travel style is accepted by the local residents. In April 2023, there were already over 120 thousand registered cars of the ETC system. The Chinese lender also referred to the juristic system of Kenya and introduced PPP for the nation, built the modern regulation framework for the program for debt sustainability. With the support of the Chinese counterpart, the Kenya operators introduced operational frameworks such as the 'Management Measures for the Expressway Operations' and the 'Emergency Response Plan for Tolling Emergencies'. This study focuses on the financing traits of China, for the management know-how sharing, it is encouraged that we would have future studies to understand the impact on how China facilitate African nations to establish modern management frameworks and provide soft skill support.

In the selection of cases in this article, we focused on the main categories of China's financing in Africa based on the structure of debt usage, including four major categories: transportation, energy, ICT, and water supply. We found that a well-planned approach driven by the development needs of the host country, investment in human capital, technology transfer, and the sharing of development philosophies ensured the success of the projects and enhanced development



effectiveness. Debt pressures constrained the time window for development. If the economy is developed first to unlock the investment potential of infrastructure, activate the cash flow from infrastructure, generate foreign exchange income, and repay external debt, it can maximize development benefits, promote effectiveness, and create a time window for further industrial development.

Measuring the effectiveness of each infrastructure project financed by China in Africa is challenging without the project level evaluation data. Data limitations also exist due to missing information from African countries. However, preliminary insights can be gleaned from project names, revealing a category of renovation projects supporting the expansion or replacement of existing capacity, commonly referred to as the ‘brownfield projects’ in the international community. These projects typically involve infrastructure with less pressure related to land acquisition, demolition or resettlement. After expansion or refurbishment, they provide a reasonable guarantee of improved economic activity benefits, along with enhancements to production facilities and living conditions. In the transportation sector, this category of projects accounts for a significant portion, making up as much as 50%⁷ of the committed and signed projects. In other words, nearly half of China’s financing in Africa for transportation projects is directed toward projects aimed at unlocking productivity potentials. For a more detailed example, we can refer to the expansion project of Bole International Airport in Ethiopia.

Ethiopia: Expansion of the Bole International Airport

For policy orientations, China’s financing for the Ethiopian aviation industry aligns with the country’s development strategy. This project primarily caters to the host country’s usage requirements and supports Ethiopia’s plan to become a leader in the African aviation industry by 2025. Situated in the Ethiopian Highlands with an average elevation of 3,000 meters and being a landlocked nation, aviation plays a crucial role in its economic takeoff, facilitating trade and global connectivity.

If we look at the development needs, we would discovered that the original Bole Airport had been in operation for about 60 years and faced passenger overload issues. In 2013, more than half a century later, China provided financing for the expansion of Bole International Airport in Ethiopia, encompassing both renovation and expansion components to enhance the airport’s comprehensive service capabilities. The Ethiopian Airlines dominated the expansion of the airport which promotes the commercial aspect of the airline.

In terms of the effectiveness of the projects, after expansion, the airport’s passenger turnover capacity significantly increased, with a daily passenger flow of approximately 67,000 people. Ethiopian Airlines became one of the most profitable airlines in Africa, reporting a net profit of \$260 million in 2019⁸. Based on estimated population

⁷ Based on statistics from the CLA database.

⁸ News Report: Ethiopian Airlines to Build a New \$5 Billion Mega Airport in Addis Ababa, Published on January 17, 2020, by Simple Flying, <https://simpleflying.com/ethiopian-airlines-new-airport/>



throughput, the airport's capacity expanded from 7 million passengers to 22 million passengers after the expansion, representing a 68% increase in operational capacity, generating economic and social impact.

Bole International Airport has been a driver of economic vitality across the African continent, radiating positive externalities. Airports serve as a nation's gateway and showcase. Bole Airport, located in the Ethiopian capital, Addis Ababa, has become a hub connecting Africa to various parts of the world. Addis Ababa is also the regional center for the African Union (AU) headquarters and other United Nations-related agencies. International travelers from around the world typically land in Ethiopia as their first stop when traveling to Africa, subsequently connecting to various African countries. The airport serves as an intercontinental public good, facilitating connectivity between the African region and the rest of the world.

For the financial sustainability, Chinese development financing has played a positive nurturing role. In 2020, Ethiopia decided to undertake the third phase expansion of the airport. The airport anticipated a substantial increase in capacity demand over the next three to four years, with a goal to expand capacity to 100 million passengers annually. The previous financing partner indicated that the current owner would use its own funds for the expansion of the third phase project, implying that there would be no further need for Chinese development financing support. The Ethiopian Airlines was created in 1956 as a state-owned firm of Ethiopia. The expansion of the airport not only performs project level financial sustainability, but significantly installs wings for the Ethiopian Airlines, for it to become one of the most profitable airline companies in Africa. The construction of the airport has significantly increased the revenue of the state-owned enterprise in Ethiopia, contributing to fiscal revenues, reflecting China's sustainable financing philosophy for Africa.

Section 1. Transportation

Among the 17 goals of the United Nations Sustainable Development Goals (SDGs), SDG Goal 9 explicitly addresses the areas of industry, innovation, and infrastructure. China's financing in Africa has undertaken a significant number of road and railway projects, contributing to the connectivity of the African continent and enhancing large-scale transportation capacity. Transportation is the largest sector of China's financing in Africa, accounting for approximately one-third of the total. According to project commitment data from the CLA database, the average commitment amount for Chinese-supported railway projects in Africa is around \$400 million, making it the most expansive sector that also becomes a sensitive factor national debt management.

Railway projects require substantial funding and are often a necessary condition for a country to embark on widespread industrialization. From a financial perspective, railway construction projects typically have poor investment returns, and commercial investors seeking profit maximization are often reluctant to invest. From the perspective of achieving policy objectives, the significant social and economic impacts generated by railways cannot be solely measured by investment returns. Typically, a country needs government-backed development financing to invest in railways, with repayment being driven by fiscal revenues generated from economic growth. Therefore, financing railway construction requires a higher level of government debt management capability compared to other sectors, and the successful



operation of railway projects can have a significant impact on a country's economic, social, and debt in a positive manner.

In China's financing in Africa, we have observed that support for railway projects is limited to just eight African countries, significantly fewer than in other sectors. Railway projects necessitate the construction of long-term development partnerships between creditor and debtor nations. The lifespan of railway projects is typically 50 years, whereas the maximum loan term offered by China is generally up to 20 years. China's financing in Africa embodies patient capital and a steadfast commitment to the continent's development, emphasizing long-term partnerships to support the construction of medium to long-term projects. We can illustrate the economic and social impacts generated by such financing through the example of the Mombasa-Nairobi Railway project in Kenya.

Kenya: Mombasa-Nairobi Railway

For policy orientations, the Mombasa-Nairobi Railway (MNR) addresses Kenya's proactive need for post-independence development. MNR is a critical project for achieving the Kenya Vision 2030, to the transformation of becoming a newly industrialized middle-income country.

The project is formulated on Kenya's railway financing needs. Construction of the MNR began in 2014 to meet the demand for replacing the capacity of the deteriorated colonial-era railways, making it the first modern railway in Kenya since independence. Apart from financing and construction, China also shared its management know-how, nurture the program for operational sustainability, sharing advices to the Kenya's government about the constraints and bottlenecks. For instance, during the initial construction of the railway, there were challenges in coordinating truck drivers, which could have affected the final transportation efficiency of the railway. Upon identifying this issue, China provided feedback to the Kenyan government. Leveraging its strong digital capabilities, the Kenyan government developed a truck driver software app, resolving the dispatching problems of truck drivers. While there was initially competition between truck drivers and the railway due to the reallocation of transportation capacity, this balance of interests was neutralized as the railway's capacity increased. Truck drivers gained access to more transportation demand, resulting in a win-win situation for all parties involved. To facilitate the operation, China also proactively conducted technology transfer. China shared expertise in internal combustion engine operation and welcomed local maintenance teams from Kenya to come and learn in China, following the principle of 'teaching a man to fish instead of giving a fish'. Currently, the MNR has achieved a high level of localization in its operations.

For delivering effectiveness, the success of the program also benefits from other creditors. The Mombasa port is financed by the Japanese creditors, which together improve the capacity of the transportation system of Kenya and make this country competitive in terms of the trade efficiency. The success of the MNR is attributed to its comprehensive transportation ecosystem, which includes connections to ports, with subsequent road transportation, and even truck drivers responsible for distributing goods from the railway yards to their final destinations, thus



enhancing the self-sustaining capabilities. The program has improved the efficiency of economic activities, with transportation time reduced from 10 hours to 5 hours, significantly lowering the transaction cost.

The MNR performs green financing, balancing the challenges of climate change and realizing the need for economic development. Comparing with other types of transportation, railways are better in reducing carbon reduction comparing with roads for the decarbonization of the transportation system. Kenya is one of Africa's major importers of second-hand vehicles, many of which pose emissions hazards due to not meeting emission standards. Prior to the MNR, a significant number of automobiles were responsible for transportation between Mombasa and Nairobi. The railway assumed and expanded the existing automobile transport capacity, alleviating congestion and reducing air pollution. Based on the actual capacity of the MNR, with 180 passenger trains and 510 freight trains operated each month, the railway has resulted in an annual reduction of approximately 640,000 tons of carbon emissions in Kenya. When calculated based on the world average per capita carbon emissions of 4.5 tons, this is equivalent to the annual carbon emissions of 142,000 individuals.

In terms of financial sustainability, MNR commenced operations on May 31, 2017, and achieved operational break-even in 2022, making it financially sustainable by covering its operational costs with railway revenue. As of May 31, 2023, the Mombasa-Nairobi Railway has celebrated its safe operation for six years. It operates an average of six passenger trains and 17 freight trains daily, transporting a total of 10.5 million passengers, 2.3 million TEUs of containers, and 26 million tons of cargo. The average occupancy rate reaches 90.9%. Moreover, the MNR adopted a very economic railway construction technology, the capital saving technology that suits the factor endowments of the nation. When compared to alternative electrification technology, the project offers a low-cost solution. China recommended MNR to use internal combustion engine that is suitable for its stage of development. This approach aimed to strike a balance between technological effectiveness, adaptability, safety, and financial pressures. This recommendation was adopted, enhancing the nation's financial credibility. Additionally, the design of the MNR reserved capacities for future technology upgrades, considering the evolution of technology choice.

China's financing also serves as regional public goods. MNR can be part of the East Africa Railway Network, connecting Kenya, Uganda, Rwanda and so on. The East Africa railway network was built under the Britain colonial period. In addition to Kenya, the Uganda section of the network is also actively seeking financing support from creditors. Due to the mega financing volume of the railway, funding from multiple countries, including private sector investment, will jointly promote the transportation development of the East African region.

