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EXPLORING CHINESE-FINANCED INFRASTRUCTURE AND ITS IMPACT ON THE
REAL GDP PER CAPITA GROWTH OF SUB-SAHARAN AFRICAN COUNTRIES

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ABSTRACT

Following the decade-long trend of Chinese-financed infrastructure in sub-Saharan Africa, economists have evaluated the impact that such deals have on the economic and social development of the region. Existing literature shows that there are mixed effects of China's involvement in the subcontinent. Supporters cite China's ability to disburse funds and begin construction of hard infrastructure at a pace unmatched by traditional donors like the OECD and the United States. Meanwhile, critics argue that China is unethically operating in the region, looking only to expand its own workforce and construction capacity at the expense of unstable African nations. This paper focuses on how several explanatory variables such as dollar amount of investment and governance ranking of a country affect that country's four-year, real GDP per capita growth. The results of the two linear regressions suggest varied results. Overall, Chinese-financed infrastructure results in more economic growth in countries that have strong governance. In addition, unofficial, non-concessional Chinese investment results in greater economic growth. However, when considering the size of the investment, large amounts of unofficial aid are detrimental to a country's real GDP per capita growth. Connecting the regression results with present literature, the paper concludes with recommendations for China and external financiers looking to fund infrastructure in sub-Saharan Africa.

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Chapter 1

Literature Review

For the past two decades, sub-Saharan Africa has been a curious landscape for foreign nations trying to navigate business and philanthropic efforts in the region. Despite experiencing some of the highest global rates of economic growth, the region remains plagued by a myriad of humanitarian and financial challenges including unemployment, lack of education, government corruption, infrastructure deficit, and food insecurity. Numerous studies suggest that the presence of well-developed infrastructure plays a fundamental role in the economic prosperity of any region. Infrastructure across subsectors such as transportation and energy enables both individuals and businesses to more easily transport goods, conduct work, receive and share current information, and live happier, more fulfilled lives. Nonetheless, a combination of factors like civil war, political corruption, tight budgetary guidelines, and dubious project planning standards has led to a degree of inaction by local African governments in solving this issue. While such factors play a role in deterring foreign investment as well, there has still been a flurry of foreign monies pouring into the region since the early 1990s. In fact, various players have marked their presence in the region's infrastructure landscape such as development banks like the World Bank, developed country's institutional investors, and rapidly evolving countries like the BRIC nations.

A particular player in the space, China, has grabbed the attention of several academics and institutions. Many published papers have explored China's specific role in the development of sub-Saharan infrastructure and the country's motives for doing so. The academic discourse

surrounding this topic is contentious, as some believe that China is unfairly exploiting African

countries' natural resources and their governments' lack of negotiation skills for personal

economic gain. Others suggest that China provides a source for infrastructure funding that is

much easier to obtain than alternative sources and that the country delivers high quality

infrastructure to the region. This literature review first explores the economic conditions of both

parties in the past two decades along with their motives in negotiating these infrastructure deals.

Afterwards, it discusses the various academic perspectives on the winners and losers of such

deals. The overall thesis does not hold a perspective on the debate, but rather explores the

economic impact that these deals have on the region's growth whilst keeping in mind that other

unobserved factors play a role in the discussion.

Figure 1-1. Geographical Breakdown of sub-Saharan Africa into Regions
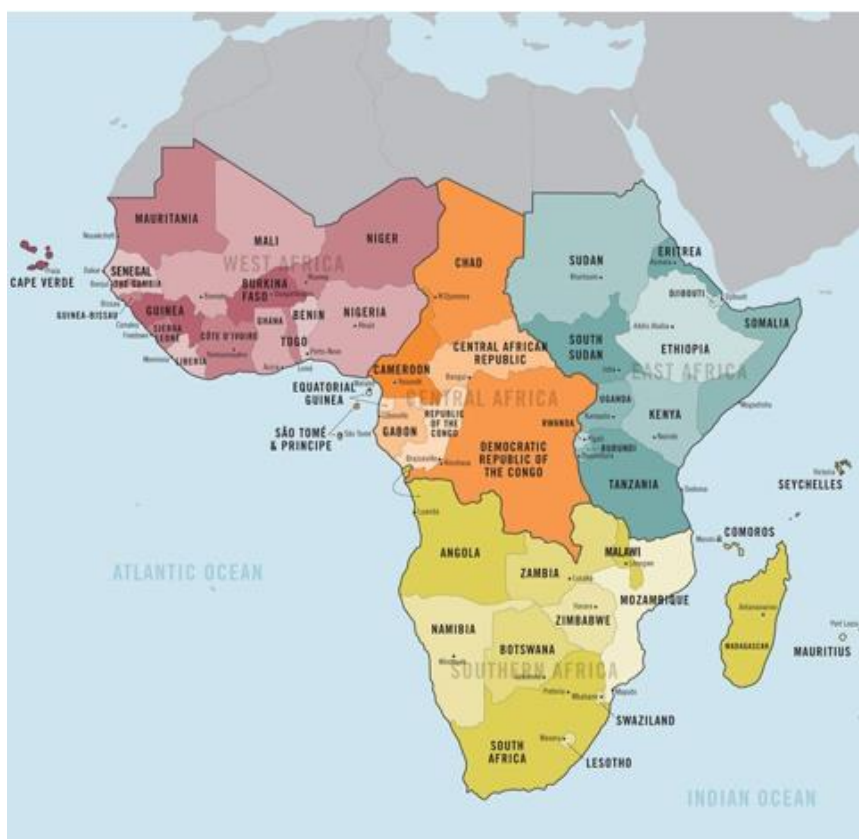
Sub-Saharan Africa's Economy and Infrastructure Deficit

Throughout the mid-2000s, sub-Saharan Africa and the continent as a whole was experiencing unprecedented economic growth that outpaced most other countries' growth, leading to popular phrase, "Africa Rising", being coined for the phenomenon. The region's growth was not just attributable to the resource boom, in which the prices of several commodities like oil, minerals, and grain surged. Other factors such as the resolution of armed conflicts, reduced inflation rate, and shrinking of budget deficits played a role. Furthermore, several governments implemented privatization policies and lowered corporate tax rates in hopes of enabling businesses to conduct commerce more easily. With real GDP growth hovering at an average of 4.9% year over year between 2000 and 2008, the continent of Africa was a region that foreign players were increasingly becoming interested in (McKinsey Insights, 2010).

Figure 1-2. Real GDP Growth between 2001 and 2005 (Source: World Bank, Development Prospects Group)
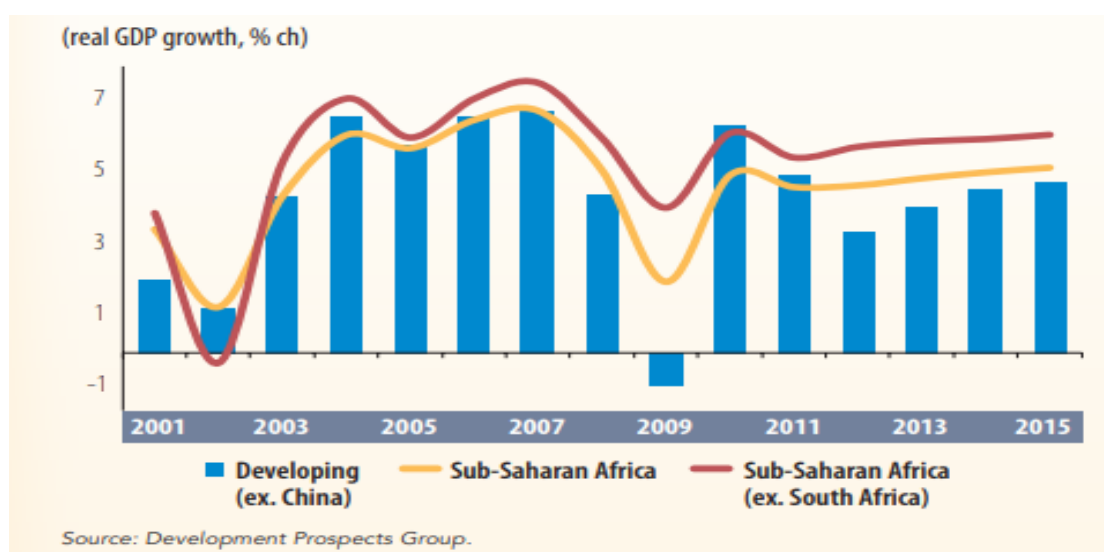
Nonetheless, infrastructure development did not grow nearly at the same pace as GDP during Africa's "rising". The African Development Bank's "African Infrastructure Development Index", or "AIDI", which calculates rankings of African countries based on metrics related to water supply, sanitation, transportation, information and communications technology (ICT), and power, found that sub-Saharan African countries on average ranked lower relative to their Northern African counterparts. Furthermore, as Figure 1-3 shows, their index rankings remained relatively stable throughout the early and mid-2000s, suggesting that little progress was made in the infrastructure space, despite the economic boom. Specifically, the AFDB found that sub-Saharan countries struggled to a greater degree with infrastructure related to transportation, ICT, and power, while most African countries, regardless of region, struggled with water supply and sanitation, as shown in Figure 1-4. In addition, Figure 1-5 specifically highlights the massive deficit of broadband lines (ICT) in the sub-Saharan region.

