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Article

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The driving factors of Chinese aid allocation to African countries

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Abstract: We investigate the driving factors of Chinese aid allocation to 44 African countries for the periods 2003–2017. The Poisson pseudo-maximum likelihood (PPML) procedure is applied to estimate the gravity model of aid and loan allocation as it can solve zero-valued observations and heterogeneity problems prevalent in the panel data set. An aggregate indicator is derived for the quality of governance using principal component analysis. We controlled for aggregate Chinese aid and loans separately because a significant share of aid allocation China commits to African countries is repayable long-term loans. Controlling for source and destination countries' motives of aid and loan allocation, our findings provide evidence that Chinese aid and loan flow to African countries is significantly determined by African countries' and China's strategic, economic and commercial factors. The results further examine the importance of China-Africa trade and Chinese FDI, China's international support and foreign policy considerations in China's aid and loan allocation policy to African countries. Additionally, it gives a detailed analysis of the aid-institution paradox.

Subjects: International Relations; Economics; Finance

Keywords: aid allocation; Poisson pseudo-maximum likelihood (PPML); gravity model; African countries; China



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PUBLIC INTEREST STATEMENT

There are several factors affecting financial aid allocation to developing countries. The driving factors for financial aid are different from donor to donor and are varying over time. It can be generally determined by donors' and receivers' countries interests, including humanitarian, strategic, geo-political, diplomatic, economic and commercial, institutional, and governance motives. China is one of the world's important donors of financial aid to African countries. China's financial aid to African countries is diverse and can be found in almost all sectors. However, increasing Chinese financial aid to African countries has led to a controversial international debate about the motives of the aid. Hence, this study examined the driving factors of Chinese financial aid allocation to African countries.

1. Introduction

China has continuously shown its commitments and nowadays, China is one of the world's most important providers of development financial assistance to African countries. China's rising financial aid has led to a controversial international debate about China's supposedly adverse effects in the developing world. The 2006 Forum on China–Africa Cooperation (FOCAC) summit drew particular international attention when China promised to double its development financial aid to African countries by 2009 in the framework of the Beijing Action Plan, and also to establish China–Africa Development Fund allocating a budget of a 5 billion US dollar. China has been providing financial aid for almost all African countries. China has become the largest provider of financial aid to Sub-Saharan African countries (Woods, 2008). According to a research project by the Center for Global Development and AidData, China allocated 350 billion US dollars to foreign aid between 2000 and 2014, running close to the US total of 394.6 billion US dollars. Almost half (45.7%) of the total Chinese financial aid has been going to African countries.

Besides, China's aid allocation in Africa is varied and can be found in almost all sectors. However, the substantial amount of China's aid to Africa allocated towards infrastructure sectors such as transport, energy and communications sectors. Also, China's aid in infrastructure development is the highest compared to other countries' aid to Africa. It constitutes for over 30% of the total value of infrastructure projects in Africa. Besides, it is reasonable to expect that loans for the infrastructure sector will receive favorable consideration in China's foreign aid in the future as it will be given due attention by the “One Belt One Road” initiative (Sun, 2015). It can be confirmed by the announcement of Export-Import Bank of China in 2013 that by 2025, China will have provided Africa with 1 trillion US dollars in the financing, including direct investment, soft loans and commercial loans (Sun, 2014).

However, according to some of the existing empirical studies, this diversified Chinese financial aid to African countries is considered to be driven by natural resources. It is linked to securing Chinese investment opportunities for Chinese companies or political support from African governments for China's global diplomacy positions and extraction of natural resources because it is biased to oil-rich African countries than those that are not oil-rich (Lum et al., 2009). In contrast, Dreher and Fuchs (2011) argue that there is no evidence that natural resource endowments dominate China's financial aid allocation. Additionally, Chinese financial aid is accused of targeting future access to export markets and profitable investments (Lum et al., 2009). Hence, it can have a negative effect if its aimed to be China's selfish quest for natural resources and damage Africa's fragile efforts to improve governance and build a sustainable future, or it can have a positive influence on African economy through expanding infrastructure investment and reinforcing domestic saving (Sun, 2014). Thus, there is no consensus and have a vast debate on the driving factors of Chinese aid allocation to African countries. Therefore, empirical examination of the drivers of Chinese aid flow to African countries is worthwhile.

Hence, the major aim of this study is to empirically examine the drivers of Chinese financial aid flow to African countries giving due emphasis on natural resources, China–Africa trade, Chinese FDI, and diplomatic and strategic relationship between China and African countries. Additionally, we match other driving factors of Chinese aid flow to African countries.

This study is significant for the following reasons. First, it examines the drivers of aid flow from China to 44 African countries emphasizing China–Africa economic relationship instruments, which is an under-researched topic. Second, we apply the Poisson pseudo-maximum likelihood (PPML) estimator that controls zero-valued observations in the sample and robust procedure to estimate in the presence of heteroscedasticity that probably exist in panel countries consideration. Finally, given the significance of the flow of Chinese aid to African countries, this study gives a policy framework and bases for further intensifying Africa–China economic linkage and gives clear evidence on the driving factors of Chinese aid flow to African countries. Furthermore, this study will provide the base for the “One Belt One Road initiative” that planned to help Africa solve its

infrastructure deficit and enhance industrialization through development aid, investment and trade connectivity of Africa with China and other countries in the route. The study will also provide a good basis for further research on the motives of Chinese aid flow to African countries. To preview our main results, we find that the China-Africa trade, Chinese FDI, diplomatic and strategic relationship, natural resources, and economic status of China are essential determinants of Chinese aid allocation for Africa.

The rest part of this paper is organized as follows. Part two presents the stylized facts of Chinese aid allocation to African countries. Part three discusses the literature review. Part four explains the data and methodology of the study. Part five presents the results and findings of the study, and part six gives conclusions based on the findings.

2. Stylized facts on Chinese aid allocation to African countries

Chinese aid covered about 20% of the total financial aid of the committee of Organization for Economic Cooperation and Development’s Development Assistance for the periods between 2001 and 2011. Unlike Western countries’ foreign aid to developing countries, which comes mainly in direct form of material transfers and money, Chinese financial aid contains flexible, quick, and primarily unconditional export credits and loans to investment in infrastructure sector (Wang et al., 2014).

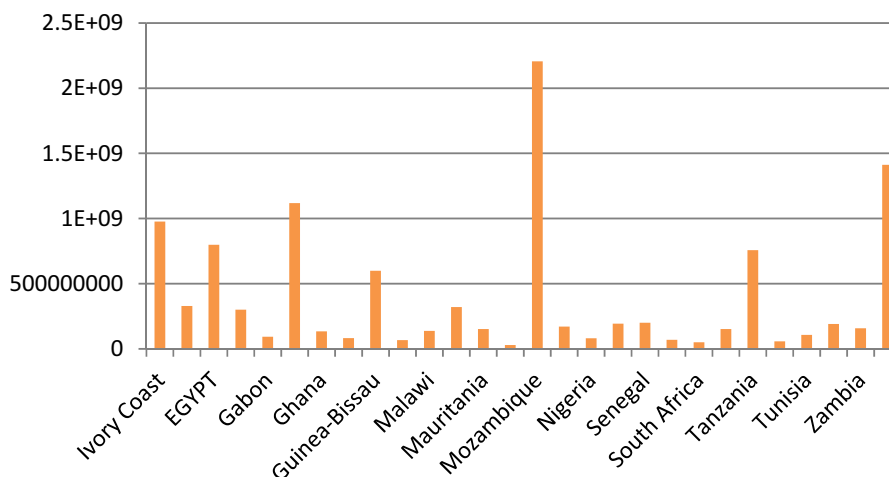
Africa is one of China’s most emphasized regions to receive Chinese financial aid. Since the launching of the Forum on China-Africa Cooperation (FOCAC) in 2000, Chinese financial aid to African countries has increased significantly. For example, in 2009, China provided 47% of its total foreign aid to African countries. It was almost half of total Chinese foreign aid shows that Africa is the major destination for Chinese aid allocation. The first five African countries receiving Chinese aid from 2000–2013 were Mozambique, Zimbabwe, Gambia, Ivory Coast, and Egypt (see Figure 1).

