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Does aid to the productive sectors cause manufacturing sector growth in Africa?

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Abstract: In recent decades, Africa has received a large share of official development assistance compared to other regions of the world. Using AidData for 2000–13, this paper examines the effects of aid to productive sectors on manufacturing growth in Africa. Econometric results show that increased assistance to these sectors is associated with an increase in growth of the manufacturing sector, with complementary effects from allocations to economic services and infrastructures. However, dynamic panel regression results show a positive long-term link between increased official development assistance to productive sectors and growth of the manufacturing sector. These findings make an important contribution to the economic literature where there is controversy over aid effectiveness at the macro level. The findings also have policy implications for allocation of aid between sectors by making rational trade-offs related to their amount and quality, with emphasis on productive sectors where investment has a major impact on growth of the manufacturing industry.

Key words: aid, allocation, productive sectors, growth, manufacturing

JEL classification: B22, C23, F35, P33

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Note: As the research is part of the author's PhD work, he will hold copyright to facilitate publication of the thesis.

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1 Introduction

Despite consistent aid flows to Africa, the level of economic development there is low when compared to other regions across the world. Indeed, Africa's gross domestic product (GDP) per capita (US$1,779) is five times lower than the world's GDP per capita (US$289). More specifically, developing countries in Africa have the lowest GDP per capita in the world at US$603, except for North African countries at US$3,103 (Table C1). Between 1990 and 2018, total aid from the Organisation for Economic Co-operation and Development's Development Assistance Committee (OECD-DAC) to developing countries increased from US$105.2 billion to US$1,900.1 billion, an increase of 80.7 per cent.[1] Over this period, the share allocated to Africa increased by more than two-thirds, on average, from US$39.3 to US$65.3 billion, an increase of 66.1 per cent.[2] This also translates to the highest average per capita official development assistance (ODA) of US$43.7 over the same period in sub-Saharan Africa, compared to countries in North Africa and the Middle East at US$47.6 (Table C3). In addition, the contributions to Africa by other non-DAC donor countries, including China, have been driving these figures up, with 14.6 per cent of this aid being provided by China (Dreher et al. 2020). Indeed, the total amount of aid allocated to African countries increased by 96.2 per cent from US$48.7 billion to US$95.1 billion between 2000 and 2013[3] (Table C2).[4]

Despite the increase in the total amount of aid, the current situation is dominated by a sectoral allocation towards the socio-economic sectors and infrastructure (Figure B1). As a result, between 2000 and 2013, a greater amount of aid was disproportionately allocated to infrastructure and social services (28.8 per cent on average) and infrastructure and economic services (24.4 per cent) than to the productive sector (8.9 per cent). Even if the level of aid allocated to the productive sectors is lower compared to other sectors, its evolution in terms of growth is relatively high in comparison to other sectors (Figure B2). Indeed, its growth rate was estimated to be 21.0 per cent and 6.0 per cent for the 2005–2009 and 2010–13 periods, respectively, while it was -10.2 per cent for 2000–04.

Moreover, African countries also face constraints in financing their general development and particularly their manufacturing sector. Indeed, sub-Saharan African countries have had weak ability to mobilize domestic savings because their relative share of GDP was 22.3 per cent between 2000 and 2019. This represents 37.3 per cent of GDP for North African countries and the Middle East (Table C3). More specifically, it is difficult for them to mobilize these domestic resources and to invest them in productive sectors that are able to generate jobs (Boukari 2014).

At a time when foreign direct investment (FDI) in sub-Saharan Africa represents only 2.5 per cent of net FDI inflows in relation to GDP allocated to all sectors, the share of net ODA received in relation to gross capital formation is the highest at 15.4 per cent compared to the other regions (Table C1). Furthermore, most FDI to Africa is captured by resource-rich countries (UNECA 2012) and ODA tends to go to countries where private financing flows are low (Boukari 2014; Chauvet and Mesplé-Somps 2007). In addition, having insufficient domestic resources to finance

[1] The words foreign aid, aid, development aid, official development assistance (hereafter ODA) are used interchangeably in this paper.

[2] Total public sector flows by country and region (ODA+OOF (other official flows)) on the OECD website.

[3] According to AidData – combining aid commitments from DAC and non-DAC donors including China, obtained from two databases of AidData's Core Research Release Version 3.0 and AidData Global Chinese Official Finance Dataset available for the period 2000–13.

[4] According to DAC data from the OECD.

economic activity forces developing countries to resort to development aid or expensive external debt (Boukari 2014). Bearing this in mind, the United Nations (UN) and African Development Bank have been demonstrating a commitment to mobilizing the capital needed for industrialization through the pursuit of target 9.2 of Sustainable Development Goal 9 and Agenda 2063, respectively.

Regarding industrial development, African countries have enormous industrial potential, particularly in the food and beverage (agro-industry), textile, and clothing sectors. Barely 30 per cent of agricultural production in these countries is undergoing industrial transformation (United Nations 2019). The UN Industrial Development Organization's Industrial Development Report 2018 (UNIDO 2018) also shows that the growth of the manufacturing sector is at the heart of the diversification process and massification of demand.