Figure 1-3. AIDI Index Subregional Scores (Source: AfDB, 2013)
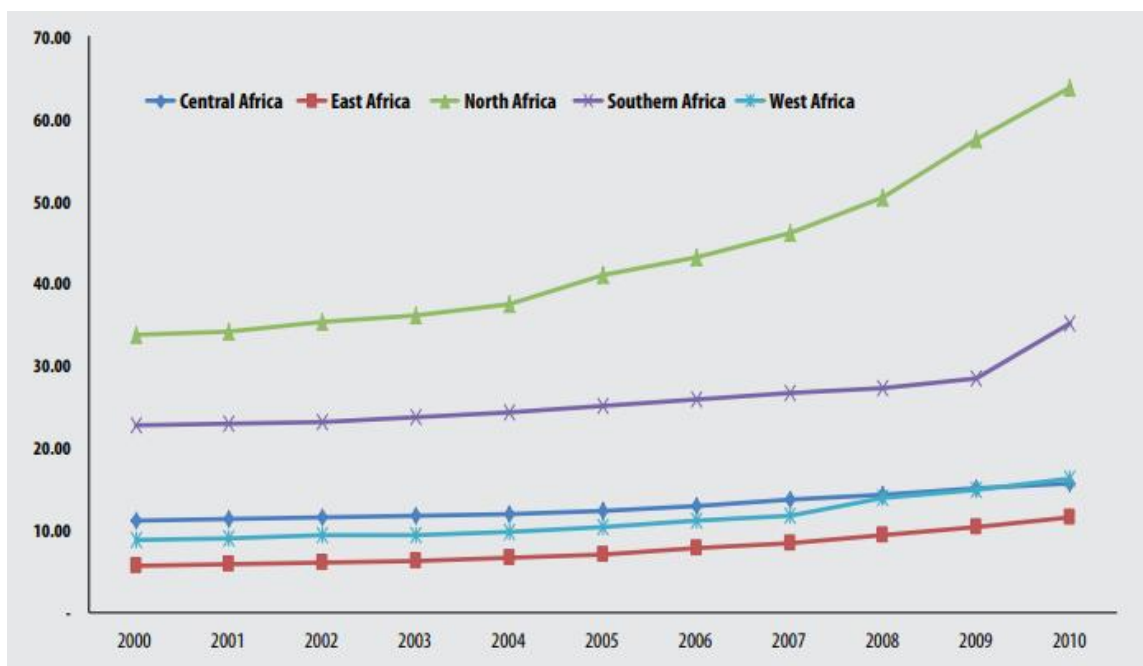
Figure 1-4. AIDI Principal Component Analysis, Scatterplot (Source: AfDB, 2016)
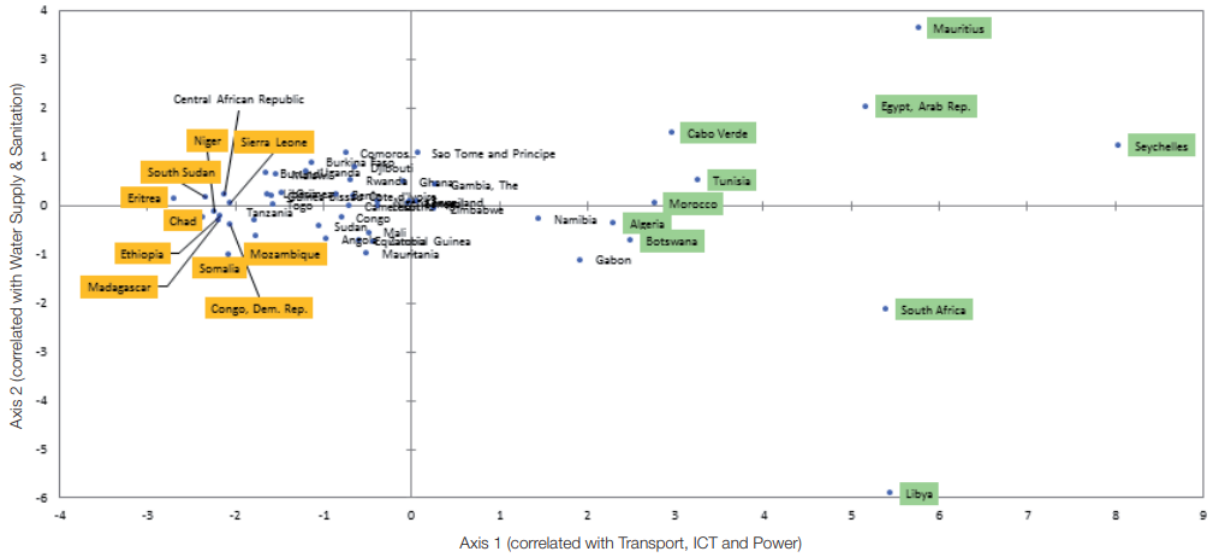
Figure 1-5. Broadband Network Lines in Africa (Source: AfDB, 2011)

With a population of around 700 million in the early to mid-2000s, sub-Saharan Africa was experiencing accelerated economic growth yet was unable to match its infrastructure to meet the growing population. Although analysts estimate that in order to solve the deficit, the region must spend $93 billion per year on infrastructure, or 15 percent of the region's GDP, sub-Saharan Africa has historically been spending on average less than half of the target number (AFDB, 2011). When looking at the causes for the lack of growth in infrastructure development, several issues come to play. Firstly, public sector financing is dominant yet significantly inefficient in achieving results. Secondly, the regional instability associated with political and violent wars makes project implementation more difficult and deters foreign investment.

While the public sector has historically acted as the primary financier for infrastructure in the region, providing about 65% of countries' financing for related expenditures, it often lacks the expertise and capacity in executing full-scale infrastructure projects (Brookings, 2015). Projects in this space are complex due to their lengthy timelines and necessity for large-scale research, capital, and human involvement at every phase of the venture. Additionally, sub-Saharan governments do not always create nor enforce frameworks that ensure quality and safety standards for infrastructure development. This deregulated environment leads to inefficiency and disorganization, where projects are often overdue in the approval process, never implemented due to lack of oversight, or delayed midway through because of a shortage of human and financial capital. Furthermore, considering that sub-Saharan governments are looking to slowly reduce their financing of infrastructure and allocate their budgets towards other public expenses, new external players must join in order to close the financing gap.

The second issue that analysts cite as a cause for the slow infrastructure growth in the region is the instability rampant through several countries. Changing political governing bodies,

violent civil wars, and refugee crises all pose challenges to the local implementation of infrastructure initiatives and the attractiveness of projects to foreign investors looking to become financiers. From a local perspective, governments do not always prioritize their focus on infrastructure, and when they do, administrations may change and allow political ideologies to drive budgetary decisions. Furthermore, considering that sub-Saharan Africa has continued to score among the highest in Transparency International's Corruption Perception Index, money pledged for infrastructure is not always spent accordingly. For external financiers, investing in sub-Saharan African infrastructure comes with high political and construction risk, among others. Some projects, such as long-distance, rural roads and rail networks often do not provide sufficient commercial returns for investors (Boston Consulting Group, 2017). Others, such as urban roads and tunnels, do provide attractive returns, but still scare investors because of potential failures and misappropriation of funds. Additionally, the lack of clear regulatory systems makes it difficult for external financiers to litigate criminals and for local governments to be held accountable.

Evidently, there has been a clear need in sub-Saharan Africa for external players to enter the infrastructure landscape and provide not only funding, but also administrative, planning, and implementation-based expertise in order to realize the completion of large-scale infrastructure projects. The reliance on the public sector is too straining for the governments' budgets and cannot act as the primary financier for the massive infrastructure development that is needed to accommodate for the region's growing economy and population.

External Players in the sub-Saharan Infrastructure Landscape

While there are several non-local, non-public sector players that operate in the region's infrastructure investment landscape, they can be generally be categorized into five key players: (1) Multilateral and regional development banks (2) Local sub-Saharan private sector (3) Foreign private sector (4) OECD members (5) Non-OECD financiers. Although there are different ways to classify external financiers, this classification, as shown in Table 1-1, will be used for the remainder of this thesis. For clarification, foreign private sector refers to any players that put money into sub-Saharan infrastructure investment either directly through construction (e.g. Aggreko), through investment vehicles (e.g. mutual funds, pension funds, sovereign wealth funds) managed by investment companies such as Vanguard, or through direct involvement in project finance (e.g. project bonds).

Table 1-1. Non-public sector financiers in sub-Saharan Infrastructure

Multilateral/Regional Development Banks	
Local sub-Saharan Private sector (includes corporations, financial institutions, products of investment firms, and local institutional investors)	
Foreign Private Sector (includes corporations, products of investment firms, and other institutional investors)	
OECD Member Countries (colored blue) (includes ODA and OOF)	
Non-OECD Countries (colored red) (includes China)	

Historically speaking, the ODF, or "official development finance", as classified by the OECD, flowing into sub-Saharan Africa consisted primarily of bilateral aid agreements, concessional and non-concessional funding from multilateral sources like the World Bank, and bilateral contracts unrelated to trade such as debt refinancing and loans. However, new forms of ODF began to emerge in the mid-1990s. The first are PPPs, or "public-private partnerships", a model in which the financing and management of infrastructure is divided between private parties and local governments. This relationship allows for financial and administrative relief for the local governments while enabling the private sector to expand into new markets and generate consistent cash flows.

The second trend was local and regional developing countries, particularly China, providing a significant portion of sub-Saharan Africa's infrastructure financing, as shown in Figure 1-6. "South-South" investment, or money that flows into developing countries such as Nigeria on behalf of emerging countries such as China, was becoming increasingly common at the time. Some of the spike in "South-South" investment may be attributable to the departure of developed country players such as the United States in the early 2000s. Because of distressed assets and pressure to pursue less risky investments, American companies such as PSEG left, creating an opportunity for countries like India and China to mark their presence in the subcontinent (Yanosek, 2007). More importantly however, large emerging countries' own economic needs and resource consumption habits act as the major driving factors for "South-South" investment. As China continues to invest heavily in the sub-Saharan region, it becomes increasingly important to explore the impact such operations and monies have on the economic prosperity and quality of life of sub-Saharan residents.

Figure 1-6. External Infrastructure Investment Commitments in sub-Saharan Africa in Millions US $ (Source: Brookings, 2016)
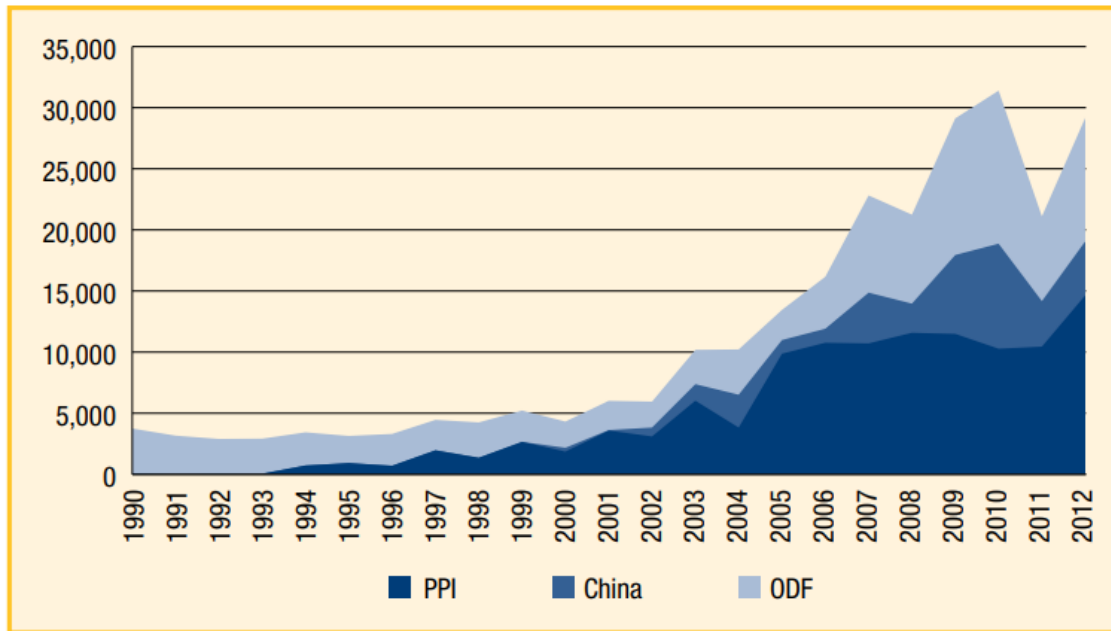
China's Economic Reform

China's speedy rise to become one of the world's largest economic and political powerhouses in just thirty years is an abnormality among developing countries. Beginning in the late 1970s, the government slowly began to open its doors to foreign direct investment and enabled businesses to incorporate and conduct trade more easily. This economic reform dealt with shifting focus from agriculture production towards industrials, and incurring massive capital spending on fixed assets such as land and factories. The change has resulted in an average 9.66 percent increase in GDP between 1989 and 2017, with an all-time high of 15.40 percent in 1993 (Trading Economics, 2018). Furthermore, this increased flow of monies both in and out of the country has allowed China to better integrate with the world economy.

Nonetheless, despite economic growth that is unmatched by most developing economies,

the Chinese government has not relinquished control of its commercial sector to capitalistic

dogma. Rather, the government limits privatization and favors state-led investment in the sectors

that promise the greatest future growth. Although Chinese SOEs or "state-owned enterprises"

make up only three percent of businesses, they account for about 30% of industrial output

(Brookings, 2016). Additionally, despite SOE's percentage share of Chinese assets and

employees decreasing slightly over time, these state-owned organizations still act as integral

components of the Chinese economy, as shown in Figure 1-7.