Chinese government, banks, and contractors extended total of 86.9 billion US dollars to state-owned enterprises and African governments between 2000 and 2014 in loans form. It was distributed to different sectors. About 24.2 billion US dollars was allocated to transportation sector, 17.6 billion US dollars for energy, and 9.0 billion US dollars for mining sector (Jyhjong et al., 2016). More than 54% of total Chinese loans to African countries in this period were made to five countries: Angola, Sudan, Kenya, Ethiopia, and the Democratic Republic of Congo.

The loans for African countries are significantly determined by availability of oil and petroleum. For example, loans to Angola is profoundly attached to the country’s oil resource, with about 50%

Figure 1. Chinese financial aid to Africa.

Source: The vertical axis shows financial aid from China to African countries and the horizontal axis shows the sample African countries. Source: Computed by the author from China-Africa Research Initiative Aid Data.



of loans to the country being made to the state-owned oil company and the other half being oil-backed infrastructure loans (Miao et al., 2020). However, Chinese loan to Ethiopia is distributed across communication, energy and transportation among other sectors (Jyhjong et al., 2016). In general, about 56% of China’s loans to African countries from 2003 to 2011 were financed by commodities (Brautigam, 2014).

The white paper on China’s foreign aid, published by the State Council of China in 2011, Chinese foreign aid can be divided into three categories: interest free loans, concessional loans, and grants (China Africa Research Initiative, 2018). Grants are mainly used to help grants recipient countries to build schools, hospitals, and low-cost homes and support water-supply projects, as well as other small and medium social welfare activities. Besides, grants are used in projects in the areas of humanitarian support, development cooperation, technical cooperation, human resources, and in-kind assistance to receiving countries (China’s Information Office of the State Council, 2011).

Interest-free loans are predominantly allocated to assist loan recipient countries contract public infrastructure and launch initiatives to enhance their livelihood. Typically, the tenure of such loans is 20 years, including ten years of repayment, five years of use, and five years of grace time (Miao et al., 2020). Interest-free loans are currently being granted mainly to developing nations with comparatively excellent financial circumstances (China’s Information Office of the State Council, 2011; Miao et al., 2020).

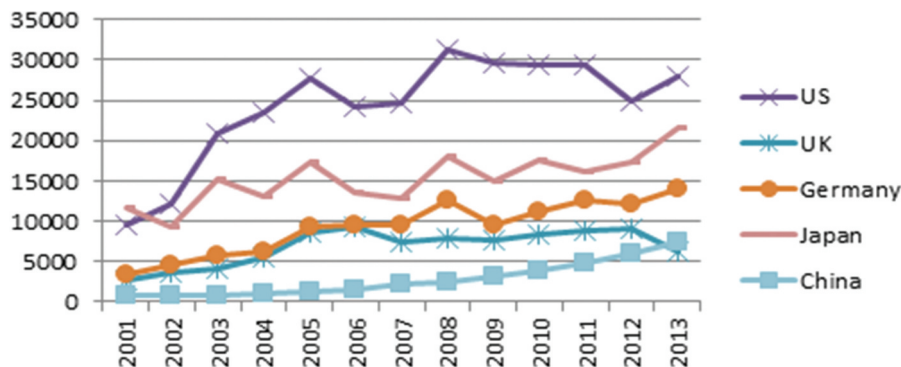
Concessional loans are used primarily to help loan recipient nations to undertake productive projects that generate social and economic opportunities as well as medium and large-sized infrastructure projects or to provide mechanical and electrical products, complete plant, technical services and other equipment. Concessional loans are raised on the market by China’s Export-Import Bank, and as the loan interest is smaller than the People’s Bank of China’s benchmark interest, the distinction is made up by the state as financial subsidies. Currently, China’s concessional loans have an annual interest rate of between 2% and 3%, and the repayment period is generally 15 to 20 years (including 5 to 20 years) (China’s Information Office of the State Council, 2011; Miao et al., 2020).

Chinese aid comprises mainly of quick, flexible, and mainly unconditional export credits and infrastructure loans (often with little or no interest) (Wang et al., 2014). However, it is allocated in several sectors, emergency, and economic developments. It mainly distributed to different sectors such as communication, infrastructure, health, education, energy, agriculture, trade and tourism, banking, and financial services (Guillon & Mathonnat, 2019).

According to the Borgen Project, the official development assistance from the US to African countries was over 97.67 billion US dollars in the last 18 years. The US was the top provider of development aid to African countries (see Figure 2). More proportion of the aid was allocated to infrastructure projects. Forty-eight percent of total financial aid to sub-Saharan African countries

Figure 2. Comparison of Africa’s major financial aid providers.

The vertical axis measures financial aid from major aid donor countries to Africa and the horizontal axis is period in years. Source: Brooking (Zhang, 2016)



from the US was allocated to infrastructure projects being the top priorities, and 26% of the aid was allocated to humanitarian issues.

Compared to the US, Chinese financial aid, like the US, China committed aid prioritizing infrastructure investment; however, with different focuses. From 2000 to 2013, about 60% of the Chinese total financial aid went to transportation with a project value of 29 billion US dollars. Twenty-five billion US dollars and 6.9 billion US dollars were allocated to energy and communication infrastructure, respectively. It might be consistent with the aim of aid for trade, which is about helping developing countries address their constraints to trade improving their poor infrastructure (roads, ports and information and communications technology) because the more proportion of Chinese financial aid is allocated to solve the infrastructural problem of African countries. Likewise, a study by Amusa et al. (2016) indicates that Chinese aid focuses on infrastructure, innovation, exports and health; and reveals that more than 70% of Chinese aid is geared towards infrastructure construction constituting over 30% of the total value of infrastructure projects in Africa.

Since its quickly increasing operations, China has had a huge effect on Africa's financial assistance landscape. Unlike the Economic Cooperation and Development Organization nations, China does not formally reveal its assistance data (Dreher et al., 2015). However, after China's economic engagement in Africa in early 2000, US foreign financial aid allocation also shifted to prioritize social sectors such as health and education sectors in which minimal Chinese aid allocated. The US spends more on the top three sectors, for which Chinese financial aid is only about 2.6%, 0.8%, and 0.07% of the total official development assistance value.

European Union financial aid to African countries mainly focuses on the social sector, such as education, health, population program, water, and sanitation. Next to the social sector, more proportion of European Union financial aid to African countries goes to the economic sector. The rest goes to humanitarian, production, military, and others. Among European Union countries, the UK, France, and Germany were the top financial aid provider for African countries (Zhang, 2016).

When we compare West countries' financial aid and the Chinese one, Chinese aid is unconditional regarding Human rights, macro management, environment, political openness. It focuses on Infrastructure investment such as Railways, roads, hospitals, schools, water systems, power generation. It is tied to Chinese companies' work, often with Chinese labor and fund transfers from the Chinese government to Chinese companies. In general, Chinese foreign aid bases on constantly assisting aid recipient nations build up their self-development capability without any political pre-conditions (Huang, 2007). It also bases on being realistic while striving for the best and mutual benefit for both China and aid receiving countries. On the other hand, western countries aid requires conditionality and assumes aid is more effective in countries where there are good governance and institutional quality where corruption is not a significant problem and should be allocated accordingly. It also provides direct financial support, and financial aid is untied (Wang et al., 2014).

3. Literature review

3.1. Motives of financial aid

There are a number of motives behind financial aid from developed countries to developing aid-receiving countries. These motives can be categorized into economic, political, and strategic interests and humanitarian motives. Even emergency aid from developed countries to developing nations has been subject to some motives. For example, Fink and Redaelli (2011) examine the determinants of global emergency aid using a data set covering 270 natural disasters. Their findings indicate that strategic and political factors also play a vital role in the distribution of emergency aid. However, humanitarian needs appear to be a significant determinant of emergency relief payments, donor governments favor smaller, closer geographically and oil-exporting

countries, and show essential biases in favor of politically less aligned nations as well as toward their former colonial ties.