Section 2. Energy

The United Nations Sustainable Development Goals (SDGs) clearly emphasize the significance of clean energy for development, such as SDG Goal 7 on affordable and clean energy and SDG Goal 13 on climate action. Energy is also the second-largest sector in China's financing for Africa, accounting for 25.3% of China's total commitment in signed



contracts for Africa⁹. Through bilateral means, China is contributing to Africa's path towards sustainable development and is having positive effects on the environment and climate change.

The technological choice of China's financing for Africa in the energy sector align with the comparative advantages of African countries. Many African nations face challenges related to coal resources and struggle to overcome bottlenecks in electricity supply during the fossil fuel era. In the era of green energy, African countries possess comparative advantages in renewable energy sources such as wind, solar power, and hydroelectric resources. With support from international development financing, the widespread adoption of electricity becomes feasible. Effective electricity projects further help African countries save foreign exchange required for importing electricity and may even increase foreign exchange earnings through electricity exports. This contributes to improving fiscal conditions and aids in debt repayment. Specific examples can be seen in the Soubré Hydropower Plant in Côte d'Ivoire and the Adama Wind Farm in Ethiopia.

Côte d'Ivoire: Soubré Hydropower Plant

For the policy orientation, in 2005, Côte d'Ivoire decided to establish a Renewable Energy Agency to promote its renewable energy strategy.

For the financing needs, Côte d'Ivoire has been engaged in financing cooperation with China since the end of its civil war in 1999. The Soubré Hydropower Plant is a major project for the cooperation of China and Côte d'Ivoire. The government secured a 370-kilometer transmission line to ensure the distribution and supply of the generated electricity. Prior to the Soubré Hydropower Plant, the country had no renewable energy projects, and China's financing support enabled this significant breakthrough.

For the effectiveness of the project, the Soubré Hydropower Plant began generating electricity in 2017. By the end of 2022, it had cumulatively generated 7.51 billion kWh of electricity, with an annual average electricity supply of 1.32 billion kWh, surpassing the originally designed capacity of 1.1 billion kWh. The project improved the national electricity capacity of nearly 14%, increased its renewable energy contribution to 45%. Despite the impact of the COVID-19 pandemic, the country experienced a robust rebound, with a GDP growth rate reaching 7% in 2021. The plant has contributed to Africa's transition to green energy, shifting Côte d'Ivoire from primarily relying on fossil fuel to comprehensive hydroelectric development. This transition has resulted in an annual reduction of greenhouse gas (GHG) emissions by 607,720 tCO_{2e}, from the commencement of electricity generation in 2017 to the year 2020 when the United Nations conducted an effectiveness evaluation. In total, GHG emissions were reduced by 2,566,041 tCO_{2e}.

In terms of financial sustainability, the project has demonstrated strong financial and economic returns, ensuring sustainability at the project level. The country has enhanced the project's financial sustainability by selling Certified

⁹ Based on statistics from the CLA database.



Emission Reductions (CERs), thereby diversifying revenue sources. With the government's facilitating capacity and the experience of the energy operators, the project's financial sustainability is bolstered. The project is designed with manageable cash flows from electricity sales for debt repayment, further reducing debt pressure and promoting debt sustainability.

The project also serves as a public good for exporting electricity to west Africa, easing the bottleneck of electricity shortages in nearby countries, for instance, in Burkina Faso and Mali.

The success of the project benefits from the overall support of China with other creditors. We observed a policy plus infrastructure interaction among China and other creditors, together as a package to fulfill the development needs of African nations. The advanced industrialized nations delivered policy reform impacts and China provided support on fixed-investment on infrastructures. Agence Française de Développement (AFD), the French development finance institute, is very active in the energy sector reform of Côte d'Ivoire. In 2017, AFD adopted the General Monetary and Multisectoral Macrodynamics for the Ecological Shift (GEMMES) program to Côte d'Ivoire. It aims to build tools for sustainable energy transition and add factors of climate change mitigation and adaptation into the macroeconomic modeling of the nation.

Other creditors also have a positive view of the energy development of Côte d'Ivoire. World Bank Group (WBG) provided multifaceted support, for instance, through policy reform, budget support, project financing, and credit enhancement by providing guarantees. During 2010 to 2019, the WBG through its arm targeting the private sector, the International Finance Corporation (IFC), invested 400 million USD to the nation, and leveraged support from other development finance institutions, such as the African Development Bank and AFD, whom altogether adding another 1.1 billion USD investment to Côte d'Ivoire. In addition, the International Development Association (IDA), another arm of the WBG, launched 30 million USD guarantee to facilitate the energy sector reform. In 2018, IDA supported CI-Energies, the state-owned enterprise in the energy sector in Côte d'Ivoire with 240 million USD guarantee to lower the bailout risk of the nation and improve volatility. This operation facilitated the debt restructure of CI-Energies for it to raise 445 million euro in the financial market. Multilateral Investment Guarantee Agency (MIGA), an arm of the WBG in addition provides 116 million USD guarantee for political risks and raised Côte d'Ivoire's investors' confidence.

Under the overall support and the interaction of various types of creditors, the electricity accessibility of Côte d'Ivoire improved from 34% in 2013 to 94% in 2020, a leap forward to fulfill the goal of universal electricity supply.

Ethiopia: Adama Wind Farm



For the policy orientation, Ethiopia released its Climate Resilient Green Economy Strategy (CRGE) during the 17th Conference of the Parties (COP 17) to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2011, aiming to becoming a climate resilient middle-income economy by 2025.

In terms of power demand, based on Ethiopia's climate change goals, the country has been actively developing clean energy resources. Currently, the power supply is dominated by hydropower. However, Ethiopia faces seasonal electricity challenges due to the uneven distribution of water resources over time and space. Despite having abundant water resources, the country still encounters power shortages during the dry season. Therefore, the development of wind power is seen as a solution to Ethiopia's seasonal electricity supply problems, complementing hydropower and enhancing power supply stability. Ethiopia enjoys abundant wind energy resources. Wind energy is proportional to the cubic power of wind speed. The wind speed in Ethiopia can reach to 7 to 9 meters per second, which is capable for large-scale wind power projects.

For the effectiveness of the project, leveraging its natural wind energy advantage, China's financing supported the wind power project in the Adama region in the central of Ethiopia, providing electricity to the capital, Addis Ababa, and those surrounding areas. The project comprises 136 wind turbines with a total installed capacity of 204 megawatts. The first and second phases of the project were handed over to the owner for operation in August 2012 and June 2016, respectively. As of 2022, the project has cumulatively generated over 835 million kilowatt-hours of electricity. The completion of this project has effectively alleviated electricity shortages in the capital region, enhanced Ethiopia's capacity to harness clean energy, and contributed to optimizing its power structure and developing low-carbon industries, thus aiding Ethiopia in achieving sustainable green development.

Section 3. Digitalization

Africa faces a digital divide compared to developed countries. The continent needs to achieve significant progress in the era of industrialization and digitalization, where opportunities and challenges coexist. The demographic dividend in Africa also presents enormous potential for digital economic development. China's cooperation with Africa in digital infrastructure and digital industries contributing to the United Nations Sustainable Development Goals (SDGs), including SDG 10 on Reduced Inequalities and SDG 8 on Decent Work and Economic Growth. In 2021, China and Africa announced the implementation of the 'China-Africa Digital Innovation Partnership'. Chinese financing for information and communication technology (ICT) projects is being carried out in 41 African countries¹⁰. Building on the strong China-Africa friendship, these projects have wide coverage across the African continent. In 2017 and 2018, the ICT sector of China-Africa financing witnessed growth rates of up to 110% and 24%, respectively. According to official Chinese government statistics, China has constructed over 50% of wireless stations and high-speed mobile broadband networks in Africa, providing information services to over 900 million people on the continent. More than

¹⁰ According to statistics from the CLA database.



1,500 companies from over 15 African countries have chosen Chinese firms as partners for their digital transformation. Additionally, 29 African governments have adopted smart e-governance solutions offered by Chinese companies. At the software level, Chinese enterprises actively support the development of African platforms for electronic payments, smart logistics (State Council Information Office of the People's Republic of China, 2021).

Given Africa's large proportion of youth in the demographic profile, developing the African digital industry aligns with the strong e-network demand of the lifestyle of the young people. Africa's population is expected to maintain high growth rates in the coming years, resulting in significant demand for digital services like telecommunications (Niu Dongfang, Shen Zhaoli, Huang Meibo, 2022). Compared to utilities like water and electricity, African citizens exhibit a higher willingness to pay for communication services. China has a competitive edge in telecommunication technology globally. In 2015, China introduced the concept of the 'Digital Silk Road'. China's financing in Africa is helping bridge the digital divide, facilitating the continent's digital transformation, and promoting the application of new technologies, further unlocking the digital economic potential in the African region.

China supports comprehensive digital infrastructure development in Africa. One significant area of investment is in fiber-optic cables, where Chinese companies have been involved in numerous projects connecting Africa with other continents, such as the Tanzania National Fiber Optic Backbone Project. These companies have also expressed optimistic outlooks for the African continent. For example, in 2015, China Telecommunications Corporation proposed the 'China-Africa Information Highway' initiative, and China Telecom has been promoting the 'Eight Vertical and Eight Horizontal' network plan, aiming to establish a terrestrial optical fiber network covering 82 major cities in 48 African countries, totaling 150,000 kilometers. Chinese digital leader Alibaba, in cooperation with the Rwandan government, has constructed the first Electronic World Trade Platform (eWTP) in Africa¹¹. Another major tech giant, Tencent, during the COVID-19 pandemic, open-sourced its international version of the Tencent Health Code module to help Africa and the rest of the world combat the pandemic.

¹¹ News report: 'What Alibaba is Doing in Africa', Xinhua News Agency, June 27, 2019.



Tanzania: National Fiber Optic Backbone Network

For the policy orientation, the project's vision is to assist Tanzania in becoming an ICT hub in East Africa, enhancing the digital capabilities in the region and aligning with Tanzania's national development plans. The project started in 2007, with China supporting the construction of Tanzania's national fiber optic backbone network, building telecommunications sites, and related applications.

In terms of the impact, the project has significantly improved the speed and stability of data transmission in the telecommunications network, extending its service capacity nationwide. This has resulted in better internet services for Tanzania's 54.16 million mobile users, leading to strong economic and social benefits. The Tanzanian government has referred to it as the 'TAZARA Information Railway'. Regarding technology and usage costs, after the project's launch, Tanzanian telecommunications operators no longer needed to invest extensively in laying optical cables themselves. They only needed to connect to the backbone network to access stable data transmission, which also enabled them to provide more affordable data services to local residents. As a result, communication costs in Tanzania have dropped by 75%, significantly promoting an increase in the number of telecommunications users.