Figure 1-7. Chinese SOEs' Percentage Share of Chinese Assets, Employees, & Value Add (Source: The Economist, 2013)
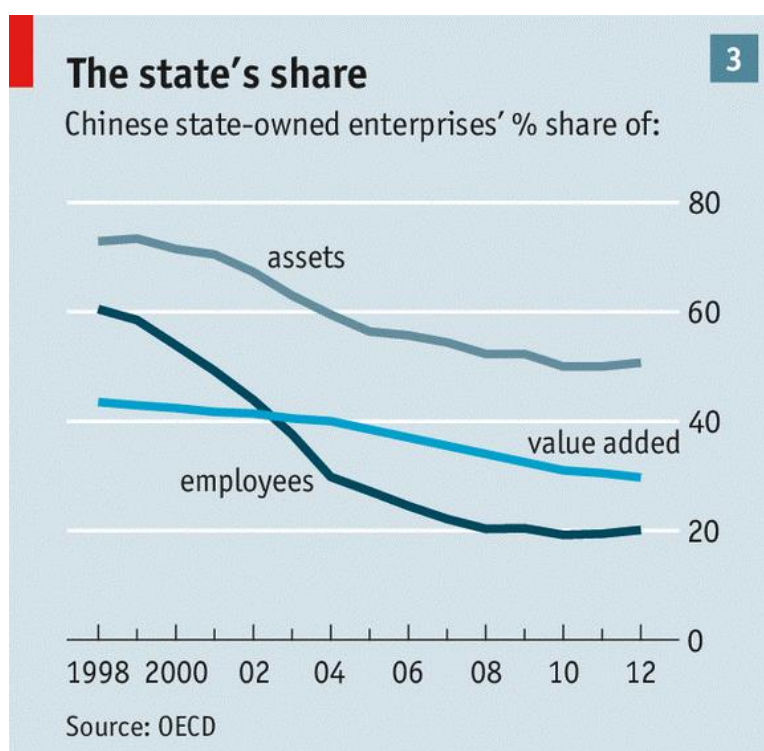
By the early 2000s, China's domestic economy had reached a point where it needed to expand outwards. Firstly, production capacity outpaced domestic demand in certain sectors like textiles, forcing Chinese SOEs to find customers in foreign markets (Alves, 2013). More importantly however, the country found that the only way to sustain its growth was to expand its domestic industrial capacity and pursue heavy capital investment. However, with their demand for commodities such as petroleum and heavy metals overtaking internal production, China looked overseas, towards resource rich lands like sub-Saharan Africa, as shown in Figure 1-8. The SOEs were incentivized to explore other countries with a variety of financial inducements like tax and tariff exemptions, as well as subsidized credit lines, all provided by Chinese state-run banks.

Figure 1-8. Sub-Saharan Africa's Natural Resource Deposits (Source: The Mineral Industries of Africa, 2016)
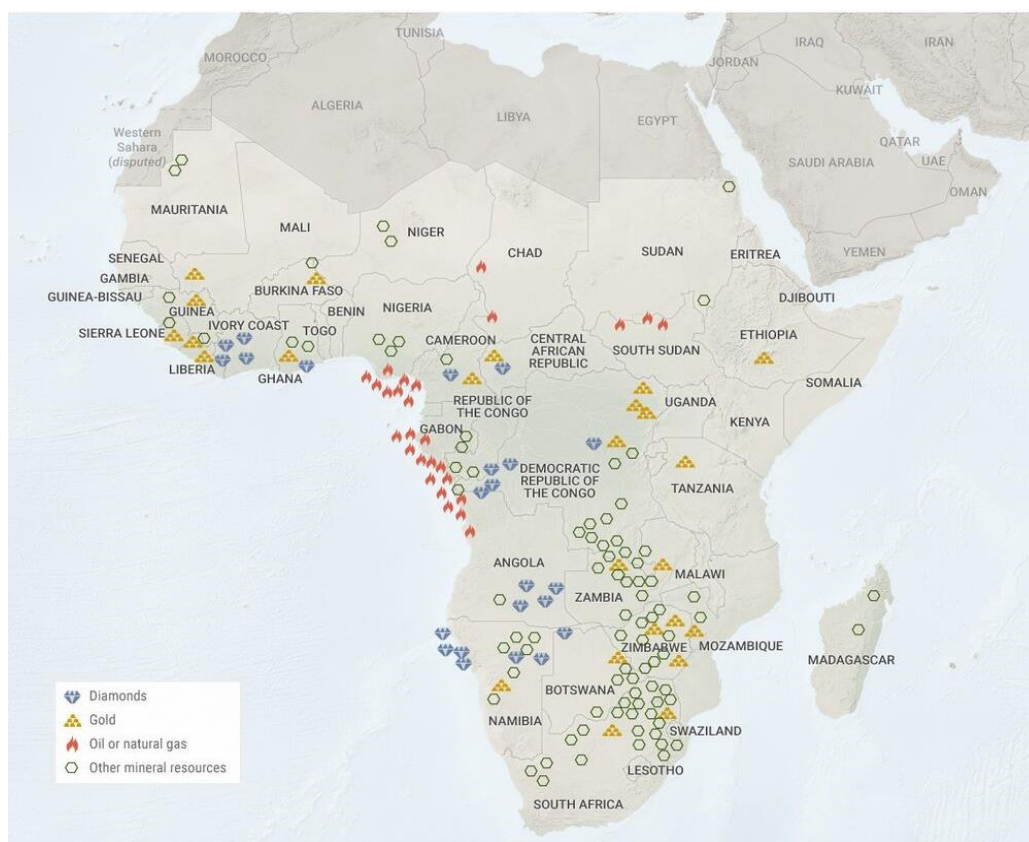
By expanding outwards, Chinese firms were also able to find new markets to expand their construction capacity and labor. Considering that China's construction industry grew at an average 22 percent between 2008 and 2013 and is predicted to make up one-fifth of the global construction industry by 2020, SOEs will continue to expand outwards and maintain this growth trend (Alves, 2013). More interestingly, these construction projects are often tied to the procurement of the natural resource in the region; for example, a Chinese SOE may agree to build an oil processing facility and surrounding roads in Nigeria in order to more easily refine the crude oil and transport it back to China. Such deals often involve equity stakes or "offtake" agreements in the foreign production assets and reserves to ensure steady flow of the resources in subsequent years and to have a stronger position in the future development of the markets.

Undoubtedly, China's economic reform propelled Chinese foreign direct investment and aid into sub-Saharan Africa. The resource-abundant region of the world has not only provided a crucial source of fuel that powers China's domestic economy, but also has enabled Chinese firms to expand into new markets and create foreign jobs for its domestic workers.

China's Investment in Sub-Saharan Africa

China has become so involved in foreign official development finance that it is currently the largest developing country to provide aid outside of the Development Assistance Committee (DAC), a coalition of OECD member countries that donate to lower income nations. While still small in magnitude relative to OECD members' aid, overall Chinese foreign aid has grown at a rapid rate of 21.8 percent annually (Zhang, 2016). On average, 39 percent of the country's aid goes to the African continent, with some years reaching 60 percent, as shown in Figure 1-9.

Meanwhile, in total dollars, Chinese aid in sub-Saharan Africa has increased over time, as shown

in Figure 1-10.

**Figure 1-9. Percentage of Total Chinese Foreign Aid Allocated to sub-Saharan Africa
(Source: William & Mary)**
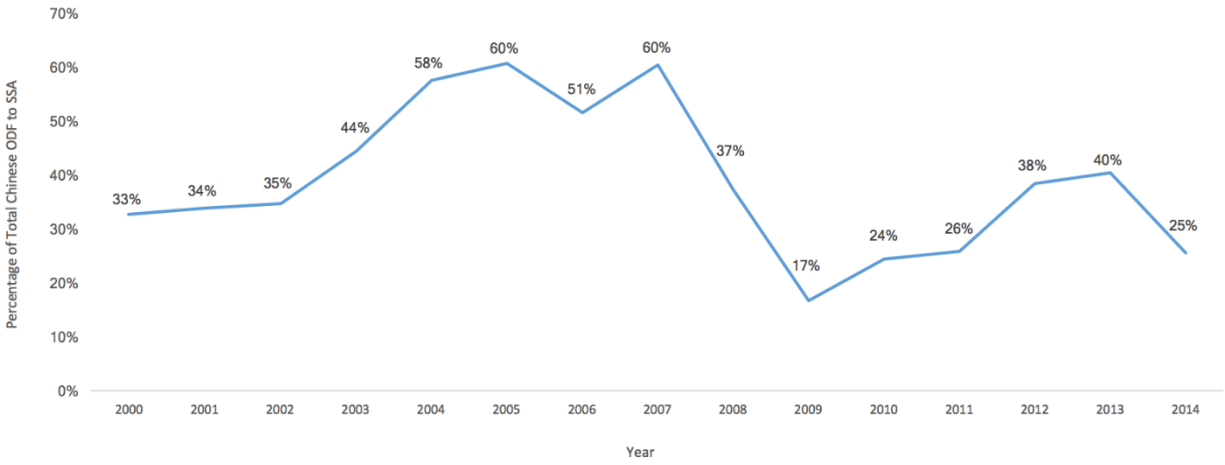
Figure 1-10. Total Chinese Foreign Aid in sub-Saharan Africa (Source: William & Mary)
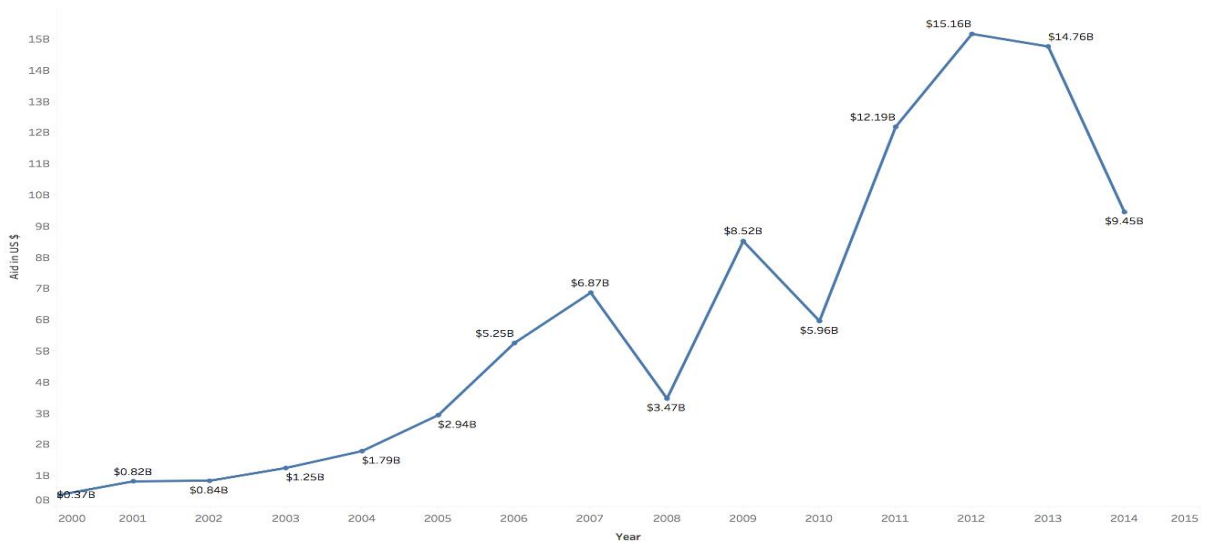
In terms of flow class as defined by the OECD (refer to Table 1-2), around $35.59 billion given to the subcontinent between 2000 and 2014 can be classified as ODA. Meanwhile, $33.72 billion is classified as OOF and $20.98 billion classified as vague. China's emphasis on OOF is contrary to many world powers such as the United States, which tend to prioritize ODA because of their membership in the OECD. The Organization for Economic Co-operation and Development push member nations to sign agreements that provide ODA for recipient countries because it is concessional, meaning it is more generous than market debt as a result of lower interest rates, longer grace periods, or both. Furthermore, the OECD can more easily monitor ODA and ensure it is earmarked for development and welfare. Meanwhile, OOF projects are generally designed for commercial purposes and cannot be as easily scrutinized. Much of the debate surrounding China's motives revolve around its focus on OOF financing, which is discussed in the next subchapter.

