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What can we learn on Chinese aid allocation motivations from new available data?
A sectorial analysis of Chinese aid to African countries

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Abstract

Since the creation of the Forum on China-Africa Cooperation (FOCAC) in 2000, Chinese official development assistance (ODA) to Africa has increased drastically. Only few analyses on the determinants of Chinese ODA allocation to African countries are available. Moreover, existing literature mainly focused on total aid flows while Chinese motivations for aid allocation might differ depending on the ODA sector considered. Our objective is to study the factors associated with Chinese aid allocation to African countries by sector between 2000 and 2014. We consider 3 ODA broad sectors as defined by the Organisation for Economic Cooperation and Development (OECD): the social infrastructure and services sector, the economic infrastructure and services sector and the production sector. Chinese ODA is measured using the AidData's Global Chinese Official Finance Dataset, 2000-2014, Version 1.0, released in fall 2017.

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…/… Over the 2000-2014 period, China allocated 971, 218 and 138 ODA projects to African countries in the social infrastructure and services sector, the economic infrastructure and services sector and the production sector respectively. Between 2000 and 2014, the economic infrastructure and services sector was the first sector in terms of ODA amount with a total of US$18.9 billion ahead from the social infrastructure and services sector with US$7 billion or the production sector with US$3.1 billion. Results of our analysis suggest that the motivations of Chinese aid allocation to African countries differ by sector. Chinese ODA in the social infrastructure and services sector appears responsive to the economic needs of recipient countries but is also driven by foreign policy considerations. Chinese economic interest, in particular for natural resources acquisition, is associated with China's ODA allocation in the economic infrastructure and services sector. Finally, while institutions in recipient countries are not related to Chinese ODA in the social infrastructure and services sector, we find that China allocates more ODA in the economic infrastructure and services sector and the production sector to African countries with weaker institutions. One of the strong conclusions of this study is to show that considering only China's overall aid to Africa can be misleading as to its underlying determinants, and therefore to point out the need to disaggregate the analysis by ODA sectors.

1. Introduction

> *On what preference an esteem is based,*
> *And that is to estimate nothing but to estimate everyone.*
>
> Molière, *Le Misanthrope,* I,1.

The forum on China-Africa Cooperation (FOCAC) was created in 2000 in Beijing in order to strengthen Sino-African economic cooperation and diplomatic relationships. Since 2000, the volume of Sino-African trade has tremendously increased from US$9.7 billion in 2000 to a peak of US$215.9 billion in 2014 (United Nations Comtrade Database). Most of Chinese imports from African countries relate to natural resources with fuels, minerals and metals making up respectively 38.5, 14.8 and 10.7% of Chinese imports from Africa in 2016 (World Integrated Trade Solution database). On the other hand, Chinese exports to African countries are dominated by the machinery and electrical sector (26.9% of exports), the textiles and clothing sector (19.1%), the metals sector (11.2%) and the transportation sector (7.3%). Over the last 20 years, Chinese Foreign Direct Investments (FDI) in Africa has also risen drastically. The global Chinese FDI stock in Africa increased from US$0.5 billion in 2003 to US$21.7 billion in 2012 (United Nations Conference on Trade and Development Bilateral FDI Statistics). This stock reached US$34.7 billion in 2015 (2015 Statistical Bulletin of China's Outward Foreign Direct Investment). According to the Africa investment report 2016 of FDI Intelligence, the coal, oil and natural gas sector ranked as the top

sector for Chinese capital investment in 2015 with US$15.7 billion invested and 24% of the total FDI stock. The alternative and renewable energy sector ranked as the second largest sector of Chinese FDI with US$12.2 billion invested and 18% of the FDI stock. In terms of type of activity, extraction and electricity accounted for almost half (46%) of the Chinese FDI stock in Africa in 2015 with US$30.1 billion invested. Moreover, in 2015, infrastructure-related activities (electricity, construction and information and communications technology & internet infrastructure) accounted for 13% of all Chinese FDI projects in Africa and for 44% of capital invested.

Since the creation of the FOCAC in 2000, Chinese official development assistance (ODA) to Africa has also largely increased. Between 2000 and 2014, African countries have received as much as 1592 Chinese ODA projects for a total amount of 34.8 billion of 2014US$. In the political sciences literature, China is often accused of allocating its ODA in its own interests. China would allocate ODA to African countries mainly to guarantee its access to the natural resources of these countries and to secure exporting markets for its products. Moreover, Chinese ODA to Africa would also be used to extend China's international support (Naim, 2007, Lin et al., 2016). China refutes these accusations and states allocating its ODA in response to the needs expressed by the recipient countries, following an equality and mutual benefit principle and according to a non-interference principle (Declaration of the Beijing Summit of the Forum on China-Africa Cooperation, 2006/11/05; Kjøllesdal et al., 2010; Second White Paper on China's Foreign Aid, 2014).

A recent literature on the determinants of Chinese ODA to African and non-African countries has emerged. As in the broader aid allocation literature on traditional donors, this recent literature has investigated the role of 3 types of variables that might influence Chinese aid allocation decisions: the needs and merits of recipient countries and the economic and political interests of China. Dreher and Fuchs (2015) study the determinants of Chinese aid allocation to all recipient countries over the 1956-2006 period. The authors use several data sources and focus on total Chinese aid as well as food aid and the number of Chinese medical teams sent to recipient countries. Their results point to the lack of influence of recipient countries' oil production for the receipt of total ODA projects and food aid but not for the receipt of Chinese medical teams. On the contrary, they show that United Nations General Assembly (UNGA) voting alignment of recipient countries with China is positively correlated with all types of Chinese aid received except for food aid. Results of Dreher and Fuchs (2015) also underline the prominence of political considerations in Chinese aid allocation. In a very recent study, Dreher et al. (2018) focus on total amounts of Chinese ODA and Other Official Flows (OOF) to African countries over the 2000-2013 period. Their results confirm those of Dreher and Fuchs (2015). Indeed, they find that foreign policy considerations, as measured by Taiwan recognition, UNGA voting alignment or temporary membership of African countries on the United Nations Security Council, are significantly correlated with Chinese ODA amount and Chinese grants. On the contrary, they find that Chinese economic interests, as measured by recipient countries' trade with China or oil production, do not impact ODA allocation but only the allocation of less concessional flows (OOF). Guillon and Mathonnat (2017) study the factors associated with Chinese heath ODA projects and amounts to African countries between 2006 and

2013. They find that Chinese health aid is responsive to the economic needs (as measured by the Growth Domestic Product - GDP - per capita) of recipient countries while it is unrelated to various measures of health needs or governance quality in African countries. They also find no strong evidence that Chinese health aid allocation decisions favor natural resources-rich countries or countries with important commercial ties with China. As highlighted by Dreher and Fuchs (2015) and Dreher et al. (2018) for Chinese ODA in all sectors, results of Guillon and Mathonnat (2017) confirm the idea that China uses its health aid as part of its foreign policy since non-adherence to the one-China policy makes the receipt of Chinese health aid very unlikely.

The Organisation for Economic Cooperation and Development (OECD) classifies ODA in 3 main sectors: 1) the social infrastructure and services sector (thereafter referred to as the social sector) which gathers ODA in education, general and reproductive health, water supply and sanitation, government and civil society and other social infrastructures; 2) the economic infrastructure and services sector (thereafter referred to as the economic sector) which includes ODA in transport and storage, communications, energy, banking and business and 3) the production sector that comprises ODA in agriculture, forestry and fishing, industry, mining and construction, trade and tourism. Existing literature on the determinants of Chinese aid allocation mainly focused on total aid flows or on specific types of aid such as food aid, health aid or the sending of medical teams. However, Chinese motivations for aid allocation might differ depending on the ODA sector considered. Given the explicit economic interests of China in specific areas of African economies such as the energy or the transportation sectors, one might hypothesize that economic motivations are more important in explaining Chinese aid allocation in the economic and production sectors compared to the social sector. On the other hand, motivations behind aid allocation to the social sector might be more related to the needs of African countries given the lack of direct economic interests of China in this sector. Besides pure altruism, aid allocation in the social sector might also be used by China as a soft power to extend its international support and visibility.

Our objective is to study the factors associated with Chinese aid allocation to African countries over the 2000-2014 period. In particular, we aim to test whether variables related to the needs and merits of African countries and to the political and economic self-interests of China differently impact the volume of Chinese aid to African countries depending on the sector considered. Compared to the existing literature, this will refine our understanding of the factors influencing the allocation of Chinese aid to Africa. Given the lack of Chinese official ODA data, we measure Chinese aid allocation to Africa using the last version of the AidData's Global Chinese Official Finance Dataset, 2000-2014, Version 1.0 (Dreher et al., 2017) released on fall 2017. We consider 3 main types of sectors mentioned above as defined by the OECD: the social sector, the economic sector and the production sector. We focus on the number of Chinese ODA projects and on ODA amount. For ODA amount, the analysis is restricted to the economic broad sector given the very high shares of social and production projects that lack financial valorization, 60.7% and 54.3% respectively versus only 28.9% for economic projects.