While ODA allocated to the productive sector is not the only source of financing for the development of the manufacturing sector, it is pertinent to question the effects it can stimulate if it is scaled up through good intersectoral coordination. More specifically, does an increase in ODA to the productive sectors lead to growth in the manufacturing sector? [5]

This paper seeks to examine the effects on the growth of the manufacturing sector of ODA to the productive sector in 26 African countries (Table A1) over the 2000–13 period. We use the amount of aid allocated to the productive sector, combining all sectoral ODA commitments by member and non-member countries of the DAC, including China.[6] The manufacturing value-added data are taken from the UNIDO database. Socio-economic indicators such as population size, urbanization rate, household final consumption expenditure per capita, gross capital formation, exports of manufactured goods, and FDI are obtained from the World Bank's World Development Indicators (WDI) database. We employ a range of econometric specifications.

First, we apply the Hausman (1978) specification test to distinguish between random effects and fixed effects and settle on the latter. The results from the static model show that an increase in ODA to the productive sectors is associated with an increase in the growth of the manufacturing sector. Indeed, this positive effect becomes more pronounced with ODA allocated to economic infrastructure and services. In other words, we observe a complementary effect between ODA to the productive sectors and economic infrastructure and services. This complementarity appears when the demographic growth rate accompanied by an increase in the urbanization rate is introduced into the estimation. It accentuates the effect of aid to productive sectors on the growth of the manufacturing sector. Indeed, if the aid allocated simultaneously to the productive sectors, infrastructure, and economic services in a highly populated and urbanized country increases, then labour incomes increase and manufacturing industry profits also increase through increased demand due to the expansion of markets for manufactured goods.

Second, we employ dynamic panel data models (autoregressive distributed lag (ARDL)/pool mean group)[7] and show a positive long-term link between an increase in ODA to the productive sectors and the growth of the manufacturing sector. These results have important policy implications for the amount of ODA to be allocated to the productive sectors if the objective is to promote the

[5] According to the OECD-DAC's definition, aid flows to all directly productive sectors including agriculture, manufacturing, trade, and tourism.

[6] Commitments are considered to be made on the date on which the loan or grant agreement is signed or on which the obligation assumed is brought to the attention of the beneficiary by any other means. For example, 77.7 per cent of Chinese projects (see Table C4) and 85.88 per cent of OECD aid have been disbursed (see Table C5).

[7] These can also be called self-reducing phased decay models.

growth of the manufacturing sector in Africa. In this context, there is an issue related to the quality of ODA when priority is given to sectors that are unproductive or have a low return on investment and little impact on growth and development (Mosley 1986; Ndikumana 2012). Therefore, donors should review their aid allocation policies if their primary objective is to promote growth and job-creation in the manufacturing sector.

The rest of the paper is structured as follows. Section 2 provides a brief review of the relevant literature. Section 3 discusses the empirical strategy and provides a description of the data, some stylized facts, and the empirical model. The results are discussed in section 4 and the final section concludes with a discussion of the policy implications from the results.

2 Literature review

The evidence on aid effectiveness is mixed at best: while individual targeted aid interventions appear to produce positive results, the impact of aid at the macroeconomic level is limited (Ndikumana 2012; Ruben 2012). This section provides a summary of the review of this literature. There is an abundant literature with mixed results on the macroeconomic level. For some, aid is effective (Hansen and Tarp 2000, 2001; Sachs 2005), while for others it is not effective (Rajan and Subramanian 2005). For others still, aid only works under certain conditions (Burnside and Dollar 2000; Cai et al. 2018; Dalgaard and Hansen 2001; Easterly et al. 2004; Guillaumont and Guillaumont-Jeanneney 2009). There are a handful of publications which consider the sectoral level, the majority of which focus on the effectiveness of aid allocated to the social and economic sectors.

For example, increased health assistance and public health spending have been found to be associated with decreased mortality from diarrhoeal diseases among children under five (Ndikumana and Pickbourn 2018). With regard to aid to the water and sanitation sector, an increase in assistance is associated with increased access to these services (Ndikumana and Pickbourn 2017), while increased support for the health and education sectors appears to be effective in reducing maternal mortality and gender inequalities in youth literacy, regardless of initial conditions (Ndikumana and Pickbourn 2016). Targeted assistance to the financial sector has been shown to have a positive effect on financial development (Maruta 2018). There is a positive and statistically significant relationship between agricultural production growth and agricultural assistance for rural development so that foreign aid for development can achieve its objective if the aid is targeted at the agricultural sector in developing countries (Kaya et al. 2008). Boukari (2014) shows that aid to the education and health sectors is a vector of human development, while Michaelowa and Weber (2006) and Yontcheva and Masud (2005) find that aid increases primary school enrolment. This is confirmed by Dreher et al. (2008)[8] and in the field of health by Newhouse and Mishra (2007) and Kotsadam et al. (2018), who show that the decrease in infant mortality is due to the amount of aid allocated to this sector. However, few authors have examined the impact of aid to the productive sector on the development of the manufacturing sector. In other words, aid effectiveness is influenced not only by its evaluation but also by its quality in terms of allocation at the macro and micro levels, hence the paradox of its macro–micro evaluation as described by Radelet et al. (2004) and Ndikumana (2012).