Table 1-2. Official Development Finance Classification of Flows (Source: OECD)

Official Development Assistance (ODA)	• Commonly known as "aid" • Concessional in terms (>=25% grant element) • Primarily intended for development and welfare
Other Official Flows (OOF)	• Non-concessional in terms (<25% grant element) • Primarily intended for commercial or representational purposes
Vague Official Finance* (Vague OF)	• Clearly official finance, but insufficient information to classify as ODA or OOF

*this term is technically not OECD terminology, but used by William & Mary AidData to classify deals that lack information

When breaking down sector allocation, the top five, in descending order, include: (1) Transport and Storage (2) Energy Generation and Supply (3) Communications (4) Water Supply and Sanitation (5) Industry, Mining, and Construction. The focus of aid in these sectors

corroborates earlier findings that China operates in the subcontinent with a focus on expanding

its construction industry and creating infrastructure that is tied to access of natural resources.

Furthermore, analysts suggest their focus in these sectors is a result of their domestic experience

during their growth phase, in which they allowed for heavy investment in infrastructure and

fixed assets to drive their economic growth (Zhang, 2016).

From a country perspective, China has provided most aid to Nigeria and Angola between

2000 and 2014, as shown in Figure 1-11. Nigeria, Africa's largest crude oil exporter, has a

significant amount of natural gas, tin, iron ore, coal, limestone, niobium, lead, and zinc; in fact,

petroleum exports revenue represents over 90 percent of the total export revenue (OPEC, 2017).

Angola is similar to Nigeria in terms of its reliance on oil export revenue. Looking forward, both

of these countries represent strategic places for China to plant itself in and integrate with their

commercial and industrial sectors.

Figure 1-11. Country Breakdown of Chinese Aid (Source: William & Mary)
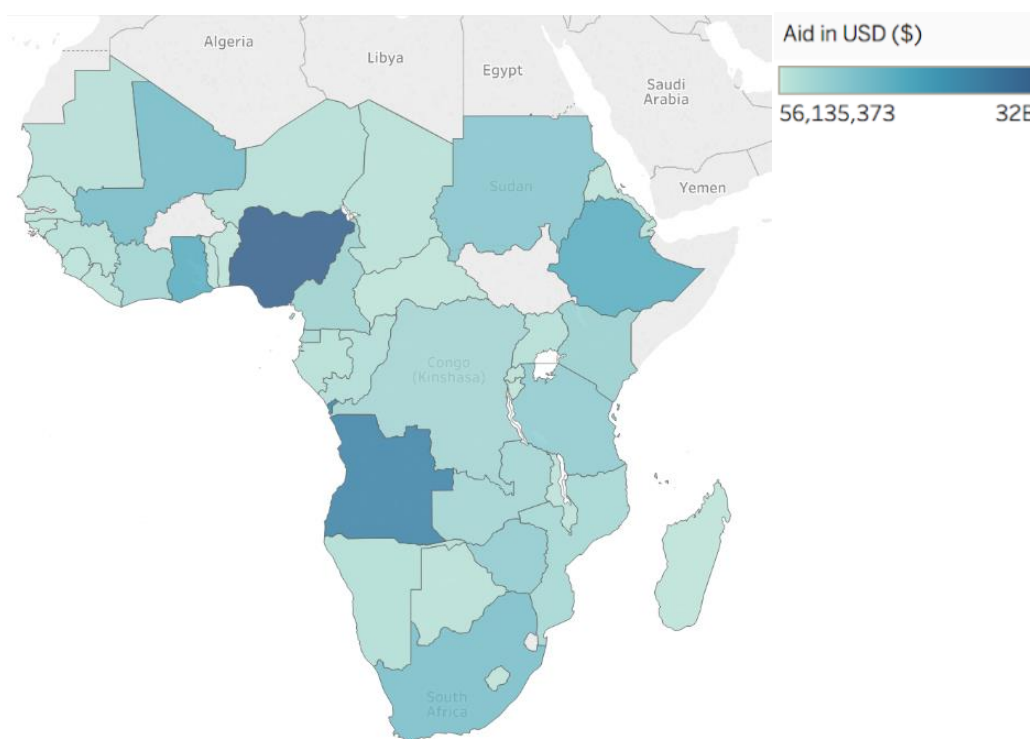
A unique, yet not thoroughly studied aspect of Chinese aid in sub-Saharan Africa are "resource-for-infrastructure", or R4I swaps. This investment vehicle is generally a concessional loan (however, not considered ODA) with a relatively long reimbursement period of 15 to 20 years and a 5 to 7-year grace period. Structured mainly as an export credit facility, these lines of credit are tied to the procurement of various goods, services, and labor (minimum of 50 percent) from China. In simpler terms, the China Exim Bank lends a reduced-interest rate loan to a Chinese SOE, which agrees to build a large-scale turnkey project (e.g. hydropower dam) or multiple infrastructure facilities (e.g. transport, agriculture, etc.) in the recipient country using a majority of Chinese labor. Meanwhile, the loan can be secured through two different methods. The first is through ownership stakes in extraction, or "offtake" rights. Offtake rights allows Chinese SOEs to enter into joint ventures with local resource-extraction firms in order to mine natural resources and operate future mining projects. This has obvious benefits, as it allows China to maintain some control over the recipient country's resource extraction while flowing the valuable minerals and oil back to its home country. The second way the loan can be secured is through compensatory trade, where the future income and long-term sales of either natural resources or primary goods such as cocoa are used to repay the loan (Oluyeju, 2017). Some R4I swaps may incorporate elements of both.

It is difficult to estimate the percentage of Chinese aid in sub-Saharan Africa that is R4I, as not all of the data is readily available by Chinese SOEs. However, R4I swaps are usually multi-billion dollar deals since they involve the construction of large-scale infrastructure such as hydropower dams and mining facilities. The first known Chinese R4I swap, coined the "Angola mode" was with Angola in 2003 and has been used as a blueprint for similar deals. This two-phase, $4.5 billion loan was oil-backed through both compensatory trade and offtake rights, and

focused on the construction of roads, railroads, housing, electricity supply lines, and more (Alves, 2013). Similar deals have taken place in Nigeria, DRC, Gabon, Ghana, and South Sudan. In fact, between 2001 and 2011, there were ten major R4I swaps either concluded or in implementation in sub-Saharan Africa, with a total value of about $22 billion (Konijn, 2014).

While these deals are not as common as more traditional aid instruments, they are worth billions of dollars and highlight the country's strategic perspective on sub-Saharan Africa. It is not surprising to see why China has used R4I swaps. Their need to tap foreign markets for natural resources, coupled with Africa's dire need for infrastructure development, makes such instruments appear quite beneficial for both sides. Nonetheless, researchers cite these deals as one of the major ways that China has exploited sub-Saharan Africa over the last decade. The following section wraps up the literature review by exploring the academic debate around Sino-African relations and discussing which side benefits more.

Sino-African Relations: Who is Winning?

As China has increased its position in sub-Saharan Africa over the past two decades, traditional donors like OECD member countries, local African civil society, and academic researchers have raised concerns about whether the East Asian behemoth is unfairly taking advantage of inherently vulnerable governments and ignoring the longer-term impact of its operations. Meanwhile, Beijing has touted its involvement in the subcontinent, claiming that its billion dollars of ODF solely benefits the recipient countries.

The infrastructure development by China has yielded incredible benefits to local citizens and businesses looking to more easily travel and communicate. Throughout the past two decades,

China has completed the construction of hard infrastructure across several countries, building railroads, airports, roads, ports, power generation grids, distribution lines, and refineries. For example, the Addis Ababa-Djibouti Railway Project, completed in 2015, was funded by a $3.3 billion loan provided by several Chinese state banks. This 472–mile railway allows landlocked Ethiopia to access the sea through Djibouti's ports and brings major improvement in facilitating international trade by reducing trader's logistical cost and delivery times (Export.gov, 2017). Apart from the obvious benefits that infrastructure brings to local citizens, Chinese investment is seen as favorable to sub-Saharan governments because of its generous terms and quick disbursement. Chinese SOEs are able to receive loans from state banks very quickly and are able to begin the provision of infrastructure at a much cheaper cost and faster pace than traditional companies are. Furthermore, these loans have very low interest rates (the Chinese government often subsidizes the interest rate differential), long reimbursement times, and no political conditions. For countries that are in dire need of infrastructure yet struggle with credit worthiness and political corruption, Chinese investment is much easier to obtain than aid from more traditional sources, like OECD members. Some argue that this alternative source of funding actually allows African governments to increase their bargaining power when negotiating with traditional donors (Alves, 2013).

Nonetheless, there are far more concerns with Chinese involvement in sub-Saharan Africa that researchers have studied. Perhaps the greatest concern deals with Africa's resource-focused approach to building infrastructure in the subcontinent. Several of China's largest investment recipients are abundant in natural resources and rely on resource export revenues for a significant portion of their GDPs. Nonetheless, the well-studied phenomenon coined "the resource curse" often plagues these countries. The idea suggests that countries plentiful in natural

resources often become too reliant on them and are unable to promote sustained growth and economic diversification, leading to overall lower quality of life (Atinc, 2013). Therefore, when China focuses its infrastructure on building oil refining facilities or roads that allow petroleum to be more easily transported to a seaport, it may be exacerbating the resource dependency. The true beneficiaries of such infrastructure, apart from Chinese SOEs, are local resource-extraction companies looking to export to foreign nations. Additionally, by allowing loans to be repaid with natural resources, China is failing to diversify the country's economy and is arguably taking resources away from local industrial and manufacturing companies looking to fuel their factories and facilities.

The terms of Chinese loans are also a matter of concern for many. Most loans are tied to the procurement of Chinese goods, services, and labor. This means that Chinese construction companies construct infrastructure using mainly their own labor, raw materials, and equipment. While this allows the East Asian nation to expand its construction capacity into new markets and provide jobs (which is cheaper than African labor, and easier for management to communicate with) for its own workforce, it strips opportunity from local construction companies and Africans looking to gain employment. Rather than helping develop the local construction industry, which in turn is tied to various industries, China maintains strict control over the entire lifecycle of projects. This significantly impedes multiplier effects in the recipient country, while fueling anti-Chinese sentiment among citizens. In fact, a working paper exploring the social impact of Chinese mining operations found that proximity to Chinese-operated mines is associated with higher anti-Chinese sentiments and unemployment (Wegenast, et. al., 2017). The paper decided to explore the topic after noticing that a high number of anti-Chinese protests were occurring in Madagascar, Zambia, Nigeria, Namibia, and Chad. Furthermore, humanitarian concerns have

been raised around Chinese SOEs' questionable labor practices such as low salaries, long shifts, and poor safety standards.