Between 2000 and 2014, China allocated 971 ODA projects to African countries in the social sector. Over the same period, China financed 218 projects in the economic sector amounting for a total of US$18.9 billion and 138 projects in the production. Our results suggest that factors associated with Chinese aid allocation depend on the sector considered. ODA in the social sector appears more responsive to the needs of African countries while it is also linked to foreign policy considerations. Natural resources acquisition is associated with total Chinese ODA allocation and more specifically to ODA allocation in the economic sector. Finally, in line with results found by the literature on Chinese FDI, China tends to allocate more economic and production ODA to African countries with weaker political governance.

2. Chinese ODA to African countries

As stated above, we use the last version of the AidData's Global Chinese Official Finance Dataset, 2000-2014, Version 1.0 (Dreher et al., 2017) to measure Chinese aid allocation to African countries. This database was created using the Tracking Under-Reported Financial Flows (TUFF) methodology that uses 3 stages: 1) identification of potential projects through extensive searching involving official sources and media reports; 2) source triangulation to search for and synthesize additional sources for each project identified in the first stage and 3) quality control. The database provides a detailed description of each project that includes the source of funding (official/unofficial), the donor intent (development, commercial, representational or mixed), the flow type (grants, technical assistance, loans, debt relief, export credits, scholarships…), the grant element, the flow class (ODA, OOF or vague), the date of the project, the recipient country, the sector of the project (Creditor Reporting System code as recorded by OECD), the status of the project (pledged, committed, in implementation, completed, suspended or cancelled) and the value of the associated funding in 2014US$.

In this database we selected Chinese ODA to African countries and gathered them in 3 broad sectors according to the OECD classification. Regarding the status of the projects, we chose to include only completed projects and projects currently under implementation. Committed or pledged projects for which the proof of money disbursement is lacking, as well as cancelled and suspended projects, were excluded from the analysis. Thus, we focus on Chinese aid disbursements, rather than commitments, to African countries.

A total of 1592 ODA projects were financed by China in Africa between 2000 and 2014 for a total amount of 34.8 (2014) US$ billion. Table 1 gives the repartition of Chinese ODA projects and amount by sector between 2000 and 2014. When looking at the number of projects, the top 5 sectors are health (466 projects, 29.2%), government and civil society (202 projects, 12.7%), education (192 projects, 12.1%), agriculture, forestry and fishing (104 projects, 6.5%) and transport and storage (98 projects, 6.2%). A different picture emerges when focusing on the amount of ODA projects. In that case, the top 5 sectors are transport and storage (US$12.4 billion, 35.8%), energy generation and supply (US$4.1 billion, 11.8%), action relating to debt (US$3.4 billion, 9.8%), water

supply and sanitation (US$2.4 billion, 7%) and communications (US$2.3 billion, 6.8%). Then, sectors where costly infrastructure projects are more prevalent rank better when analyzing ODA amount rather than ODA projects. This is broadly confirmed by the analysis of the mean amount of ODA projects. As for total ODA amounts, the transport and storage, energy generation and supply and water supply and sanitation sectors are in the top 5 sectors. Two sectors enter the top 5 when considering the mean amount of ODA projects: the industry, mining and construction sector and the trade and tourism sector. It should be noted that financial valorization is lacking for an important number of ODA projects. Some sectors particularly suffer from this weakness; for example the health sector where the amount is missing for 70.2% of ODA projects or the education sector where 66.2% of ODA projects lack financial valorization. Other main sectors for which financial amounts of ODA projects are widely missing include the government and civil society sector, the communication sector, the energy supply and generation sector, the agriculture, forestry and fishing sector and the industry, mining and construction sector.

Table 1: Chinese ODA to Africa by sector (2000-2014)

Sector	2000-2014 Projects Total	%	Rank	Amount (2014US$) Total	%	Rank	% projects with missing amount	Mean amount† (2014US$)
Education	192	12.06	3	468 578 102	1.35	12	66.15	7 208 894
Health	466	29.27	1	1 033 209 712	2.97	10	70.17	7 433 163
Population Policies / Reproductive Health	5	0.31	18				20.00	
Water Supply and Sanitation	33	2.07	12	2 421 585 269	6.96	4	33.33	110 072 058
Government and Civil Society	202	12.69	2	1 356 232 634	3.90	9	46.53	12 557 710
Other Social infrastructure / services	73	4.59	7	1 744 647 120	5.01	7	32.88	35 605 043
Transport and Storage	98	6.16	5	12 473 528 239	35.84	1	31.63	186 172 063
Communications	60	3.77	9	2 353 820 716	6.76	5	41.67	67 252 020
Energy Generation and Supply	58	3.64	10	4 097 086 723	11.77	2	41.38	120 502 551
Banking and Financial Services	1	0.06	22				100.00	
Business and Other Services	2	0.13	21	5 569 156	0.02	21	50.00	5 569 156
Agriculture, Forestry and Fishing	104	6.53	4	219 301 687	0.63	15	58.65	5 100 039
Industry, Mining, Construction	28	1.76	13	1 883 830 952	5.41	6	60.71	171 257 359
Trade and Tourism	6	0.38	17	979 674 136	2.82	11	0.00	163 279 023
General Environmental Protection	5	0.31	19	10 964 468	0.03	20	40.00	3 654 823
Women	8	0.50	16	11 657 675	0.03	19	62.50	3 885 892
Other Multisector	45	2.83	11	1 669 084 743	4.80	8	51.11	75 867 488
General Budget Support	3	0.19	20	49 690 137	0.14	17	0.00	16 563 379
Developmental food aid	26	1.63	14	62 652 069	0.18	16	46.15	4 475 148
Non-food commodity assistance	3	0.19	20	3 906 077	0.01	22	66.67	3 906 077
Action Relating to Debt	62	3.89	8	3 417 068 532	9.82	3	16.13	65 712 856
Emergency Response	96	6.03	6	249 595 419	0.72	14	32.29	3 839 930
Administrative Costs of Donors	0	0.00	23	0	0.00	23		
Support to NGOs* and Government Organizations	3	0.19	20	12 596 477	0.04	18	0.00	4 198 826
Non specified	13	0.82	15	299 157 609	0.80	13	0.00	23 012 124
Total	**1592**	**100**		**34 801 465 045**	**100**			

† Per project with financial valorization available
* Non-governmental Organizations

We now focus on the 3 broad OECD sectors. Figure 1 shows the repartition of ODA projects and amount by broad sectors. Over the 2000-2014 period, the social sector gathered 971 projects (61% of all ODA projects) for a total amount of US$7 billion (20.2% of the total ODA amount). The economic sector grouped 218 projects (13.8% of total) with a total amount of US$18.9 billion (54.4% of total). Finally, the production sector is the smallest broad sector as it included only 138 projects (8.7% of total) for a total amount of US$3.1 billion (8.9% of total). As mentioned above, the main caveat of analyzing Chinese ODA amount is the existence of missing values for the financial

valorization of ODA projects. This is particularly problematic in the social sector where 557 ODA projects over 971 (60.7%) lack financial valorization and in the production sector where the financial amount is missing for 75 ODA projects over 138 (54.3%). In the economic sector, only 63 ODA projects over 218 (28.9%) lack financial valorization. It follows that smaller ODA amounts observed in the social and production sectors are partly attributable to the higher shares of projects lacking financial valorization in these 2 sectors.

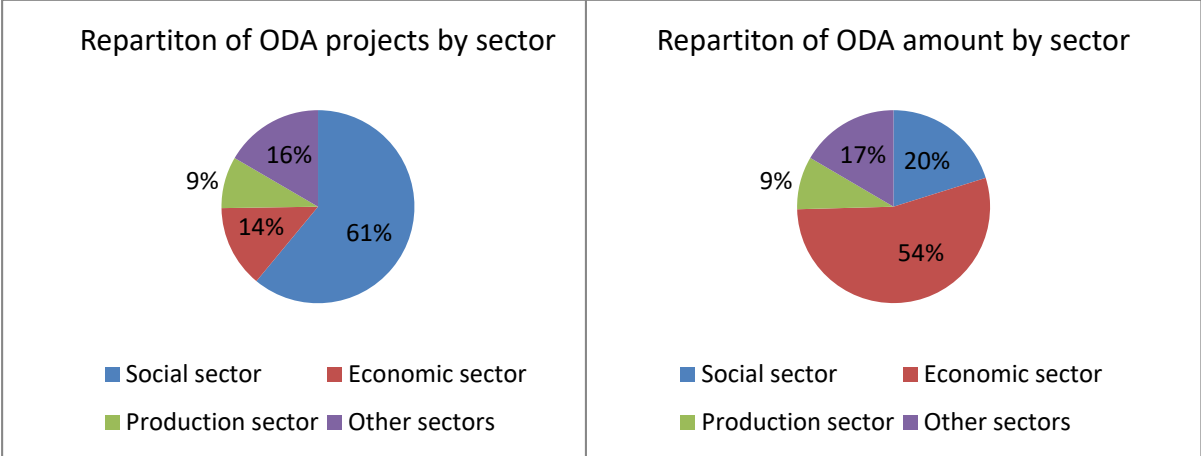**Figure 1: Repartition of Chinese ODA projects and amount by sector**

Figure 2 and Table 1 show the evolution of Chinese ODA projects and amount to African countries by broad sector between 2000 and 2014.