The economic literature on the development of the industrial sector highlights the link between capital accumulation and industrialization through the provision of foreign capital in the form of

[8] Cited by Ndikumana (2012).

FDI or ODA. The coordination of aid in the form of intersectoral investments in a backward economy is one of the conditions which can lead it towards industrialization (Rosenstein-Rodan 1943). Big-push theory proposes a theoretical model which identifies economic development as a lack of productive capital needed for the establishment of heavy industries with high added value, thus creating reciprocal supply and demand. Domar (1946),[9] via a production function whose only limiting factor is capital, assumes that investment increases production capacity on the supply side through the increase in capital, while variation in investment leads to an increase in demand on the demand side by the Keynesian multiplier.[10] This can lead to the development of the manufacturing sector. The work of Murphy et al. (1989b) shows that the coordination of aid in the form of cross-sectoral investments in a backward economy is one of the conditions that can lead it towards industrialization.

By formalizing this theory, these authors not only emphasize the notion of sectoral priority but also analyse the conditions for the transition from a subsistence economy to an industrial economy which creates growth. According to these pioneers of development economics, the process of capital accumulation leads to economic development as there is no difference between economic growth and economic development. Charnoz and Severino (2007) suggest that progress merges with growth through industrialization and must lead to social progress by trickle-down effects: health, education, and reduction of inequalities.

In addition, the adoption of the Millennium Development Goals in the 2000s and the SDGs in 2015 changed the focus of development aid from growth to the goal of poverty reduction through various targets to be achieved, which may or may not have a positive impact on poverty. To our knowledge, most of the empirical work analyses the effects of aggregate aid on the factors that can influence the competitiveness of industries, while the question of the relative sectoral allocation remains relatively unexplored. Rajan and Subramanian (2005) tested the link between aggregate aid and the growth of labour-intensive industries and tradable and exportable goods through the effect of aid on the real exchange rate. They examined the effect of aid inflows on the competitiveness of the industrial sector (as measured by the interaction between aid and labour-intensive industry) in different countries by comparing growth between labour-intensive and capital-intensive industries. The results indicate that labour-intensive industries (likely to be affected by higher wages) grow relatively more slowly than capital-intensive and non-exportable sectors, respectively, in countries with high aid flows.

Similarly, Tressel and Prati (2006) find that aid tends to decrease exports. Aid inflows do not make these effects inevitable. The more aid is spent on tradable goods (imported capital goods, foreign consultants) or goods that are not in limited quantities (unskilled labour) and/or that are accompanied by domestic fiscal adjustments, the less wages will rise to an excessive degree and the less the real exchange rate will appreciate. Prati et al. (2003)[11] find a negative impact of aid on the competitiveness of enterprises. Werker et al. (2009), on the analysis of the impact of aid from OPEC Gulf countries to poor Muslim countries, indicate the effects of aid on the different components of GDP. As there is a positive link between aid and imports through improved balance of payments and as a large part of domestic capital in developing countries is imported (Alfaro and Hammel 2007; Eaton and Kortum 2001), the aid has a much more significant positive effect on imported capital goods (electrical, non-electrical, and industrial), automotives and automotive equipment (current assets), and other consumer goods. An aid inflow equal to 1 per

[9] Quoted by Muet (1993).

[10] Quoted by Muet (1993).

[11] Cited by Werker et al. (2009).

cent of GDP increases imports of capital goods (capital accumulation) by 0.2 per cent of GDP, circulating assets (vehicles) by 0.3 per cent of GDP, and other everyday consumer goods by almost 0.4 per cent of GDP.

Therefore, although much of the aid is spent on imports of other consumer goods, some aid is also used for the import of capital goods (imported tangible fixed assets). In particular, analysis by type of aid shows that it may have less impact on domestic wages or the exchange rate, the more it is spent on imports (Rajan and Subramanian, 2005). The measure of capital accumulation is gross capital formation, which consists of private and government spending on capital assets, net changes in inventory levels, and net acquisitions of valuables. In the medium term, the aid seems to have a positive effect on investment (Werker et al. 2009).

While the development of manufacturing can lead to growth, to our knowledge, few empirical studies exist on the analysis of the effects of aid allocated to productive sectors on the growth of the manufacturing sector in Africa. At a time when the development of this sector no longer appears to be only an instrument that can contribute to growth but is, rather, a sustainable development objective, examining the effects of this kind of aid on the growth of the manufacturing sector is not only timely but also essential.

3 Stylized facts and data sources

3.1 Data sources

We obtained annual data covering the period from 2000 to 2013. Data on the amount of aid allocated to the different sectors was obtained from the AidData portal.[12] The merger of databases in the AidData portal made it possible to obtain the total aggregate ODA allocated to the sector under study for 26 African countries by exhaustively combining ODA committed by member and non-member countries of the OECD-DAC, including China. According to the OECD-DAC's definition, aid flows to all directly productive sectors, including agriculture,[13] manufacturing,[14] and trade and tourism,[15] are grouped under this heading. The analyses consider the total amount of aid committed and targeted to the data of the different sectors rather than the amount disbursed. Aid commitments are preferred to disbursements for two main reasons. First, in many cases, data on aid disbursed at the sectoral level are lacking because they are 'irregular' in most aid data sources. Second, the disbursement of aid is unpredictable in relation to commitments, in the sense that the

[12] The data on the volume of aid allocated to the different sectors used in this article come from the AidData portal and are available over a period from 2000 to 2013 after merging two databases, namely AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset.