A third major concern regarding Chinese infrastructure development in sub-Saharan Africa is the lack of political conditionality in the financing agreements. Unlike OECD member nations, which require recipient countries to adopt specific regulatory frameworks or anti-corruption standards prior to receiving aid, China often fails to put in place such controls. As touched on earlier, most sub-Saharan countries rank high in corruption indices; therefore, it is not surprising that the OECD tries to ensure its aid is properly allocated for economic development by mandating provisions for democracy, good governance, and human rights. Critics argue China's non-conditional loans undermine the decade-long effort to improve overall transparency and governance in the region. Meanwhile, sub-Saharan countries prefer China's "non-interference policy", as it allows them to more easily secure financing and circumvent IMF and World Bank regulations. According to the Washington Post, one study found that as Chinese aid to sub-Saharan countries increases, political violence rates increase as well (Kishi and Raleigh, 2015). The paper argues that the non-conditional nature of Chinese aid makes it easier for African leaders to abuse civilians and allocate money towards political, often violent agendas, such as overly intrusive surveillance and forced displacement. The opposition suggests that R4I swaps in particular actually reduce the chance of embezzlement since all transactions occur with Chinese SOEs in a contained system. Nevertheless, more sub-Saharan African countries are joining transparency organizations and initiatives in an effort to reverse the systematic corruption and secure more financing in the future. An example of this trend is apparent in the Extractive Industries Transparency Initiative (EITI), a global standard that requires countries and companies to disclose information about their oil, gas, and mining operations, throughout the entire value

chain. Around 44 percent of sub-Saharan countries currently report to the EITI to some degree (Ponsford, et. al., 2018).

Finally, the less studied concerns with Chinese infrastructure development in the subcontinent deals with the quality of infrastructure, lack of maintenance, environmental pollution, and magnitude of loans. World organizations have raised the issue that the multi-billion dollar loans provided by China may increase the cycle of debt that several sub-Saharan countries have experienced throughout the last two decades. In fact, about twelve years ago, the IMF made a public warning that China was too aggressive in its lending to the subcontinent and should be wary of creating a "new wave of hidden debt" (Financial Times, 2006). This issue becomes more interesting when compared to the debt relief landscape in the region. The World Bank, IMF, and Paris Club had forgiven $89 billion in debt to Sub-Saharan Africa between 1996 and 2007, while China forgave below $3 billion during a similar period (Alves, 2013). Thus, some argue that China is free riding the debt relief provided by multilateral institutions and OECD member nations.

Evidently, there are several aspects to debate around Chinese financing and construction of infrastructure in sub-Saharan Africa. This literature review provides a thorough background on both players in this space and their motives for participating in such deals. The rest of the thesis focuses on the methodology behind the analysis and the results and interpretation of the data. Afterwards, it ties the results with the issues mentioned in the literature review in order to discuss suggestions for further research as well as policy implications and future best practices for external financiers.

Chapter 2

Methodology

This thesis explores the impact that Chinese overseas official finance, including both

ODA and OOF, has on sub-Saharan countries' real GDP per capita change. While there are

several economic dependent variables that could be included in the analysis, such as

unemployment or inflation change, the change in real GDP per capita is one of the most readily

available and easily understood indicators for a country's economic growth. The metric is

adjusted for inflation and population, and thus represents the change in total output, per person,

that a country produces between years. This is useful when looking at how sub-Saharan African

countries perform relative to one another over time. The data for real GDP per capita is based on

2010 US\$ and is imported from the World Bank database. For Eritrea and South Sudan, some

values were missing. The missing years' values are filled in using the IMF DataMapper's real

GDP growth predictors. The same IMF dataset is also used to predict values until 2018. The

dependent variable is calculated by finding the percentage change in real GPD per capita

between the fourth year following the project year and the project year itself. This is because it

takes several years for country leadership and companies to complete infrastructure projects and

realize economic impacts on a country.

Primary Data Source Cleaning

The primary source of data for this thesis comes from AidData, a research lab at William

& Mary College that collects information in order to help policymakers and researchers more

easily understand foreign investments. AidData's "Global Chinese Official Finance", version

1.0, dataset is used. This tracks all known records of overseas Chinese official finance between 2000 and 2014 in the major regions of the world. It captures various data points on its 4300 projects (worth $350 billion), such as flow class as per OECD guidelines, intent, sector, and start and end dates. For records that are loans, it has further data points on loan type, interest rate, grace period, and maturity. William & Mary collects the data using a methodology it coins "TUFF". This rigorous procedure, which is explained thoroughly on its website, triangulates and verifies open-source information using advanced technology and human verification.

Since there are over 4000 records in the original data set, specific filters are applied in order to yield the most relevant data for the thesis. Firstly, only records that are marked "TRUE" in the "recommended_for_research" field are included in the analysis. These are projects that are in the commitment, implementation, or completion stages and are not considered "umbrella" projects, or projects that include multiple sub-projects. This ensures that no records are double counted or included if they were ever cancelled or suspended. Secondly, sectors are filtered in order to include ones related to infrastructure, as shown in Table 2-1. Thirdly, any records in which the flow class is considered "vague" is filtered out. This ensures that the analysis focuses only on the difference in impact between ODA and OOF. Fourthly, recipient countries are filtered so that only sub-Saharan countries as defined by the World Bank were included, as shown in Figure 2-1. It is important to note that Niger and Somalia are considered sub-Saharan, however are not included in the data set because of the lack of economic data (e.g. real GDP per capita) on the countries. Also, Burkina Faso, The Gambia, Sao Tome and Principe, and Swaziland are not included because no records of Chinese finance within the parameters of the filters are recorded in the data set. Finally, any record with no transaction amount is filtered out. Ultimately, 853 records are analyzed using statistical regressions.

Table 2-1. Included and Excluded Sectors in Analysis

Included sectors	Excluded sectors
- Agriculture, Forestry, and Fishing - Communications - Education - Energy Generation and Supply - Government and Civil Society - Health - Industry, Mining, Construction - Other Multisector - Other Social infrastructure and services - Population Policies / Programmes and Reproductive Health - Transport and Storage - Water Supply and Sanitation	- Banking and Financial Services - Business and Other Services - Developmental Food Aid/Food Security Assistance - Emergency Response - General Budget Support - Trade and Tourism - Unallocated/Unspecified

Figure 2-1. Sub-Saharan Countries (in blue)

Selecting Explanatory Variables

The experiment does not just include the dollar amount of infrastructure projects as an explanatory variable, but also OECD flow class and country categorization as per the Ibrahim Index of African Governance (IIAG). Firstly, it includes OECD flow class because much of the debate focuses on China's use of non-concessional OOF in sub-Saharan Africa and if recipient countries benefit from such aid. Thus, a new dummy variable is created in which a value of 0 is assigned to ODA records and a value of 1 for OOF records.

Secondly, country categorization refers to the score a country receives from the IIAG. The IIAG is a tool that measures and monitors governance in African countries based on four high-level categories: (1) Safety & Rule of Law (2) Participation & Human Rights (3) Sustainable Economic Opportunity (4) Human Development. These four categories contain several sub-categories such as national security, welfare, education, and public management. Ultimately, the IIAG contains 100 indicators from 36 independent sources and acts as a thorough measurement of how sub-Saharan countries rank amongst one another in overall governance. The scores fall between 0.0 and 100.0, with 100.0 indicating that a country has a perfect governance structure. The scoring mechanism is used to create two different explanatory variables, which are used separately in each regression.

In Regression 1, for each record, the mean of the country's IIAG score between (and including) the investment year and the four subsequent years is calculated. For example, if there is a record of Chinese investment in Mali in 2001, the mean of Mali's IIAG scores in 2001, 2002, 2003, 2004, and 2005 is calculated. Ultimately, the range of the average scores fall between 16.38 and 81.28. The scores are divided into thirds (low, medium, and high governance) and a dummy categorical variable is coded. The variable assigns values of 0, 1, and 2

respectively, as shown in Table 2-2. In the Regression 2, the raw IIAG score that a country

received in the initial year of the investment is included as a new data field in each record.

Therefore, for the same record of Chinese investment in Mali in 2001, the raw IIAG score that

Mali received in that year is included. This allows the score to remain continuous, rather than

categorical. As a result, governance is interpreted slightly differently in each regression.

Table 2-2. Assigning Dummy Variables based on Average IIAG score

5 Year Average IIAG Score	Governance Level	Dummy Variable
$16.38 \leq x \leq 42.32$	Low governance	0
$42.33 \leq x \leq 53.90$	Medium governance	1
$53.91 \leq x \leq 81.28$	High governance	2

Creating Interaction Terms

Rather than simply regressing the economic output onto the explanatory variables,

interaction terms are included in order to see how the combined effect of two variables impact

the real GDP per capita growth of sub-Saharan countries. Both regressions interact dollar amount

of Chinese infrastructure investment with flow class. This is to test the hypothesis that the impact

that dollar amount of investment has on the real GDP per capita growth is different if the

investment is official aid (ODA) versus unofficial aid (OOF). Secondly, Regression 1 interacts

the governance ranking dummy variable with the flow class dummy variable to test whether the

flow class' impact on economic growth varies whether the recipient country is a low, medium, or

high governance country. Meanwhile, Regression 2 interacts the continuous, raw IIAG score

variable with flow class to test a similar hypothesis. Finally, Regression 1 interacts the

governance ranking dummy variable with amount to test whether there is a significant difference

in the simple slope estimate for amount between low, medium, and high governance countries. A

summary of the regressions' variables and interaction terms can be found below, in Table 2-3.

Table 2-3. Regression Variable and Interaction Terms Characteristics

Variable	Type of Variable	Detail	Mean (Std. Dev)	Units	Regression 1 or 2
rgdpcap	Dependent, continuous	four year real GDP per capita change	.1510533	Percentage change (based on 2010 US $)	Both
amt	Independent, continuous	magnitude of Chinese ODF	2.14×10^8	US $	Both
fc	Independent, categorical	flow class (type of Chinese ODF)	.391536	ODA = 0 OOF = 1	Both
$iiag^{avg}$	Independent, categorical	five year average IIAG score	.8102373	Low governance = 0 Medium governance = 1 High governance = 2	1
$iiag^{y1}$	Independent, continuous	IIAG score in initial investment year	12.17525	Number between 0 and 100	2
amt * fc	Interaction term	magnitude of Chinese ODF * flow class	n/a	n/a	Both
$fc * iiag^{avg}$	Interaction term	flow class * five year average IIAG score	n/a	n/a	1
$fc * iiag^{y1}$	Interaction term	flow class * IIAG score in initial investment year	n/a	n/a	2
$iiag^{avg} *$ amt	Interaction term	five year average IIAG score * magnitude of Chinese ODF	n/a	n/a	1

Developing the Two Regressions

Both regressions attempt to explain a 4-year percentage change in real GDP per capita

based on three explanatory variables and multiple interaction terms. Regression 1 contains one

continuous variable (dollar amount of Chinese aid) and two categorical variables (flow class and

IIAG ranking into low, medium, and high). It also contains the interaction terms between amount

and flow class, flow class and IIAG ranking, and IIAG ranking and amount. Meanwhile,

Regression 2 is composed of two continuous variables (dollar amount of Chinese aid and raw

IIAG score) and one categorical variable (flow class). It also contains the interaction terms

between amount and flow class, and flow class and raw IIAG score. The two regressions in their

simplified formulas are shown below, in Table 2-4.

<div align="center">Table 2-4. Two Regression Formulas</div>

Regression 1	$rgdpcap = \alpha + \beta_1(amt) + \beta_2(fc) + \beta_3(\text{iiag}^{avg}) + \beta_4(amt * fc) + \beta_5(fc * \text{iiag}^{avg}) + \beta_6(\text{iiag}^{avg} * amt) + \in$
Regression 2	$rgdpcap = \alpha + \beta_1(amt) + \beta_2(fc) + \beta_3(iiag^{y1}) + \beta_4(amt * fc) + \beta_5(fc * iiag^{y1}) + \in$

<div align="center">

Hypotheses for Regression Models

</div>

The paper hypothesizes that all else equal, Chinese investment in infrastructure will have

a positive impact on a sub-Saharan country's economic growth. When looking specifically at the

flow class, ODA is believed to have a greater impact than OOF due to its concessional terms and

favorable finance conditions. Thirdly, in terms of governance, the paper believes that high

governance countries (both in categorical rankings and raw scores) will experience greater

economic growth from Chinese infrastructure investment relative to lower governance ones. This

is because higher governance countries have stronger leadership and regulatory frameworks in

place to properly receive and disburse funds. Fourthly, when taking into consideration

interactions, it is hypothesized that there is a significant difference on amount's slope between

the two flow classes, with ODA having a greater impact than OOF on economic growth. For the

interaction between flow class and governance, higher governance countries will experience greater economic growth when flow class equals 0 (ODA) and 1 (OOF). It is believed to follow the same pattern in Regression 2 when interacting flow class and the raw IIAG score. Finally, when interacting governance with amount, the paper predicts that higher governance countries will cause a greater positive change in amount's simple slope relative to lower governance countries.