The number of projects in the economic and production sectors remained relatively stable over time. On the contrary, the number of ODA projects in the social sector increased over time, particularly between 2006 and 2009 when the number of social ODA projects reached 118 (12.2% of the total). Over the study period, ODA amounts appear more volatile than the number of ODA projects, especially in the economic sector. In 2006, the amount of economic ODA increased a first time to reach US$1.8 billion while it was only of US$761 million in 2005. The amount of economic ODA then decreased steadily between 2006 and 2010. A new increase in economic ODA amount is observed between 2010 and 2012 when the amount of economic ODA reached its peak at US$3.5 billion (18.5% of the total). The amount of economic ODA then decreased sharply in 2013. Beyond the global trends it is therefore important to consider the instability of Chinese ODA whether it's the number of projects or the amount. Coefficients of variation (standard deviation/average) show that instability is much stronger for economic and production projects than for total aid and for social sector support.

Figure 2: Evolution of ODA projects and amount by year and type of project
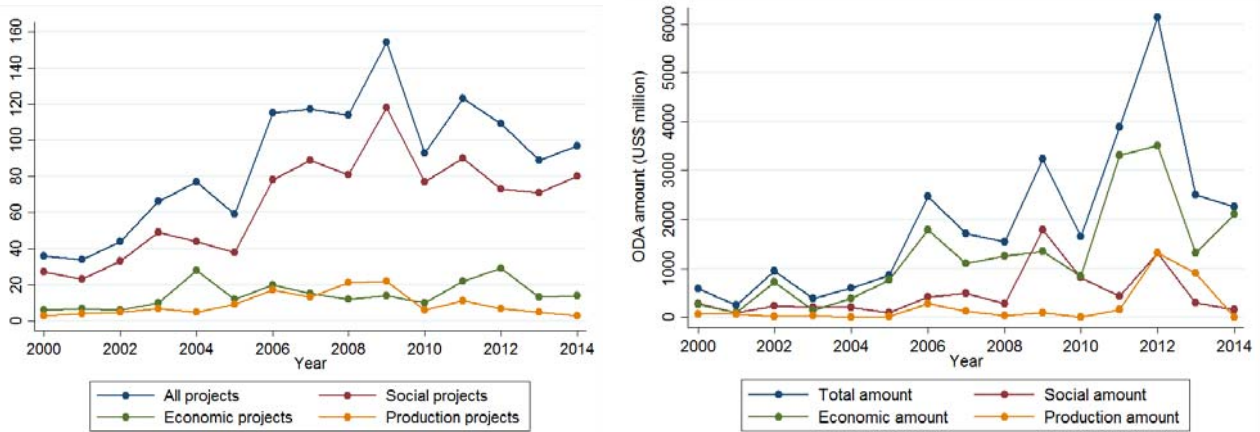
If we look at the Herfindahl-Hirschman concentration index, we can also note that Chinese aid to Africa is not very concentrated for the number of projects in the 3 sectors, but that it is notably more for the amount, and quite strongly for production sector (see Table A1 in Appendix A).

Table 3 displays the top 5 recipient countries for ODA projects and amount between 2000 and 2014. Four countries received no ODA project in either broad sector over the study period: Burkina Faso, Gambia, Sao Tome and Principe and Swaziland. When considering the 3 broad sectors together, 23 countries benefited from 1 to 20 projects and 10 from 21 to 74 projects. Over the study period, Tanzania is the country that received the highest number of all broad sectors projects with a total of 74 projects (5.6% of total ODA projects in the 3 broad sectors) including 53 projects in the social sector (5.5% of all social ODA projects) where it also ranks as the top recipient, 14 projects in the economic sector (6.4% of all economic ODA projects) where it ranks third and 7 projects (5.1% of all production ODA projects) in the production sector where it ranks fifth. The second highest recipient country is Zimbabwe with a total of 71 projects (5.4% of total) in the 3 broad sectors. Zimbabwe ranks as the top recipient country for production projects (with 11 projects, 8% of total), as the second highest recipient for social projects (with 47 projects, 4.8% of total) and as the fifth recipient for economic projects (with 13 projects, 6% of total). Uganda is the third highest recipient country with a total of 59 projects (4.4% of total). Uganda is also in the top 5 recipient countries for social and production projects with respectively 44 (4.5% of total) and 7 projects (5.1% of total). Liberia and Ghana complete the top 5 of recipient countries with 55 (4.1% of total) and 53 (4% of total) projects respectively in all 3 broad sectors. Liberia is also in the top 5 for social and production projects (41 and 10 projects, 4.2% and 7.2% of total) while Ghana is in the top 5 for social and economic projects (39 and 13 projects, 4% and 6% of total).

The country that received the highest amount of Chinese ODA in the 3 broad sectors between 2000 and 2014 is Tanzania, which is also the top recipient for the number of projects, with a total of almost US$3 billion (10.2% of the total ODA amount in the 3 broad sectors). Being ranked in the top 5 for ODA projects does not guarantee a country to be in the top 5 for ODA amount. Indeed, Tanzania and Zimbabwe are the only countries in the top 5 for both ODA projects and amount in

the 3 broad sectors. Three countries not previously listed in the top 5 of ODA projects appear in the top 5 for ODA amount in the 3 broad sectors: Cameroon, Nigeria and Ethiopia. Ranking modifications between ODA projects and amount might be explained by 2 factors; the larger size of ODA projects received by some countries or the higher prevalence of missing ODA amounts for other countries. If we only look at the economic sector, for which missing amounts of ODA projects are less frequent, we still find a difference in the ranking for ODA projects and amount. This indicates that Cote d'Ivoire, Eritrea, Zambia and the Republic of Congo, which rank in the top 5 for economic ODA amount but not for ODA projects, tended to benefit from larger economic ODA projects between 2000 and 2014.

Table 2: Evolution of ODA projects and amount by year and type of project

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	SD*/ mean
Total projects	36	34	44	66	77	59	115	117	114	154	93	123	109	89	97	0.40
Social projects	27	23	33	49	44	38	78	89	81	118	77	90	73	71	80	0.42
Economic projects	6	7	6	10	28	12	20	15	12	14	10	22	29	13	14	0.50
Production projects	3	4	5	7	5	9	17	13	21	22	6	11	7	5	3	0.69
Total amount (2014 US$ million)	586	246	952	385	590	861	2480	1716	1548	3234	1645	3890	6130	2507	2262	0.82
Social amount (2014 US$ million)	271	89	225	205	205	86	414	490	270	1785	808	424	1309	291	153	1.03
Economic amount (2014 US$ million)	258	93	713	145	384	761	1789	1095	1252	1349	838	3315	3508	1316	2109	0.83
Production amount (2014 US$ million)	57	64	14	35	0	14	278	131	26	100	0	151	1312	900	0	1.86

* Standard deviation

Table 3: Top 5 recipient countries by broad sector

ODA projects											
Country	**Total**	**%**	**Country**	**Social sector**	**%**	**Country**	**Economic sector**	**%**	**Country**	**Production sector**	**%**
Tanzania	74	5.6	Tanzania	53	5.5	Kenya	17	7.8	Zimbabwe	11	8
Zimbabwe	71	5.4	Zimbabwe	47	4.8	Zambia	15	6.9	Liberia	10	7.2
Uganda	59	4.4	Uganda	44	4.5	Tanzania	14	6.4	Niger	8	5.8
Liberia	55	4.1	Liberia	41	4.2	Ghana	13	6	Kenya	7	5.1
Ghana	53	4	Ghana	39	4	Zimbabwe	13	6	Sierra Leone. Tanzania. Uganda	7	5.1
ODA amount (2014 US$ billion)											
Country	**Total**	**%**	**Country**	**Social sector**	**%**	**Country**	**Economic sector**	**%**	**Country**	**Production sector**	**%**
Tanzania	2.97	10.2	Cameroon	1.25	17.8	Nigeria	2.01	10.6	Tanzania	1.31	42.3
Cameroon	2.88	9.9	Zimbabwe	1.06	15.1	Ethiopia	1.84	9.7	Cote d'Ivoire	1.02	33.1
Nigeria	2.04	7	Equatorial Guinea	0.48	6.8	Cameroon	1.57	8.3	Eritrea	0.30	9.6
Ethiopia	2.00	6.9	Kenya	0.37	5.3	Mozambique	1.50	7.9	Zambia	0.08	2.5
Zimbabwe	1.79	6.2	Uganda	0.34	4.8	Tanzania	1.43	7.6	Congo. Rep.	0.06	2

