

Development aid and fiber-optic network providers: China, the World Bank, and the ICT sector in Africa

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About the author

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Abstract

In an increasingly data-driven world economy, digitalization permeates key sectors such as agriculture, manufacturing, healthcare, and telecommunications, and underpins international development programs throughout the Global South. However, the major obstacle to employing ICTs for development in poor regions remains the backbone infrastructure such as broadband network cables. Developing countries with restrained budgets and limited manufacturing capabilities depend on foreign network equipment providers for the technology, and foreign finance including development assistance to pay for it.

Against this background, this paper examines how foreign donors impact the information and communication technology landscape in Sub-Saharan Africa where, as illustrated in this paper, China and the “West” pursue their own paths to digital development. While the “Western” donor community seeks a human-centered approach with ICT policies at its core, China launched the Digital Silk Road supporting domestic technology companies in investment projects abroad. By mapping geospatial data of fiber networks in Africa and the geographical distribution of Chinese and World Bank development assistance, the paper explores (1) which are the dominant equipment providers for fiber networks in Sub-Saharan Africa and (2) if there are any patterns between the choice of an infrastructure provider and the distribution of development aid inflows.

The paper finds that a high level of Chinese development aid flows nearly always coincides with a Chinese ICT infrastructure provider (i.e., Huawei, ZTE). By contrast, high World Bank aid inflows appear uncorrelated with the infrastructure provider choice. By providing an overview of the principal approaches to digital development (i.e., ICT4D and Digital Silk Road) and mapping the diffusion of foreign players in the continent's digital infrastructure, this paper shows how China's strategy gives its domestic companies an edge in the telecommunication sector. More generally, the paper contributes to situate the digital development of developing countries in the broader international political economy debates.

Keywords

Africa, China, development finance, ICT infrastructure, ICT4D, World Bank

Introduction

As millions of people shop online, videocall each other and stream on demand, billions are yet to enter their first Google search because they lack access to internet. After nearly three decades of “ICT for development” (ICT4D), universal internet access remains an illusion especially for many remote communities in the Global South. From a human rights perspective, access to internet is considered an extension of the fundamental right of access to information provided in Article 19 of the Universal Declaration of Human Rights. Despite the critique that ICTs would exacerbate existing inequalities (Rothe, 2020), universal internet access was also a critical action item in the Millennium Development Goals (MDGs) and now prominently features in the Sustainable Development Goals (SDGs). The persisting global digital divide notwithstanding, enormous progress has been achieved—not least thanks to ambitious development programs by foreign donors. Led by OECD-DAC donor states and multilateral institutions like the World Bank, the “Western” development community has attempted a three-fold scheme, acknowledging that universal internet access presupposes reliable infrastructure, a solid regulatory framework, and widespread digital literacy. Arguably, the most challenging part is constructing the necessary backbone infrastructure for it is a capital-intensive endeavor that usually requires sophisticated know-how in possession of private companies rather than states. In the case of Africa, geography poses an additional obstacle since infrastructure layout to vast but sparsely populated land is completely unprofitable. This impasse gives rise to a complex power dynamic between donor states, technology companies, and recipient governments.

African governments are unable to solve the puzzle by themselves as they act from a tight squeeze. On the one hand, parts of their economies have come to rely on ICTs, but they do not have the capacity to meet this demand with homegrown innovation. On the other hand, they generally do not dispose of sufficient internal funds to finance the costly and constantly upgrading ICT infrastructure. Hence, their agency is conditioned by dual dependency on foreign technology and finance to pay for the kit. As two of the main infrastructure financiers of recent times, China and the World Bank are aware of the dilemma and seek to tackle it according to their own development strategies. China launched the Digital Silk Road, a sister project of the Belt and Road Initiative, to support domestic technology companies in large infrastructure projects abroad. Besides fostering its technological clout in developing countries, this “going-out” strategy also helps the slowing domestic economy cope with overproduction in the infrastructure sector (Liao & Katada, 2021). By contrast, the World Bank provides funding for large infrastructure projects under conditions of good governance and transparency. World Bank finance is therefore aimed at the most competitive bidder. The underlying implication is that Chinese finance by design boosts Chinese infrastructure providers while World Bank funding does not discriminate technology companies based on their origin. The final choice of the source of funding, however free or restricted by terms and conditions, belongs to African governments.

Against this background, this exploratory paper plots the diffusion of broadband network equipment providers over time and space and considers the overall geographic distribution of development aid flows by China and the World Bank over the past 20 years. To this end, the paper first offers an overview of the fiber-optic broadband landscape in Africa. Data on development finance is then used to compare aid flows with the presence of certain telecommunication manufacturers, before contextualizing the results of this exploratory exercise. The aim is to shed light on where ICT and development (finance) meet on the ground. By approaching the persisting challenge of internet access for all from a development finance perspective, this paper also contributes to situate the ICT4D paradigm in the broader international political economy debates. Finally, it engages with current debates on why closing the digital gap has proven so challenging (Fife & Pereira, 2016).

The paper proceeds as follows. The next section sets out the different approaches to international development aid including ICT4D and China's Digital Silk Road. Section Three explains the data collection and methodology. Section Four presents the analysis and Section Five discusses the results. Section Six concludes.

Theoretical background

The acronym ICT4D (ICT for development) captures the idea that information and communication technologies would incite progress in developing and least developed countries. Different studies showed a positive and significant link between telecommunications infrastructure and growth under certain conditions (Cardona, et al., 2013). Existing literature shows that ICTs benefit economic growth in developed countries (Dewan & Kraemer, 2000) but reports mixed results for the MENA region and developing countries more generally. While some analyses found a positive effect of ICT investment on economic growth (Seo, et al., 2009; Vu, 2011), other studies show evidence of an ambiguous or even negative impact of ICT on economic development (Hassan, 2005; Lee, et al., 2005). Many scholars pessimistic of the ICT4D paradigm criticize how ICT-based development approaches exacerbate the digital divide between and within countries but also along race and gender lines (Unwin, 2017). For instance, the most important determinant of local disparities in ICT diffusion is the availability of reliable electricity. Another critique of ICT4D draws on the contradictory role of ICTs within the entirety of the Sustainable Development Goals (SDGs). As Rothe (2020) highlights, ICTs are associated with multi-layered externalities ranging from environmental concerns to trade and production asymmetries between the Global North and Global South. While acknowledging that ICT diffusion entails risks and unintended consequences, there is widespread consensus among the international community that ICTs can serve as a tool to empower people and communities in disadvantaged regions. As scholars, governments, multilateral organizations, technology companies and others became preoccupied with bringing ICTs for development, different players established different

strategies. The following sub-sections juxtapose two of the main “schools”, the “Western” and Chinese approach to digital development.