However, the motives for giving aid are different from donor to donor and are changing over time. Donors themselves often emphasize that they provide aid for humanitarian reasons, for helping recipients develop themselves. On the other hand, Some critics state that donors generally only have their interest in mind when giving aid (Riddell, 2008). In reality, when giving aid, donors often seek win-win situations, where the criteria used for providing aid reflect both the recipient country's needs and the donor's interests and are beneficial for both. The reasons for giving aid are different from donor to donor, but in general, several clusters of motives can be identified. Riddell proposes seven motives of foreign financial aid flow, such as emergency needs; to support aid recipients with attaining their development objectives; to indicate solidarity; to further pursue their own strategic and political interests. Additionally, they are motivated to assist in promoting donor-country commercial interests; because of historical and cultural ties; to provide and strengthen global public goods (Riddell, 2008). Therefore, the motives of aid allocation can be categorized into four general areas: humanitarian, economic, geopolitical, and governance motives.

3.1.1. *Humanitarian and emergency motives of financial aid*

The major donors often assert that aid is motivated by a humanitarian concern to promote development and poverty reduction (Isopi & Mavrotas, 2009). Promoting development includes technical cooperation, grant aid, and loan aid to improve skill development by assisting the educational sector, vocational, and technical training projects in aid receiving countries (Yoshida & Yamada, 2012). Furthermore, it further can be explained by external corporate social responsibility programs that are aimed to alleviate poverty through skill development and training (Dobers, 2009; Hao et al., 2018). Although the extent to which humanitarian motives are essential for donors' aid allocation is often exaggerated, over the years, the protection of human rights has become an increasingly important motive for developmental aid. Empirical studies support this shift: greater respect for human rights by recipient results in them receiving more aid. Respect for human rights is usually measured by indexes on political and civil rights (Younas, 2008).

The formulation of the Millennium Development Goals (MDGs) has played a significant role in this regard. By committing themselves to the MDGs, the donors have openly dedicated themselves to tackle extreme poverty in several ways. There are eight MDGs, and they are set to be achieved by 2015. The eight objectives are: attaining universal primary education; eradicating extreme hunger and poverty; decreasing child mortality; encouraging gender equality and empowering females; enhancing maternal health; fighting HIV/AIDS epidemics, malaria, and other illnesses; ensuring sustainability and governance of the environment and creating a Global Development Partnership. It is believed that these goals have led to a more strategic approach to recipient country selection (OECD, 2006). Committing to them has provided donors—multilateral, bilateral, and NGOs—with a framework that has made it easier to distribute aid for humanitarian purposes since progress can be measured, and there are clear targets. However, cultural and religious views will constraint the role of financial aid in solving humanitarian issues. Nonetheless, considerations of the social, environmental, and economic issues are applicable to all cultural and international settings (Hao et al., 2018).

Humanitarian motives are relatively speaking more critically concerning multilateral aid than with respect to bilateral aid. This is especially true for aid distributed through the United Nations but holds for other multilateral institutions. Donor countries often look after their national interests, which is not the case with a more neutral multilateral institution such as one of the UN bodies (Riddell, 2008). It is important to note that multilateral aid cannot be seen as separate from bilateral aid since a large part of the aid budget of different governments is going to multilateral institutions to be distributed from there (Riddell, 2008). Therefore, donor countries are ensuring that part of the aid they provide is distributed in a more neutral way. Multilateral institutions have

their interest in mind, but compared to bilateral institutions, the nationalistic tendency is nearly absent.

3.1.2. Economic motives of financial aid

It primarily encompasses support to production sectors, including support to the private sector, financial sector, agriculture, industry, infrastructure, and trade-related activities. Economic interests have been found to shape developed countries' aid allocations to developing countries (Jones & Tarp, 2016). Furthermore, it also indicates the economic interests of the donor state. For example, it can be used to open foreign markets to multinational corporations aid-providing countries to help the domestic firm of aid providing country employment for the donor's domestic workers (Dreher et al., 2011). This motive also includes the commercial interest in purchasing goods and services from the donor country.

Furthermore, resource seeking can also be one of the economic motives of aid allocation. The commercial interest is mostly common for non-DAC aid providers because they tie with the obligation of buying to purchase goods and services from the donor country or providing employment opportunities to the donor country. For example, China's foreign aid is directed towards infrastructure development requiring 50% of the construction contracts to be awarded to Chinese contractors and 50% of the materials to be procured by a Chinese business (Kjøllestad & Welle-Strand, 2010).

3.1.3. Geopolitical and foreign policy motives of financial aid

Geopolitical motives for foreign aid allocation have evolved and, in turn, affected the levels and direction of aid flows. In this regard, foreign aid is used to further foreign policy goals of donor countries, increase regional power, and advance donor countries' national interests in the region of aid-receiving countries. The geopolitical interests of donors include a wide range of instruments like military aid and allies at war, supporting in military expenditures, colonial history, and voting in favor of donors in United Nations General Assembly (Clist, 2011; Dreher et al., 2011; Fleck & Kilby, 2010).

3.1.4. Institutional quality motives of financial aid

From around 1990 onwards, good governance has increasingly become an important objective for development cooperation. Donors began to expect recipient countries to respect human rights and to set up institutions for democratic accountability and willing to provide aid for supporting these goals (Hoebink, 2006). It mostly emphasis on like protection of civil rights, institutionalized checks and balances, press freedom, the possibility of replacing governments by-elections, and also political stability (Dijkstra, 2018).

3.2. Driving factors of Chinese financial aid to Africa and hypothesis development

The driving factors for giving aid to developing countries are different from donor to donor and are evolving. The financial aid flow from developed countries to developing countries can be motivated by many factors. Donors themselves often emphasize that they provide aid for helping aid recipients develop themselves. On the other hand, donors only have their interests in mind when giving aid (Riddell, 2008). The motives of financial aid flow from developed countries to developing countries can be broadly categorized into economic, political and strategic interests, institutional, and humanitarian.

The economic interests of donor countries have been found to shape developed countries' aid allocations to developing countries (Jones & Tarp, 2016). For example, it can be used to open foreign markets to multinational corporations' aid-providing countries, help the domestic firm of aid allocating countries, or provide employment for the donor's domestic workers (Dreher et al., 2011). This motive also includes the commercial interest in purchasing goods and services from the donor country, resources seeking or extraction and trade. This recent study (Dreher et al., 2011) supports the results of one of the most comprehensive previous studies of aid allocation

studied by Berthélemy (2006), which supports the donor interest model in the sense that all bilateral donors target their assistance to their most significant trading partners. It also confirms that there is a negative relation between aid allocation and GNP per capita.

In this regard, some scholars argue that one of the motives of Chinese financial aid in African countries is China's economic interest to secure natural resources. Hence China's desire for resource security may be a significant driver of Chinese aid, and other financial flows to African countries (Lengauer, 2011; Lum et al., 2009) these literature reveal that China's foreign aid to Africa and other developing countries is driven primarily by the need for natural resources. Hence, China would allocate official development assistance to African countries mainly to guarantee its access to the natural resources and minerals of these countries. Chinese financial aid allocation is linked to securing Chinese investment opportunities for Chinese companies or political support from African governments for China's global diplomacy positions and extraction of natural resources as it is biased to oil-rich African countries than those that are not oil-rich (Lum et al., 2009). In contrast, Dreher and Fuchs (2011) argue that there is no evidence that natural resource endowments dominate China's financial aid allocation. Besides, Chinese financial aid is accused of targeting future access to export markets and profitable investments (Lum et al., 2009). On the other hand, the study by Dreher and Fuchs (2015) indicate that Chinese economic interests in African countries proxied by African countries trade with China or oil production export do not significantly impact Chinese official development distribution. Furthermore, Dreher & Fuchs (2011) studied the factors associated with Chinese health official development projects and amounts to African countries between 2006 and 2013. They find that Chinese health financial aid is determined by the economic needs and factors such as the Gross Domestic Product (GDP) per capita of recipient countries, indicating humanitarian motives of Chinese financial aid to African countries. Based on the literature mentioned above, the following hypotheses have been developed.