3. Methods

Following the literature on aid allocation (Berthélemy and Tichit, 2004; Dollar and Levine, 2006; Berthélemy, 2006; Nunnenkamp and Öhler, 2011) we consider 3 types of variables that might influence Chinese aid allocation: the needs and merits of African countries and the political and economic self-interests of China. To measure the needs of African countries we use the GDP per capita and the ratio of the total debt service[1] to Growth National Income (GNI). In robustness analysis, we use the Human Development Index (HDI) instead of the GDP per capita as an alternative measure of African countries' needs. To measure merits of recipient countries we use the control of corruption index of Kaufmann et al. (2011). This index is rated on a scale from -2.5 to 2.5 where a score of 2.5 represents the highest level of corruption control. In robustness analysis we test for the impact of another measure of corruption: the Corruption Perceptions Index (CPI, Transparency International). As alternative measures of merits, we also use 2 other Worldwide Governance Indicators, namely the regulatory quality and rule of law indexes (Kaufmann et al., 2011). We distinguish between economic and political interests of China. To measure Chinese economic interests we use 2 variables: the natural resources rent in African countries and their openness rate to China, both being measured as percentages of GDP. Political interests of China are taken into account by the use of 2 variables: the United Nations General Assembly (UNGA)

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[1] Total debt service is the sum of principal repayments and interest actually paid in currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the International Monetary Fund (IMF).

voting alignment of African countries with China (Strezhnev and Voeten, 2013) and a binary variable which is equal to 1 if the country has official diplomatic relations with Taiwan (Rich, 2009). As a control variable we also insert a binary variable equal to 1 if English is an official language in the recipient country. In order to test whether Chinese ODA is a complement or a substitute to ODA of traditional donors, we also insert ODA commitments of Development Assistance Committee (DAC) countries (OECD data) as an explanatory variable. Table B1 in Appendix B provides the definitions and data sources of all explanatory variables.

We study the number of ODA projects and the amount of ODA allocated by China to the different African countries. We stratify the analysis by broad ODA sectors and distinguish between ODA in the social, economic and production sectors. As financial valorization is lacking for more than half of social (60.7%) and production (54.3%) ODA projects, we restrict the analysis of ODA amount to the economic sector. To derive the value of Chinese ODA in the economic broad sector we first calculate ODA amounts by country-year for each of the 5 individual sectors included in the broad economic sector (transport and storage, communications, energy generation and supply, banking and financial services and business and other services). For each individual sector, the amount of Chinese ODA is equal to 0 if a country received no Chinese ODA project in a given year while it is coded as missing if financial valorization lacks for all projects received by a country in this sector a given year. If data on the financial amount is available for at least one project in the individual sector, the amount of ODA is calculated as the sum of every monetary values available for projects received by the country in a given year in this sector. After calculating ODA amounts in individual sectors, we derive the amount of economic ODA by summing the individual sectors' ODA amounts. For each country-year observation, the amount of economic ODA is equal to 0 if ODA amounts are null in all individual sectors. The amount of Chinese ODA in the economic broad sector is coded as missing if ODA amounts are lacking for all individual sectors. Otherwise, the value of Chinese economic ODA is calculated as the sum of all non-missing individual sectors' amounts. The overall correlation between economic ODA projects and amount is equal to 0.52 and is significant at the 1% level[2].

An important proportion of countries received no Chinese ODA project or amount each year. This leads to an overrepresentation of 0 values in our data. Thus, simple OLS regressions cannot be used as they would result in coefficients biased toward 0. This would ultimately lead to an underestimation of the impact of needs, merits and interests variables on Chinese ODA allocation. The overrepresentation of zeros in data is often dealt with specific econometric models such as two-part models or Heckman selection models. However, the use of such models would assume that China proceeds sequentially in its aid allocation decisions by first choosing the recipient countries and then deciding on the volume of ODA to allocate to these countries. This assumption appears unrealistic as the literature has shown the lack of centralization and coordination in Chinese aid policy which involves multiple actors at the national and regional levels (Grépin et al.,

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[2] Corresponding correlations are much lower for the social and production sectors, 0.2577 and 0.1992 respectively, due to a high share of missing values for the amount of ODA projects in these sectors.

2014; Lin et al., 2016). Instead, we decide to use maximum likelihood Poisson regressions to study both Chinese ODA projects and amount. Silva and Tenreyro (2006 and 2011) have demonstrated that Poisson models perform well in the presence of heteroskedasticity and many zero observations. Moreover, the use of Poisson regressions has become common in the trade literature to estimate gravity models (Shepherd, 2010; Fernandes et al., 2016; Anderson and Yotov, 2016) and Poisson regressions have recently been used to estimate the factors associated with DAC countries aid allocation (Acht et al., 2015). A body of the aid allocation literature also uses Tobit models to estimate factors associated with aid allocation (Berthélemy and Tichit, 2004; Nunnenkamp and Öhler, 2011). The Tobit model allows estimating the factors associated with the volume of aid while correcting for the downward bias introduced by the many 0 observations. In Tobit models, the estimation is done in one step such that independent variables are assumed to have similar impacts on the probability of receiving aid and on the volume of aid allocated among recipient countries. The main drawback of the Tobit model is the homoscedasticity condition it imposes on residuals. Because of this this limitation, we only use it to test the robustness of our results.

A part of the aid literature chooses to use aid shares of recipient countries in the total aid of the donor country, rather than absolute amounts of aid, as dependent variables (Neumayer, 2003. Clist, 2011; Acht et al., 2015). To test the robustness of results based on absolute volumes of Chinese aid, we also run regressions using the shares of Chinese aid received using fractional probit models. The share ODA projects received by a country in a given year is equal to the number of ODA projects received by this country this year divided by the total annual number of Chinese ODA projects to African countries. Similarly, the share of economic ODA amount received by a country in a given year is equal to the amount of economic ODA received by the country this year divided by the annual total amount of Chinese economic ODA to African countries.

To retain intra-country heterogeneity for the identification of factors associated with Chinese aid allocation we chose to use pooled regressions rather than fixed effect regressions. Indeed, fixed effect regressions wipe out intra-country heterogeneity over time and mainly rely on inter-country heterogeneity for the estimation of regressions coefficients. In our analysis, the use of fixed effect regressions would be problematic given the low variability over time and within country of some independent variables such as Taiwan recognition or the governance quality indicators. We include year fixed effects in all regression analyses and compute robust standard errors clustered at the country level. Following a common pattern in the aid allocation literature, we lag independent variables by one year (except ODA amount from DAC countries and the dummy variable for English speaking countries) in order to limit reverse causation concerns (Berthélemy and Tichit, 2004; Younas, 2008; Stubbs et al., 2016).

4. Results

4.1. Descriptive statistics

Table 4 provides the descriptive statistics of dependent variables for the sample used in regression analyses. Descriptive statistics for independent variable can be found in Table C1 in Appendix C.

Table 4: Descriptive statistics for the sample used in regression analyses

Variable	Obs.	Mean / %	Std. Dev.	Min	Max
Total ODA projects	578	1.925606	2.031725	0	11
Social ODA projects	578	1.385813	1.53015	0	7
Economic ODA projects	578	0.330449	0.691473	0	4
Economic ODA amount (2014 US$ million)	578	29.94396	111.8945	0	919.7054
Production ODA projects	578	0.209342	0.50931	0	3

In average, African countries received 1.93 Chinese ODA projects per year in all 3 broad sectors between 2000 and 2014. The maximum number of Chinese ODA projects received by an African country over a given year is 11 for Uganda in 2014. Over the 2000-2014 period, the mean annual number of social projects is 1.39 with a maximum of 7 for Uganda in 2009 and 2017, Sudan in 2009, Niger in 2010, Liberia in 2011 and Ghana in 2009. For economic and production projects, the mean number of projects received by African countries each year is much lower and equal to 0.33 and 0.21 respectively. The maximum numbers of economic and production projects received in a given year are 4 and 3 respectively. In average, African countries received US$29.9 million of economic ODA each year over the 2000-2014 period. The maximum economic ODA amount received over a given year is equal to US$919.7 million for Nigeria in 2006.

4.2. Results of regression analyses using ODA projects and amount

Table 5 displays the results of the main analysis using Poisson regressions. Results are expressed as incidence rate ratios (IRR) in order to quantify the impact of the independent variables on the dependent variables. A coefficient higher than 1 (lower than 1) indicates a positive (negative) correlation between the dependent and independent variables.