The “Western” approach to ICT4D

Historically, the “West”, understood as the international system that emerged from the history and traditions of Europe and North America, has been the principal actor on the international development stage. As such, the Western development community established different institutions and channels to provide aid to less developed countries. The forum per definition in charge of governing international aid is the Development Assistance Committee at the Organization for Economic Cooperation and Development (OECD-DAC). Yet, in the African context, development cooperation is steered mostly by the European Union and its member states and the World Bank.

To grasp of the “Western” conception of ICT4D, a guidebook to ICT for development (Labelle, 2005) commissioned by the Asia-Pacific chapter of the United Nations Development Program (UNDP) encapsulates the core of the paradigm. The report envisions three stages to achieve a development-oriented diffusion of ICTs towards universal access to internet. First, the mainstreaming of ICTs for development shall be human centered as a means and in its end, leading to universal internet access. This perspective is also reflected in the Millennium Development Goals and the Sustainable Development Goals. Secondly, stakeholders shall set the agenda by formulating a strategic plan, followed by a concrete action plan. Thereby, ICT visions, guidelines, and policies defining and managing ICT diffusion must take the human-centered approach into account. Finally, the guidebook acknowledges that the international telecommunication sector inevitably affects the physical diffusion of the backbone infrastructure which shall comply with the human-centered approach. Hence, the “Western” conception of ICT4D considers ICT policies as instrumental to ensure that the layout of the backbone infrastructure observes the underlying principles of the Sustainable Development Goals. This emphasis on ICT strategies and visions is recurring in the policy documents of other development players, like the European Union’s “Digital4Development” policy.

The European Union is the largest integrated economic space worldwide and when its member states stand united behind a policy, its voice carries normative power beyond its external borders. Even though all EU member states remain sovereign to exercise their own foreign policies, the Common Foreign and Security Policy (CFSP) provides a mechanism for cooperation and aims at policy coherence across the Union (Hadfield, 2017). In the field of digital development, the Union aims at an equitable and sustainable digital transition in developing countries. Thus, the influence of the Old Continent resonates especially in the Global South whose security stabilization

and socioeconomic development through digitalization are at the heart of EU development policy (European Commission, 2017).

With a Commission Staff Working Document on “Digital4Development: mainstreaming digital technologies and services into EU Development Policy” adopted in 2017, the European Commission officially acknowledges the role of ICTs in the Sustainable Development Goals. The paper addresses both challenges and opportunities of ICTs in the development context and, accordingly, identifies four priority areas for action. The first aim is to promote access to digital infrastructure including affordable and secure broadband connectivity as well as to address the necessary regulatory reforms. A second focus is on digital literacy and skills. Thirdly, the paper establishes measures to foster digital entrepreneurship and create jobs, and finally, the overarching goal is to promote the use of digital technologies as an enabler for sustainable development. Although the policy is aimed at all developing countries, the initiatives, projects, and general examples named in the working document reveal a strong focus on Africa. In fact, a word search yields 52 matches for the term “Africa” (including both North Africa and Sub-Saharan Africa), eleven matches for “Asia” (Central Asia, East Asia, South-East Asia), and only seven mentions of “America” (Central and Latin America) or the “Caribbean”. Annex 1 of the document outlines eight short-term indicative types of actions for 2017 of which five are concentrated in Africa; among the 15 medium-term (2018-2020) indicative types of measures listed in Annex 2 twelve are focused on Africa while the other three are “global”.

Considering the total official development assistance committed to developing countries, only a tiny fraction of the funds is committed directly to digital development. Instead, other projects promote the digital transition indirectly by “mainstreaming” new technologies in all sectors of the economy and across all strata of society. In fact, without a dedicated budget, Digital4Development relies on existing programs in the context of the Multiannual Financial Framework or the European Development Fund. Thus, different regions benefit from different amounts of financing coming from different sources. Over the past ten years, the EU devoted approximately 350 million euros to digital initiatives in EU partner countries and allocated more than 110 million euros for on-going digital projects (European Commission, 2017). The supported initiatives fall into one of three broader categories: infrastructure network projects, creativity and cultural diversity, and policy harmonization. About 31 percent of these funds went to the European Neighborhood, with the European Neighborhood Instrument as the main source of funding. Asia and Africa received 43 percent and 19 percent respectively. Only 7 percent of the investments flowed into projects in Latin America. The funding for the three regions in the Global South mostly relied on the Development Cooperation Instrument. This apportioning illustrates a partial mismatch between prevalent regions in the policy and the ICT-linked disbursement destinations. Although Africa was mentioned almost five times more often than Asia, the latter attracted more than half of Africa’s financing over the past decade. In fact, Asia received more than Africa and the European Neighborhood combined if one also

considers the North African countries which benefited from part of the European Neighborhood Instrument, a 15.4-billion-euro budget from 2014 to 2020. Latin America and the Caribbean carry peripheral significance in both the policy documents and the funds. Outside the pan-European Development Fund, only a fraction of the funds, 459.04 million euros or 0.09 percent, went to the telecommunication sector. However, this qualification obscures the fact that digital technologies are increasingly an integral component of development programs rather than a project *per se*, ultimately fulfilling the scope of the Digital4Development policy.