For the regional positive externalities, the project has developed a backbone network spanning 7,437 kilometers, covering all 21 administrative regions of Tanzania, and connecting with six neighboring countries and two international submarine cables. It established regional connections within East Africa, linking Tanzania with six other East African countries, including Kenya, Uganda, and Rwanda, making Tanzania a crucial communication hub in East Africa.

Section 4. Benefiting People's Livelihood

The United Nations Sustainable Development Goals encompass various areas of social development, including SDG Goal 6 on Clean Water and Sanitation, SDG Goal 2 on Zero Hunger, SDG Goal 3 on Good Health and Well-being, SDG Goal 11 on Sustainable Cities and Communities, and SDG Goal 4 on Quality Education. Approximately 10% of China's financing to Africa supports projects related to social development, including those related to food, clean drinking water, education, health, medical facilities, housing and etc.¹² The commitment amounts for individual projects are typically around \$70 million, covering more than 200 loan projects. In terms of construction achievements, the financed projects have constructed approximately 4.74 million square meters of affordable housing and commercial buildings, built 11 hospitals, and added 2.71 million cubic meters per day of water supply capacity. China's financing projects in Africa that benefit livelihoods encompass 93 loan projects, with an average commitment of about \$79.88 million per project¹³. These projects play a crucial role in improving community life and hygiene. For China in its

¹² Based on statistics from the CLA database.

¹³ Based on statistics from the CLA database.



current stage of development as a developing country, it may not have abundant funds for extensive non-repayable assistance, and projects in this category may offer limited financial returns. However, they demonstrate China's concern for improving the lives of the African people.

Senegal: Rural Well Digging Project

For the policy orientation, this project was a star project of Senegal's 'Rural Development Emergency Plan'. In 2017, the President of Senegal attended the groundbreaking ceremony of the Rural Well Digging Project, with the good will that the projects would benefit the entire nation.

For the demand on water supply, due to the relatively low level of industrialization in Senegal, rural areas, in particular, faced severe water binding constrains and the hygiene issues, leading to the spread of infectious diseases. There is the urgent need of renovating the water supply system.

For the effectiveness of the program, this project covered thirteen major regions of Senegal, spanning the entire country. It involved the construction and reconstruction of over two hundred water wells, laying 1,800 kilometers of water supply pipelines, and establishing hundreds of water supply points, water towers, and livestock watering troughs¹⁴. This extensive network of wells and water infrastructure not only benefited the population but also provided comprehensive water sources for agriculture, livestock farming, and daily life. In 2019, the Rural Well Digging Project was completed and put into operation. It covered approximately one-seventh of the national population with two hundred wells and earned the nickname 'Wells of Happiness' on the African continent. According to estimates by Senegal's Ministry of Water and Sanitation¹⁵, this project increased the drinking water access rate to 91%, producing significant positive social impacts. During the construction period, the project also created more than 3000 jobs for local people.

The project has saved people time in obtaining basic living materials, providing conditions for further productive activities. Due to the lack of basic necessities, people are unable to invest in education, further reducing their chances of seeking employment, leading to a vicious cycle. The livelihood projects address the basic survival issues of the people in a short period. Previously, villagers had to spend four hours each day traveling to fetch water outside the village by horse-drawn carts. With the well project, villagers can now access water sources directly at their village entrance¹⁶. This has allowed young people to save time, no longer needing to queue from midnight until dawn, and providing them with more opportunities for education.

¹⁴ News Report: China International Contractors Association, 'Comprehensive Launch of China's Rural Well Digging Project in Senegal', March 8, 2017.

¹⁵ News Report: 'China-Aided Rural Well Digging Project in Senegal Writes a Story of Sino-Senegalese Friendship', Jiandao Network, May 27, 2022.

¹⁶ News Report: 'Enriched Connotations of China-Africa Cooperation through Vivid Stories in President Xi's Signed Article', Xinhua News Agency, July 22, 2021. Read the full article here: <http://news.cnnb.com.cn/system/2021/07/22/030271601.shtml>



For the financial sustainability, the technological features of this project aligned with the usage patterns and development stage of Africa. The African continent, in terms of water resource utilization, had yet to widely establish piped water systems. Given the early stages of urbanization and industrialization in many areas, addressing the need for drinking water in Africa often involved direct well-digging methods. Establishing comprehensive water pipeline systems across large areas in a short period presented significant challenges. Well-digging, with its low-cost approach, could effectively improve water conditions on a smaller scale, minimizing the financial burden and meeting the immediate demand for infrastructure.

This project has raised interest from the private sector, as carbon credits generated by the project can bring foreign exchange to Senegal, promoting debt sustainability. The project helps increase resilience to climate change and leverages private sector development. A carbon trading company will calculate carbon credits generated by the implementation of the well project, based on factors such as the population covered by the well project and the water usage. These credits will then be sold, following the VCS (Verified Carbon Standard) guidelines. The project is being carried out by a company based in Guangzhou, China, with potential buyers from large European and American enterprises, fostering triangular cooperation. The project has completed the calculation of carbon credits and is currently undergoing its on-site verification by a third-party, with an expected annual income of hundreds of thousands of dollars in foreign exchange for Senegal.

China-Africa Human Capacity Building

For the policy orientation, African nations have a strong focus on human capital investment. Gabon plans to establish a batch of vocational education centers in its 'Emerging Development Strategy'. Uganda has placed talent development on the agenda in its 'Vision 2040 Development Strategy'. Ghana's National Education Strategic Plan 2018-2030 aims to transform Ghana into a 'learning nation', with a particular focus on distance education to enhance education capabilities at all levels and in all regions, including tracking indicators such as enrollment rates in the distance education. Ignited by the devotion of human capital development of the African nations, African countries and China signed a 'Plan for China-Africa Cooperation on Talent Development' when political leaders attended the China-Africa Leaders' Dialogue in August 2023.

For the talent, there is the unrest for Africa's large, young population to gain educational resources in many African countries. Africa's population structure indicates a significant demand for youth education and vocational training. After receiving education and training, African youth can enter the workforce, secure employment that leads to social stability. This also contributes to the enhancement of human capital, making a significant support to Africa's economic development.



For China's sovereign financing in Africa, from 2000 to 2020, according to the CLA database, China supported approximately \$1.6 billion across 33 projects for the education sector in Africa, covering 12 African nations, such as Kenya, Angola, Gabon, Ghana, Uganda, and etc.

In Kenya, China's talent training program in Africa has provided advanced equipment to 47 county-youth service teams and for 134 vocational colleges. It has also conducted vocational training to over 60,000 teachers and students. In Gabon, three vocational education centers supported by Chinese financial institutions will facilitate a large number of Gabonese students to visit China in the future, promoting technology transfer from China to Africa. In Ghana, Chinese financial institutions have supported the construction of the network infrastructure at the University of Ghana, establishing a distance education system in the main and branch campuses. The program bridged the digital divide between Ghana and developed countries. In Uganda, Chinese financing institutions support the construction of the national science and technology entrepreneurship institution, which is expected to train 2,000 professionals annually in the field of agricultural and industrial machinery. China is also actively promoting vocational and technical cooperation in Africa through initiatives like the 'Luban Workshop', offering short-term technical training to institutions such as the University of Durban in South Africa. Graduates of the Lu Ban Workshop have secured jobs in high-tech industries and entered renowned global companies like Amazon and Microsoft. These projects address bottlenecks in the education sector of the host countries, providing financing services that match their development stages and needs. This helps alleviate the talent shortages in African countries and supports industrial transformation by enhancing human capital.

Chapter 5. Summary of Main Findings and Policy Recommendations

Section 1. Summary of Main Findings

1.1 About China's Sovereign Financing in Africa

At the macro level of global development, China is a major contributor and a burgeoning force for the global development financing system. As China's economy grew, the development impact of China spilled over to Africa, building infrastructure, and laying the foundation of the economic and social development for the African continent. In Africa, a development partner like China has never occurred in history, demonstrating the positive impact of China on global development issues, and fostering the prosperity of south-south cooperation.

In terms of the sovereign financing market, multilateral development banks, including the World Bank contribute to most of Africa's external debt, amounting to 33%. The international investors in developed financial markets support the bond issuance of Africa's nations, accounting for 30% of the debt (Wang and Xu, 2023). China is not the dominant contributor in terms of the sovereign debt of African nations. Compared with the UK, US, and France, who made contributions to the multilateral system in history, as China's growing lending needs, China adopted a more bilateral focused financial mechanism on Africa. The bilateral cooperation between China and Africa has very clear policy



frameworks. In terms of the financing philosophy and policies, China and Africa established the Forum on China-Africa Cooperation (FOCAC) in 2000 to facilitate policy communication, with evolving policy orientations, such as the ‘Three Networks and One Modernization’, the ‘Ten Major Plans’, the ‘Eight Major Actions’, and the ‘Nine Projects’. In 2013, China raised the ‘Belt and Road Initiative’, which is in line with the policy objective of the global economy, to promote green energy, tackle the challenge of climate change, and provide public goods for the global society.

At the micro level, this study has conducted case study research and econometric modeling to assess the effectiveness of China’s financing to Africa at the project level. Overall, we discovered that China’s policy toward Africa is in line with the United Nations Sustainable Development Goals and the twin goals of the World Bank. The bilateral system of China contributes to the delivery of global development policies. China as an emerging creditor, has the potential to promote information sharing, post-evaluation, and policy communication with other creditors. China has made substantial contributions to the economic, social, debt sustainable development of African nations.

We focused on the project content to understand the financing effect. China has provided not only financial support but sharing development experiences on management know-how. China built the first toll road in Kenya, adopting the PPP model, ETC system, and introduced the modern regulation framework. Over 67% of the financing goes to infrastructure, such as railways, roads, ICT, water supply, ports, energy sectors, and so on. China’s financing in Africa calls for green energy and supports the digital construction of Africa. China only enacted railway projects in 8 selected countries because of the challenging essence of railways that require technical fiscal and operational management. In contrast, based on the traits of the young population in Africa, who require internet and telecommunication services for their daily life, China conducted ICT projects in 41 countries, covering most African nations for a digital Africa. China considered the local conditions in terms of cost, demand, and operation capacities and formulated practical solutions. In the transport system, over 50% of the projects are to expand, renovate, or replace an existing project, to unleash the rising demand constraint by the poor condition of the existing projects. Those expansion projects instantly improved the living quality of the African people. Many of the railways are also the first railways built in the nation after independence, which signifies the modern industrialization of the nation. For the energy sector, during the fossil fuel-fired era, Africa did not have abundant resources in coal. Nowadays, the green technology helps Africa unleash its potential in green energy and benefit from the natural endowments in wind, thermal, and hydro. By exporting electricity, green finance to Africa tackles the electricity bottleneck and improves foreign exchange revenue for Africa. The volatility of the exchange rate of US dollar caused disturbance for African nations paying debt. The effectiveness of China finance in Africa also depends on the actions of Africa's debt management options. We call for the global society to look at the sector focus of the loan flow, to assess its impact and serve the strategic arrangement of African fiscal capacity.