H1a: *Chinese financial aid to African countries is positively affected by the natural resources of African countries.*

H1b: *Chinese financial aid negatively affected by the per capita income of African countries.*

H1c: *Chinese financial aid to African countries is positively affected by the China-Africa trade.*

Moreover, Chinese aid to African countries would also be used to have China's international support and recognition (Naim, 2007). Furthermore, Dreher et al. (2015) find that the allocation of Chinese aid is driven primarily by foreign policy considerations. They show that the United Nations General Assembly voting alignment and similarity of recipient countries with China are positively associated with all types of Chinese aid received except for food aid. Likewise, Guillon and Mathonnat (2017) studied the factors associated with Chinese health official development projects and amounts to African countries between 2006 and 2013. This study provides evidence that China uses its health financial aid as part of its foreign policy and diplomacy since non-adherence to the one-China policy makes the receipt of Chinese health financial aid very unlikely. Similarly, allocating financial aid can be determined by the aid providing countries' economic performance.

H2a: *Chinese financial aid is motivated by strategic and diplomatic relations with African countries.*

H2b: *Chinese financial aid to African countries is positively affected by China's economic performance.*

H2c: *Chinese financial aid to African countries is positively affected by Chinese FDI to African countries.*

Different studies provide evidence that aid allocation to developing countries from developed countries aims to strengthen the institutional quality of aid receiving countries. For example, on the aims of aid allocation conducted by Berthélemy (2006) argue that donors give more aid to recipients countries with better governance and institutional quality indicators like democracy, which supports recipient need model. This study concludes that there is a positive relationship between aid allocation and democracy. Thus, good governance and better institutional quality are one of the important motivations to provide financial aid to developing countries mainly to promote human rights and to set up institutions for democratic accountability (Hoebink, 2006). Besides, a more recent study by Dijkstra (2018) claims that allocating financial aid to developing countries mostly emphasis on the wide range of institutional set up of aid receiving countries including protection of civil rights, institutionalized checks and balances, press freedom, the possibility of replacing governments by-elections, and also political stability.

Unlike these empirical studies, Chinese financial aid to developing countries is not associated with the institutional quality of aid receiving countries as China claims to follow a policy of non-interference in the domestic politics of sovereign governments, which implies that aid allocation decisions are made without considering the political institutions of recipient countries (Dreher et al., 2015).

H3a: *Chinese aid is allocated independently of political-institutional quality in African countries.*

H3b: *Chinese financial aid is not motivated by improvement in economic institutional quality of African countries.*

4. Methodology and data

This section contains a detailed discussion on methodologies and instruments used to examine the motives of Chinese aid flow to African countries.

4.1. Gravity model specification of PPML

This part is concerned with the description of the estimation method used in the section. We employ a Poisson Pseudo-Maximum Likelihood (PPML) estimator developed by Santos Silva and Tenreiro (2006) to estimate aid flow under gravity model framework based on the following advantages of the model.

The gravity model is most regularly applied by international and regional economists to study a flow variable-trade. Analysis of the effects of international flow factors, such as the impacts of multilateral, regional and bilateral relationships has given acceptance to the effectiveness of gravity specification examining the effects of these relationships. The gravity estimation has arisen as a crucial and popular estimation in explaining and predicting flow variables such as trade FDI, migration, remittance, and aid flow among countries. It is among the most robust empirical regularities in economics (Chaney, 2018). The model has been used to examine trade, FDI, migration, financial flow, currency union, and regional trade agreements. It has become the workhorse in international trade (Head & Mayer, 2013), in which the proven popularity are primarily due to its exceptional success in predicting bilateral trade flows.

The theoretical basis for the gravity model was formally introduced by Anderson (1979) and later extended by Anderson and Van Wincoop (2003). Specifically, the gravity equation has been derived under the classical or standard trade theory and new trade theories (Kareem & Kareem, 2014). Generally, a gravity model supposes that the volume of trade between any two nations will be directly related to the product of their economic masses usual measured by real gross domestic product (real GDP) or gross national product (GNP) and inversely proportional to the distance between them (Rauch, 1999). This specification is also used for other flow variables such as FDI, aid, remittance, and migration flow. Tinbergen's (1962) founding work launched a vast theoretical and empirical

literature on trade gravity equation. All theories based on various trade foundations such as increasing returns to scale, resource endowment, technological distinctions, and Armington demand requirements predict a gravity association for trade owes similar to Newton's universal gravity law. This idea of gravity specification is based on Isaac Newton's proposition of the law of universal gravitation. The law states that the gravitation force between two objects "i" and "j" is directly proportional to the product of the masses of the objects and inversely related to the distance between these two objects. In its simplest form, according to Tinbergen (1962), flow-dependent variables (trade flow, aid flow, and other flow variables) the gravity equation states that the trade, aid, migration and other flow variables from nation i to nation j, denoted by X_{ij} , is proportional to different explanatory variables d_i domestic variables of receiving countries, f_j foreign countries variables and C_{ij} some common to domestic and foreign countries explanatory variables and η_{ij} stochastic term.

$$X_{ij} = \beta_0 d_i^{\beta_n} f_j^{\beta_m} C_{ij}^{\beta_z} \eta_{ij} \quad (1)$$

The natural logarithm transformation of the above equation gives us:

$$\ln X_{ij} = \beta_0 + \beta_n \ln d_i + \beta_m \ln f_j + \beta_z \ln C_{ij} + \ln \eta_{ij} \quad (2)$$

According to Santos Silva and Tenreyro (2006), the gravitational assessment method's validity is mainly dependent on the premise that η_{ij} and, therefore, $\ln \eta_{ij}$, are statistically independent of the regressors. To observe why this happens, note that the expected value of the logarithm form of a random variable is contingent on its mean and distributions of higher-order moments. Therefore, if the variance of the error factor $\ln \eta_{ij}$ in the formula (2) rests on f_j , d_i and C_{ij} , the expected value of $\ln \eta_{ij}$ will also depend on the regressors, in violation of the OLS consistency condition. Hence, the best alternative method for estimating the gravity model is Poisson Pseudo-Maximum Likelihood (PPML) estimator developed by Santos Silva and Tenreyro (2006), which is currently used to estimate trade flow and other gravity estimations.

4.1.1. The role of PPML in accommodating zero-value observations

There is more than 30% of zero-valued observations in our sample. Hence, using a log-linear method to estimate the gravity specification results in loss of information because transforming data to logarithm form drops zero-valued observations (Borojo & Yushi, 2020). Dropping zero-valued observations potentially leads to sample selection bias, which has become an important issue in recent empirical work. This empirical strategy, followed by the vast mainstream of empirical research, is simply to drop the pairs from the data set with zero-valued observations and estimate the Ordinary Least Square (OLS) in log-linear form. In turn, excluding zero-valued observations reduces the efficiency of data and leads to biased estimates (Gómez-Herrera, 2013).

The fundamental problem is that in the presence of heteroskedasticity, the log-linearization (any non-linear transformation) of the empirical model extends to incorrect estimates. It is because the expected value of a random variables' logarithm form relies on its distributions of higher-order moments. Thus, the transformed errors will usually be associated with the explanatory variables if the errors are heteroskedastic. An extra log-linearization issue is that it is inconsistent with the presence of zeros in trade data, resulting in many unsatisfactory options, including sample truncation (i.e., elimination of zero-trade pairs) and further non-linear conversions of the dependent variable (Santos Silva & Tenreyro, 2006).

Some researchers run the model that adds one to the dependent variable or use a Tobit estimator to fix this issue. Nonetheless, this method will result in inconsistent estimators of the parameters. The seriousness of these inaccuracies will rely on the specific features of the sample and model applied, however, there is no reason to think they will be negligible in the specifications. The best alternative procedure for applying the gravity method to control zero-valued observations in the data is the PPML procedure. Hence the capability of Poisson estimation to include zero-valued observations in the data without any additions to the basic method is significantly

essential. The PPML method is generally well behaved and robust even when the proportion of zeros in the data is significantly high (Santos Silva & Tenreyro, 2011).