Since many “Western” donors such as the European Union and its member states have directed their development assistance away from large-scale infrastructure projects and towards social and environmental programs, the World Bank stands out as one of the remaining financiers of projects like fiber-optic broadband network construction. The World Bank issues its payments through either of its two branches, namely the International Development Association (IDA) or the International Bank for Reconstruction and Development (IBRD). IDA funds are allocated at highly concessional terms with no or low interest rates, based on the recipient countries’ “income levels and record of success in managing their economies and their ongoing IDA projects” (“IDA Financing”). IDA lending is therefore similar to “official development assistance” (ODA) under the OECD-DAC framework. The IBRD, a global development cooperative owned by 189 member countries, traditionally engages with middle-income countries, including those which have “graduated” from IDA support, by providing financial products and policy advice. Many of these fundings would be considered OOF-like (official other flows) by the OECD-DAC. In both cases, the World Bank engages in policy-based lending which comes with numerous policy and structural conditions. Regardless of the merits and critique, good governance conditionalities is how the World Bank and the “West” in general accounts for the use of their taxpayers’ money (Santiso, 2001). The principle of conditionality, usually aimed at enhancing both the legitimacy and effectiveness of government, is therefore an intrinsic requirement of “Western” aid and loans to developing countries. However, since such conditionalities are often unpopular among recipient governments, Chinese economic assistance has evolved into the main alternative source of aid (Li, 2017).

The Chinese approach to digital development

Compared to the “West”, China is still a developing country itself and a relatively “new” actor in development cooperation. China’s foreign and aid policies towards other regions of the Global South have evolved from an initial period of mostly ideological cooperation (1948-1978), followed by a focus on domestic market-oriented reforms and the improvement of its own economic conditions (1979-1999), to the current period characterized by increasing economic pragmatism which started around 2000 (Samy, 2010). While the official rhetoric underscores equal partnerships and a “win-win” strategy for all stakeholders, the coming to power of Xi Jinping and his launch of

the Belt and Road Initiative (BRI) in 2013 marked the beginning of China's new political and economic assertiveness abroad (Mulvad, 2019). Less than two years later, President Xi Jinping's signature foreign policy undertaking was given an additional dimension—the "Digital Silk Road" (DSR). While the system of assisting domestic companies had been practiced since the early days of economic pragmatism, the 13th Five-Year-Plan and a range of complementary domestic policies defined how to create a "win-win" digital development path with China at the core (Hungerland & Chan, 2021). Above all, Chinese policymakers insist that the Digital Silk Road ought to be built by Chinese companies. Besides enhancing digital development abroad, this strategy is also expected to deliver benefits for China itself. First, the increased competitiveness of Chinese firms reflects on China's economy and global influence (Hernandez, 2019). Secondly, this "going-out" strategy eases the overcapacity of the domestic telecommunication infrastructure production (Liao & Katada, 2021). Finally, the Digital Silk Road offers a forum for China to cooperate with other countries in order to establish (technical) standards and promoting internet sovereignty (Shen, 2018).

Against this background, the conception of the Digital Silk Road implies that China pursues digital development through the direct provision of infrastructure rather than the policies and regulations of the "Western" approach. To this end, the Chinese state cultivates a symbiotic relationship with the private sector. While big technology companies like Huawei and ZTE provide the technological know-how, Chinese state entities facilitate the granting of both commercial and concessional loans or alternative financing schemes. Indeed, since China does not adhere to the OECD-DAC framework, its infrastructure investments comprise loans, export credits, and development assistance. However, it is worth noting that contrary to the wide-spread belief, excessively low interest-rate loans, granted as concessional loans by China's EXIM bank, only account for a minor portion of the bank's total lending (Chen, 2021). Instead, a popular Chinese financial practice in Africa is the "EPC+F" scheme where Chinese contractors like Huawei or ZTE oversee the "engineering, procurement, and construction" of infrastructure projects and Chinese banks provide "financing" (Chen, 2021, p. 18).

Construction projects in Uganda and Zambia have shown that this approach may actually prove more costly compared to conventional OECD funding (Australian Strategic Policy Institute, 2021). Nevertheless, debtor states might opt for a less cost-efficient solution because through the "EPC+F" scheme Chinese contenders are able to advance the initial capital cost themselves—a decisive factor for states which might be barred from regular credit, either because of their credit rating or because the project itself might not be financially viable. Hence, "EPC+F" confers Chinese companies like Huawei and ZTE a competitive advantage over their Western counterparts Ericsson and Nokia because of their comprehensive rather than cheap solutions. Meanwhile, Chinese financial institutions take advantage of their country's structural power to enhance a project's credibility, employing China's international clout in production and finance as well as security. Commonly employed instruments

range from fiscal or sovereign guarantees of the recipient state to state-owned or state-coordinated assets as guarantees or collateral, commodities or “future receivables” like next years’ oil revenues, or “cross-guaranteeing” multiple government-led projects at once (Chen, 2021). Developing countries might forgo the most cost-efficient offer in one place to promote several financially “interconnected” projects. Closely related to “cross-guaranteed” undertakings, some countries’ choices may be informed by the general level of trade or their long-standing bilateral relations with one of the leading technological countries, like Tanzania and Zambia with China or Kenya with the United Kingdom. Moreover, Chinese investments tend to impose fewer obligations especially in the field of democratic governance and neoliberal reforms than development assistance from OECD-countries (Morvaridi & Hughes, 2018; Li, 2017). In this sense, Chinese development aid represents an attractive alternative to traditional donors, causing various donors to compete for influence in developing regions (Amuhaya & Degterev, 2019; van Klyton et al., 2020).

Data and methodology

This paper employs geospatial maps to gain a better insight into the geographical presence of the various network equipment providers, the destination of development aid, and consequently, to identify possible patterns in the choice of the provider. The geocoded data of fiber networks in Africa is collected by the Network Startup Resource Center (NSRC) and available in open access (AfTER Fibre). While the database includes detailed information on the geographical rollout, owner, and operator, among others, it does not specify the respective network equipment providers and year of commitment. Hence, I scrutinized past newspaper articles in order to determine the infrastructure provider of every single cable. This method was successful for 108 out of 130 fiber construction projects, while the providers of the remaining 22 fiber cables could not be identified. Most newspaper articles did not explicitly mention the date of the agreement with the foreign telecommunication manufacturers. Nevertheless, given the nature of newspaper articles, the year of commitment could be inferred from the publication date itself.