[13] Agriculture: development of cultivation and livestock, provision of means of production such as agricultural equipment and fertilizers, irrigation service, pest control service, or veterinarians; agricultural services, forestry (including arboriculture) and fisheries; soil conservation and extension of arable land; construction of agricultural buildings, storage and means of transport for agriculture; geodetic and soil studies, land and water use. The activities of agricultural development banks are included under this heading.

[14] Manufacturing: aid for manufacturing and extractive industries of all kinds, including geological and projection studies; oil and mineral development and refining; processing of food and other agricultural products; manufacture of fertilizers and agricultural equipment; handicrafts and storage; and storage of non-agricultural products.

[15] Trade and tourism: export promotion, trade, and distribution; banks (including industrial development banks); and hotels and other tourist facilities.

amount of aid can be disbursed mainly during periods of high domestic production or revenue and retained when domestic economic activity declines.[16]

The figures on manufacturing value added come from the UNIDO database. Other control variables include socio-economic indicators such as population size, urbanization rate, household final consumption expenditure per capita, gross capital formation, exports of manufactured goods and FDI. Data on these variables were obtained from the World Bank's WDI.

3.2 Stylized facts

Table 1 summarizes the descriptive statistics of the key variables used in the regression over the period 2000–13. There was an average growth of 4.73 per cent in manufacturing value added per capita (MVAPC) compared to 18.06 per cent in total aid allocated to the productive sectors over the period 2000–13. In addition, the minimum and maximum growth in aid varied between 14.98 per cent and 21.75 per cent, with a standard deviation of 1.11 per cent.

Table 1: Descriptive statistics of key variables in Africa over the period 2000–13

Variable	Obs.	Average	Std. Dev.	Min.	Max.
Growth rate of manufacturing value added per capita (%)	364	4.73	1.11	2.87	7.08
Growth rate of aid allocated to the productive sector (%)	364	18.13	1.40	14.98	21.79
Official development assistance for social infrastructure and services	364	19.41	1.00	16.92	21.48
Official development assistance for economic infrastructure and services	364	19.48	1.10	16.70	22.50
Population growth rate (%)	364	16.22	1.39	13.20	18.96
Urbanization rate (%)	364	37.11	17.20	8.25	87.16
Growth rate of household final consumption expenditure per capita (%)	364	6.76	0.86	5.20	8.75
Growth rate of gross capital formation (%)	364	21.85	1.60	18.63	25.19
Exports of manufactured goods (% of goods exported)	364	27.23	26.42	0.00	94.88
Foreign direct investment, net inflows (% of GDP)	364	3.30	4.56	-2.00	39.46

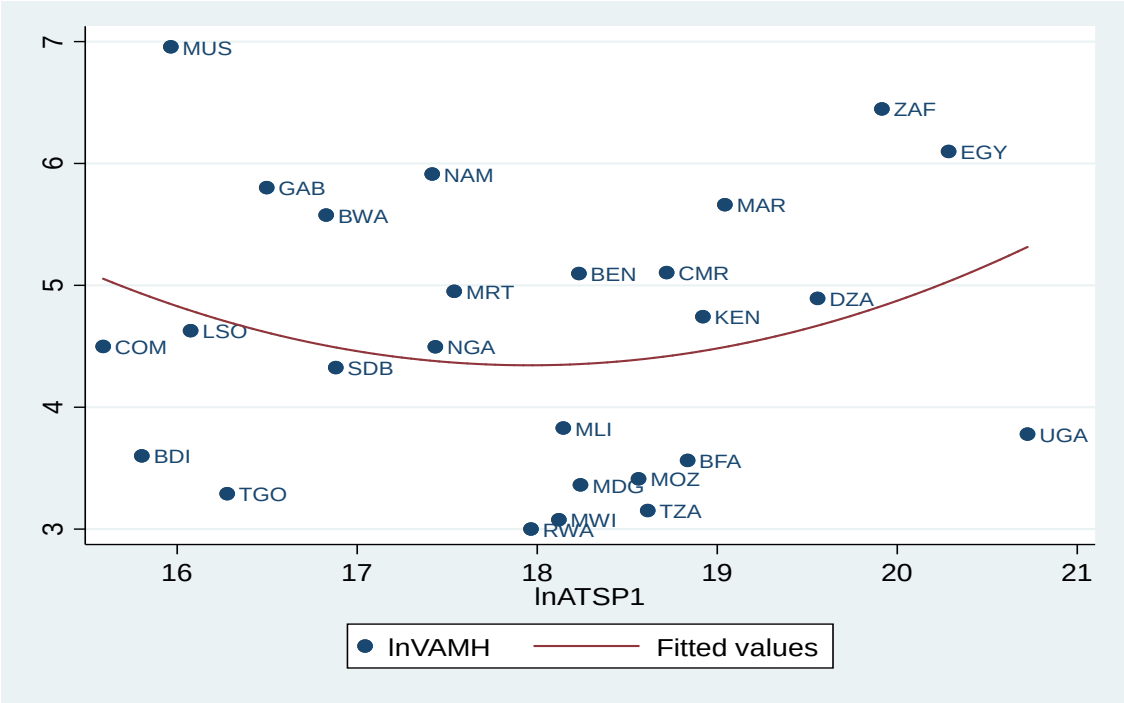
Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, World Development Indicators, and UNIDO.