Table 5: Factors associated with Chinese ODA projects and amount

	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	0.950**	0.945***	0.974	0.938	0.943
	(0.0194)	(0.0189)	(0.0326)	(0.0609)	(0.0348)
Debt to GNI ratio	0.995***	0.993***	0.999	1.000	0.999
	(0.00181)	(0.00209)	(0.00367)	(0.0142)	(0.00240)
Population	0.993***	0.994***	0.994**	1.002	0.993**
	(0.00113)	(0.00128)	(0.00265)	(0.00350)	(0.00283)
Control of corruption index	0.798**	0.938	0.570***	0.775	0.455***
	(0.0819)	(0.110)	(0.0933)	(0.319)	(0.103)
Natural resources rent	1.010***	1.010***	1.016***	1.041***	0.998
	(0.00276)	(0.00338)	(0.00600)	(0.0127)	(0.00963)
Openness rate	1.002	1.005*	0.985***	0.892**	1.009
	(0.00210)	(0.00256)	(0.00425)	(0.0480)	(0.00540)
UNGA voting alignement	1.004**	1.004*	1.007	0.992	1.001
	(0.00189)	(0.00219)	(0.00454)	(0.00976)	(0.00499)
Taiwan recognition	0.0336***	0.0355***	0.0505***	0.0775**	9.04e-08***
	(0.0251)	(0.0257)	(0.0478)	(0.0798)	(4.33e-08)
English-speaking country	2.532***	2.148***	5.235***	4.422**	2.722***
	(0.252)	(0.230)	(1.038)	(2.563)	(0.763)
Total ODA DAC countries	1.000**				
	(0.000140)				
Social ODA DAC countries		1.000			
		(0.000176)			
Economic ODA DAC countries			1.001***	1.002***	
			(0.000456)	(0.000715)	
Production ODA DAC countries					1.002
					(0.00116)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	578	581	578	578	581

Incidence rate ratios ; * p<0.10, ** p<0.05, *** p<0.01

Needs. Lower levels of GDP per capita and debt service ratio are associated with higher levels of Chinese aid, as a whole and for the social sector. Regarding the needs variables, the GDP per capita in African countries is negatively correlated with the total number of Chinese ODA projects when considering the 3 broad sectors together. A US$1000 increase in GDP per capita is associated with a 5% decrease in the number of ODA projects received by African countries. When decomposing the analysis by sector, we find that the GDP per capita is significantly associated with the number of social projects but not with the number of economic or production projects nor the amount of economic ODA. A US$1000 increase in GDP per capita is associated with a 5.5% decrease in the number of Chinese social ODA projects received by African countries. When using the HDI as an alternative measure of needs, we again find a negative correlation between needs of African countries and the total number of projects in the 3 broad sectors as well as the number of

social projects. This alternative measure of needs is also negatively correlated with the number of ODA projects in the production sector (see Table D1 in Appendix D). As for the GDP per capita, the debt to GNI ratio is negatively associated with the total number of projects in the 3 broad sectors and the number of social ODA projects but not with the number of projects or the amount of ODA in the economic and production sectors. The correlations between the debt ratio and the total number of projects or the number of social projects are negative. There are however of low magnitude as a one percentage point increase in debt to GNI ratio is associated with only 0.5 and 0.7% decreases in the total number of projects and the number of social projects respectively. Similar to results obtained for traditional donors in the aid allocation literature, the size of the population is negatively correlated with the number of Chinese ODA projects, whatever the sector.

Merits. Lower control of corruption is associated with more aid, globally and for the economic and production sectors. Turning to merits variables, we find a negative correlation between the control of corruption index in African countries and the total number of Chinese ODA in the 3 broad sectors. African countries with higher levels of corruption received a higher number of all-sectors Chinese ODA projects between 2000 and 2014. When disaggregating the analysis by sector, we find that this overall association is driven by the economic and production sectors. Indeed, while there is no significant association between corruption and the number of social projects, the analysis highlights negative and significant correlations between the control of corruption index and the number of economic and production projects. For the economic sector, the association between corruption and the volume of Chinese ODA only holds for the number of projects. These results are confirmed for an alternative measure of corruption, the corruption perceptions index (see Table D2 in Appendix D). When using alternative measures of governance, we find a negative correlation between the regulatory quality index and the number of projects in the economic sector and a negative correlation between the rule of law index and the number of Chinese ODA projects in the production sector (see Table D3 and D4 in Appendix D).

Chinese economic interests. A high endowment in natural resources is a good context for benefiting from more Chinese ODA. On the contrary, foreign policy divergences with China have globally the opposite effect. Regarding Chinese economic interests, regression analyses point to a positive correlation between the natural resources rent in African countries and the total number of Chinese ODA projects. If we disaggregate the analysis by sector, we see that this association is only significant for the social and economic sectors. Moreover, the association is of higher magnitude for the economic sector compared to the social sector as a one percentage point increase in the natural resources rent is associated with a 1% increase in the number of social projects and a 1.6% increase in the number of economic projects. For the economic sector, results also show a positive correlation between the natural resources rent and the amount of ODA. A one percentage point increase in the natural resources rent is associated with a 4.1% increase in Chinese economic ODA amount. The openness rate of African countries to China is not significantly correlated with the number of ODA projects received in the 3 broad sectors. This lack of

significance is explained by the existence of opposite correlations between the openness rate to China and the number of Chinese ODA projects depending on the sector considered. Results indicate a positive, marginally significant and low correlation between the openness rate to China and the number of social ODA projects while they point to a negative and much stronger correlation between this variable and the number of economic projects. This negative association is confirmed when looking at economic ODA amount instead of projects. We find no significant correlation between the openness rate to China and the receipt of production projects.

Taiwan recognition by an African country almost systematically excludes it from the receipt of Chinese ODA, whatever the sector. Indeed, we find negative and very strong correlations between Taiwan recognition and Chinese ODA in all broad sectors. For the second Chinese political interests' variable, results show a positive correlation between the total number of ODA projects and UNGA voting alignment of African countries with China. A sectorial analysis indicates that social ODA projects are associated with this variable but not ODA in the economic or production sectors. The magnitude of these correlations are however low as a one percentage point increase in UNGA voting alignment with China is only associated with a 0.4% increases in social ODA projects and all-sectors ODA projects.

Regarding the relation between Chinese and DAC donors ODA, our results show that Chinese aid and DAC ODA commitments are positively correlated in the economic sector but not in the social or production sectors.

Robustness of results. Table 6 displays the results of the alternative regression analysis using Tobit specifications. These specifications broadly confirm our results. Results for needs and merits variables as well as for the natural resources rent are identical to those obtained using Poisson regressions. For the openness rate to China, we again find a positive correlation between this variable and the number of social projects and negative correlations with economic ODA projects and amount. However, using Tobit regressions, results now indicate a positive correlation between the openness rate to China and the number of Chinese ODA production projects. For the political interests' variables, we still find negative and very strong correlations between Taiwan recognition and the all types of Chinese ODA[3]. However, differences emerge with the Poisson specifications for the UNGA voting alignment with China variable. While we previously found that UNGA voting alignment with China was positively correlated with total ODA projects and ODA projects in the social sector, results now only point to a positive correlation between this variable and the number of ODA projects in the economic sector.

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[3] The Taiwan recognition variable was omitted in the estimation of the Tobit model production ODA projects given convergence issues.

Table 6: Tobit specifications for factors associated with Chinese ODA volume

	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	-0.119***	-0.105***	-0.0411	-7500447.0	-0.0430
	(0.0423)	(0.0356)	(0.0370)	(7867367.9)	(0.0347)
Debt to GNI ratio	-0.0166**	-0.0184***	-0.00359	-2895784.0	0.00466
	(0.00712)	(0.00553)	(0.00500)	(1893543.6)	(0.00391)
Population	-0.0204***	-0.0125***	-0.00989**	-374988.0	-0.00659*
	(0.00344)	(0.00266)	(0.00389)	(777915.3)	(0.00366)
Control of corruption index	-0.664**	-0.188	-0.644***	-52987371.6	-1.091***
	(0.301)	(0.255)	(0.229)	(42443913.0)	(0.296)
Natural resources rent	0.0240***	0.0176**	0.0228***	4197742.7***	0.804
	(0.00737)	(0.00745)	(0.00634)	(1360616.9)	(0.0127)
Openness rate	0.0200**	0.0277***	-0.0182***	-5215305.1***	0.0121*
	(0.00961)	(0.00771)	(0.00540)	(1297907.8)	(0.00722)
UNGA voting alignement	0.00712	0.00600	0.0105**	569851.7	0.00966
	(0.00513)	(0.00442)	(0.00532)	(1370450.7)	(0.00722)
Taiwan recognition	-6.075***	-4.649***	-2.942***	-419845214.8***	
	(0.729)	(0.619)	(0.740)	(139420934.9)	
English-speaking country	2.456***	1.571***	2.052***	280468538.2***	1.083***
	(0.310)	(0.254)	(0.270)	(51784032.4)	(0.288)
Total ODA DAC countries	0.000867*				
	(0.000470)				
Social ODA DAC countries		0.000564			
		(0.000515)			
Economic ODA DAC countries			0.00144*	252832.8	
			(0.000833)	(159058.0)	
Production ODA DAC countries					0.00213
					(0.00145)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	578	581	578	578	581

Standard errors in parentheses ; * p<0.10, ** p<0.05, *** p<0.01

4.3. Results of regressions analyses using aid shares

Results are confirmed by analyses based on aid shares (number of projects and amounts). Results of regression analyses using aid shares are very similar to those obtained using absolute volumes of Chinese ODA. For needs variables we again find negative correlations between the GDP per capita in African countries and the number of Chinese ODA projects in the 3 broad sectors as well as the number of social ODA projects. Contrary to the previous analysis, we now also find a negative correlation between the share of production projects and the GDP per capita. For the debt to GNI ratio results are identical to the previous analysis. The debt ratio is negatively correlated with the share of total projects in the 3 broad sectors and the share of social projects. Results using aid shares again point to a negative association between the size of the population and Chinese aid

allocation. The population size is negatively correlated with the shares of Chinese ODA projects received globally and in the 3 individual sectors.