The geocoded data for development aid is also provided in open access by the research lab “AidData” within the William & Mary’s Global Research Institute. For this paper, I downloaded the databases of the World Bank development assistance and the ODA and OOF-like aid inflows from China. The most current version (Version 1.4.2) of the geocoded dataset for World Bank assistance includes all projects approved in the IBRD/IDA lending lines from 1995 to 2014. In absence of transparent reporting, the data on Chinese aid flows relies on the careful data collection by AidData and includes projects up until 2017 which “roughly correspond to the OECD’s definition of Official Development Assistance (ODA)”. For each country I considered the data at the highest administrative, that is, the first sub-national (usually regional) level in order to detect differences in aid inflows within the various countries.

After cleaning and pre-processing all data, I first plotted the fiber-optic cables based on their manufacturer using the R-package *ggplot2*. For this map, I downloaded the underlying geocoded country data from GADM (Version 4.0.4). Then I created two separate maps showing the levels of aid inflows by the World Bank and China, respectively. Finally, I drew an overlapping map of the fiber-optic cables and the World Bank aid flows to display any geographic correlations between the two. All maps are based on the World Geodesic System 1984 (WGS84) datum, the most commonly used model of the shape of the earth (Hijmans, 2021, p. 21).

Several limits and caveats concerning the data availability are in order. The geocoded version of World Bank development assistance is only available in aggregate terms for the entire period 1995-2014, thereby obscuring any changes in the level of aid inflows over the 20-year period in question. The data also ignore the fact that World Bank assistance is distinct from sovereign aid flows. Nevertheless, in the absence of fine-grained geocoded data on sovereign flows this paper assumed World Bank aid to reflect the geographical priorities of Western donor states. Similarly, data on Chinese aid flows are largely missing for East and West Africa and therefore presumed to be unsubstantial. One shall also bear in mind that aid flows are only one of numerous financial instruments that China employs in developing countries (Bräutigam, 2011).

Analysis

The collected data showed that over 70 percent of the fiber-optic cables in Africa were realized by Huawei and ZTE. Most of Huawei's network infrastructure was laid out between 2011 and 2014 with a smaller peak in 2020 (Figure 1). ZTE deployed its own cables in three small waves in 2011, 2018 and 2020. Before Huawei, the most popular provider was Ericsson. Finally, other manufacturers like the South African Liquid Telecom increased their presence after 2018.

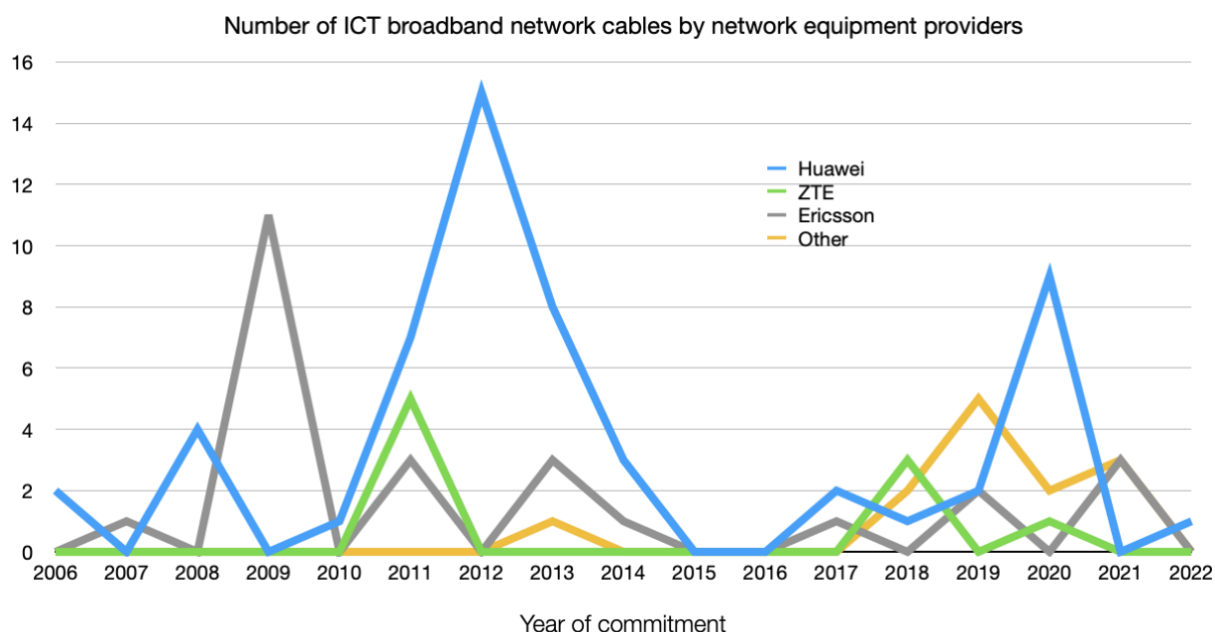


Figure 1: Temporal distribution of agreements with network equipment providers

Figure 2 maps the geographical diffusion of fiber network cables on the African continent and illustrates which network equipment providers supplied them. The map confirms Huawei as the dominant contender, especially in West Africa and along the Western coast of Central and Southern Africa. Moreover, Huawei is also present in Ethiopia, Uganda, Zambia, and Zimbabwe. ZTE completes the Chinese presence on the continent as the main provider in Burundi, Ethiopia, South Africa, and Zambia. By comparison, Ericsson laid most of the fiber-optic cables in Ghana, Madagascar, and Mozambique as well as the undersea cable of Angola. Nokia is partially present in Kenya. Finally, Botswana, the Democratic Republic of Congo, and Tanzania opted for other telecommunications network manufacturers: the first two chose the South Africa-based Liquid Telecoms, Tanzania the Vietnamese Viettel.