1.2 Insights from the perspective of new structural economics



From the perspective of new structural economics (NSE), it is a structural characteristic for countries with low income to look for foreign finance. The financing demands are endogenous to a certain income level of the nation. China's financing to Africa is in line with its development needs. If we look at debt structure, we can notice that many of the infrastructure projects formed public assets for the African nations. In the future, those nations would refinance those projects with fixed assets, improve the mobility of their public asset, and generate fiscal revenue from the capital market. If the IMF analyzes those infrastructure projects by calculating the public assets, we would form a more holistic view of the effectiveness of China's financing to Africa. For generating growth, NSE reckons that the factor endowment and natural resources of a nation is set at a given period. Therefore, there is an optimal industrial structure that suits this setting with the lowest cost for the nation to gain competitiveness in the global market. The cost contains production cost and transaction cost. With sovereign financing building infrastructure, a nation can lower transaction costs, developing industries following its comparative advantages, to win in the global market and generate growth. China's financing of Africa supports large-scale infrastructure projects and contributes to the development and debt self-reinforcing cycle. The philosophy of China's sovereign financing is to build a self-sustaining development path to ensure debt sustainability. Therefore, China built several financing platforms to support enterprises and the private sector, adding its strength in equity investment, to form a package solution for Africa's development.

1.3 Main findings of empirical research

In terms of the econometric modeling analysis, this research adopted a project-level loan commitment database collected by Boston University, from 2000-2020, covering 49 African nations. The assessment reevaluates the effectiveness of China's sovereign financing in Africa. The scope of the research covers loans supported by sovereign credit and the general public sector. The study provides empirical evidence from multiple perspectives that China's loans have implicit positive impacts in Africa. It employs regression methods to estimate causal relationships between Chinese loans and six pivotal dimensions: economic growth, job creation, infrastructure improvement, human capital improvement, export earnings, and foreign direct investment. In addition to ordinary least squares (OLS) estimation, the report employs the instrumental variable two-stage least squares (IV-2SLS) estimation method to address endogeneity concerns of Chinese loans. The report also conducts a structural analysis to observe the effectiveness of Chinese loans in African country development based on characteristics such as creditor type, borrowing country income level, and the sectoral allocation of loan flows.

The empirical results show that China's loans have a generally positive impact on the economic growth of African nations, and improve the livelihood of the African people. The loan has had a significant impact on education and improved the hard infrastructure of education facilities and the literacy rate. The study also shows that loans generate a positive impact on manufacturing job creation, infrastructure development, and globalization. However, the results indicate a negative impact on agricultural job creation statistically, which could be explained as the result of moving people from agriculture to industries. In the future, the investment should enhance its focus on the agriculture sector of Africa, building the agriculture infrastructure. China's loans have significantly improved the overall transportation system, the electricity facilities, the ICT sectors, and many other areas, lowering transaction costs. The loan has triggered larger-scale investment and trade, promoting economic growth.



In terms of the heterogeneity of the creditors, we discovered that Chinese official lenders have a bigger positive impact on Africa, compared with the non-official lenders of China, on the FDI inflow, export, and economic growth of Africa. The non-official lenders of China also had a positive impact on the export and infrastructure development of Africa, comparing with other indicators, illustrating the fact that all Chinese creditors, including the commercial lenders, have contributed positively to the export and infrastructure construction of Africa, which benefits the debt sustainability.

In terms of the income level of borrowing countries, we discovered that China's loans have a bigger positive impact on countries with lower income levels on job creation, export, GDP growth, and infrastructure improvement. The results indicate that China's financing is more dedicated to less developed areas, contributing to achieving the SDGs of the United Nations. On education, the indicator of enrollment, the impact of China's finance is bigger in more advanced African countries, compared with lower-income nations, which indicates that the improvement in the education system may need a certain foundation to generate bigger impacts.

We looked at the sector focus of loan flow and discovered that infrastructure projects also contribute to a higher level of school enrolment, and its impact is even stronger than those of social sector projects and industrial projects. The findings can elicit reflections on global development policies. In the Senegal rural well-drilling project shows that when the residents acquired easy access to clean water, saved their time for long-distance water collection, and secured their time for school. The infrastructure can improve living standards, improve transport conditions, and make education more accessible. The finding also enriches the understanding of China a more infrastructure-focused financing strength. China's financing of infrastructure also leads to the development of the social sector. In addition, China's financing of the industries and social welfare generated a larger impact on FDI inflow for Africa, compared with infrastructure projects. One explanation could be that industrial projects promote foreign investment and industrial clustering, which boosted positive feedback. Future research can further explore relevant mechanisms.

The goal of the research is to contribute to the knowledge system on the effectiveness of loans to borrowing countries and try to avoid bias from international politics and other factors. The empirical study aims to reconfirm the case studies, considering the specific needs of the borrowing nations, the comparative advantages, the complex global context, and the social and political interactions forged by the loan's activities. The study is conducted with an open and non-biased mindset. By applying this comprehensive methodology, we could have a more nuanced understanding of the impact of the loans to the borrowing nations, identify potential risks and opportunities, and formulate more effective policies to promote sustainable development and poverty reduction.

The study has some limits. It should be noted that we need to enhance the effectiveness and reliability of the data. A significant limitation is the discrepancy in the accuracy, the time dimension, and the statistical caliber of loan data collected among institutions. Due to the lack of data, it may detriment a thorough understanding of the investigated phenomenon.

Section 2. Policy Recommendations

2.1 To China's overall financing structure in supporting Africa



(1). At the macro level, to the global development, the African population is very young and will account for a large share globally. The development of Africa is now faced with a huge financing gap, the traditional multilateral system and the advanced industrialized nations cannot provide enough support. The study has made empirical evidence that China delivered a positive impact on African countries through sovereign finance. China and Africa have experienced the same path of independence, as the biggest emerging lender, China will be increasingly important for Africa's development. As China grows, its development impact will continue to spill over to Africa. In the future, China could enhance its support for significant infrastructure projects in Africa, provide public goods for Africa, and deliver its financing effectiveness for the development of Africa.

(2). China could uphold the multilateralism. For policy impact, China could enhance cooperation with multilateral and official bilateral institutions, improve coordination with other creditors, and promote information sharing. In addition, China could encourage Chinese firms and financial institutions to adopt triangular cooperation with their foreign counterparts. For instance, for the mega railway projects and regional railway networks in Africa, joint finance with other creditors can lower the financing pressure and enhance the sovereign guarantees to protect the lender. We could further leverage the positive externalities of railways through the formation of railway networks. China as a single country, cannot afford the debt pressure of African nations. The international organization has strength in the country's debt management. China should stick to its advantages in project management. Nowadays, the African nation is facing debt pressure, China can build a multilayer financial system, combining different flow types and creditors and be more resilient to the challenges of the global environment. The system can enlarge both sovereign and non-sovereign financing, official and commercial lenders, and increase support to SMEs, the integration of investment, construction, and operation.

(3). At the micro level, for the loan flow sector focus, we discovered that most of the loans go to infrastructure development, and care for the endogenous financing demand of African countries. China's financing of Africa cares for the development stage and the endowment characteristics of African nations. China values the development needs of Africa and does not require political conditions. Those projects cure the development bottlenecks. We discovered many of the infrastructures also share the characteristics of regional public goods. In the future, China's financing to Africa can enhance its support in strategic infrastructure projects, and facilitate regional integration and trade integration, such as in ICT, railway, and the shipping system, to raise the level of systematic transportation capacity. The study figured out that China's financing to Africa has a strategic focus on human capital development. In the future, there could be evaluations on the effective way of talent development. Considering the development needs of African nations, we could design indicators to better understand what kind of talent program best serves Africa and improve the effectiveness of China's loans.

(4). From the perspective of new structural economics, development financing should strengthen the support of industries. African nations need to develop industries that follow their comparative advantages. We could take industrial parks as a tool to cultivate quick success. In the case study section, the project that has strong self-sustaining capacity shows that we need to match the infrastructure sovereign financing with the revenue-generating capacity of the state-owned enterprises (SOE) of the owner countries. This arrangement can ensure the borrowing entity is the same as the revenue-generating body to ease the debt burden. In the future, China develop a package of investment



plus financing. We could consider the effectiveness of the SOEs and increase investment to the public firm, to promote the development impact of the sovereign financing.

(5). On theory building, the Chinese creditors can enhance their knowledge base and the theoretical framework. The Chinese financing system can better leverage the support of think tanks and academic institutions both domestically and overseas. China can work out a theoretical framework based on the experience of China in international development finance and share it with the global society for policies and governance. Moreover, China can also draw from the international advice and experiences.

2.2 To Africa nations

(1). African countries can maintain the principle of country ownership and guide the policy directions of how to evaluate the effectiveness of international development policies and financing, conducting a systematic evaluation of those programs. At the same time, African nations can leverage international organizations to lower the short-term debt pressure. Through project financing from China, Africa can develop industries in line with their comparative advantages, promote export and earn foreign exchange, and work at greater strength in attracting export-oriented firms who can bring international orders. It is expected that with the appropriate development path, African nations can build the engines for their growth on a self-sustaining path and promote structural transformation in the long term.

(2). To perform effectiveness in the long run, this study recommends that African countries adopt post-construction evaluations, to evaluate the operation effectiveness. Also, the operator needs to conduct long-term, reliable, and comprehensive data collection. Based on the dataset, we would be able to shape a more holistic view of the effectiveness of the projects and share the information with the stakeholders that build synergies for all.

(3). Many African nations are in the early stage of industrialization with capital constraints. On one hand, to lower the fiscal risk, African nations can try all currency financing, according to the market conditions, and lower the reliance on US dollars for the pressure of US dollar appreciation. On the other hand, African nations can improve the development finance institutions' capacity in their county. The sector focus of the policy financing should be in line with the needs of the current development stage. It could also be considered to leverage the multilateral institutions to cultivate the national credit in the financial market. African nations could improve the on-lending loans from the World Bank or the regional development banks and build the government credit in the long term. Apart from borrowing money, the borrower could build broaden their funding sources, for instance, introducing PPP, leveraging funds and equity investment along with the loans, etc.