4.1.2. *The role of PPML solving heteroscedasticity issues*

In gravity estimations, the concerns of heteroscedasticity are significantly essential. If the error term in the model is heteroskedastic, which is highly probable in practice, then the error term's expected value depends on one or more of the explanatory variables because it includes the variance term. This violates Ordinary Least Square (OLS)'s first hypothesis and indicates that the OLS estimator may be biased and inaccurate. The existence of heteroscedasticity in the original non-linear gravity model specification is subject to the premise of a multiplicative error term needs the adaptation of a totally different estimation strategy. Santos Silva and Tenreyro (2006) provide a simple way of solving the heteroscedasticity problem. They show that if the gravity model contains the correct set of explanatory variables, the PPML method gives a consistent estimates of the original non-linear model. It is precisely the same as to running a type of non-linear least squares on the original equation. Additionally, the simulations of Monte Carlo and the results of regression show that this practice can lead to considerable biases in the presence of heteroskedasticity. These findings indicate that the Poisson pseudo-maximum-like estimator should be used as a substitute for the conventional log-linear model when there is proof of heteroskedasticity (Santos Silva & Tenreyro, 2006).

Thus, we employ the PPML estimator, a robust estimator to accommodate zero-valued observation and heteroscedasticity problems that likely occur in our estimation because of considering many countries in the sample framework. Without the practice of log-linearization, the PPML method permits zero outcomes, and it is a robust method to take into account heteroscedasticity because the second or higher moment conditions are absent from the estimation procedure in it. Therefore, this method of analysis is employed to determine the impacts of control variables on Chinese financial aid flow to African countries. Control variables are included based on empirical literature that identified the most critical determining variables of aid flow using Bayesian statistical techniques (Blonigen & Piger, 2011).

Hence using this method, we define our gravity model in PPML using the following econometric equation. The gravity model considering Chinese financial aid as a dependent variable is a function of different explanatory variables is defined in the following two equations:

$$aid_{ict} = \beta_0 + \beta_n X_{ict} + \beta_m Z_{ict} + \delta + \eta_{ict} \quad (3)$$

Where, aid_{cit} denotes financial aid and loan from China to Africa, X_{ict} represents traditional variables such as real GDP per capita, China's voting alignment with African countries in the UN General Assembly, debt GDP ratio of African countries, the population size of African countries, natural resources depletion rate of African countries, the distance between capital cities African countries and China, institutional quality indicators of African countries, polity represents the level of democracy in African countries. Z_{ict} represents the diplomatic relationship between China and African countries that is a dummy variable 1 if African country support one-China policy and 0 otherwise, trade openness between China and African countries, real GDP per capita of China and Chinese FDI flow to African countries. δ is time dummy and η_{ict} is the stochastic term. The variables in the formula (3) are transformed to log-linear specification using a natural logarithm for numerical valued variables.

Chinese aid allocation and Chinese loan to African countries are dependent variables. Both Chinese and aid and loan allocation to African countries are in the current US dollar. They are introduced in levels instead of logarithms.

The natural resources depletion rate represents natural resources extraction interest. It includes the depletion rate of all-natural resources, including petroleum, fuel, wood, and others in African

countries. It is included in the determinants of Chinese aid allocation to African countries following the previous literature, such as works of Lum et al. (2009), Lengauer (2011), and Dreher and Fuchs (2011), which relate natural resources with aid allocation.

Recognition of one-China policy and China's voting alignment with African countries in the UN General Assembly is used to proxy the diplomatic relationship of African countries and China. Chinese aid allocation to African countries would be affected by China's international support, recognition, and foreign policy considerations (Naim, 2007; Dreher & Fuchs, 2015; Guillon & Mathonnat, 2017).

Trade relationships between China and African countries trade are used to measure African countries' trade intensity with China. The volume of trade (the sum of export and import) between China and Africa is used to proxy the commercial interest of aid allocating country. It is controlled in the study following the studies by Dreher et al. (2011) and Berthélemy (2006), which supports the donor interest model in the sense that all bilateral donors target their assistance to their most significant trading partners.

Institutional quality index and polity variables are used to represent the level of governance and democracy. Institutional quality index is derived using six worldwide governance indicators (see Table 1). Furthermore, the democratic status of the countries is proxied by the polity variable. Controlling these variables in the aid allocation model is consistent with the previous literature. For example, Berthélemy (2006), Dijkstra (2018) and Hoebink (2006) argue that donors allocate more aid to countries with good governance and better institutional quality. Likewise, economic freedom indicator is used to capture economic institutions of African countries.

The economic freedom indicator is used as a proxy for economic institutions of African countries. Following (Pearson et al., 2012; Sambharya & Rasheed, 2015), we add an average economic freedom index and seven major economic freedom indicators from the Heritage Foundation and Fraser Institute. These are property rights, legal protection, regulation, sound money, freedom to trade internationally, government size, and investment freedom. The interesting thing here is that all variables used to develop the index come from the International Country Risk Guide, the Global Competitiveness Report, and the World Bank's Doing Business project so that the subjective judgments of the authors do not influence the index. Government size represents the extent of government consumption, tax rate, transfer and subsidy, and government investment. Legal protection and property right show the key ingredients of a legal system, such as the security of property rights and the rule of law, an independent and unbiased judiciary, and impartial and effective enforcement of the law. The regulation represents labor and credit market and business regulation. In all cases, these indicators' values vary from 0 to 10, with higher values corresponding to a better status (Fraser Institute, 2018).

Real GDP per capita is used to approximate economic size and market potential proxy. Thus, it represents the market motives of Chinese FDI flow to African countries (Lemi, 2017). Population size is included one of the variables affecting Chinese aid allocation to African countries. In general, aid might be allocated to countries with lower population sizes, revealing a potential discrepancy in the aid allocation process, implying an increase in population size in aid receiving country negatively affects aid inflow (Haque et al., 2015).

The real GDP per capita of China is used to proxy the effect of China's domestic economic status on Chinese aid outflow to African countries. Besides, Chinese FDI flow to African countries is included in the model as Chinese loan is mostly allocated to the infrastructural sector. Physical distance, cross-cultural differences, a religious and common language can affect capital flow among countries and corporate social responsibility disclosure (Farooq et al., 2019). However, the physical distance between the capital of African countries and China is controlled in the model.

Table 1. Principal component analysis for the institutional quality

Component	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Eigenvalue	4.565	0.613	0.460	0.178	0.104	0.079
Proportion	0.761	0.102	0.077	0.030	0.017	0.013
Cumulative	0.761	0.863	0.940	0.969	0.987	1.000
Eigenvalues						
Variable	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5	Vector 6
Control corruption	0.428	-0.240	-0.120	0.778	-0.338	0.162
Rule of law	0.448	-0.178	-0.051	-0.072	0.134	-0.861
Regulatory quality	0.435	0.071	-0.282	-0.565	-0.613	0.180
Government effectiveness	0.433	-0.152	-0.370	-0.125	0.692	0.397
Absence of instability	0.368	-0.209	0.868	-0.158	0.043	0.203
Voice and accountability	0.322	0.916	0.117	0.177	0.110	-0.027
Overall KMO						0.883

Source: computed by authors.

The debt GDP ratio of African countries is included to represent the creditworthiness of African countries. It is a simple and normally used measure for creditworthiness. The allocation of financial aid will be affected by the probability of repayment. Therefore, it would be expected that there will be a negative relationship between Chinese aid and the ratio of debt-to-GDP (Dreher et al., 2015).

4.2. The data and instrument of measurements

Our study covers Chinese aid flow to 44 African countries for the periods 2003–2014 and 2003–2017 for Chinese aid allocation and Chinese loan, respectively, based on the availability of data. The study focuses on the period 2000 to 2017, during which active Chinese engagement in Africa started to start. The list countries included in the study is reported in Appendix B. The data is extracted from 2000 based on the Forum on China-Africa Cooperation (FOCAC), which has provided the foundation for accelerating economic cooperation between China and African countries. Since this cooperation, Chinese finance flows to Africa have also grown significantly. Another important issue here is the sources of financial aid data.

Chinese loan to Africa data is compiled by Johns Hopkins SAIS China-Africa Research Institute (CARI). Chinese financial aid data is taken from AidData's Chinese official finance to Africa dataset (version 1.2), and loan data is taken from data compiled by Johns Hopkins SAIS China-Africa Research Initiative (version 1.3), to look at the drivers of Chinese loan to African countries.