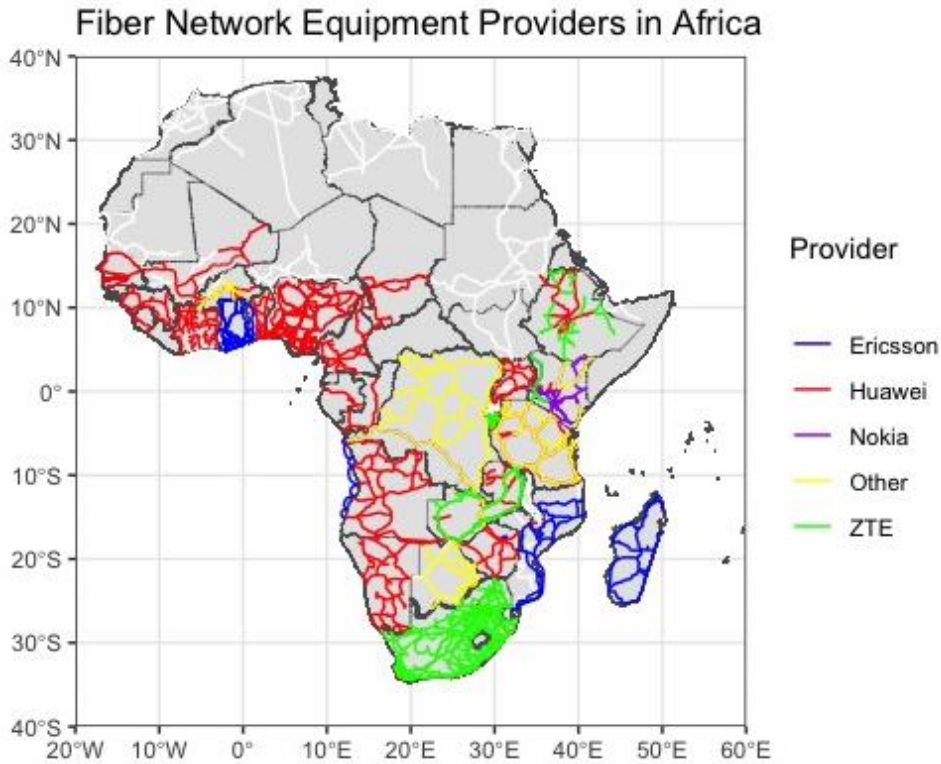


Figure 2: Network Equipment Providers of Fiber Broadband in Africa

Figure 3 shows the regions of Sub-Saharan Africa corresponding to the first-level administrative units of each country. The color fill indicates the total amount of aid inflows by the World Bank, both via IBRD and IDA channels, from 1995 to 2014. The regions with the lowest and lower-medium aid inflows belong mostly to countries on the Western coast of Central and Southern Africa, but also Chad, South Sudan, Botswana, and parts of Zimbabwe. The largest amounts of aid went to Western and Eastern Africa as well as Mozambique, parts of South Africa, and many regions in Central Africa.

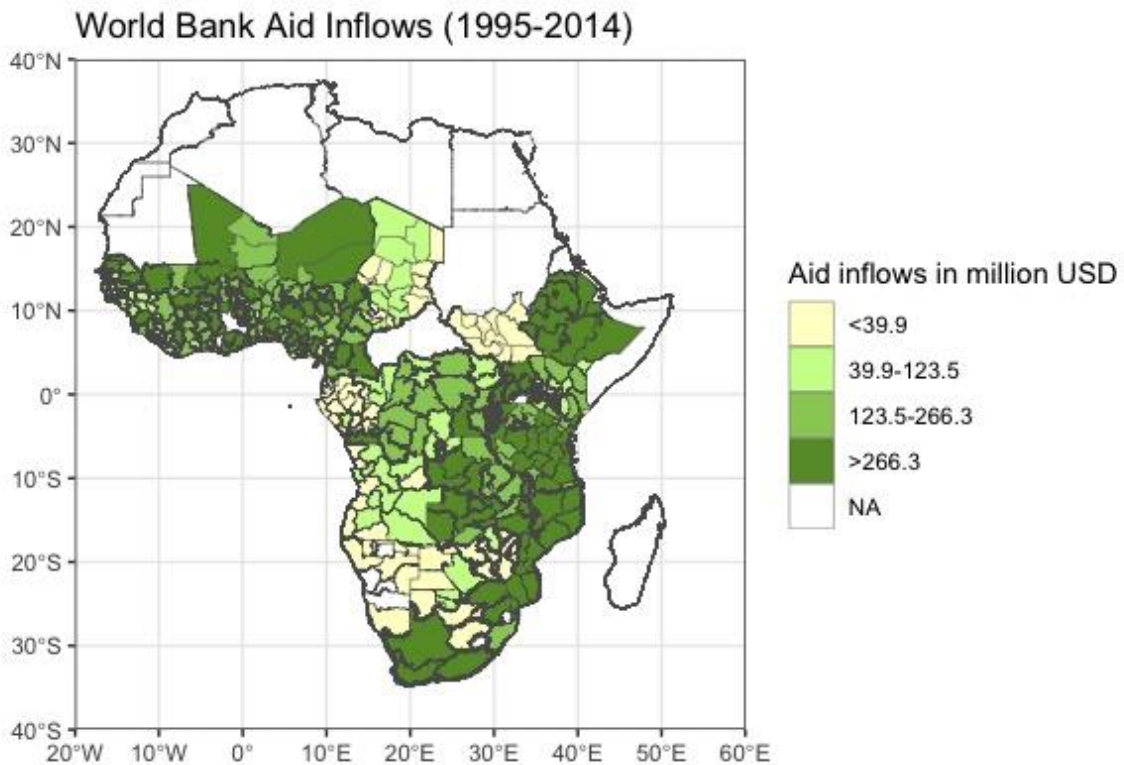


Figure 3: World Bank aid inflows from 1995-2014, by quartile

Figure 4 shows the financial inflows from China which are deemed equivalent to the OECD-DAC classification of development assistance. Unfortunately, data are missing for more than half of all regions and therefore does not allow for broader conclusions. The map does, however, show a concentration of financial inflows to certain countries known to have close relations with Beijing, including Angola, Ethiopia, Zambia, Zimbabwe as well as Niger in Western Africa. Overall, Chinese financial flows have been recorded for most regions along the Western coast of Central and Southern Africa and many parts of Southern Africa. Compared to Figure 3, these regions roughly correspond to the regions with lower inflows of World Bank aid.