(4). In terms of the policy architecture, it is recommended that African countries strengthen the policy formation with the United Nations 2030 Sustainable Development Goals and the African Union 2063 Agenda. African countries' development strategies can work more closely with the 'Belt and Road Initiative', the Forum on China Africa Cooperation, the China Expo for Development, and other mechanisms and platforms of China.

2.3 To the international structure

(1). The proportion of low-income countries in Africa is the highest in the world. Africa's economic and social development requires a large amount of foreign financial support. The region is also of great significance for global development. The international community needs to continuously increase investment in Africa and to address their



core issues. The convening of the first African Climate Summit in September 2023 represents the great unity of South countries. The international community urgently needs to formulate policy guidance based on the development needs of African countries.

(2). The international organizations have advantages of debt management at the country level. The global international development financial institutions should strengthen their support for African countries to cope with short-term debt pressure. MDBs could leverage their excellent shareholder credit resources and low-cost financing advantages through grants or other flow types and ease the conditions for projects with long-term development potential for Africa.

(3). With China's growing support for Africa's infrastructure construction, the United States and Japan have also increased their investments or financing commitment to Africa's infrastructure sector. This study shows infrastructure construction has a positive effect on all the dimensions of Africa's economic and social sectors as of the indicators covered. This paper calls for the advanced industrialized nations to improve their support for the infrastructure sector in Africa.

(4). For the international debt evaluation standards, it is recommended that the global society evaluate debt sustainability at the project level from the perspective of debt usage. In terms of national debt management, we could notice the formation of fixed assets and run calculations on whether the debt can help generate development benefits.

(5). With the rapid growth of emerging economies, we noticed emerging lenders. The multilateral institutions established by emerging economies, such as the New Development Bank, have the potential to deliver a positive impact on the development of Africa. It is recommended that emerging lenders continue to support globalization and forge a more diversified financing system. We should encourage loan flow through multiple channels, and strengthen communication of creditors for setting standards. We should promote triangular cooperation in Africa and promote global prosperity by addressing the development bottleneck of African countries.

(6). According to this study, we noticed that commercial and private creditors are increasingly becoming major financing sources for African countries. They have an important role in resolving African countries' debt risk. The international community should attach great importance to strengthening the coordination and supervision of the private and commercial lenders, for them to take responsibility and jointly safeguard global financial security.



Annex

Table A1: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)-gdpconstant	1.000															
(2)-Chinese loan	0.294	1.000														
(3)-material	-0.028	0.441	1.000													
(4)-schooling	0.119	0.052	0.072	1.000												
(5)-electricity	0.268	0.077	-0.016	0.684	1.000											
(6)-employment	-0.199	0.067	0.146	-0.693	-0.716	1.000										
(7)-export/GDP	0.661	0.277	0.143	0.324	0.358	-0.506	1.000									
(8)-FDI inflows	0.681	0.313	0.157	0.022	0.178	-0.101	0.427	1.000								
(9)-ln(inflation)	0.236	-0.015	-0.260	-0.157	-0.158	0.055	0.113	0.162	1.000							
(10)-ln(gov't spend)	-0.433	0.081	0.294	-0.132	-0.249	0.405	-0.373	-0.175	-0.039	1.000						
(11)-total resource	0.237	0.240	0.164	-0.506	-0.501	0.518	0.079	0.299	0.190	0.046	1.000					
(12)-labor	0.740	0.370	0.210	-0.291	-0.216	0.395	0.393	0.551	0.195	-0.084	0.586	1.000				
(13)-gfcf	-0.124	-0.020	-0.082	-0.299	-0.108	0.058	-0.226	0.118	0.099	0.238	0.041	-0.123	1.000			
(14)-rule of law	-0.185	-0.146	-0.056	0.580	0.538	-0.511	0.092	-0.082	-0.024	0.087	-0.601	-0.413	0.057	1.000		
(15)-regime	-0.122	-0.144	-0.038	0.555	0.428	-0.463	0.103	-0.048	-0.013	-0.013	-0.412	-0.330	-0.177	0.735	1.000	
(16)-landlock	-0.259	0.052	0.172	-0.223	-0.389	0.386	-0.221	-0.277	0.099	0.279	0.117	0.034	0.116	0.095	-0.041	1.000

Note: Chinese loan is the current value of Chinese loans measured in dollars and transformed using a logarithmic function. However, the regression estimates are calculated using lagged values of Chinese loan ranging from 1 to 3 years.

Table A2: List of the 49 countries in the sample

Countries	Number of projects	Countries	Number of projects
Algeria	2	Gambia, The	1
Angola	254	Ghana	53
Benin	11	Guinea	16
Botswana	15	Kenya	43
Burkina Faso	2	Lesotho	6
Burundi	8	Liberia	2
Cabo Verde	5	Madagascar	7
Cameroon	45	Malawi	4
Central African Republic	8	Mali	11
Chad	5	Mauritania	8
Comoros	3	Mauritius	31
Congo, Dem. Rep.	59	Morocco	9
Congo, Rep.	36	Mozambique	20
Cote d'Ivoire	24	Namibia	18
Djibouti	12	Niger	6
Egypt, Arab Rep.	18	Nigeria	21
Equatorial Guinea	22	Rwanda	14
Eritrea	10	Senegal	17
Ethiopia	52	Seychelles	6
Gabon	25	Sierra Leone	7
South Africa	23	Tunisia	7
South Sudan	2	Uganda	18
Sudan	66	Zambia	78
Tanzania	13	Zimbabwe	30
Togo	16		

Note: The table summarizes the list of 49 countries and their number of projects included in panel regression analysis with country and year fixed effects, which is based on BU (2023)'s country data spanning from 2000 to 2020.。



Table A3: Variable's description and descriptive statistics

Variables	Description	Sources	Obs	Mean	Std. Dev.	Min	Max
ln(Chinese loan)	Chinese loan at project level in US Dollar	BU	1,169	3.70	1.55	-0.60	9.21
ln(gdpconstant)	Gross domestic product at constant prices (2015)	WDI	1,156	24.11	1.18	20.37	26.96
GDP growth	The annual increase in GDP rate, expressed as a percentage based on market prices	WDI	1,154	5.19	5.29	-17.67	63.38
employment	Total employment rate, including employment in the agricultural and industrial sectors	WDI	1,153	4.10	0.22	3.34	4.52
export/GDP	Total exports of goods and services percentage to GDP	WDI	1,100	22.90	1.27	17.86	25.44
FDI inflow	Net inflows of foreign direct investment	UNTACD	920	20.26	1.53	12.67	23.03
electricity	Access to electricity (% of the population) for the entire country or urban areas is adopted to capture infrastructure improvement	WDI	1,168	3.61	0.58	1.41	4.61
schooling	School enrollment in secondary and tertiary education	Barro-Lee	712	3.80	0.42	1.94	4.70
material (steel production)	Steel Production in China	WSA	1,169	6.36	0.48	4.86	6.96
foreign_reserve	Chinese foreign reserves refer to the foreign currency assets held by the People's Bank of China	IMF	1,169	2.45	1.13	0.17	3.89
inflation	The inflation rate is determined by the annual percentage change of the CPI	WDI	1,100	1.95	1.11	-2.88	6.24
Money supply	Year-on-year percent change in the money supply M2 (% of GDP)	WDI	1,110	31.63	22.20	3.42	176.79
gov't spend	Government total expenditures	WDI	1,113	4.60	0.16	3.99	5.12
rule of law	Rule of Law index (the extent to which the law is enforced and respected)	WGI	1,148	25.21	20.01	0.48	82.59
corruption control	The corruption control indicator	WGI	1,148	23.54	21.14	0.47	85.19
bureaucracy	Measurement of the quality of governance in each economy	WGI	1,014	0.33	0.16	0.00	0.64
regime	Level of autocracy and democracy (measuring the extent to which power is concentrated in the hands of a few versus distributed among many)	DD	1,167	1.22	0.75	0.00	3.00
total resource	Total natural resources rents indicating the natural resource endowments (% of GDP)	WDI	1,161	2.22	1.57	-6.75	4.09
gfcf: gross fixed capital formation	Gross fixed capital formation-investment in fixed assets such as buildings and machinery - (% of GDP)	WDI	1,113	3.17	0.38	0.42	4.04
labor	Number of people participating in the labor force	WDI	1,163	15.69	1.25	11.78	18.03
population	Total number of people in each country, which to some extent indicates the market size	WDI	1,169	16.64	1.27	11.33	19.13



Note: 'ln' indicates the logarithm transformation. WSA refers to World Steel Association, DD dataset refers to Democracy-Dictatorship (DD) database, WGI refers to World Governance Indicators.

Table A4: The effects of Chinese lending on economic growth, FDI inflows, exports, and infrastructure by creditor

Variables	(a)-Dep var: GDP growth		(b)-Dep var: FDI inflows		(c)-Dep var: Exports		(d)-Dep var: Electricity	
	(A4-1-1)	(A4-1-2)	(A4-2-1)	(A4-2-2)	(A4-3-1)	(A4-3-2)	(A4-4-1)	(A4-4-2)
L3.ln(Chinese loan)	0.279*** (0.063)	0.036 (0.055)	0.586** (0.281)	0.129 (0.111)	0.171** (0.080)	0.089* (0.047)	0.106** (0.044)	0.055** (0.023)
ln(inflation)	0.029 (0.037)	-0.054 (0.074)	-0.044 (0.073)	-0.286 (0.200)	-0.040 (0.039)	-0.205*** (0.056)	0.002 (0.013)	-0.101*** (0.026)
ln(Money supply)	0.009*** (0.003)	0.017*** (0.005)	0.017 (0.602)	0.893 (0.732)	0.833*** (0.155)	0.458** (0.221)	0.007*** (0.002)	-0.004* (0.002)
ln(gov't spend)	-0.023*** (0.003)	-0.028*** (0.007)	0.580 (1.383)	2.197 (1.764)	-1.215** (0.519)	-1.038*** (0.393)	-0.300** (0.134)	-0.212 (0.241)
ln(total resource)	-0.084** (0.033)	-0.027 (0.151)	0.054 (0.162)	0.216 (0.471)	0.260** (0.110)	0.629*** (0.144)	-0.006 (0.032)	-0.127*** (0.049)
ln(gfcf)	0.236 (0.162)	0.172 (0.235)	0.862* (0.495)	1.911** (0.803)	0.133 (0.123)	0.519* (0.265)	0.163** (0.066)	0.178** (0.074)
corruption control	-0.035 (0.138)	0.026 (0.270)	0.005 (0.020)	0.045** (0.021)	0.001 (0.006)	0.002 (0.013)	-0.005*** (0.002)	0.001 (0.003)
rule of law	-0.003 (0.004)	0.005 (0.009)	-0.017 (0.033)	-0.030 (0.022)	-0.014* (0.008)	-0.007 (0.008)	0.005 (0.003)	0.005 (0.004)
Other X_{it}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	13.592*** (0.955)	12.740*** (1.804)	57.637 (39.338)	2.750 (19.690)	13.240 (8.886)	-14.051 (11.266)		
Observations	643	256	520	142	620	252	668	248
R-squared	0.707	0.923	0.480	0.912	0.937	0.969	0.120	0.578
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Creditors	PPG-Official	PPG-Non-official	PPG-Official	PPG-Non-official	PPG-Official	PPG- Non-official	PPG-Official	PPG- Non-official

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.