Figure 1 shows a U-shape between the average growth rates of MVAPC and aid allocated to the productive sectors over the period under analysis. The U-shaped relationship is observed when using the average growth rates over the five-year periods from 2000–04 and 2005–09 and over the four-year period from 2010–13, as shown in Figures 2, 3, and 4 respectively. The plots also highlight heterogeneity between countries, based on four distinct groups. The first group includes countries where the average rate of aid to the productive sectors and that of the MVAPC are increasing simultaneously. These are Egypt, Morocco, Cameroon, Kenya, Algeria, Benin, Nigeria, Mauritania, Namibia, and South Africa. The second group consists of countries, such as Uganda, Burkina Faso, Mozambique, Tanzania, Mali, Madagascar, Malawi, and Rwanda, whose average ODA growth is growing faster than that of MVAPC. There is a third group of Mauritius, Gabon, Botswana, the Comoros Islands, Lesotho, and Sudan where the average MVAPC rate is growing

[16] See Maruta (2018).

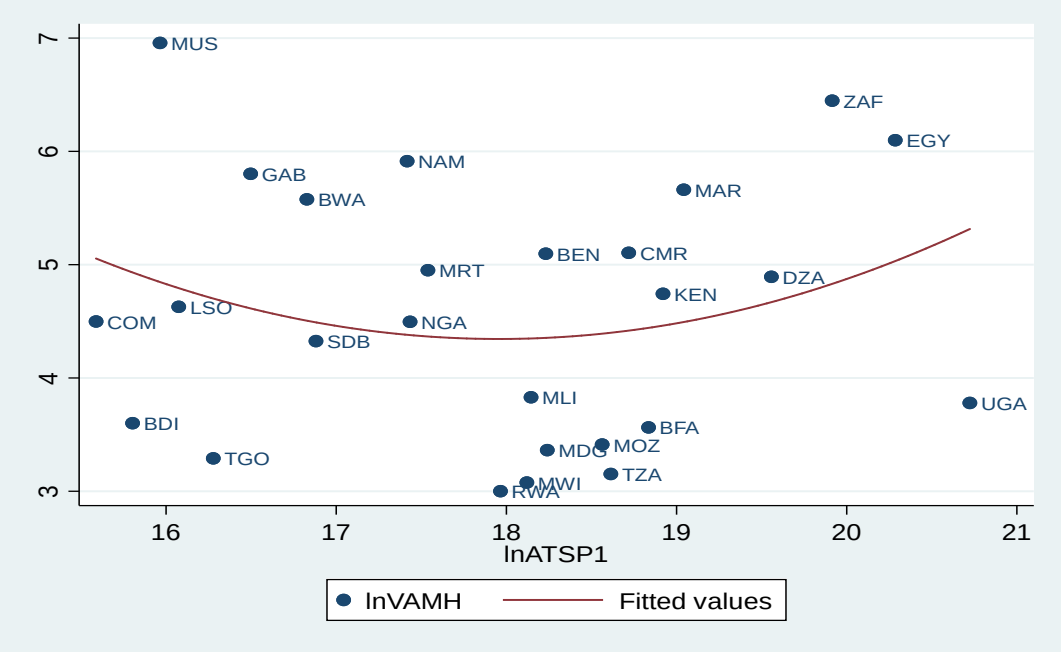
faster than that of aid to the sectors under analysis. Finally, Burundi and Togo are the last group recording low average growth rates of aid to the productive sectors and that of MVAPC.

Figure 1: Evolution of the average growth rate of MVAPC and total aid allocated to productive sectors in Africa between 2000 and 2013