Regression Shortcomings

Understandably, it is difficult to conduct a flawless regression analysis that can explain change in real GDP per capita to a high degree of accuracy. Real GDP per capita is caused by an amalgamation of factors, many of which are unobservable. The first limitation with the analysis comes from omitted variable bias, or the bias in regression results due to omitted explanatory variables. There are likely several regressors included in the error term which are correlated to both the dependent variable and one or more of the independent variables and not included in both regressions. The paper mitigates this shortcoming by including the IIAG score as an explanatory variable. Considering the score is composed of 100 indicators, which relate to a country's political, social, and economic laws and governance structures, it acts as a combination of other individual variables that were likely omitted.

Another potential concern with the regression analysis is the composition of the dependent variable. Infrastructure projects can take anywhere from one year to over ten years to complete, depending on a variety of factors including approval processes, human labor supply, available financial capital, and government involvement. Nonetheless, to simplify the analysis in

this thesis, the dependent variable is the four-year change in real GDP per capita starting from

the initial investment year. In reality, the economic impact realized from infrastructure

development may begin immediately in the first year through job creation and manufacturing

output. At the same time, other economic impacts may only be realized years after the

completion of the infrastructure project, when the infrastructure is effectively being utilized on a

large scale to help local citizens and businesses travel and communicate more easily.

Furthermore, because the data set had less than one third of its records contain actual start and

end dates for the projects, it was difficult to create an approach that would most accurately

account for time differences in the completion of projects.

Chapter 3

Results

Regression 1

The results of the OLS regression 1 are shown below, in Table 3-1. All else equal, the dollar amount of Chinese official development finance has an inconclusive impact on economic growth. Although the coefficient is negative, it is not statistically significant. Meanwhile, when looking at flow class in isolation, countries receiving OOF have .1855 points higher real GDP per capita growth over four years than countries receiving ODA. This contrasts my preliminary hypothesis, which stated that ODA is more correlated to economic growth relative to OOF due to ODA's concessional nature. Even when interacting flow class with amount, there is no statistically significant impact that OOF has on amount's slope relative to ODA.

All else equal, medium and high governance countries experience greater positive economic growth relative to low governance nations. The high governance countries have the largest coefficient relative to the other two categories. When interacting flow class with governance, medium governance countries experience the most positive economic growth from ODA as investment amount increases, as shown in Table 3-2 and Figure 3-1. In the case of OOF, high governance countries experience the steepest growth, as shown in Figure 3-2. In both cases, low governance countries have declining economic growth as dollar amount increases. However, for low dollar amount of OOF investments, low governance nations have the greatest economic growth relative to medium and high governance countries.

Finally, the interaction between governance and amount suggests that the slope of amount becomes steeper for medium governance countries versus low and high governance when the investment amount is greater than \$500,000,000, as shown in Figure 3-1.

Table 3-1. OLS Regression 1 Output

Variable	Coefficient	Standard Error	p-value	n = 853
amt	-1.18×10^{-10}	6.14×10^{-11}	0.055	$R^2 = .1129$
fc = 1	.1854868	.0188088	0.000 **	
$\text{iiag}^{\text{avg}} = 1$ $\text{iiag}^{\text{avg}} = 2$	.0437354 .0745429	.0144702 .0142598	0.003 ** 0.000 **	
fc = 1 * amt	-4.05×10^{-11}	5.47×10^{-11}	0.459	
$\text{iiag}^{\text{avg}} = 1$ * fc =1 $\text{iiag}^{\text{avg}} = 2$ * fc =1	-.1559029 -.1790071	.033001 .038214	0.000 ** 0.000 **	
$\text{iiag}^{\text{avg}} = 1$ * amt $\text{iiag}^{\text{avg}} = 2$ * amt	1.82×10^{-10} 1.24×10^{-10}	5.97×10^{-11} 6.55×10^{-11}	0.002 ** 0.059	
constant	.0670735	.0112851	0.000 **	

**: $p \leq .05$, Significant at 95% confidence interval
Note: the coefficients for variables involving fc=1, iiag^{avg}=1, iiag^{avg}=2, are relative to base values of 0

Table 3-2. Coefficients for Interaction between iiag$^{\text{avg}}$ and flow class

iiag$^{\text{avg}}$	fc	Coefficient on Amt	Intercept
0	0	-1.18×10^{-10}	.0670735
0	1	-1.585×10^{-10}	.2525603
1	0	6.4×10^{-11}	.1108089
1	1	2.35×10^{-11}	.1403928
2	0	1.88×10^{-10}	.1853518
2	1	1.475×10^{-10}	.0359286

Figure 3-1. Impact of Amount at Flow Class = 0
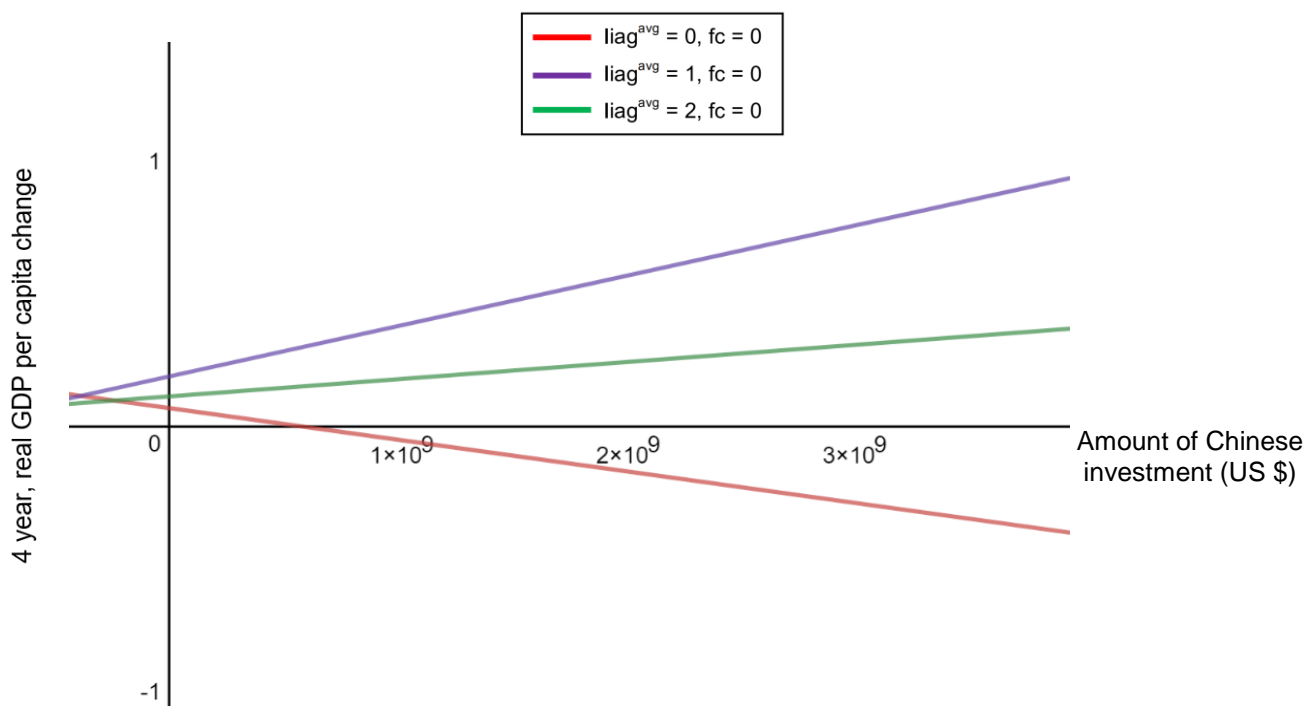
Figure 3-2. Impact of Amount at Flow Class = 1
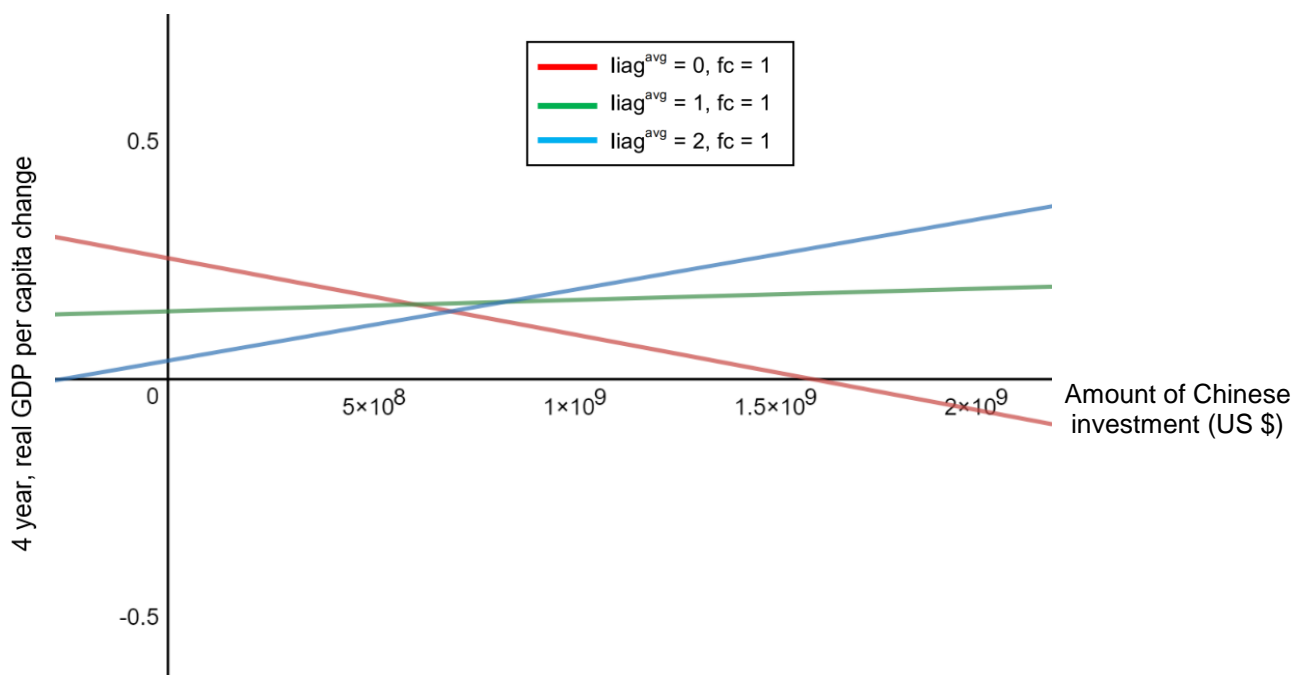
Figure 3-3. Interaction between iiag^avg and amt at 95% Confidence Intervals
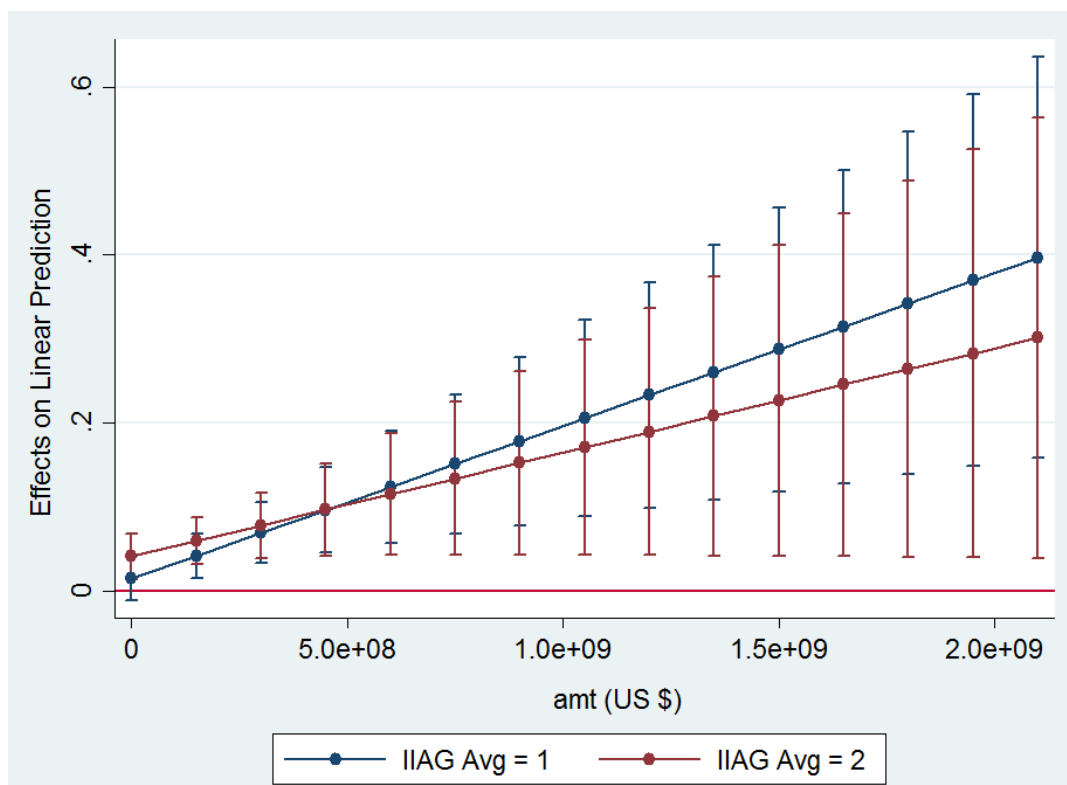
Regression 2