Table A5: The effects of Chinese loans on human capital improvement and employment creation by Creditor

Variables	(a)—Dep var: Enrollment rate		(b)—Dep var: Employment	
	(A5-1-1)	(A5-1-2)	(A5-2-1)	(A5-2-2)
L3.ln(Chinese loan)	0.146** (0.071)	-0.174*** (0.053)	0.107* (0.061)	0.017 (0.045)
ln(total resource)	-0.231*** (0.074)	0.028 (0.184)	0.044 (0.081)	0.341*** (0.102)
ln(inflation)	-0.117*** (0.045)	-0.179** (0.073)	-0.100** (0.049)	-0.206*** (0.064)
ln(Money supply)	0.021*** (0.003)	0.015*** (0.004)	0.010*** (0.004)	0.007** (0.004)
ln(gov't spend)	0.516 (0.338)	0.615 (0.472)	-0.333 (0.460)	0.287 (0.552)
ln(gfcf)	0.004 (0.135)	0.450** (0.203)	0.119 (0.146)	-0.247 (0.186)
regime	0.585*** (0.110)	0.091 (0.110)	0.260** (0.110)	-0.159* (0.092)
corruption control	-0.025*** (0.005)	-0.005 (0.005)	0.005 (0.006)	0.015** (0.006)
Other X_{it}	Yes	Yes	Yes	Yes
Constant	0.481 (1.778)	-11.456*** (2.874)	4.684** (2.153)	-1.014 (2.891)
Observations	386	177	596	255
R-squared	0.564	0.689	0.358	0.880
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Creditors	PPG-Official	PPG-Non-official	PPG-Official	PPG-Non-official

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.



Table A6: The effects of Chinese lending on human capital, infrastructure, and FDI inflows by income group

Variables	(a)—Dep var: Enrollment rate				(b)—Dep var: Electricity		(c)—Dep var: FDI inflows	
	(A6-1-1)	(A6-1-2)	(A6-2-1)	(A6-2-2)	(A6-3-1)	(A6-3-2)	(A6-4-1)	(A6-4-2)
L3.ln(Chinese loan)	0.066 (0.063)	0.045* (0.023)	0.042 (0.065)	0.218*** (0.050)	0.135* (0.078)	0.099*** (0.037)	0.235** (0.094)	0.066 (0.118)
ln(gfcf)	-0.194 (0.185)	-0.030 (0.061)	-0.801*** (0.167)	0.587*** (0.163)	-0.101 (0.119)	-0.024 (0.074)	0.606* (0.366)	-0.346 (0.397)
ln(total resource)	-0.125** (0.049)	-0.212*** (0.055)	0.099 (0.084)	-0.807*** (0.164)	-0.021 (0.107)	-0.033 (0.037)	0.619*** (0.203)	0.065 (0.207)
ln(population)	-0.053 (0.061)	-0.193*** (0.036)	-0.240** (0.108)	-0.227 (0.138)	0.000 (0.000)	-1.444*** (0.520)	-0.615 (5.018)	2.453 (1.593)
ln(inflation)	-0.006 (0.022)	0.019 (0.022)	-0.114*** (0.039)	-0.114* (0.062)	0.022 (0.024)	-0.020 (0.017)	-0.096 (0.102)	-0.035 (0.101)
ln(Money supply)	0.004* (0.002)	0.002 (0.002)	0.019*** (0.003)	-0.009 (0.016)	0.001 (0.008)	0.002 (0.002)	0.374 (0.866)	-0.455 (0.532)
regime	-0.007 (0.071)	-0.138* (0.072)	0.044 (0.110)	-0.095 (0.196)	0.124 (0.077)	-0.141*** (0.035)	0.218 (0.204)	-0.262 (0.227)
ln(gov't spend)	0.264 (0.403)	0.148 (0.232)	0.948 (0.622)	-1.882*** (0.376)	0.741 (0.488)	-0.035 (0.165)	2.527* (1.459)	1.610 (1.436)
corruption control	0.001 (0.003)	-0.016*** (0.002)	-0.004 (0.004)	-0.029*** (0.004)	0.004 (0.005)	-0.012*** (0.002)	0.014 (0.016)	-0.003 (0.012)
GDP growth					0.007 (0.008)	-0.003 (0.005)		
rule of law					0.008 (0.006)	0.007** (0.003)	0.013 (0.022)	0.014 (0.016)
Other X_{it}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.190 (2.437)	7.296*** (1.154)	2.293 (3.241)	14.991*** (2.729)			33.867 (30.100)	-30.435 (27.795)
Observations	285	153	382	157	273	548	251	308
R-squared	0.770	0.868	0.851	0.635	0.410	0.171	0.858	0.805
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income group	(2)	(3)	(2)	(3)	(2)	(3)	(2)	(3)

Note: The income group is classified by (1) high-income group, (2) low-income category, (3) lower-middle income, and (4) upper-middle income. Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.



Table A7: The effects of Chinese lending on growth, employment, and exports by Income group

Variables	(a)—Dep var: GDP growth			(b)—Dep var: Employment			(c)—Dep var: Exports	
	(A7-1-1)	(A7-1-2)	(A7-1-3)	(A7-2-1)	(A7-2-2)	(A7-2-3)	(A7-3-1)	(A7-3-2)
L3.ln(Chinese loan)	0.405*** (0.113)	0.065 (0.040)	0.062 (0.048)	0.302*** (0.098)	0.193** (0.094)	-0.098 (0.115)	0.122** (0.061)	0.061** (0.029)
ln(labor)	0.709*** (0.112)	0.954*** (0.038)	0.959*** (0.036)	-0.018 (0.063)	-0.311*** (0.077)	0.106*** (0.024)	-3.616*** (0.985)	0.504 (1.316)
ln(gfcf)	1.175*** (0.189)	-0.004 (0.094)	0.164 (0.117)	0.304** (0.127)	-0.161 (0.253)	0.433 (0.270)	0.011 (0.121)	0.341** (0.163)
ln(total resource)	-0.950*** (0.176)	0.101*** (0.035)	-0.053* (0.029)	-0.165* (0.084)	0.162 (0.128)	-0.102* (0.055)	0.812*** (0.197)	0.388*** (0.099)
ln(inflation)	0.027 (0.062)	0.060*** (0.022)	0.005 (0.049)	0.053 (0.061)	-0.095*** (0.031)	-0.053 (0.069)	-0.039 (0.052)	-0.123*** (0.043)
ln(Money supply)	-0.019* (0.010)	0.019*** (0.001)	0.009** (0.004)	0.020** (0.009)	0.012*** (0.003)	0.008* (0.005)	0.079 (0.323)	0.493** (0.194)
ln(gov't spend)	-0.033*** (0.006)	-0.011*** (0.002)	-0.021*** (0.003)	-2.312*** (0.326)	1.001* (0.588)	-1.481 (1.144)	-0.613 (0.607)	-2.185*** (0.398)
rule of law	-0.020** (0.009)	-0.018*** (0.005)	-0.018*** (0.003)	-0.008 (0.005)	-0.013** (0.006)	-0.000 (0.004)	0.019*** (0.005)	-0.018*** (0.005)
regime	0.063 (0.160)	0.068 (0.050)	-0.096 (0.104)	-0.018 (0.177)	0.122 (0.112)	0.271** (0.134)	0.010 (0.111)	0.055 (0.076)
corruption control	-0.090 (0.189)	0.389*** (0.139)	0.256*** (0.098)	-0.016*** (0.006)	0.013* (0.007)	0.003* (0.002)	0.000 (0.008)	-0.002 (0.006)
Other X_{it}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	13.160*** (1.645)	9.808*** (0.742)	12.256*** (0.860)	11.550*** (1.006)	2.490 (2.505)	7.562 (5.290)	-14.681 (13.164)	-3.213 (9.135)
Observations	260	536	106	255	532	67	265	546
R-squared	0.701	0.955	0.994		0.462	0.936	0.932	0.967
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income group	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.



Table A8: The effects of Chinese lending on growth, infrastructure, and employment by Sector

Variables	(a)—Dep var: Growth		(b)—Dep var: Electricity		(c)—Dep var: Employment	
	(A8-1-1)	(A8-1-2)	(A8-2-1)	(A8-2-2)	(A8-3-1)	(A8-3-2)
L3.ln(Chinese loan)	0.307*** (0.066)	0.040 (0.064)	0.187*** (0.031)	0.036 (0.026)	0.150** (0.067)	0.089 (0.059)
ln(labor)	0.755*** (0.052)	0.645*** (0.052)	-0.249** (0.115)	-0.194 (0.119)	-0.076 (0.060)	-0.131* (0.072)
ln(gfcf)	0.201 (0.159)	-0.045 (0.169)	-0.249** (0.115)	-0.194 (0.119)	0.010 (0.149)	0.126 (0.190)
ln(total resource)	-0.070* (0.037)	0.047 (0.047)	0.012 (0.029)	0.002 (0.027)	0.107 (0.069)	0.094 (0.087)
ln(inflation)	0.091** (0.035)	0.107** (0.053)	-0.075*** (0.026)	-0.153*** (0.041)	-0.123*** (0.039)	-0.148*** (0.051)
ln(Money supply)	0.013*** (0.003)	0.020*** (0.003)	0.002 (0.003)	0.002 (0.003)	0.008** (0.004)	0.017*** (0.004)
ln(gov't spend)	-0.023*** (0.004)	-0.016*** (0.004)	0.500 (0.307)	0.287 (0.326)	-0.252 (0.457)	-0.075 (0.502)
rule of law	-0.004 (0.006)	-0.001 (0.008)	0.006 (0.006)	0.020*** (0.003)	-0.008* (0.005)	-0.017*** (0.004)
regime	0.136 (0.085)	0.308** (0.146)	-0.037 (0.061)	-0.121 (0.085)	0.177* (0.098)	0.244* (0.125)
corruption control	0.060 (0.177)	-0.390 (0.250)	0.004 (0.004)	-0.010*** (0.003)	0.012*** (0.004)	0.011** (0.006)
Other X_{it}	Yes	Yes	Yes	Yes	Yes	Yes
Constant	12.673*** (1.152)	13.445*** (1.305)	-0.686 (1.556)	-2.475 (2.224)	4.325** (1.992)	4.094 (3.234)
Observations	567	180	567	180	539	173
R-squared	0.721	0.893	0.561	0.737	0.349	0.592
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Sector 1	Sector 2	Sector 1	Sector 2	Sector 1	Sector 2

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively. Sector 1 and Sector 2 are shown in the article.