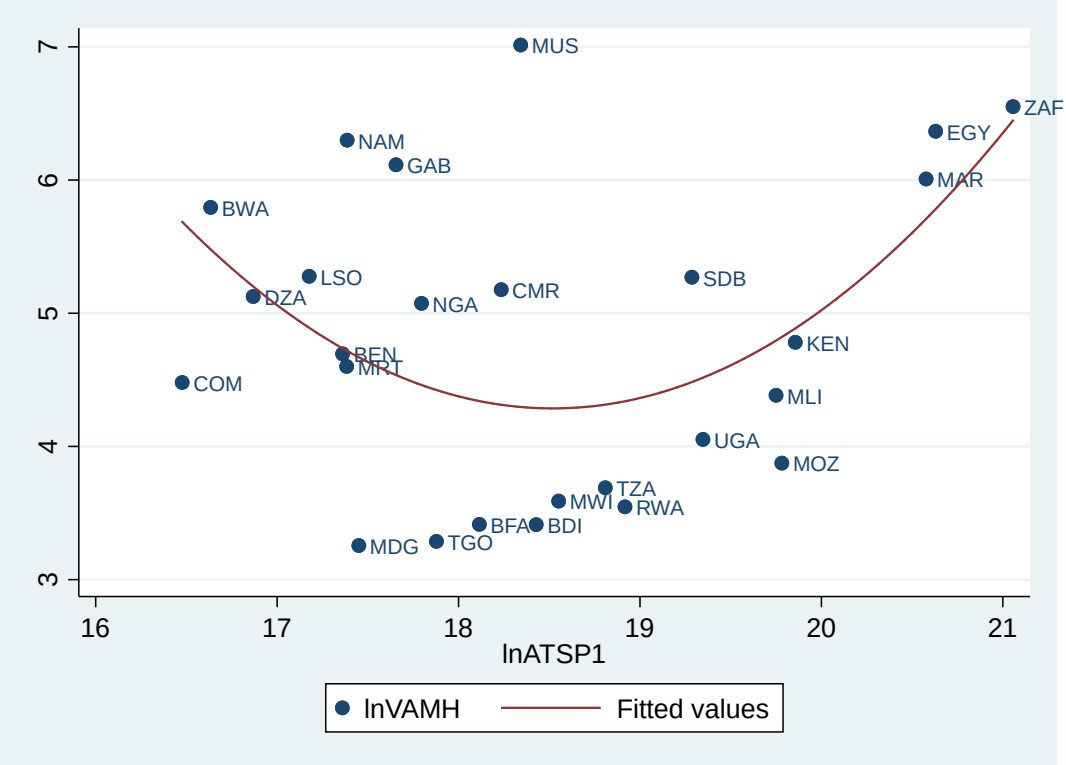
Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, and UNIDO.

Figure 2: Evolution of the growth rate of MVAPC and total aid allocated to productive sectors in Africa between 2000 and 2004



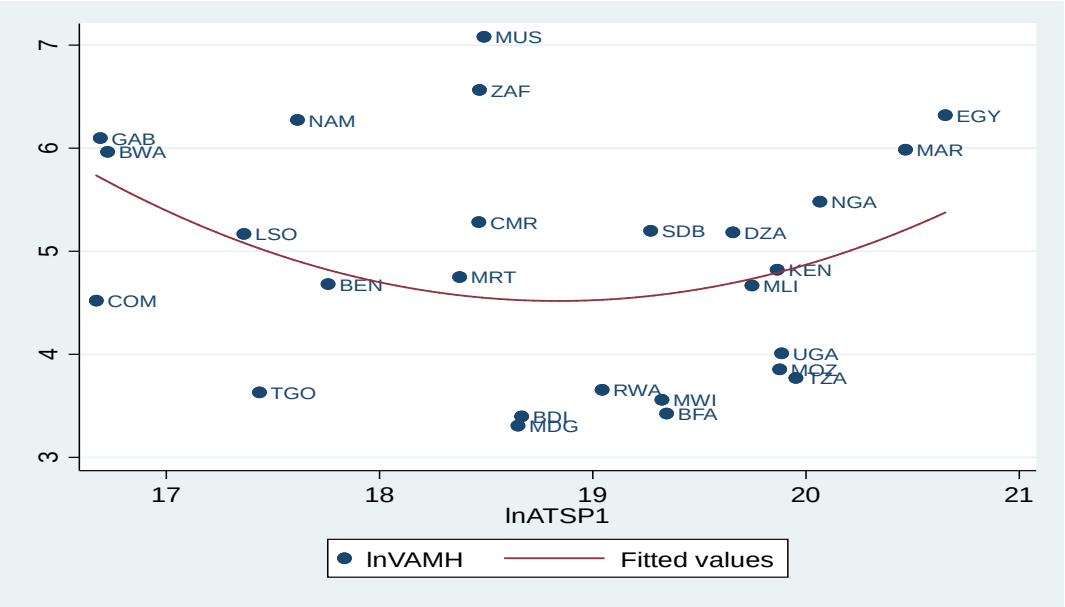
Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, and UNIDO.

Figure 3: Evolution of the growth rate of MVAPC and total aid allocated to productive sectors in Africa between 2005 and 2009



Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, and UNIDO.

Figure 4: Evolution of the growth rate of MVAPC and total aid allocated to productive sectors in Africa between 2010 and 2013



Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, and UNIDO.

In addition, there are regional disparities in terms of variations in the level of development of the manufacturing sector and the attractiveness of aid allocated to the productive sectors (Table 2). On the one hand, this is particularly the case among the top 15 countries whose MVAPC growth rate is higher than the African average of 4.73 per cent, those of southern Africa, and the Indian Ocean. These are countries such as Mauritius (6.99 per cent), South Africa (6.53 per cent), Namibia (6.15 per cent), Botswana (5.67 per cent), Lesotho (5.17 per cent), the Maghreb countries including Egypt (6.23 per cent), Morocco (5.82) and Algeria (5.03 per cent) except for Gabon (5.97 per cent) and Cameroon (5.18 per cent). On the other hand, the first two countries to record a high growth rate in aid allocated to the productive sector are from the Maghreb, namely Egypt (20.02 per cent) and Morocco (19.29 per cent). They are followed by East African countries such as Uganda (19.10 per cent), Kenya (19.03 per cent), and Tanzania (19.02 per cent) and finally those of West Africa such as Nigeria (19.00 per cent), Mali (18.87), and Burkina Faso (18.62 per cent). Malawi and the Comoros Islands show little change in per capita manufacturing value added and aid allocated to the productive sector, respectively.