Other explanatory variables were mostly utilized from World Development Indicator of the World Bank (2018a) and Worldwide Governance indicators of World Bank (2018b) databases.

The list of variables, definition, and data sources are presented in Appendix A. Both Chinese loan flow and aid allocation are in the current US dollar.

4.3. Political and governance index derived using Principal component analysis

For this section, the empirical analysis uses the dataset of six Worldwide Governance Indicators (WGI) for political and governance institutional quality (World Bank, 2018b). Accordingly, the rule of law, absence of violence and instability, regulatory quality, control of corruption, voice and accountability and government effectiveness are used to capture the quality of political institutions of African countries following different kinds of literature (Buchanan et al., 2012; Kurul & Yalta, 2017). The rule of law shows the contract and property rights protection and abilities of police and court to enhance private rights. Political stability and absence of violence represent the capability of government in avoiding and solving external and internal conflicts, and ethnic tensions and control of corruption indicate the position of countries in fighting against corruption. Regulatory quality is a perception of the government's ability to formulate and enforce sound policies and laws that permit and inspire the growth of the private sector. The effectiveness of government demonstrates the perception of the quality of public services supplied and the quality of the civil service provided and the level of its independence from political pressures, the quality of policy preparation and execution, and the legitimacy of the government's engagement to these measures. Voice and accountability catches the view of the degree to which citizens can choose their government, an opportunity of free expression and association, and free media. Their values range from -2.5 to 2.5 , with greater values that match better organizations.

Using these six indicators of institutional quality of African countries, we derive a single composite indicator using principal component analysis. Table 1 below shows that the eigenvalues of the first principal component of governance and institutional quality are greater than 1 ($4.565 > 1$). However, the other components do not have the eigenvalues greater than one. The study uses the first principal component's eigenvectors as weights in constructing an institutional and governance index because it explains 76% of the variation in the original variables of institutional quality. Furthermore, we control the polity variable from the Polity IV Project to proxy African countries' democracy level. According to the Center of Systematic Peace, the polity variable examines the concomitant attributes of democratic and autocratic governance in governing institutions rather than discreet and mutually exclusive types of governance. The polity score indicates a 21-point spectrum of this regime authority range from -10 (hereditary monarchy) to $+10$

(consolidated democracy). The Polity scheme has six components and measures the main characteristics of political competition, executive recruitment, and executive authority constraints. It further registers changes in the governing authority's institutionalized behaviors. Therefore, the index of good governance and polity is used to capture the political and governance institutional environment of African countries.

4.4. Principal component analysis

Multivariate analysis often begins with data that involves a large number of correlated variables. The data with a large number of correlated variables can be reduced using Principal component analysis (PCA). It is a dimension reduction technique that can be used to reduce a vast range of variables to a small set that still retains much of the information in the large set. It is a mathematical operation that transforms several correlated variables (potentially) into a (lower) amount of uncorrelated variables called main components. The first principal component reflects as much information variation as is required, and each successor component accounts for as much of the remaining variability as possible. We chose this approach as it helps us implement a purely mathematical transformation without considering any priors about the underlying data structure. We used the main component analysis to derive institutional quality metrics from 6 single variables that aim to reduce the dimensions of data. It transforms the data into new aggregate variables. The variances of the main components are the component's values. Typically the first principal component has the highest variation for all of the combinations. Similarly, in all cases, the Kaiser-Meyer-Olkin sampling adequacy measure (KMO) is used to check the PCA's adequacy. The minimum KMO criteria for PCA analysis is 0.5. (see Table 1).

5. Results and findings

In this section, we spelled out the drivers of Chinese aid allocation to African countries. The first two columns of Table 2 provide the estimation results using aid as a dependent variable. We have controlled economic and strategic relationship instruments (China-Africa trade, Chinese FDI, diplomatic relationship) separately as the Chinese foreign trade, Chinese FDI, service contracts, and cooperation have been closely mixed, combined and overlapped (McCormick, 2008).

5.1. The driving factors of Chinese aid to African countries

The effect of trade openness between China and African countries has a robust positive effect on Chinese aid allocation to African countries. Thus, China-Africa bilateral trade ties have an essential role in driving development finance from China as expected from the literature. This finding supports that trade cooperation between African countries and China boosts aid and loan flow to African countries. Therefore, the provision of aid to African countries enables China to expand into new African markets and to revive its multinational corporation's activities in Africa. Hence the result supports our hypothesis that economic interest is a stronger driver of Chinese financial aid to African countries.

Likewise, Chinese aid flow to African countries is the diplomatic relationship between African countries and China. It is a dummy variable indicating Chinese aid flow to countries with a strong diplomatic relation with China compared to countries that do not have diplomatic relations with China. Furthermore, China's voting alignment with African countries in the UN General Assembly has a robust positive effect on Chinese aid flow to African countries. Therefore, the diplomatic relationship between China and African countries plays a significant role in promoting Chinese aid flow. On top of that, China's economic performance can also influence its aid and loan allocation to African countries. This effect is shown by the statistically significant coefficients of the per capita GDP of China.

Another essential variable is natural resources. As we can observe from Table 2, its coefficient is positive and statistically significant. It implies that African countries that are endowed with the higher natural resources are likely receiving more Chinese financial aid. Hence Chinese aid flow to African countries is derived by the demand of China to access natural resources. This result is in line with the findings of Alden and Alves (2009).

Population size has a significantly positive effect on Chinese aid flow to African countries. Thus, this result indicates that Chinese aid flow to Africa is associated with population size. The

Table 2. The driving factors of Chinese aid to African countries (PPML estimation)

Variables	I	II	III	IV
logdpC _{it}	0.129 (0.225)	0.152 (0.227)	-0.351 (0.271)	0.092 (0.228)
logdistw _{ict}	-4.870** (2.056)	-5.214** (2.074)	-5.861*** (1.904)	-6.042*** (2.176)
logexdebt _{it}	0.531** (0.257)	0.545** (0.257)	0.310 (0.264)	0.532** (0.260)
lognatural _{it}	0.405** (0.198)	0.406** (0.203)	0.263** (0.127)	0.394* (0.208)
logagree _{ict}	1.007 (1.973)	0.816 (1.948)	-0.505 (1.592)	0.699 (1.977)
logpop _{it}	0.764*** (0.218)	0.764*** (0.217)	0.439** (0.189)	0.621*** (0.229)
logpoli _{it}	-0.462 (0.647)	-0.433 (0.656)	-0.222 (0.576)	-0.586 (0.627)
loginstitutional _{it}	-0.326 (0.376)	-0.369 (0.379)	-0.668* (0.361)	-0.409 (0.406)
logeconomicfree _{it}	-1.850 (1.299)	-1.850 (1.326)	-0.799 (1.086)	-1.516 (1.370)
Diplomacy _{ict}	2.610* (1.437)			
logdpccchina _{ct}		1.846*** (0.405)		
logtrade _{ict}			0.313** (0.133)	
logFDI _{ict}				0.150 (0.104)
_cons	-11.140 (18.304)	-19.655 (18.267)	3.561 (14.676)	-6.132 (18.008)
Time dummy	Yes	Yes	Yes	Yes
Obs.	428	428	426	380
R2	0.409	0.407	0.429	0.406
Ramsey	0.991	0.831	0.558	0.481

***Significant at 1%, ** significant at 5%, * significant at 10%, standard error in parenthesis, Ramsey: model specification test, Obs.: Observation. aid_{ict} denotes aid from China to Africa (dependent), gdpca is real GDP per capita, agree is China's voting alignment with African countries in the UN General Assembly, exdept is debt GDP ratio of African countries to represent creditworthiness of African countries, natural is natural resources depletion rate of African countries that represent depletion rate of all-natural resources in African countries, distw is distance between capital cities African countries and China, gdpchina is real GDP per capita of China to proxy the effect of domestic economic status of China on Chinese FDI outflow to African countries, diplomacy is dummy variable 1 if African country support one-China policy and 0 otherwise, trade is trade flow between China and African countries, pop is the population size of African countries, FDI represents Chinese FDI flow to African countries, Politicalinstu represents institutional quality indicators of African countries, polity represents the level of democracy in African countries and economicfree represents economic freedom of African countries.