Table A9: The effects of Chinese lending on FDI inflows, exports, and school enrollment by sector

Variables	(a)—Dep var: Exports		(b)—Dep var: FDI inflows		(c)—Dep var: Enrollment rate	
	(A9-1-1)	(A9-1-2)	(A9-2-1)	(A9-2-2)	(A9-3-1)	(A9-3-2)
L3.ln(Chinese loan)	0.167*** (0.065)	0.047* (0.025)	0.298 (0.199)	0.368** (0.154)	0.111** (0.056)	-0.085* (0.049)
ln(inflation)	-0.033 (0.039)	-0.069 (0.044)	-0.025 (0.085)	-0.142 (0.158)	-0.085** (0.041)	-0.067* (0.039)
ln(Money supply)	0.823*** (0.188)	0.871*** (0.118)	-0.427 (0.553)	0.830 (0.543)	0.014*** (0.003)	0.021*** (0.003)
ln(gov't spend)	-1.845*** (0.392)	-1.519*** (0.369)	0.940 (1.045)	0.740 (1.325)	0.544 (0.371)	0.730* (0.389)
ln(total resource)	0.408*** (0.108)	0.437*** (0.134)	0.127 (0.246)	-0.096 (0.186)	-0.118** (0.056)	-0.093 (0.076)
ln(labor)	-0.371 (1.528)	4.667*** (1.414)	1.502 (2.413)	1.457 (4.067)		
ln(gfcf)	0.310*** (0.116)	0.164 (0.177)	0.554 (0.404)	1.284** (0.513)	-0.189 (0.138)	-0.202 (0.172)
corruption control	0.003 (0.007)	0.007 (0.004)	0.015 (0.018)	-0.016 (0.016)	-0.010** (0.004)	-0.016*** (0.004)
rule of law	-0.004 (0.008)	-0.025*** (0.004)	0.015 (0.018)	0.002 (0.014)		
regime	-0.029 (0.084)	-0.013 (0.066)	-0.027 (0.269)	0.002 (0.510)	0.331*** (0.105)	0.589*** (0.090)
Other X_{it}	Yes	Yes	Yes	Yes	Yes	Yes
Constant	12.292 (9.291)	2.604 (8.979)	11.787 (28.438)	66.733** (29.653)	0.821 (2.115)	-1.964 (2.376)
Observations	551	176	428	111	383	110
R-squared	0.941	0.985	0.720	0.796	0.442	0.854
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Sector 1	Sector 2	Sector 1	Sector 2	Sector 1	Sector 2

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively.



Table A10: The effects of Chinese lending on economic growth, infrastructure, and school enrollment at the aggregate level

Variables	(a)—Dep var: GDP growth	(b)—Dep var: Electricity	(c)—Dep var: Enrollment rate
	(A10-1-1)	(A10-2-1)	(A10-3-1)
L1.ln(Chinese loan)	0.217* (0.113)	0.050* (0.025)	0.052** (0.022)
L1.ln(Chinese loan)*period	-0.069 (0.050)	-0.014 (0.012)	-0.027** (0.011)
L1.ln(Chinese loan)*L1.ln(Chinese loan)	-0.007 (0.016)	-0.002 (0.003)	0.001 (0.002)
ln(population) regime	-0.812 (2.038)	1.789*** (0.524)	2.511*** (0.496)
ln(labor)	0.365* (0.194)	0.010 (0.049)	0.023 (0.040)
ln(Money supply)	-0.201 (2.233)		-1.023* (0.536)
ln(Money supply)	-0.751 (0.465)		-0.015 (0.078)
ln(gov't spend)	-3.684*** (1.072)	0.287 (0.223)	0.457** (0.200)
ln(gfcf)	1.325*** (0.435)	0.005 (0.058)	-0.048 (0.072)
GDP growth		-0.002 (0.003)	
ln(total resource)		0.010*** (0.003)	
period	0.602** (0.265)	0.020 (0.129)	0.137*** (0.048)
Constant	32.450* (17.079)	-27.93*** (8.867)	-23.852*** (4.146)
Observations	247	255	174
R-squared	0.193	0.628	0.756
Number of countries	37	31	34
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively. Period is a dummy variable that takes the value of 1 when the year is between 2000-2010, 2 when the year is between 2010-2016, and 3 when the year is between 2016-2020.



Table A11: The effects of Chinese lending on FDI inflows, export, and employment creation at the aggregate level

Variables	(a)—Dep var: FDI inflows	(b)—Dep var: Exports	(c)—Dep var: Employment	
	(A11-1-1)	(A11-2-1)	(A11-3-1)	(A11-3-2)
L1.ln(Chinese loan)	0.324** (0.136)	0.070* (0.041)	0.025* (0.013)	-0.014 (0.014)
L1.ln(Chinese loan)*period	-0.139** (0.053)	-0.048*** (0.016)	-0.012 (0.011)	0.004 (0.005)
L1.ln(Chinese loan)*L1.ln(Chinese loan)	-0.002 (0.019)	0.004 (0.005)	-0.001 (0.002)	0.002 (0.002)
rule of law	0.013 (0.012)	-0.018*** (0.006)	0.006 (0.004)	-0.004*** (0.001)
regime	0.119 (0.183)	0.020 (0.049)	-0.070** (0.026)	0.076*** (0.026)
ln(labor)	1.725 (2.940)	0.429 (0.969)	-0.783* (0.426)	0.951** (0.369)
ln(population)	-0.369 (3.435)	1.684* (0.910)	1.452*** (0.443)	0.127 (0.308)
ln(Money supply)	-1.049** (0.499)	0.017*** (0.006)	0.088 (0.067)	-0.073 (0.078)
ln(gov't spend)	0.893 (1.711)	-0.016** (0.006)	-0.125 (0.150)	0.047 (0.074)
ln(gfcf)	0.813 (0.554)	0.416*** (0.144)	0.049 (0.057)	0.012 (0.019)
ln(total resource)			0.060*** (0.019)	0.006 (0.018)
period	0.974*** (0.343)	0.200* (0.106)	-0.090** (0.043)	-0.300*** (0.058)
Constant	-6.420 (30.822)	-11.437 (7.653)	-8.920 (5.560)	-12.181*** (3.764)
Observations	254	238	268	268
R-squared	0.314	0.592	0.352	0.648
Number of countries	37	33	37	37
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Note: Clustered robust standard errors in parentheses. ***, ** and * denote significance levels at 1%, 5% and 10%, respectively. The dependent variable in the Model (11-3-2) is employment in the agricultural sector.

References

1. Angrist, J. D., & Krueger, A. B. (2001). Instrumental variables and the search for identification: From supply and demand to natural experiments. *Journal of Economic Perspectives*, 15(4), 69-85. doi:<https://doi.org/10.3386/w8456>
2. Appiah-Kubi, M. & Jarrett, J. (2023). Chinese aid and crime: Evidence from Africa. *Journal of International Development*, 1– 29. <https://doi.org/10.1002/jid.3742>
3. Atitianti, P. A. (2023). The impact of Chinese aid on political trust. *Journal of International Development*, 35(2), 233-259. doi:<https://doi.org/10.1002/jid.3683>
4. Atitianti, P. A., & Asiamah, S. K. (2023). Aid and governance: Impact of Chinese aid on the evaluation of government performance in Sub-Saharan Africa. *Africa Spectrum*, 58(1), 64-88. doi:<https://10.1177/00020397231160192>
5. Ayele, S. & Mutyaba, V. (2021). Chinese-funded electricity generation in Sub-Saharan Africa and implications for public debt and transition to renewable energy. IDS Working Paper 557. Institute of Development Studies.
6. Bluhm, R., Dreher, A., Fuchs, A., Parks, B., Strange, A., & Tierney, M. J. (2018). Connective financing: Chinese infrastructure projects and the diffusion of economic activity in developing countries. *AidData Working Paper #64*. Williamsburg, VA: AidData at William & Mary.
7. BU. (2023). Chinese loans to Africa database (CLA). Retrieved from Boston University Global Development Policy Center, <https://www.bu.edu/gdp/chinese-loans-to-africa-database/>
8. Carmody, P. & Wainwright, J. (2022). Contradiction and restructuring in the Belt and Road Initiative: reflections on China's pause in the 'Go world'. *Third World Quarterly*, 43, 2830-2851.
9. Cepal, N. U. (1999). Finding solutions to the debt problems of developing countries: report of the executive committee on economic and social affairs of the United Nations (New York, 20 May 1999), ECLAC.
10. Chen, B., & Lin, J. Y. (2014). Development strategy, urbanization and the urban-rural income gap in China. *Social Sciences in China*, 35(1), 5-20. doi:<https://doi.org/10.1080/02529203.2013.875651>
11. Chen, C.C. (陈晨晨). (2022). Whose development finance can better advance the life standard and the economy of Africa. *World Economics and Politics*. (谁的发展融资更能改善非洲的经济和生活条件. 世界经济与政治). No.499(03):59-91+158.
12. Chiyemura, F., Shen, W. & Chen, Y. (2021). Scaling China's green energy investment in Sub-Saharan Africa: Challenges and prospects. Institute of Development Studies.