The results of the second regression are shown in Table 3-3. Similar to the first

regression, this OLS model suggests that all else equal, dollar amount of investment has a

positive, yet not statistically significant, impact on four year, real GDP per capita growth. In

addition, similar to Regression 1, countries receiving OOF have greater economic growth than

countries receiving ODA. The coefficient for OOF is actually much larger in this regression than

the prior one.

The primary difference in this regression is the use of the country's IIAG score in the

initial investment year as a continuous variable, ranging from 0 to 100, rather than a five-year

average that is coded into a dummy variable. All else equal, a one unit increase in the IIAG score

that a country receives leads to a .0021578-point increase in that country's four-year economic

growth. This is a similar observation to the one made in the previous regression, whereby higher

governance score nations experience greater economic growth because of Chinese infrastructure

investment. When interacting flow class with governance, there is a positive coefficient when

flow class is 0, and a negative coefficient when flow class is 1, as shown in Table 3-4. Finally,

by interacting flow class with amount, the coefficient on amount goes from a value not

statistically significantly different from zero to a statistically significant negative value when

moving from flow class 0 to flow class 1.

Table 3-3. OLS Regression 2 Output

Variable	Coefficient on Amt	Standard Error	p-value	n = 853
amt	3.47×10^{-11}	3.97×10^{-11}	0.383	$R^2 = .0973$
fc = 1	.3743007	.0495361	0.000 **	
iiag^{y1}	.0021578	.0004702	0.000 **	
fc = 1 * amt	-1.01×10^{-10}	5.03×10^{-11}	0.046 **	
fc = 1 * iiag^{y1}	-.0061261	.0011171	0.000 **	
constant	.0013006	.0247258	0.958	

**: $p \leq .05$, Significant at 95% confidence interval
Note: the coefficients for variables involving fc = 1 are relative to the base values of fc = 0

Table 3-4. Coefficients for Interaction between fc & amt, and fc & iiag^{y1}, respectively

fc	Coefficient on amt	Coefficient on iiag^{y1}	Intercept
0	3.47×10^{-11}	.0021578	.0013006
1	-6.63×10^{-11}	-.0039683	.3756013

Drawing Conclusions

In terms of similarities, both regressions suggest that all else equal, OOF has a greater impact on economic growth relative to ODA. While it is earlier hypothesized that the opposite would be true due to ODA's more concessional nature, there are a few potential explanations for the observed relationship. Firstly, a greater percentage of Chinese OOF aid between 2000 and 2014 were in "high impact" sectors (Communications, Energy Generation and Supply, Industry/Mining/Construction, Transport and Storage, and Water Supply and Sanitation). While 91% of OOF projects were in high impact infrastructure sectors, only 78% of ODA projects were in those same sectors. These high impact sectors are often the larger scale projects that are able to yield greater economic impact on a country relative to sectors such as health and education. An alternate explanation deals with the classification of Chinese investments. Technically, only OECD member nations' aid is officially classified as ODA or OOF, as they are terms created by the OECD. Non-members nations' aid, such as China's, is never classified by the OECD. For the data set used in this thesis, William & Mary classified the investments to the best of their ability. Furthermore, Chinese ODA is likely different from OECD members' ODA. While they are similar in terms of concessional grant elements, there are little to no economic or political conditions tied to Chinese ODA. Therefore, further analysis comparing the characteristics of Chinese aid versus OECD member nations' aid would allow for a more nuanced understanding of the differences and their impact on recipient countries.

There are also similar patterns between IIAG governance rankings in the two regressions. In Regression 1, it is observed that the highest governance countries experience the greatest economic growth holding all other variables equal. Similarly, Regression 2 found a positive correlation between the raw IIAG score a country has in its initial year of Chinese investment

with its economic growth. This suggests that the more governance and structure a country has in place, the better it is able to utilize infrastructure investment/aid in order to spur economic development. This conclusion holds true even when interacting flow class with governance. Regression 1 finds medium governance countries fare best with ODA, while high governance countries fare best with OOF. On both occasions, low governance countries experience decreased economic growth as investment amount increases. Interestingly, when governance is interacted with amount, Regression 1 finds that medium governance ($iiag^{avg} = 1$) countries' more positively impact amount's slope relative to lower and higher governance, when the investment amount is greater than $500,000,000. The reason for this is difficult to explain causally. There could be an unobservable commonality among medium governance countries, which suggests effectiveness in utilizing large Chinese investments.

There are interesting conclusions that arise when observing Regression 2's interaction between flow class and amount, and flow class and raw IIAG score. Firstly, ODA results in increased economic growth as investment amount increases. Considering ODA has a grant element of at least 25 percent, it is likely that sub-Saharan countries have an easier time meeting the financial terms and guidelines of even very large investments. In terms of governance, it makes sense that ODA produces increased economic growth as governance score increases. Higher governance countries likely have stronger leadership, more regulatory frameworks, better expertise, and less corruption in handling foreign investment and aid. However, moving from ODA to OOF results in steeper, negative coefficients on both amount and $iiag^{y1}$, as shown in Table 3-4. The negative coefficient on amount suggests OOF investments are better at lower dollar amounts. This may be because too much non-concessional investment puts a significant financial burden on sub-Saharan countries and makes it more difficult for leadership to meet the

terms of the agreement, particularly if it is a loan. Alternatively, it may be that too much investment makes sub-Saharan leadership less diligent in allocating money towards infrastructure development and leads to funneling of extra money towards political or corrupt causes, which can often exacerbate the economic situation of a nation. Nonetheless, it is more difficult to understand why the coefficient on iiag^{y1} is negative, as this suggests decreased economic growth from OOF as governance score increases. This conclusion contrasts the one found in Regression 1 and thus may be attributable to some shortcoming in the development of the regression, as mentioned in the earlier section.

Chapter 4

Suggestions for Further Research

The regressions and analyses conducted in this thesis are elementary and need further development in order to reach conclusions that are more comprehensive. As mentioned earlier, perhaps the most significant issue with the analysis is omitted variable bias. One way to solve this issue is by finding better explanatory variables that have impact on real GDP per capita growth. Better access to thorough data sets on economic variables such as capital formation, export and import trade flow, and natural resources, along with non-economic variables such as political freedom and education, can allow for more thorough analyses with higher r-squared values. However, it is important not to include too many variables and subsequently overfit the model.

A more specific recommendation is to incorporate an instrumental variable in the regression in order to yield a more unbiased output. In this thesis' regressions, there is likely endogeneity, or the presence of explanatory variables which are correlated with the error term. To solve for such issues, an instrument, or new variable is created which is uncorrelated with the error term yet correlated with the independent variable(s). It only influences the outcome through its interaction with the independent variable, and does not affect the outcome/dependent variable directly. Determining which instruments are truly exogenous may be difficult because it must be proved that it is neither correlated with the error term nor have a direct impact on the outcome. Some common instruments used in econometric analyses include natural disasters and policy

changes. A working paper using the same William & Mary data set utilized in this thesis incorporates Chinese steel production and foreign aid budgets as instruments in their analyses.

While this paper primarily looks at explaining past changes in sub-Saharan economic growth based on Chinese infrastructure investment, there are more advanced regression models that can predict future changes in real GDP per capita. One example includes auto-regression models, in which a variable is regressed onto lagged values of itself. A particular type of auto-regression model that is useful for econometrics is the autoregressive integrated moving average (ARIMA) model, which regresses Y not only on lagged values of itself, but also on lagged values of error terms, or moving averages. Overall, this model is better than a simple ordinary least squares (OLS) regression because it allows one to forecast with lower error terms. There are also other variations of regressions including finite and infinite distributed lag models.

Finally, it could be valuable to use other economic dependent variables to gauge Chinese infrastructure investment's impact on sub-Saharan countries. Although this thesis focuses only on real GDP per capita growth, other potential economic variables include change in unemployment and real wage growth. It could be interesting to compare regression outputs from models using different dependent variables to see whether they follow similar patterns. In other words, how will the betas from a model regressing real GDP per capita growth onto Chinese infrastructure investment compare to one that regresses change in unemployment on the same explanatory variable.

Chapter 5

Future Policy Implications

Based on Regression Analysis

The regression results, coupled with existing academic literature, may provide valuable advice for both sub-Saharan nations and Chinese state-owned enterprises interested in negotiating further infrastructure development deals. Based on the output from Regression 1 and 2, it appears that all else equal, OOF has a greater impact on sub-Saharan economic growth than ODA. However, it would be hasty to recommend that China fund all of its sub-Saharan infrastructure endeavors using OOF. While OOF may be more impactful since it is earmarked for commercial purposes rather than welfare, and is more easily disbursed, its non-concessional nature may be too financially risky for unstable nations to handle. With potential concerns regarding China's growing contribution to sub-Saharan Africa's debt as well as free riding other nations' debt forgiveness, the East Asian nation should use a country-by-country basis when deciding between ODA and OOF.