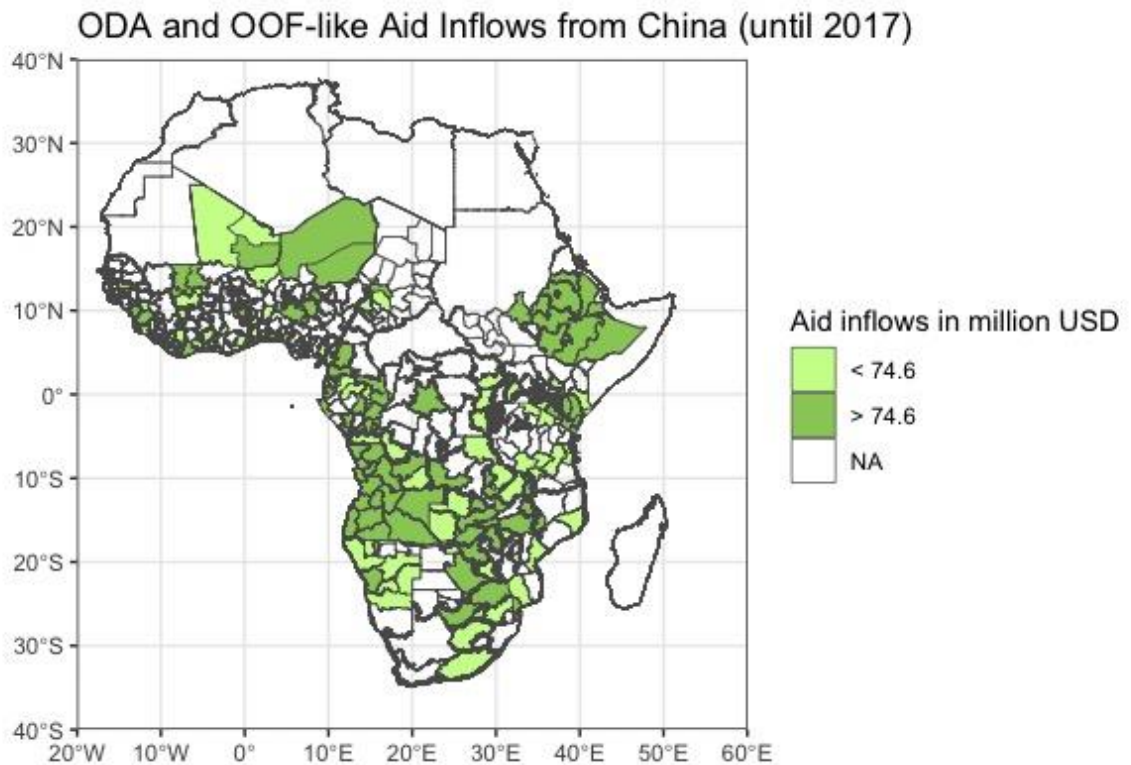


Figure 4: ODA and OOF-like aid inflows from China until 2017

Figure 5 compares the geographical distribution of fiber cables by network equipment providers with the level of aid inflows by the World Bank. The map suggests four possible scenarios which will be further elaborated in the following section: firstly, Huawei dominates in Western Africa where most regions received above-average aid inflows; secondly, most regions in Central and Eastern Africa also received above-average aid but chose network providers other than Huawei; thirdly, Huawei dominates in regions on the Western coast of Central Africa and in Southern Africa (except South Africa) which received below-average amounts of aid; and fourthly, the ZTE dominates in regions with comparatively large aid inflows and close ties with China, in particular Burundi, Ethiopia, South Africa, and Zambia.