-
13. Corkin, L. (2012). Chinese construction companies in Angola: A local linkages perspective. *Resources Policy*, 37(4), 475-483. doi:<https://doi.org/10.1016/j.resourpol.2012.06.002>
 14. Dollar, D. (2019). Understanding China's Belt and Road infrastructure projects in Africa. The Brookings Institute.
 15. Dreher, A., Fuchs, A., Parks, B., Strange, A., & Tierney, M. J. (2021). Aid, China, and growth: Evidence from a new global development finance dataset. *American Economic Journal: Economic Policy*, 13(2), 135-174. doi:<https://10.1257/pol.20180631>
 16. Eichengreen, B., El-Ganainy, A., Esteves, R. P., & Mitchener, K. J. (2018). Chapter 1: Public Debt through the Ages. In Abbas, S. A., Pienkowski, A., & Rogoff, K. (Eds.), *Sovereign Debt: A Guide for Economists and Practitioners*. IMF. Oxford University Press.
 17. Gallagher, K. P., Kamal, R., Jin, J., Chen, Y., & Ma, X. (2018). Energizing development finance? The benefits and risks of China's development finance in the global energy sector. *Energy Policy*, 122, 313-321. doi:<https://doi.org/10.1016/j.enpol.2018.06.009>
 18. Gemueva, K. A. (2018). Chinese infrastructure projects in Sub-Saharan Africa: credit financing. *Outlines of global transformations: politics, economics, law*, 11, 55-73.
 19. Guillon, M., & Mathonnat, J. (2020). What can we learn on Chinese aid allocation motivations from available data? A sectorial analysis of Chinese aid to African countries. *China Economic Review*, 60, 101265. doi:<https://doi.org/10.1016/j.chieco.2019.01.004>
 20. Guo, S., An, J., & Jiang, H. (2022). Chinese aid and local employment in Africa. *Available at SSRN*. doi:<http://dx.doi.org/10.2139/ssrn.3718578>
 21. Hongrong, Y., Xiaolu, Z., & Meibo, H. (2021). How China's aid helps recipient countries build export capacity. *China Economist*, 16(2), 2-16. doi:<https://10.19602/j.chinaeconomist.2021.03.01>
 22. Horn, S., Reinhart, C. M. & Trebesch, C. (2021). China's overseas lending. *Journal of International Economics*, Volume 133, 103539. <https://doi.org/10.1016/j.jinteco.2021.103539>
 23. Hudson, A. (2006). UK aid to Africa. Overseas Development Institute. London, January.
 24. International Monetary Fund (IMF). (2005). Operational framework for debt sustainability assessments in low-income countries - further considerations. Washington, March.
 25. International Monetary Fund (IMF). (2018). Fiscal Monitor: Managing public wealth. Washington, October.
 26. Larsen, M. L., Voituriez, T., & Nedopil, C. (2023). Chinese overseas development funds: An assessment

-
- of their sustainability approaches. *Journal of International Development*. doi:<https://doi.org/10.1002/jid.3778>
27. Leszczensky, L., & Wolbring, T. (2022). How to deal with reverse causality using panel data? Recommendations for researchers based on a simulation study. *Sociological Methods & Research*, 51(2), 837-865. doi:<https://10.1177/0049124119882473>
 28. Lin, J.Y. (林毅夫). (2011). New structural economics-rebuilding the framework of development economics. *Quarterly Journal of Economics*. (新结构经济学——重构发展经济学的框架经济学(季刊)), 2011, 10(01):1-32.DOI:10.13821/j.cnki.ceq.2011.01.014.
 29. Lin, J.Y. (林毅夫). (2023) Public debt and development: the new structural economics perspective. Based on the presentation at the Conference on Chinese Development Finance organized by Finance for Development Lab at Paris School of Economics on March 28, 2023. Institute of New Structural Economics at Peking University. (《公共债务与国家发展：新结构经济学视角》，根据巴黎经济学院发展融资研究室组织的“中国发展融资会议”上的发言整理，北京大学新结构经济学研究院.)
 30. Lin, J.Y., & Wang, Y. (林毅夫, 王燕).(2016). Going beyond aid-development cooperation for structural transformation. Cambridge University Press. (《超越发展援助：在一个多极世界中重构发展合作新理念》.北京大学出版社.)
 31. Lin, J.Y. & Wang, Y. (2020). Seventy years of economic development: A review from the angle of new structural economics. *China & World Economy*, 28: 26-50. <https://doi.org/10.1111/cwe.12340>
 32. Manasseh, C. O., Abada, F. C., Okiche, E. L., Okanya, O., Nwakoby, I. C., Offu, P., & Nwonye, N. G. (2022). External debt and economic growth in Sub-Saharan Africa: Does governance matter? *Plos One*, 17(3). doi:<https://doi.org/10.1371/journal.pone.0264082>
 33. Mandon, P., & Woldemichael, M. T. (2023). Has Chinese aid benefited recipient countries? Evidence from a meta-regression analysis. *World Development*, 166, 106211. doi:<https://doi.org/10.1016/j.worlddev.2023.106211>
 34. Marchesi, S., Masi, T., & Paul, S. (2021). Project aid and firm performance. *University of Milan Bicocca Department of Economics, Management and Statistics Working Paper* (479).
 35. Martorano, B., Metzger, L., & Sanfilippo, M. (2020). Chinese development assistance and household welfare in Sub-Saharan Africa. *World Development*, 129, 104909. doi:<https://doi.org/10.1016/j.worlddev.2020.104909>
 36. Martuscelli, A. (2020). The economics of China's engagement with Africa: What is the empirical

-
- evidence? *Development Policy Review*, 38(3), 285-302. doi:<https://doi.org/10.1111/dpr.12456>
37. Mlambo, C. (2022). China in Africa: An examination of the impact of China's loans on growth in selected African states. *Economies*, 10(7), 154. doi:<https://doi.org/10.3390/economies10070154>
38. Niu, D.F., Shen, S.L., & Huang, H.B. (牛东芳, 沈昭利, 黄梅波). (2022). The engine and development direction of China Africa's joint construction of 'a digital Africa'. *West Asia and Africa*. (中非共建“数字非洲”的动力与发展路向. 西亚非洲), (03):66-87+158.
39. Onjala, J. (2018). China's development loans and the threat of debt crisis in Kenya. *Development Policy Review*, 36, O710-O728.
40. Roberts, M. R., & Whited, T. M. (2013). Chapter 7: Endogeneity in empirical corporate finance. In G. M. Constantinides, M. Harris, & R. M. Stulz (Eds.), *Handbook of the Economics of Finance* (Vol. 2, pp. 493-572): Elsevier.
41. Rodrik, D. (2016). Premature deindustrialization. *Journal of economic growth*, 21, 1-33.
42. Rong, M.(戎梅). (2015) .Factors that influence the sustainability of sovereign debt- an analysis based on the facts. *World Economic and Political Forum*. (主权债务可持续性的影响因素——基于特征事实的分析. 世界经济与政治论坛), 2015(04):103-126.
43. Rowley, A. (2020). The Myth of China's 'Debt Trap' Diplomacy. *Nikkei Asia*, November, 25.
44. Savin, I., Marson, M., & Sutormina, M. (2020). How different aid flows affect different trade flows: Evidence from Africa and its largest donors. *Structural Change and Economic Dynamics*, 55, 119-136. doi:<https://doi.org/10.1016/j.strueco.2020.08.004>
45. Tang, X.Y. (唐晓阳). (2022). The trap of financial capital: the impact of international bonds on the debt sustainability of developing countries. Tsinghua University. (《金融资本的陷阱:国际债券对发展中国家主权债务可持续性的影响》.清华大学战略与安全研究中心.)
46. Usman, Z. (2021). What do we know about Chinese lending in Africa? *Carnegie Endowment for International Peace Article*. Accessed July, 26, 2022.
47. Wang, Y. & Xu, Y. (2023). China and Africa: A new narrative on debt sustainability and infrastructure financing. *Journal of Infrastructure, Policy and Development*, 7(1): 2181. doi: 10.24294/jipd.v7i1.2181
48. Watkins, M. (2022). Undermining conditionality? The effect of Chinese development assistance on compliance with World Bank project agreements. *The Review of International Organizations*, 17(4), 667-690. doi:<https://10.1007/s11558-021-09443-z>
49. Wegenast, T., Krauser, M., Strüver, G., & Giesen, J. (2019). At Africa's expense? Disaggregating the

-
- employment effects of Chinese mining operations in Sub-Saharan Africa. *World Development*, 118, 39-51. doi:<https://doi.org/10.1016/j.worlddev.2019.02.007>
50. Were, A. (2018). Debt trap?: Chinese loans and Africa's development options. South African Institute of International Affairs. <http://www.jstor.org/stable/resrep25988>
51. Wright, Mark L. J., et al.(2019). The seniority structure of sovereign debt. no. 759, Federal Reserve Bank of Minneapolis. <https://jstor.org/stable/community.28111381>.
52. Xu, J., & Carey, R.(2015).Post-2015 global governance of official development finance: Harnessing the renaissance of public entrepreneurship. *Journal of International Development*. 27 (6): 856–80. <https://onlinelibrary.wiley.com/doi/abs/10.1002/jid.3120>.
53. Xu, J., Sun, C., & Jiang, H. (2022). Can China's aid promote the value-added exports of recipient countries? *Applied Economics*, 54(55), 6418-6436. doi:<https://10.1080/00036846.2022.2064969>
54. Xu, Q.Y., Sun, L.Y., & Xiong, W.T., (徐奇渊,孙靓莹,熊婉婷).(2023). Sovereign Debt Problem of developing nations: a systematic, comprehensive, and effective solution. *Latin American Studies*. (发展中国家主权债务问题:一个系统、全面、有效的综合解决框架.拉丁美洲研究),45(2):1-16.<http://kns.cnki.net/kcms/detail/11.1160.C.20230426.1715.004.html>
55. Xu, J., Marodon, R., Ru, X., Ren, X., & Wu, X.(2021). What are public development banks and development financing institutions?—Qualification criteria, stylized facts and development trends. *China Economic Quarterly International*, volume 1, issue 4: 271-294.
56. Xu, Z., Zhang, Y., & Sun, Y. (2020). Will foreign aid foster economic development? Grid panel data evidence from China's aid to Africa. *Emerging Markets Finance and Trade*, 56(14), 3383-3404. doi:10.1080/1540496X.2019.1696187
57. Xu, Z. P. & Zhang, Y. (2020). Can Chinese aid win the hearts and minds of Africa's local population? *Economic Modelling*, 90, 322-330.
58. Yang, G., Yang, Y., Tang, T. & Dai, L. (2023). Does China's aid boost firm performance in recipient countries? *Finance Research Letters*, 55, 103958.
59. Yu, H. (2017). Motivation behind China's 'One Belt, One Road' initiatives and establishment of the Asian Infrastructure Investment Bank. *Journal of Contemporary China*, 26(105), 353-368. doi:<https://10.1080/10670564.2016.1245894>
60. Zhang, L., Zhuang, Y., Ding, Y. & Liu, Z. (2023). Infrastructure and poverty reduction: Assessing the dynamic impact of Chinese infrastructure investment in Sub-Saharan Africa. *Journal of Asian*

Economics, 84, 101573.

61. State Council Information Office of the People's Republic of China. (中华人民共和国国务院新闻办公室).(2021). *China and Africa in the New Era*. (《新时代的中非合作》.)