Table 7: Factors associated with Chinese ODA shares

	Share of Chinese ODA				
	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	-0.0210**	-0.0227***	-0.00910	-0.0231	-0.0257*
	(0.00830)	(0.00820)	(0.0136)	(0.0199)	(0.0140)
Debt to GNI ratio	-0.00218**	-0.00292***	-0.000477	-0.00928	-0.00109
	(0.000953)	(0.00111)	(0.00139)	(0.00854)	(0.00193)
Population	-0.00325***	-0.00313***	-0.00374**	-0.000714	-0.00214
	(0.000563)	(0.000548)	(0.00162)	(0.00155)	(0.00161)
Control of corruption index	-0.131***	-0.0765	-0.265***	0.0231	-0.416***
	(0.0453)	(0.0513)	(0.0906)	(0.147)	(0.126)
Natural resources rent	0.00444***	0.00444***	0.00651**	0.0158***	0.000217
	(0.00108)	(0.00129)	(0.00256)	(0.00379)	(0.00550)
Openness rate	0.000747	0.00219*	-0.00845***	-0.0300**	0.00322
	(0.000977)	(0.00113)	(0.00199)	(0.0152)	(0.00305)
UNGA voting alignement	0.00220**	0.00232**	0.00452**	0.00232	0.00217
	(0.000870)	(0.000948)	(0.00189)	(0.00344)	(0.00249)
Taiwan recognition	-1.221***	-1.179***	-1.019***	-0.977***	-3.744***
	(0.189)	(0.189)	(0.300)	(0.306)	(0.130)
English-speaking country	0.430***	0.352***	0.752***	0.720***	0.446***
	(0.0457)	(0.0480)	(0.0905)	(0.154)	(0.130)
Total ODA DAC countries	0.000130*				
	(0.0000674)				
Social ODA DAC countries		0.000139			
		(0.0000877)			
Economic ODA DAC countries			0.000784***	0.000998***	
			(0.000256)	(0.000373)	
Production ODA DAC countries					0.000760
					(0.000906)
Constant	-2.503***	-2.456***	-2.916***	-2.768***	-2.636***
	(0.0931)	(0.0980)	(0.205)	(0.360)	(0.278)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	578	581	578	578	581
Standard errors in parentheses ; * p<0.10, ** p<0.05, *** p<0.01					

Regarding the merits variable, our results indicate that the control of corruption index is negatively correlated with the shares of economic and production projects as well as the share of projects in the 3 sectors. These results are similar to those obtained using the number of aid projects.

For Chinese economic interests' variables, results are perfectly similar to those obtained when studying the absolute volume if Chinese aid. The natural resources rent is positively correlated with the share of all-sectors projects, with the shares of social and economic projects and with the share

of economic ODA amount. As in the previous analysis, the openness rate to China is positively correlated with the share of social projects but negatively correlated with the shares of economic projects and amount.

Similar to what was found in the analysis using aid volumes, Taiwan recognition is negatively and very strongly correlated with the shares of Chinese ODA projects in all individual sectors and the share of economic ODA. Once again, results indicate a positive correlation between UNGA voting alignment with China and the share of social projects as well as the share of all-sectors ODA projects. UNGA voting alignment of African countries with China is now also positively correlated with the share of economic projects received while this variable was not previously significantly correlated with the number of economic projects.

When using the shares of Chinese ODA instead of absolute aid volumes, we again find a positive correlation between economic ODA commitments of DAC countries and Chinese economic ODA.

5. Discussion

This paper provides a sectorial analyses of the determinants of Chinese aid allocation in African countries. We consider 3 types of ODA sectors; the social infrastructure and services sector, the economic infrastructure and services sector and the production sector. We study the differentiated impacts of African countries needs and merits as well as Chinese interests on aid allocation decisions of China in these 3 broad sectors. Our results show the need of disaggregating the analysis by sector when studying the determinants of Chinese ODA in Africa. Indeed, any analysis considering all-sectors ODA might lead to misleading results as we find that needs, merits and interest variables exert different influences on Chinese aid allocation decisions depending on the sector considered. Our main results are summarized thereafter.

First, GDP per capita matters for getting Chinese ODA in the social sector, but not in other sectors. Our results show that needs of African countries, as measured by the GDP per capita, influence the allocation of Chinese ODA in the social sector but not in the economic or production sectors. Dreher and Fuchs (2015) find total Chinese ODA projects and amount are negatively correlated with the GDP per capita of recipient countries over the 1996-2006 period while Dreher et al. (2018) find that GDP per capita in African countries is negatively correlated with the total amount of all-sectors ODA they received from China between 2000 and 2013. Our results also indicate a negative association between GDP per capita in African countries and the receipt of all-sectors Chinese ODA projects. In addition, our results show that this overall association is driven by projects received in the social sector and that this pattern is not confirmed for the economic and production sectors. This is coherent with results of Guillon and Mathonnat (2017) who find a negative correlation between the GDP per capita of African countries and the number health ODA projects they received from China over the 2006-2013 period.

Second, Chinese ODA to the economic and production sectors is rather moving towards countries with weak quality of governance, but this is not the case for social sector. We find that the quality of governance in African countries; as measured by several governance variables related to corruption, regulatory quality or rule of law; is negatively correlated with Chinese aid allocation in the economic and production sectors but unrelated with Chinese ODA in the social sector. This second result indicates that African countries with weaker political governance tend to benefit more from Chinese ODA in the economic and production sectors. It is in line with results found in the literature studying the determinants of Chinese FDI. For example, Buckley et al. (2007) find that Chinese FDI over the 1984-2001 period is associated with lower levels of political stability in recipient countries. Sanfilippo (2010) investigates the determinants of Chinese FDI in African countries between 1998 and 2007 and also finds that Chinese FDIs are more important in African countries with lower civil liberties. In several papers, Kolstad and Wiig (2011, 2012) show that Chinese FDIs are attracted to African countries with a combination of large natural resources and poor institutions as measured by the rule of law index. Then, Chinese ODA allocation decisions tend to follow the same motivations as FDI allocation decisions in the economic and production sectors. Previous studies on the determinants of Chinese ODA have found that governance in recipient countries neither influences the global volume of Chinese ODA in terms of projects number or amount (Dreher and Fuchs, 2015; Dreher et al. 2018) nor Chinese health aid projects number or amount (Guillon and Mathonnat, 2017). We also find no significant association between our governance variables and the total number of Chinese ODA projects in African countries. However, our results confirm the global pattern for the social sector but reject it for the economic and production sectors. Thus, our results allow for a better understanding of the association between political governance in recipient countries and Chinese ODA.

Third, our results indicate that African countries with high endowments of natural resources tend to receive more Chinese ODA when considering the 3 broad sectors all together. This finding contradicts those of Dreher and Fuchs (2015[4]) and Dreher et al. (2018) who find no association between oil endowment of recipient countries and Chinese ODA[5]. Our results indicate that the association between the natural resources rent and the volume of Chinese ODA holds in the social and economic sectors but not in the production sector. Our result regarding the positive correlation between the natural resources rent and the number of social ODA projects is in line with those of Guillon and Mathonnat (2017) who find that China allocated slightly more health aid projects to African countries with a high endowment of natural resources between 2006 and 2013.

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[4] Based on the previous version of the database.
[5] Differences in results might partly be owing to the fact that we use the number of ODA projects, rather than ODA amount as in Dreher and Fuchs (2015) and Dreher et al. (2018), given the high number of social and production sectors' ODA projects lacking financial valorization. Moreover, we do not consider all ODA projects as in Dreher and Fuchs (2015) and Dreher et al. (2018) but only projects related to the social, economic and production sectors that constitute 84% of all Chinese ODA projects to African countries between 2000 and 2014.

Our results also point to a positive association between the openness rate to China and the overall number of all broad sectors Chinese ODA projects received by African countries. This is in line with the findings of Dreher and Fuchs (2015) who find, over the 1996-2006 period, a positive correlation between China's total exports to a recipient country and the number of Chinese ODA projects it received. However, it contradicts results of Dreher et al. (2018) who find no association between the volume of trade with China and the total amount of ODA received by African countries[6]. If a sectorial analysis of Chinese ODA allocation decisions is not conducted, global results might be misleading for the impact of economic ties with China on the receipt of Chinese ODA. Indeed, we find that the openness rate to China is positively correlated with the number of social projects but uncorrelated with the number of production projects. On the other hand, the openness rate to China is negatively correlated with the number and amount of Chinese ODA projects in the economic sector. Economic motivations behind Chinese aid then seem to differ depending on the sector considered. Our results tend to indicate that aid in the social sector, as shown for health aid (Guillon and Mathonnat, 2017), is used as a reward for the opening of domestic markets in African countries. On the contrary, countries which trade less with China tend to received more Chinese economic ODA, especially in the energy generation and supply sector that mainly gathers infrastructure projects relating to power plants construction or rehabilitation[7]. Then, Chinese economic ODA in Africa does not appear conditional on economic ties of African countries with China.