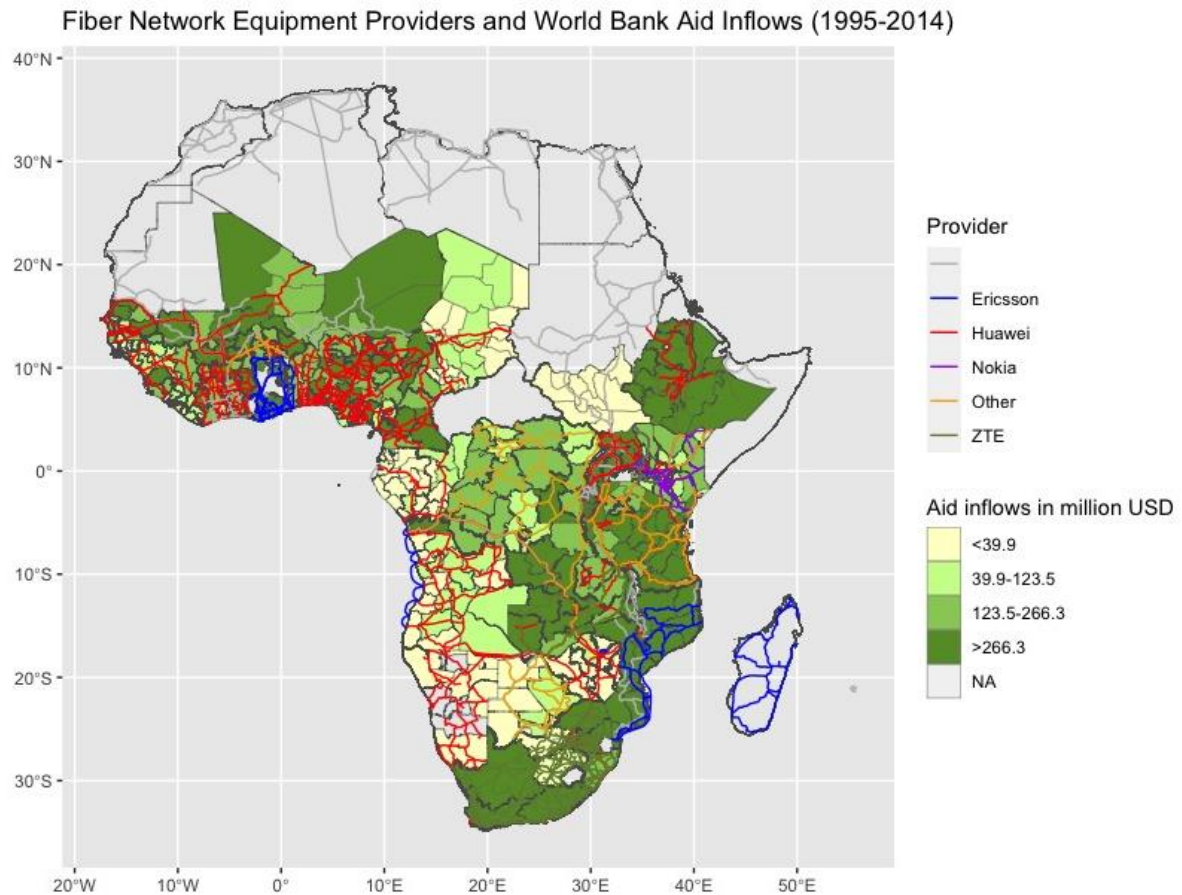


Figure 5: Fiber network equipment providers compared to World Bank aid inflows from 1995-2014

Discussion

The geographical distribution of development assistance reveals that aid flows from China, where recorded, and the World Bank are almost diametrically opposed to one another. In fact, the World Bank disbursed most of its aid in regions with a high population density (i.e., Western Africa, Eastern Africa, and South Africa). By contrast, Chinese aid inflows appear most consistent in China-friendly Ethiopia, Zambia, and Zimbabwe, and along the Western coast of Central and Southern Africa, even though the latter are relatively sparsely populated. The combined constellation of the geographical diffusion of certain providers and development aid offers fertile ground for discussion and further inquiry.

Table 1 roughly summarizes the correlation between provider choice and development aid inflows.

Table 1: Summary of findings

	Above-average World Bank aid	Below-average World Bank aid
Consistent Chinese aid inflows	ZTE	Huawei
Assumed absence of Chinese aid inflows (due to missing data)	Any provider	n/a

Three general statements can be made and are henceforth considered in detail.

1. Consistent Chinese aid inflows nearly always entail a China-based provider.

This is the case along the Western coast of Central Africa (i.e., Gabon, Republic of Congo), wide parts of Southern Africa (i.e., Angola, Namibia, partly South Africa, Zambia, Zimbabwe), in conflict-prone Mali as well as in Ethiopia and Uganda in Eastern Africa. While the states along the Western coast of Central Africa will be considered in depth under the third statement, this proposition focuses on remaining areas where consistent aid inflows from China are met with above-average development assistance by the World Bank. Since the countries in question all share strong commercial and/or security ties with Beijing, it is likely that structural power dynamics affected the choice of the infrastructure provider.

Zambia, Ethiopia, and Mali are illustrative examples thereof. Sino-Zambian relations have been well established since the 1970s when China built the Tanzania-Zambia Railway (TAZARA) linking landlocked Zambia to the port of Dar es Salaam. Currently, although not among the top trading partners, China is Zambia's largest national creditor (Cinotto, 2021). Zambia has also received above-average aid inflows by the World Bank and constant development assistance from China: as predicted by the summary table above, Zambia is one of few countries on the continent featuring ZTE fiber-optic cables.

In Ethiopia, Chinese foreign aid for information and communication technologies predated the commercial relations of the recent years. In fact, when Ethiopia Telecommunications Corporation teamed up with Huawei, ZTE, and China

International Telecommunication Construction Corporation (CITCC) to boost mobile users in Ethiopia in the mid-2000s, Ethiopia was still a peripheral destination for Chinese foreign direct investment (Wang et al., 2020). Since then, Ethiopia has become the top beneficiary of the Digital Silk Road funds in Africa (Chimbelu, 2019). Chinese aid and investment facilitated a “developmental” model based on the use of the Internet, an approach thoroughly guided and controlled by the Ethiopian government (Gagliardone & Golooba-Mutebi, 2016). To date, Ethiopia not only hosts Chinese textile factories, uses Chinese surveillance kit, and took out numerous loans from China, but also hired ZTE to build the domestic broadband infrastructure (Wang et al., 2020). Arguably, the choice of ZTE could well have been favored by the overall influence of Chinese business and technology know-how.

Over the past decade, China also established itself as a security provider even in countries with limited trade relations like the Sahel states. Mali is a case in point: In 2013, China reinforced a UN peacekeeping mission in a country which is not a major trading partner for the first time (Lanteigne, 2019). Since then, it also stepped up in the G5 Sahel security and counterterrorism operations in the region, including in Burkina Faso, Niger, and Chad (Leigh, 2021). As the Sahel generally received above-average World Bank assistance, in line with the logical propositions of this paper, in most countries the provider of choice fell on Huawei.

It is worth noting that in areas of high World Bank aid inflows the choice between Huawei and ZTE correlates with the level of Chinese aid inflows. Where data on Chinese aid inflows are patchy and thus presumably low-level or absent, Huawei prevails. Where consistent Chinese aid inflows coincide with above-average World Bank assistance like in Ethiopia, South Africa, and Zambia, ZTE prevails. However, independently of the amount of World Bank aid inflows, Chinese development assistance and Chinese network equipment providers almost always occur simultaneously.

2. Above-average World Bank aid inflows alone seem to be uncorrelated with provider choice.

Even though East and West African countries benefited from similarly high amounts of World Bank aid inflows, the providers in those countries vary widely. Overall, more countries in Eastern Africa resisted Chinese infrastructure providers compared to their West African peers, albeit evidence of Chinese development assistance is equally scarce throughout both macro-areas. In fact, the diversity of supply firms constitutes one of the main differences between the regional entity ECOWAS in West Africa and the East African Community (EAC). While among the EAC member states Uganda is an outlier having chosen Huawei, Ghana is the only ECOWAS member state not featuring Huawei equipment. As the data on Chinese aid inflows is very scattered and largely incomplete for both regions, it is impossible to conclude whether Chinese

development assistance by itself affected this difference. Yet, a deeper consideration of the countries in question provides a better understanding.