One way China can assess recipient countries is by using their governance scorings. In this case, higher governance is positively correlated with economic growth when all other variables are held equal. Even when considering flow class in the context of governance, medium and high governance countries perform the best with both ODA and OOF respectively. All of these conclusions suggest that China should solely provide financing for better governance nations and avoid investing in lower governance ones. In reality, however, lower scored nations

are also in need of infrastructure development and foreign investment. Thus, lower scored

nations should aspire to reach higher governance rankings by focusing more attention on the sub-

indicators of the Ibrahim Index of African Governance. In other words, sub-Saharan countries

should invest more heavily in multiple areas such as national security, accountability, human

rights, and education, as shown below in Figure 5-1. This not only will likely increase the

effectiveness of Chinese foreign investment and aid, but also allow the countries to appear more

attractive for other nations' looking to invest. Furthermore, improving standards across

categories such as safety and human development will result in direct positive effects on the

quality of life, happiness, and freedom that Sub-Saharan residents experience.

Figure 5-1. Categories and Sub-Categories of IIAG (Source: Mo Ibrahim Foundation)
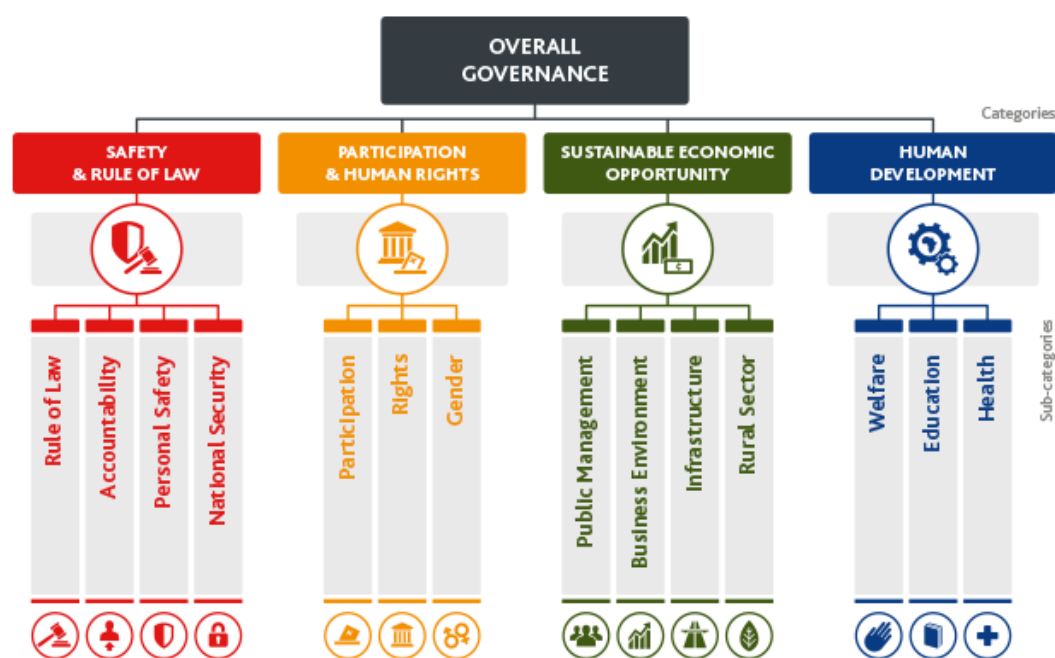
China should also take into consideration the dollar amount of aid provided to sub-Saharan nations based on flow class. For ODA infrastructure deals, the dollar amount is positively correlated with economic growth. Thus, China does not need to necessarily worry about investing significant amounts of money in the region if the deal is classified as official development aid. As mentioned earlier, this is likely because ODA's grant element makes it easier for sub-Saharan nations to incorporate into their budgets and pay back the debt. However, recipient countries should be more wary when accepting large OOF deals. Regression 2 finds that for OOF deals, as investment amount increases, economic growth declines. Thus, sub-Saharan countries should negotiate smaller OOF deals, particularly considering that such deals do not have grant elements and generally consist of higher interest rates relative to their ODA counterparts. Smaller deals may enable the countries to more effectively disburse the money towards the infrastructure development and allow for easier repayment of loans and other debt instruments.

Based on Existing Literature

There is existing literature that discusses recommendations for external financiers looking to develop infrastructure in sub-Saharan Africa. One recommendation is for China to work with sub-Saharan nations in producing more transparent and accessible data regarding its operations in the region. Although China has made progress over the years thorough cooperation (not full out membership) with the OECD and EITI, its SOEs do not report all relevant data that researchers and analysts need to better understand the relationship. Furthermore, several nations that score low on governance fail to report all the details of an infrastructure project in a clear

and organized manner via frameworks and proper documentation. Considering the debate around Sino-African relations is so contentious, information that is more transparent allows for more sound analyses. For example, the oft-cited complaint that Chinese SOEs flood sub-Saharan nations with its own labor is difficult to contextualize in numbers. However, if African leadership publishes data on how many work visas it grants to Chinese construction companies, policymakers and researchers can better understand the magnitude of the issue (Dollar, 2016). Other aspects that need better reporting include how much debt African nations take on with or without sovereign guarantees and the specific financial stipulations within the debt agreements.

A second recommendation for China is to play a more active role in improving its recipients' countries governance. Historically, China has taken a "no-strings" approach where it provides investment and aid to a region without tying political or social conditions to it. However, human rights activists and economists argue that such indifference makes China complicit in the humanitarian, environmental, and political turmoil that sub-Saharan nations are experiencing. The earlier mentioned study about how sub-Saharan countries become more violent after receiving Chinese aid only makes these claims more troublesome. One way that China can reverse its inaction is by making tangible steps towards assisting governmental and judicial systems in operating more efficiently. This includes ensuring that proper regulatory and legal frameworks and systems are in place, as well as providing project management advisory and other technical assistance. Secondly, China can avoid financing low governance nations or ones that actively violate international human rights laws unless there are clear stipulations in place for the African leadership to fix its internal issues. This is similar to how OECD member nations provide aid to countries with questionable governance. In terms of improving social impact, it can provide a greater portion of its debt financing to soft infrastructure like hospitals

and schools. Thirdly, it should engage the local community where the infrastructure is located and ensure that surrounding residents and parties are comfortable and that China meets their concerns. One way China can do this is by reducing its environmental footprint when constructing infrastructure, which will in turn allow the surrounding residents to maintain (if already present) their access to clean water and air.

Finally, China should do a better job at engaging the entire country throughout the lifecycle of the infrastructure projects. As mentioned earlier, a significant portion of Chinese infrastructure projects use Chinese SOEs, labor, and construction capacity. This creates a bubble where true economic growth effectively stays contained within China's borders and fails to amplify the recipient country. One way China can fix this is to train more African labor and utilize the local workforce over its domestic one. Also, rather than sourcing all of its construction equipment from its own borders, it should work with local African construction companies in using their capacity. Understandably, this may not be in China's best interest because it takes away jobs and expansion opportunities from its own companies. However, local African leadership should be stricter in negotiating with China by demanding less Chinese-sourced workers and equipment. In the long term, African leadership must ensure that multiplier effects are realized. If not, sub-Saharan nations will have the proper infrastructure in place yet lack growth in its local sectors. For a region that needs to create 20 million jobs per year to accommodate for its booming workforce, sub-Saharan Africa needs to prioritize its own human capital in the coming years.

Chapter 6

Conclusion

There is no clear answer as to whether China or sub-Saharan Africa is the sole winner in Chinese-financed infrastructure deals. Evidently, researchers must consider a multitude of factors when evaluating the effectiveness of these transactions. There are obvious benefits to providing hard infrastructure such as highways and dams for local sub-Saharan residents. Nonetheless, weighing such benefits against the several concerns regarding China's inaction towards improving sub-Saharan governance, contribution to the region's debt balance, and exclusion of African labor and construction, is difficult to do. Ultimately, both parties have responsibilities to improve the effectiveness and fairness of infrastructure deals. While China should begin to adopt the recommendations mentioned in the previous section, sub-Saharan Africa should also strive towards improving its own governance and strengthening its position during negotiations. The relationship between China and the region is quite interesting, as sub-Saharan Africa resembles China prior to its economic boom. If the major world players like the OECD member nations, BRIC nations, and multilateral institutions work together with local African governments in closing the region's infrastructure deficit in an honest and mutually beneficial way, the subcontinent will be able to accommodate its booming population and catapult itself to economic prosperity.

Appendix A

List of sub-Saharan African Nations (World Bank)

Angola	Senegal
Benin	Seychelles
Botswana	Sierra Leone
Burkina Faso	Somalia
Burundi	South Africa
Cameroon	South Sudan
Cape Verde	Sudan
Central African Rep.	Swaziland
Chad	Tanzania
Comoros	Togo
Congo, Dem. Rep.	Uganda
Congo, Rep.	Zambia
Cote D'Ivoire	Zimbabwe
Equatorial Guinea	
Eritrea	
Ethiopia	
Gabon	
Gambia, The	
Ghana	
Guinea	
Guinea-Bissau	
Kenya	
Lesotho	
Liberia	
Madagascar	
Malawi	
Mali	
Mauritania	
Mauritius	
Mozambique	
Namibia	
Niger	
Nigeria	
Rwanda	
Sao Tome And Principe	

Appendix B

Regression Outputs in Stata

OLS Regression 1

. regress delta4YR amt i.flowclass i.IIAGDummy i.flowclass#c.amt i.IIAGDummy#i.flowclass c.amt#i.IIAGDummy

Source	SS	df	MS		
Model	2.19464629	9	.243849587	Number of obs = 853	
Residual	17.2455321	843	.020457333	F(9, 843) = 11.92	
				Prob > F = 0.0000	
				R-squared = 0.1129	
				Adj R-squared = 0.1034	
Total	19.4401784	852	.022817111	Root MSE = .14303	

delta4YR	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
amt	-1.18e-10	6.14e-11	-1.92	0.055	-2.38e-10 2.76e-12
1.flowclass	.1854868	.0188088	9.86	0.000	.1485692 .2224043
IIAGDummy					
1	.0437354	.0144702	3.02	0.003	.0153335 .0721374
2	.0745429	.0142598	5.23	0.000	.046554 .1025317
flowclass#c.amt					
1	-4.05e-11	5.47e-11	-0.74	0.459	-1.48e-10 6.68e-11
IIAGDummy#flowclass					
1 1	-.1559029	.033001	-4.72	0.000	-.2206768 -.0911291
2 1	-.1790071	.038214	-4.68	0.000	-.2540129 -.1040013
IIAGDummy#c.amt					
1	1.82e-10	5.97e-11	3.05	0.002	6.49e-11 2.99e-10
2	1.24e-10	6.55e-11	1.89	0.059	-4.54e-12 2.53e-10
_cons	.0670735	.0112851	5.94	0.000	.0449233 .0892237

OLS Regression 2

. regress delta4YR amt i.flowclass RawIIAG i.flowclass#c.amt i.flowclass#c.RawIIAG

Source	SS	df	MS		
Model	1.89125596	5	.378251192	Number of obs = 853	
Residual	17.5489224	847	.020718917	F(5, 847) = 18.26	
				Prob > F = 0.0000	
				R-squared = 0.0973	
				Adj R-squared = 0.0920	
Total	19.4401784	852	.022817111	Root MSE = .14394	

delta4YR	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
amt	3.47e-11	3.97e-11	0.87	0.383	-4.33e-11 1.13e-10
1.flowclass	.3743007	.0495361	7.56	0.000	.2770728 .4715285
RawIIAG	.0021578	.0004702	4.59	0.000	.001235 .0030807
flowclass#c.amt					
1	-1.01e-10	5.03e-11	-2.00	0.046	-1.99e-10 -1.90e-12
flowclass#c.RawIIAG					
1	-.0061261	.0011171	-5.48	0.000	-.0083188 -.0039335
_cons	.0013006	.0247258	0.05	0.958	-.0472304 .0498315

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