Fourth, as observed in all previous studies of Chinese ODA determinants, our results indicate that adherence to the One-China policy is a necessary condition to benefit from Chinese ODA. This is true for all aid sectors and whether studying the number of ODA projects or ODA amount. UNGA voting alignment with China is positively correlated with the number of ODA projects received when considering the 3 broad sectors together. This result differs from those obtained by Dreher and Fuchs (2015) who find no association between UNGA voting alignment with China and all-sectors Chinese ODA amount and projects received over the 1996-2006 period. It also differs from findings of Dreher et al. (2018) who show that the total amount of Chinese ODA received by African countries between 2000 and 2012 is independent of their UNGA voting alignment with China. A possible explanation for these conflicting results could rely on the fact that ODA projects are more reactive than ODA amount to UNGA voting patterns of African countries. Indeed, projects relating to technical assistance such as trainings, scholarships or the sending of Chinese experts, whose financial valorization is more often lacking, are more easily cancelled than costly infrastructure projects in cases of political disagreements between China and an African country. Again, our analysis stresses out the need to disaggregate the analysis by ODA sectors when studying the factors associated with Chinese ODA. Indeed, UNGA voting alignment of African countries with China appears to be associated with the number of social ODA projects (which more

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[6] Idem.

[7] When looking at Chinese ODA by individual sectors, we find that the negative correlation between the openness to China and the receipt of economic projects is mainly driven by the energy supply and generation sector (results not shown).

often correspond to technical assistance projects in the form of training, scholarships or sending of Chinese experts) and, to a lesser extent, to the number of economic ODA projects. However, it appears unrelated to the amount of economic ODA or the number of production projects received.

Overall, it appears that Chinese ODA allocation decisions rely on different motivations depending on the sector considered. While Chinese ODA in the social sector is more responsive to the economic needs of recipient countries, it also appears to be driven by foreign policy considerations. We find some evidence that Chinese economic interests, in particular for natural resources acquisition, are associated with China's ODA allocation in general and more specifically in the economic sector. Finally, while governance quality in recipient countries is unassociated with ODA in the social sector, our results show that China tend to allocate more economic and production ODA to African countries with weaker institutions similar to what is observed for its FDI allocation.

Our work is not without limitations. Chinese ODA data used in the analysis are less complete than those available for OECD countries or international organizations. In particular, the financial valorization of ODA is lacking for a high number of projects. This led us to restrict the analysis of ODA amount to the economic sector where the financial valorization of ODA projects is less often missing. However, Chinese official ODA data are very sparse due to a large fragmentation of funding agencies (China Ministry of Commerce, Export-Import Bank of China, China Development Bank and various provincial agencies among others) and possibly owing to a will of Chinese authorities to retain specific information on overseas development activities. Despite the limitations of the data we use, we believe our results bring new and important information on the underlying motivations of Chinese aid allocation in the absence of comprehensive official ODA data, one strong conclusion of this study being, as we have pointed out, the need to disaggregate the analysis by ODA sectors.

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Appendix A: Herfindahl-Hirschman concentration indexes for projects and amount by sector

Table A1: Herfindahl-Hirschman concentration indexes for projects and amount

Herfindahl-Hirschman concentration indexes					
Social sector		Economic sector		Production sector	
Projects	Amount	Projects	Amount	Projects	Amount
0.0321	0.1617	0.0749	0.1277	0.0722	0.4767

Appendix B: Description of variables used in the regression analyses

Table B1: Definition and source of variables used in regression analyses

Variable name	Definition	Source
Total projects	Number of Chinese ODA projects in the social, economic and production sectors	AidData's Dataset
Social projects	Number of Chinese ODA projects in the social sector	AidData's Dataset
Economic projects	Number of Chinese ODA projects in the economic sector	AidData's Dataset
Economic amount	Amount of Chinese ODA in the economic sector (2014 US$)	AidData's Dataset
Production projects	Number of Chinese ODA projects in the production sector	AidData's Dataset
GDP per capita	GDP per capita in thousand (2011 US$), lag	World Bank data
Debt to GNI ratio	Total debt service (sum of principal repayments and interest actually paid in currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments to the IMF) in % of GNI, lag	World Bank data
Population	Population in million, lag	World Bank data
Control of corruption index	Index representing the control of corruption ranging from -2.5 to 2.5 with higher values corresponding to better governance, lag	World Bank data from the Worldwide Governance Indicators (Kaufmann et al., 2011) ; https://data.worldbank.org/
Natural resources rent	The total natural resources rent, is the sum of oil, natural gas, coal (hard and soft), mineral and forest rents, expressed in % of GDP, lag	World Bank data ; https://data.worldbank.org/
Openness rate	Exports of China to recipient countries plus exports of recipient countries to China, expressed as % of African countries' GDP, lag	World Integrated Trade Solution ; https://wits.worldbank.org/
UNGA voting alignment	Voting alignment in the United Nations General Assembly with China in all vote, expressed in %, lag	Strezhnev and Voeten (2013)
Taiwan recognition	Equal to 1 if the country has diplomatic relations with Taiwan and 0 otherwise, lag	Rich (2009), own calculation
English-speaking country	Equal to 1 if English is an official language in the country and 0 otherwise	Own calculation
Total ODA DAC countries	ODA commitments of DAC countries in the social, economic and production sectors, 2015 US$ million	OECD ; http://www.oecd-ilibrary.org/development/data/detailed-aid-statistics_dev-aid-stat-data-en

Social ODA DAC countries	ODA commitments of DAC countries in the social sector, 2015 US$ million	OECD ; http://www.oecd-ilibrary.org/development/data/detailed-aid-statistics_dev-aid-stat-data-en
Economic ODA DAC countries	ODA commitments of DAC countries in the economic sector, 2015 US$ million	OECD ; http://www.oecd-ilibrary.org/development/data/detailed-aid-statistics_dev-aid-stat-data-en
Production ODA DAC countries	ODA commitments of DAC countries in the production sector, 2015 US$ million	OECD ; http://www.oecd-ilibrary.org/development/data/detailed-aid-statistics_dev-aid-stat-data-en
HDI	Human development Index, lag	World Bank data ; https://data.worldbank.org/
Corruption perceptions Index	The corruption perceptions index ranks countries based on how corrupt a country's public sector is perceived to be. It ranges between 0 (highly corrupt) and 10 (very clean), lag	Transparency International ; https://www.transparency.org/research/cpi/overview
Rule of law Index	The regulatory quality index rates the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. It is measured on a scale from -2.5 to 2.5 where the score of 2.5 represents the best political governance, lag	World Bank data from the Worldwide Governance Indicators (Kaufmann et al., 2011) ; https://data.worldbank.org/
Voice and accountability Index	The rule of law index measures the extent to which agents have confidence in and abide by the rules of society. It is measured on a scale from -2.5 to 2.5 where the score of 2.5 represents the best political governance, rights, the police, and the courts), lag	World Bank data from the Worldwide Governance Indicators (Kaufmann et al., 2011) ; https://data.worldbank.org/

Appendix C: Descriptive statistics of independent variables

Table C1: Descriptive statistics of independent variables

Variable	Obs.	Mean / %	Std. Dev.	Min	Max
GDP per capita (2011 US$)	578	3779.709	4113.115	492.607	18171.9
Debt to GNI ratio	578	3.013914	7.814267	.06151	135.376
Population (million)	578	20.32137	27.452	0.13716	172.8165
Control of corruption index	578	-0.593172	0.541979	-1.56607	1.24967
Natural resources rent (% of GDP)	578	15.54244	15.30094	.001854	77.0545
Openness rate (% of GDP)	578	2.024906	6.249	.0048387	83.77744
UNGA voting alignment (%)	578	72.80586	19.25451	0	95.89041
Taiwan recognition					
Yes (%)		9.69			
No (%)		90.31			
English as official language					
Yes (%)		43.77			
No (%)		56.23			
Total ODA commitments DAC countries (2015 US$ million)	578	315.3663	360.2944	3.67707	2923.09
Social ODA commitments DAC countries (2015 US$ million)	578	221.3089	252.5458	2.315479	2628.62
Economic ODA commitments DAC countries (2015 US$ million)	578	58.33875	123.1154	.005865	1003.1
Production ODA commitments DAC countries (2015 US$ million)	578	35.71864	56.13234	.019719	539.7914

Mean GDP per capita of African countries between 1999 and 2013 was US$3780 (2011 US$) with a high heterogeneity as the standard deviation is equal to US$4113, the minimum to US$493 and the maximum to US$18,172. In average, the total debt service represented 3% of African countries' GNI. Again, we see a large variability in debt to GNI ratios as, over a given year, the least indebted country had a debt to GNI ratio of 0.06% and the most indebted country a debt to GNI ratio of 135%. Mean population in the sample is 27.452 million with a minimum of 0.14 million and a maximum of 172.82 million. Almost half of African countries (43.8%) have adopted English as one of their official languages.