In East Africa, a comparatively digitally mature part of the continent, Kenya, Rwanda, and Tanzania limited Chinese fiber-optic cables to a minimum. While Kenya awarded tenders to all major manufacturers, Rwanda signed an exclusivity agreement with the South Korean KT Corporation to bring 4G coverage across the country (Gagliardone & Golooba-Mutebi, 2016). The most interesting case, however, is Tanzania: despite its longstanding relations with the People's Republic of China and an initial small tender in favor of Huawei, Tanzania turned to Vietnam's military-run Viettel for a large-scale expansion of the broadband backbone infrastructure, reaching all 26 regions and about 81 percent of the country (Mohammed & Goldberg, 2015). This shift was accompanied by a general rupture of Sino-Tanzanian business relations during the Magufuli administration (2015-2021) which, among others, also halted the port project in Bagamoyo ("Tanzania Halt Bagamoyo Port Project", 2019). In the end, only Uganda and Burundi adopted Chinese-built fiber technology by Huawei and ZTE, respectively. The diverse landscape of infrastructure suppliers throughout the East African Community suggests that developing countries can choose between several viable providers from different countries, including developing countries from the Global South (i.e., Viettel). Hence, it appears that in East Africa high development inflows from the World Bank are unrelated to the fiber-optic networks layout.

With regards to West Africa, the majority of regions benefited from World Bank aid inflows above the continental average, except for most areas in The Gambia, Guinea, Guinea-Bissau, Sierra Leone, and Liberia. Yet, the only country which deviated from Huawei as the main infrastructure provider is Ghana. At closer look, Ghana stands out in many respects. Ghana is an anglophone country surrounded by mostly francophone neighbors. It is the only "free" country in the region with a Global Freedom Score of 80 points compared to a lamentable average of 49.7 points in the other West African states (Freedom House, 2022). Ghana is also one of the strongest economies in the region: in 2021, it had one of the highest annual GDPs, second only to Nigeria, and its nationals enjoyed one of the highest GDP per capita, slightly behind Cape Verdeans and Ivorians. Although an in-depth consideration of these aspects goes beyond the scope of the exploratory nature of this paper, each of them leaves a hint on what could determine African countries' choice for or against Huawei in a context of high World Bank development assistance.

What can be concluded from this panorama is that above-average World Bank aid inflows yield widely different outcomes for infrastructure providers suggesting that they incentivize competitive tenders attainable by any contender.

- 3. In areas of low World Bank aid inflows, Chinese development assistance is almost always consistent, and the provider of choice is usually Huawei.*

As mentioned earlier, numerous states along the Western coast of Central and Southern Africa but also Zimbabwe received below-average World Bank aid inflows but almost all their sub-national regions benefited from additional assistance from China. All of them chose Huawei for their fiber-optic networks. Two kinds of commercial mechanisms are plausible: first, lower World Bank aid inflows imply that the national governments possess fewer financial means and are therefore more prone to development projects with an inherent finance component like those in a “EPC+F” format. Secondly, since all these countries are sparsely populated, investment in broadband networks beyond the urban centers are probably economically unviable and therefore not attractive to private sector investors. By contrast, China frequently implements large-scale infrastructure projects regardless of their viability by cross-financing them with other projects or by tying African governments to allegedly exploitative conditions.

In fact, in all these countries China enjoys enormous commercial importance, either as principal export destination, main foreign investor or national creditor. For instance, in 2020 China was the number one buyer of petroleum in oil-dependent Angola, Republic of Congo, and Gabon (Simoes & Hidalgo, 2011). Namibia had a more balanced trade sheet with 29 percent of its export trade value in copper and 28 percent in precious metals and gems, mostly gold and diamonds. While China bought 70 percent of Namibian copper, more than half of its gold and diamonds went to South Africa or Botswana. Although not a top trading partner, for years China has been Zimbabwe’s largest foreign direct investor (Sun, 2016). Further empirical analyses and case studies are therefore likely to reveal that Chinese structural power especially in the economic and financial sphere favored the choice of Huawei.

Conclusion

Against the backdrop of “ICT for development” and its deep-seated challenge of connecting the unconnected, the geospatial exploration of fiber-optic networks and development assistance revealed that to date foreign network equipment providers managed to connect nearly every country in Sub-Saharan Africa. Given that most network cables were laid out by Chinese companies, this paper compared how the “Western” human-centered approach to ICT4D and the China-centered “Digital Silk Road” stimulated ICT infrastructure development. While the “West” focuses on the formulation of policies and regulations and integrates ICT as a component in its development programs, China employs ICTs as a means to enhance its own standing in the international political economy. Accordingly, the political leaders seek out strategic partnerships with the domestic technology companies and support large-scale infrastructure investments with a plethora of financial tools like including development assistance, loans, or export credits.

In this sense, this paper illuminated to what extent development assistance was instrumentalized to benefit the donor's flagship companies in the digital sphere. Three main trends could be identified. Chinese development aid flows nearly always coincide with a Chinese provider—ZTE when Chinese assistance coincides with above-average World Bank aid, Huawei where World Bank aid is comparatively low. It is also worth noting that Chinese aid flows usually complement other ties, whether commercial or security related. By contrast, high World Bank aid inflows appear uncorrelated with the infrastructure provider choice as shown by beneficiaries in East and West Africa: in the absence of Chinese development aid, the provider choice varies widely from well-established (i.e., Ericsson, Huawei) to less-known (i.e., Viettel) firms. By providing an overview of the foreign players in the continent's digital infrastructure landscape, this paper showed that structural power factors, including technological and commercial clout on the international stage, likely affects the provider choice in the context of Chinese influence while World Bank assistance does not favor a particular company. More broadly, the paper suggests that the vast presence of Chinese infrastructure providers cannot be explained by the mere price factor but involves different kinds of considerations on behalf of African governments. Beyond the immediate international political economy considerations, the Chinese strategy appears to “deliver” universal internet access more effectively.

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