Table 2: Averages of key variables by country over the period 2000–13

	Average growth rate of manufacturing value added per capita (%)	Average growth rate of aid to the productive sector (%)
Mauritius	6.99	17.21
South Africa	6.53	18.56
Egypt	6.23	20.36
Namibia	6.15	17.64
Gabon	5.97	16.95
Morocco	5.82	19.29
Botswana	5.67	16.59
Cameroon	5.18	18.48
Lesotho	5.17	16.28
Algeria	5.03	17.76
Nigeria	4.9	19.23
Benin	4.88	18.09
Kenya	4.78	19.05
Mauritania	4.75	17.97
Sudan	4.7	18.01
Comoros	4.46	15.88
Mali	4.21	18.96
Uganda	3.94	19.14
Mozambique	3.84	19.16
Burkina Faso	3.59	18.62
Tanzania	3.48	19.36
Burundi	3.45	17.25
Rwanda	3.39	18.14
Madagascar	3.32	18.54
Togo	3.3	16.42
Malawi	3.23	18.5

Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, World Development Indicators, and UNIDO.

4 Empirical strategy

The empirical analysis carried out in this study tests the effects of ODA allocated to productive sectors on the growth of the manufacturing sector in Africa. In summary, these are aid commitments in amounts (in billions of constant 2011 USD) in the form of capital in the agricultural, manufacturing, and trade sectors as well as tourism.

We applied the Hausman test to choose between a standard fixed effects and a random effects model, with the test favouring the former over the latter (p-value < 0.05). Furthermore, specification adequacy is enhanced by performing heteroskedasticity[17] and serial correlation tests.[18] For i = 1,2,…,N countries over the period t = 1,2,…,T the baseline specification is as follows:

$$lnMvap_{it} = \alpha_i + \beta \ln Atsp_{it} + \theta X_{it} + u_{it} \quad (1)$$

[17] Breusch and Pagan Lagrange multiplier (LM) test for random effects.

[18] Wooldridge test for autocorrelation in panel data.

Where: α_i, β, θ are model coefficients; α_i is the country-specific unobservable effect *i*, $lnMvap_{it}$ is the growth rate of manufacturing value added per capita for country *i* at time *t* which measures the evolution of a country's manufacturing sector, defined as a relative value of net manufacturing output relative to population size (UNIDO 2012); $\ln Atsp_{it}$ is the growth rate of total aid allocated to the productive sector for country *i* at time *t*. u_{it} is the error term of the model.

X_{it} are control variables (see appendix Table A2) which can influence the evolution of the manufacturing sector. These include: population growth rate; variation in the urbanization rate; household final consumption expenditure per capita growth rate as a proxy of local demand; gross capital formation growth rate as a proxy for the physical capital accumulation and increases manufacturing value added (Barrios et al. 2005); change in the share of exports of manufactured goods in GDP; the variation rate of FDI net inflows; and an interaction variable between change in the population growth rate and change in the urbanization growth rate which indicates the change in local demand for manufactured products (Murphy et al. 1989a). Indeed, a large and concentrated population with homogeneous tastes and preferences is an important factor in industrialization.

For dynamic estimation models, we use Pooled Mean Group/Autoregressive Distributed Lag (PMG/ARDL) for two reasons. First, the series of variables used in our paper are a combination of nonstationary and stationary variables.[19] Second, the models allow for identification of both the long-term effects common to all the countries under analysis and the short-term effects specific to each country, thus allowing heterogeneity to be considered after the cointegration tests.[20]

$$\Delta \ ln \ Mvap_{it} = \beta \ln Atsp_t + \theta X_t + \alpha_1 CC_{it} + \alpha_2 \Delta \ ln \ Mvap_{it-1} + \alpha_3 \Delta \ X_{it} + \lambda_i \ u_{it} \qquad (2)$$

In equation (2), the adjustment variable of the cointegration relationship represents cointegration coefficients. The coefficient α_1, which represents heterogeneous short-term effects, must have a negative sign in different lags and be constant.

Finally, the results of the econometric estimates shown in Table 3 present static fixed individual effect models of generalized least squares (GLS) (columns 1 to 4) and those of PMG/ARDL (columns 5 to 7).

[19] We applied the different unit root tests based on Hurlin and Mignon (2006).

[20] Therefore, we sought to highlight long-term equilibrium relationships between variables through the application of cointegration tests on these panel data (Pesaran et al. 2001).