The mean value of the control of corruption index is -0.59, which indicates a high level of corruption among African countries in our sample over the 1999-2013 period. In average, the natural resources rent was equal to 15.5% among African countries between 1999 and 2013. The maximum value of the natural resources rent (77.1%) is reached by the Republic of Congo in 2007. The mean openness rate to China is only 2% but with large variations across the sample. Among the sample used in regression analyses, the highest openness rate to China (83.8%) is exhibited by Liberia in 2012. UNGA voting alignment of African countries with China is high and equal to 71.5% on average. In Africa, few countries chose to recognize Taiwan between 1999 and 2013 (only 9.7%

of country-year observations). ODA commitments of DAC countries to African countries in the 3 broad sectors averaged US$315.4 (2015 US$) million over the 1999-2013 period. Mean ODA commitments of DAC countries were higher in the social sectors (US$221.3 million) than in the economic sector (US$58.34 million) or the production sector (US$35.7 million).

Appendix D: Results of regression analysis using alternative measures of needs and merits

Table D1: Regression analyses using the HDI as an alternative measure of needs

	Total projects	Social projects	Economic projects	Economic amount	Production projects
HDI	0.192**	0.198**	0.817	0.259	0.0309***
	(0.125)	(0.133)	(1.009)	(0.701)	(0.0413)
Debt to GNI ratio	0.994***	0.992***	0.998	0.996	0.999
	(0.00197)	(0.00244)	(0.00371)	(0.0146)	(0.00237)
Population	0.992***	0.993***	0.994**	1.001	0.994**
	(0.00128)	(0.00144)	(0.00263)	(0.00319)	(0.00285)
Control of corruption index	0.781**	0.894	0.535***	0.706	0.515***
	(0.0819)	(0.111)	(0.0822)	(0.302)	(0.102)
Natural resources rent	1.011***	1.010**	1.016***	1.040***	1.000
	(0.00366)	(0.00445)	(0.00618)	(0.0123)	(0.00931)
Openness rate	1.002	1.005*	0.986***	0.906**	1.007
	(0.00230)	(0.00276)	(0.00454)	(0.0429)	(0.00540)
UNGA voting alignement	1.004**	1.004*	1.007	0.992	1.003
	(0.00200)	(0.00231)	(0.00434)	(0.0102)	(0.00487)
Taiwan recognition	0.0332***	0.0350***	0.0496***	0.0721**	0.000000122***
	(0.0248)	(0.0255)	(0.0473)	(0.0755)	(5.75e-08)
English-speaking country	2.666***	2.246***	5.591***	4.939***	2.981***
	(0.262)	(0.245)	(1.132)	(2.685)	(0.729)
Total ODA DAC countries	1.000***				
	(0.000133)				
Social ODA DAC countries		1.000**			
		(0.000171)			
Economic ODA DAC countries			1.001***	1.002***	
			(0.000458)	(0.000772)	
Production ODA DAC countries					1.002**
					(0.00118)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	566	569	566	566	569
Incidence rate ratios ; * p<0.10, ** p<0.05, *** p<0.01					

Table D2: Regression analyses using the CPI as an alternative measure of merits

	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	0.942***	0.932***	0.973	0.960	0.967
	(0.0209)	(0.0195)	(0.0390)	(0.0656)	(0.0410)
Debt to GNI ratio	0.994***	0.993***	0.997	0.998	0.997
	(0.00181)	(0.00212)	(0.00390)	(0.0141)	(0.00241)
Population	0.993***	0.994***	0.995*	1.001	0.994**
	(0.00121)	(0.00136)	(0.00273)	(0.00354)	(0.00297)
Corruption perceptions index	0.995	1.007	0.974**	0.963	0.947***
	(0.00598)	(0.00649)	(0.0121)	(0.0249)	(0.0175)
Natural resources rent	1.013***	1.013***	1.019***	1.043***	0.999
	(0.00290)	(0.00354)	(0.00652)	(0.0144)	(0.00954)
Openness rate	1.001	1.003	0.988***	0.894*	1.011*
	(0.00212)	(0.00248)	(0.00439)	(0.0527)	(0.00592)
UNGA voting alignement	1.003	1.003	1.004	0.994	1.006
	(0.00208)	(0.00234)	(0.00476)	(0.0101)	(0.00611)
Taiwan recognition	0.0291***	0.0266***	0.0591***	0.0875**	0.000000451***
	(0.0262)	(0.0242)	(0.0553)	(0.0881)	(0.000000232)
English-speaking country	2.516***	2.151***	5.213***	5.252***	2.614***
	(0.274)	(0.251)	(1.100)	(3.249)	(0.692)
Total ODA DAC countries	1.000**				
	(0.000137)				
Social ODA DAC countries		1.000			
		(0.000168)			
Economic ODA DAC countries			1.001***	1.002***	
			(0.000454)	(0.000728)	
Production ODA DAC countries					1.001
					(0.00135)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	523	524	523	523	524

Incidence rate ratios ; * p<0.10, ** p<0.05, *** p<0.01

Table D3: Regression analyses using the regulatory quality index as an alternative measure of merits

	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	0.938***	0.939***	0.952	0.925	0.890***
	(0.0193)	(0.0183)	(0.0335)	(0.0519)	(0.0323)
Debt to GNI ratio	0.995**	0.993***	1.000	1.001	0.998
	(0.00202)	(0.00222)	(0.00381)	(0.0140)	(0.00272)
Population	0.994***	0.994***	0.996	1.003	0.996
	(0.00109)	(0.00131)	(0.00250)	(0.00303)	(0.00322)
Regulatory quality index	0.958	1.024	0.768**	0.981	0.997
	(0.0855)	(0.0937)	(0.0914)	(0.275)	(0.227)
Natural resources rent	1.013***	1.011***	1.020***	1.044***	1.007
	(0.00264)	(0.00294)	(0.00593)	(0.0128)	(0.00956)
Openness rate	1.001	1.004*	0.985***	0.890**	1.005
	(0.00191)	(0.00238)	(0.00388)	(0.0500)	(0.00488)
UNGA voting alignement	1.004*	1.004*	1.006	0.992	1.000
	(0.00203)	(0.00231)	(0.00450)	(0.0102)	(0.00490)
Taiwan recognition	0.0342***	0.0354***	0.0540***	0.0783**	0.000000438***
	(0.0255)	(0.0256)	(0.0516)	(0.0807)	(0.000000203)
English-speaking country	2.434***	2.133***	4.746***	4.166***	2.462***
	(0.247)	(0.229)	(0.892)	(2.179)	(0.703)
Total ODA DAC countries	1.000**				
	(0.000135)				
Social ODA DAC countries		1.000			
		(0.000176)			
Economic ODA DAC countries			1.002***	1.002***	
			(0.000470)	(0.000721)	
Production ODA DAC countries					1.001
					(0.00146)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	578	581	578	578	581

Incidence rate ratios ; * p<0.10, ** p<0.05, *** p<0.01

Table D4: Regression analyses using the rule of law index as an alternative measure of merits

	Total projects	Social projects	Economic projects	Economic amount	Production projects
GDP per capita	0.939***	0.934***	0.948	0.919	0.931*
	(0.0211)	(0.0201)	(0.0338)	(0.0590)	(0.0406)
Debt to GNI ratio	0.995***	0.993***	0.999	1.002	0.998
	(0.00176)	(0.00200)	(0.00380)	(0.0139)	(0.00234)
Population	0.994***	0.994***	0.995*	1.003	0.995*
	(0.00124)	(0.00145)	(0.00251)	(0.00360)	(0.00305)
Rule of law index	0.949	1.092	0.840	1.070	0.621**
	(0.115)	(0.150)	(0.148)	(0.429)	(0.135)
Natural resources rent	1.012***	1.012***	1.020***	1.045***	1.001
	(0.00272)	(0.00322)	(0.00609)	(0.0120)	(0.00903)
Openness rate	1.001	1.004*	0.983***	0.888**	1.006
	(0.00219)	(0.00256)	(0.00431)	(0.0485)	(0.00513)
UNGA voting alignement	1.004*	1.004	1.008	0.992	1.001
	(0.00223)	(0.00259)	(0.00471)	(0.0100)	(0.00456)
Taiwan recognition	0.0342***	0.0351***	0.0531***	0.0776**	0.000000469***
	(0.0256)	(0.0253)	(0.0511)	(0.0803)	(0.000000213)
English-speaking country	2.464***	2.105***	4.939***	4.084**	2.580***
	(0.263)	(0.239)	(0.963)	(2.364)	(0.739)
Total ODA DAC countries	1.000**				
	(0.000135)				
Social ODA DAC countries		1.000			
		(0.000167)			
Economic ODA DAC countries			1.001***	1.002***	
			(0.000475)	(0.000705)	
Production ODA DAC countries					1.002*
					(0.00119)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	578	581	578	578	581

Incidence rate ratios ; * p<0.10, ** p<0.05, *** p<0.01

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

Pascal