Sources: regression results.

geographical distance between African countries and China has a significant negative effect on aid allocation, indicating that physical distance discourages the aid flow.

5.2. The driving factors of Chinese loan to African countries

We also estimate loan allocation separately because a more significant share of aid allocation China commits to African countries is repayable (long-term loans). It is based on the spirit that even though China allocates some humanitarian emergency aid, the predominant Chinese aid allocation approach to African countries is designed to maximize the mutual benefits to be gained from trade, emphasizes loans rather than grants, and focuses on the physical infrastructure needed to reduce production and marketing costs (Wang et al., 2014).

The coefficient of per capita GDP is positive and statistically significant. Its coefficient is robustly significant in all columns, indicating that as per capita GDP of countries increases, aid and loan flow will increase. This indicates that Chinese aid to African countries mostly flows economically better performing African countries. Hence Chinese loan flows to Africa are strongly oriented towards countries, which provide evidence that China considers economic motives African countries. This result can be loosely explained that more Chinese loans are allocated to the infrastructure sector, which can promote economic performance loan receiving countries.

The effect of economic freedom is negative and statistically significant. Thus, the effect of economic freedom on the flow of Chinese financial assistance is negative. The effect of distance capital of China and African countries is negative and statistically significant. Since each African country's geographic location with respect to China measures economic remoteness and reflects the trading opportunities available to each African country with China, remoteness negatively correlated with Chinese loan flow.

Trade openness between China and African countries has a robust positive effect on Chinese loan allocation to African countries. Furthermore, the effect of Chinese FDI on Chinese loan allocation to African countries is robustly significant and positive implying that the stock of Chinese FDI in the African countries may be influenced the amount of Chinese loan received by African countries as FDI promotes the economic performance and capacity of recipients to absorb aid (Chauvet & Sandrine, 2006).

Furthermore, African countries that are rich in natural resources are likely receiving more Chinese loans. The coefficient of population size is significantly positive, indicating that Chinese loan flow to Africa is correlated with population size. The coefficient of geographical distance between African countries and China is significantly negative. China's voting similarity with African countries in the UN General Assembly has a robust positive effect on Chinese loan flow to African countries. The effect of diplomatic relationship (recognition of one-China policy) has a positive effect on Chinese loan flow to African countries.

5.3. Discussion, theoretical and practical implications

In this section, we discuss the drivers of Chinese aid and loan allocation to African countries based on the theoretical framework and policy perspective. From the theoretical point of view, several motives shape financial aid flow from developed and emerging countries to developing countries. These financial motives differ from donor to donor and defined from donors and receipts need models.

The deriving factors of financial aid can be seen from donor countries' side as donors themselves emphasize helping aid recipients develop themselves or donors' interest in mind when giving aid (Riddell, 2008). In the general framework, the driving factors of financial aid to developing countries can be broadly categorized into economic, political, and strategic, institutional, and humanitarian interests. Therefore, in this part, we illustrate the driving factors of Chinese financial aid to African countries subject to the theoretical framework.

The economic interest of financial aid is indicated by natural resources seeking of donor countries and the trade relationship of donor and aid receiver countries. In this regard, the impacts of China-Africa trade on Chinese financial aid and loan flow to African countries is positive and statistically significant, implying that one of the motives of Chinese financial aid to African countries is motivated by economic interest.

Also, the importance of trade in aid allocation is highlighted in China's aid policy through the introduction of new instruments that linked aid, trade, and investment between China and Africa. The results of this study are consistent with the study by Berthélemy (2006) argues that the foremost driving factors for giving aid are commercial interests. Even if a donor does not have strong geopolitical interests, all donors have trade interests. This result reveals that Chinese aid more likely uses trade openness as one of the criteria for determining Chinese aid allocation to African countries. It is intuitive because African countries have supply-side infrastructural

constraints such as transportation, communication, and energy. As we can observe from the Chinese aid data to African countries, it mostly flows to these sectors, promotes their export capacity, and reduces their infrastructure constraint, promoting trade openness between African countries and China. Chinese aid promotes not only its export but also the export performance of African countries to China. Hence the result supports the argument that economic interest is a stronger driver of Chinese financial aid to African countries.

Similarly, the impact of the natural resources extraction rate on Chinese aid allocation to African countries is robustly positive. It is not surprising because the expansion of the Chinese domestic economy has further driven China's interest in sub-Saharan Africa's natural resources. The result is convincing as it is argued that Chinese loan provision to African countries partly motivated by the trading of infrastructure for natural resources. For example, China used Angola's large oil resources to overcome its lack of creditworthiness in the international financial market. Similarly, China provided a loan to Gabon in exchange for manganese exploration rights and the Democratic Republic of Congo in exchange for cobalt mining development. Many other such deals were also signed with other African countries. Likewise, China allocates more financial aid to relatively oil-rich African countries than those that are not oil-rich. About half of the top ten recipients of Chinese aid in the past ten years provided access to oil and petroleum.

Thus, it gives evidence that Chinese financial aid allocation to African countries is motivated by donors' needs model predictions, such as economic and commercial interests (resources seeking, FDI and trade) of China and African countries. These findings are consistent with some previous studies such as Berthélemy (2006), Dreher et al. (2011), Jones and Tarp (2016) and Pettersson and Johansson (2011) those support for the notion that bilateral donors target their assistance to their most significant trading partners and countries with abundant natural resource. Furthermore, some literature conducted on the Chinese financial aid flow to African countries came with the conclusion that one of the driving factors of Chinese financial aid to African countries is natural resources (Alden and Alves, 2009; Lengauer, 2011; Lum et al., 2009). Thus, Chinese loan to African countries is significantly determined by the availability of natural resources in African countries, trade and FDI relationship between China and African countries, implying that donor needs model predicts the financial aid flow from China to African countries.

From practical point of view, it is claimed that Chinese aid specifically loans mainly goes to capital investment and infrastructure. It helps solve supply-side infrastructural constraints such as transportation, communication and energy for African countries. However, the relationship between natural resources and Chinese loan allocation should be critically considered. Besides, China-Africa trade and FDI relationship should be promoted to attract Chinese aid to African countries.

Another important determinant of financial flow to developing countries is the political and strategic interests of donor countries. This motive is used to further foreign policy goals of donor countries, to increase regional power, to promote the national interests of donor countries in the region of aid-receiving countries. It includes voting in favor of donors in the United Nations General Assembly (Clist, 2011; Dreher et al., 2011; Fleck & Kilby, 2010). Chinese financial aid is also in line with the hypothesis that it would be used to have China's international support and foreign policy considerations. Our findings are in line with the studies conducted by Dreher et al. (2015), Guillon and Mathonnat (2017) and Naim (2007) that reveal the allocation of Chinese aid is motivated by political and strategic interests of China. Therefore, Chinese financial aid to African countries is used to boost diplomatic power on the international stage and deepen cooperation with African countries. Therefore, this study's findings reveal that Chinese aid to African countries consistent with the donor interest model that predicts aid is allocated according to the perceived economic, political, and security interests of donors.

Additionally, the results in Table 3 show that there is a statistically significant positive relation between loan and GDP per capita, meaning that poverty is negatively associated with Chinese loan distribution, which is against the poverty reduction target of aid allocation. Besides, the impact of the population size of African countries is robustly positive. The result is in contrast with the assumption that aid might be allocated to countries with lower population sizes (Haque et al., 2015).

Recently good governance has increasingly become a significant motivation to provide financial aid to developing countries mainly to promote human rights and to set up institutions for

Table 3. The driving factors of Chinese loans to African countries (PPML estimation)

Variables	I	II	III	IV
loggdpc _{it}	0.573*** (0.201)	0.575*** (0.200)	0.505** (0.241)	0.478** (0.203)
logdistw _{ict}	-5.611 (3.882)	-4.559 (3.403)	-4.836* (2.778)	-7.012** (2.997)
logexdebt _{it}	-0.035 (0.268)	-0.102 (0.258)	-0.165 (0.200)	-0.054 (0.220)
lognatural _{it}	0.391** (0.152)	0.388** (0.154)	0.212* (0.126)	0.309** (0.137)
logagree _{ict}	3.112*** (0.660)	3.281*** (0.658)	2.569*** (0.561)	2.835*** (0.623)
logpop _{it}	0.899*** (0.228)	0.898*** (0.229)	0.464* (0.258)	0.744*** (0.238)
logpoli _{it}	-0.248 (0.497)	-0.293 (0.504)	-0.068 (0.423)	-0.475 (0.473)
loginstitutional _{it}	0.687 (0.638)	0.719 (0.620)	0.243 (0.745)	0.700 (0.600)
logeconomicfree _{it}	-2.659** (1.303)	-2.716** (1.291)	-1.285 (1.451)	-2.251** (0.995)
Diplomacy _{ict}	2.242** (0.929)			
loggdpcchina _{ct}		4.152*** (0.758)		
logtrade _{ict}			0.495*** (0.120)	
logFDI _{ict}				0.429*** (0.085)
_cons	-43.172*** (6.733)	-73.955*** (8.362)	-25.125*** (5.554)	-30.820*** (7.403)
Time dummy	Yes	Yes	Yes	Yes
Obs.	342	342	342	326
R2	0.538	0.503	0.364	0.435
Ramsey	0.112	0.314	0.800	0.491

***Significant at 1%, ** significant at 5%, * significant at 10%, standard error in parenthesis, Ramsey: model specification test, Obs.: Observation. loan_{ict} denotes aid from China to Africa (dependent), gdpc_a is real GDP per capita, agree is China's voting alignment with African countries in the UN General Assembly, exdebt is debt GDP ratio of African countries to represent creditworthiness of African countries, natural is natural resources depletion rate of African countries that represent depletion rate of all-natural resources in African countries, distw is distance between capital cities African countries and China, gdpcchina is real GDP per capita of China to proxy the effect of domestic economic status of China on Chinese FDI outflow to African countries, diplomacy is dummy variable 1 if African country support one-China policy and 0 otherwise, trade is trade openness between China and African countries, pop is the population size of African countries, FDI represents Chinese FDI flow to African countries, Politicalinstu represents institutional quality indicators of African countries, polity represents the level of democracy in African countries and economicfree represents economic freedom of African countries.

Sources: regression results.

democratic accountability (Hoebink, 2006). It mostly emphasis on the wide range of institutional setup of aid receiving countries including protection of civil rights, institutionalized checks and balances, press freedom, the possibility of replacing governments by-elections, and also political stability (Dijkstra, 2018). According to the receipt need model, donors allocate more aid to recipient countries with better governance and democracy indicators (Berthélemy, 2006).

In aid-institution paradox literature, foreign aid has been taken as an extractable rent present in most developing countries, including some African countries. Higher aid levels negatively affect the quality of governance, as measured by indexes of bureaucratic quality, corruption, and the rule of law. Hence more aid is allocated to recipients with better governance indicators like democracy, which supports the recipient's need model (Berthélemy, 2006). This study regarding the impacts of institutional quality on Chinese financial aid flow to African has conducted a detailed investigation using governance and democratic institutional level of African countries (see Tables 2 and 3). The results reveal that China does not allocate aid systematically to countries with a higher degree of institutionalized democracy. Thus, Chinese aid flow to African countries has received much criticism with neglect of human rights issues and governance in aid recipient African countries. This result is expected because China provides foreign aid regardless of the status of institutional quality and governance subject to China's non-interference principle. Furthermore, China dues to follow a policy of non-interference in the domestic politics of financial aid receipt countries, which implies that aid allocation decisions are made without considering the political institutions of recipient countries (Dreher et al., 2015). Even though China follows the non-interference policy when allocating financial aid to African countries, it should closely follow whether the aid has allocated and efficiently used for the target the aid has been allocated.

6. Conclusions

This study has examined the driving factors of Chinese aid allocation to African countries. More specifically, it gives a detailed analysis of the motivation of Chinese aid allocation for 44 African countries using a robust and recently released data set for the periods 2003–2017. Additionally, the novelty of this study is employing the PPML method that helps include zero-valued observations in the data and robust method of estimation in the presence of heteroscedasticity for Chinese financial aid flow to African countries as the variables of our interest are in flow terms. We also repeated the exercise using loan allocation as a dependent variable because a more significant share of aid allocation China commits to African countries is repayable (long-term loans). It is based on the principle that the predominant Chinese aid allocation approach to African countries is designed to maximize the mutual benefits gained from trade, emphasize loans rather than grants, and focus on the physical infrastructure needed to reduce production and marketing costs.

The study findings reveal that African countries with large population sizes receive relatively more aid from revealing that population size determines Chinese aid per capita that African countries may expect to receive. The finding of this study further reveals that Chinese aid allocation is determined by trade cooperation between African countries and China. Likewise, Chinese FDI flow drives aid allocation to FDI hosting African countries. It implies that Chinese aid allocation is promoted by opening markets to Chinese multinational corporations. It is also robustly affected by the diplomatic relationship. Thus, in this regard, Chinese aid allocation is used to further foreign policy goals, to increase regional power, to advance the national interests of itself in the aid-receiving African countries as voting in favor of donors in the UN General Assembly. Hence Chinese aid flow to African countries is dictated by political and strategic considerations of China. Besides, China does not allocate aid systematically to countries with a higher degree of institutionalized democracy. Finally, African countries with higher natural resources depletion rates likely receive more Chinese loans implying that economic self-interest has been identified as one of the significant factors.

To sum up, we found evidence that Chinese aid allocation is associated with bilateral trade, FDI, strategic and diplomatic relationship affinity and natural resources need as well as economic motives of African countries.

Furthermore, trade openness between China and African countries has a robust positive effect on Chinese loan allocation to African countries. The coefficient of per capita GDP is positive and statistically significant. Likewise, the effect of Chinese FDI on Chinese loan allocation to African countries is robustly significant and positive. African countries that are rich in natural resources are likely receiving more Chinese loans. The coefficient of population size is significantly positive, indicating that Chinese loan flow to Africa is correlated with population size. China's voting alignment with African countries in the UN General Assembly has a significantly positive effect on Chinese loan flow to African countries. The effect of diplomatic relationship (recognition of one-China policy) has a positive effect on Chinese loan flow to African countries. However, the effect of economic freedom is negative and statistically significant.

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Appendix A.

Table A1. Definition of variables and source of data

Variable	Definition of Variables	Source of Data
loggdp	Logarithm form of real GDP per capita (in Million US Dollar at constant 2005 US dollar)	WDI
loginstitution	Logarithm form of institutional quality of countries	WGI
logodarest	Logarithm form of official development assistance (Aid) from the rest of the world to Africa	WDI
lognatural	Logarithm form of natural resources extraction rate	WDI
logtrade	Logarithm form The trade between China to African countries	WDI
aid	Official development assistance (Aid) from China to Africa	AidData
loFDI	Logarithm of Chinese FDI flow to African countries	China Africa Research Initiative
loan	Loan flow from China to Africa	China Africa Research Initiative
loggdpca	Logarithm form of per capita real GDP of China	WDI
logpop	Logarithm form of the total population of the reporting country	WDI
logdis _{ict}	Logarithm form of the distance between capitals of African countries and China	CEPII
logagree	Logarithm form of voting similarity between China and African countries	Voeten et al. (2009)
Diplomacy	Dummy 1 yes and 0 no diplomatic relationship	Wikipedia
logeconomicfree	Logarithm form Economic freedom indicator	Fraser Institute

Appendix B. The list of African countries included in the sample

Angola, Benin, Burkina Faso, Botswana, Ivory Coast, Cameroon, Congo Republic, Comoros, Capo Verde, Djibouti, Algeria, Egypt, Ethiopia, Gabon, Ghana, Guinea, Gambia, Guinea-Bissau, Kenya, Liberia, Libya, Morocco, Madagascar, Mali, Mozambique, Mauritania, Mauritius, Malawi, Namibia, Niger, Nigeria, Rwanda, Sudan, Senegal, Sierra Leone, Seychelles, Chad, Togo, Tunisia, Tanzania, Uganda, South Africa, Zambia and Zimbabwe.



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