Table 3: Impact of ODA to productive sectors on manufacturing growth in Africa over the period 2000–13

VARIABLES	(1) GLS	(2) GLS	(3) GLS	(4) GLS	(5) PMG	(6) PMG	(7) PMG
Growth rate of aid allocated to the productive sector (%)	0.0927***	0.0352***	0.0887***	0.105***	0.0311***	0.0350***	-0.0233***
	(0.0191)	(0.0101)	(0.0218)	(0.0220)	(0.00565)	(0.00623)	(0.00750)
Population growth rate (%)	0.0655	-0.0288	0.0693	-0.151*	-0.937***	-1.165***	-0.329***
	(0.0488)	(0.0647)	(0.0494)	(0.0774)	(0.250)	(0.122)	(0.0659)
Urbanization rate (%)	0.00545**	0.00642	0.00525**	-0.0309**	0.0583***	0.0125*	
	(0.00217)	(0.00428)	(0.00221)	(0.0147)	(0.0119)	(0.00740)	
Growth rate of household final consumption expenditure per capita (%)	1.215***	0.805***	1.213***	1.122***	0.222**	0.747***	0.221***
	(0.0547)	(0.0791)	(0.0547)	(0.0605)	(0.0887)	(0.0517)	(0.0731)
Growth rate of gross capital formation (%)	-0.0940*	0.0451	-0.0969**	-0.0303	-0.00236		
	(0.0489)	(0.0331)	(0.0493)	(0.0521)	(0.0226)		
Exports of manufactured goods (% of goods exported)	0.00253***	0.00191	0.00251***	0.00202**			
	(0.000870)	(0.00116)	(0.000872)	(0.000856)			
Official development assistance allocated to social infrastructure and services (%)			-0.0271	0.0287		-0.0328***	0.0224
			(0.0371)	(0.0383)		(0.00894)	(0.0141)
Official development assistance allocated to economic infrastructure and services (%)			0.0311	0.0762**			0.0434***
			(0.0307)	(0.0333)			(0.0107)
Interaction population growth rate*urbanization rate				0.00228**			
				(0.000927)			
Foreign direct investment, net inflows (% of GDP)				0.000240			
				(0.00470)			
Cointegration coefficient					-0.510***	-0.558***	-0.309***
					(0.0928)	(0.129)	(0.0618)
D. (Growth rate of aid allocated to the productive sector)					(0.00430)	-0.0109*	0.0134***
						(0.00565)	(0.00501)
D. (Growth rate of household final consumption expenditure per capita)					-0.256	-0.123	0.162
					(0.214)	(0.224)	(0.243)
D. (Population growth rate)					-3.838	16.89	5.188
					(9.244)	(18.93)	(6.606)
D. (Rate of urbanization)					0.137	-0.544	
					(0.237)	(1.137)	

D. (Growth rate of training gross capital)					0.0771* (0.0407)		
D. (Official development assistance allocated to social infrastructure and services)						0.0159* (0.00863)	-0.00751 (0.00677)
D. (Official development assistance allocated to economic infrastructure and services)							-1.29e-05 (0.00897)
Constant	-4.441*** (0.360)	-2.120* (1.103)	-4.423*** (0.447)	-3.840*** (0.765)	7.961*** (1.475)	9.535*** (1.880)	2.285*** (0.417)
Observations	364	364	364	364	338	338	338
Number of countries	26	26	26	26			
Country FE	YES	YES	YES	YES			
Year FE		YES		YES			
Log Likelihood					742.6279	743.4393	722.041

Note: the variable explained is manufacturing value added per capita (logarithm) for equations 1 to 4 and its difference for equations 5 to 7. The values in parentheses represent the standard deviations. ***, ** and * represent statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

Source: author's calculation based on data from Aid Data's core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset, World Development Indicators, and UNIDO.

5 Main results

We start by presenting our baseline results, where we analyse the extent to which manufacturing sector growth is affected by aid allocated to the productive sector. In other words, we test whether the MVAPC growth rate is a result of change in aid allocated to the productive sector.

For the GLS method (Table 3, columns 1–4), controlling for country and time fixed effects, the results show a positive effect of our variable of interest (aid allocated to the productive sectors) on the manufacturing industry growth. In other words, the rate of change of ODA to productive sectors has a positive effect on the growth rate of MVAPC. An increase in the allocation of ODA to the productive sectors induces an increase in the rate of MVAPC. These results suggest that a 10 per cent increase in ODA to these sectors is associated with an increase of between 0.35 and 1.05 per cent in MVAPC.

We then test the joint effects of ODA allocated to the different sectors by simultaneously introducing them into the models (Table 3, column 3). The relationship between aid to the productive sector and manufacturing sector is still statistically positive and significant. Moreover, the results suggest a non-complementary effect on manufacturing sector growth between ODA to the productive sectors and infrastructure and socio-economic services.

However, the introduction of the interaction variable between the urbanization rate and population growth indicates the role that joint population and urbanization growth might play in local demand for manufactured goods.[21] This improves the results of the estimate by showing a complementarity effect between aid allocated to the productive sectors and aid to infrastructure and economic services. These results are intuitive because they also confirm the results of the work of Murphy et al. (1989b) and Charnoz and Severino (2007) which indicates that the coordination of aid in the form of cross-sectoral investments in a backward economy is one of the conditions that can lead to its industrialization. In other words, the mutual reinforcement of investment sectors through aid is therefore a key asset of a great industrial push (Rosenstein-Rodan 1943). Indeed, it is the simultaneity and synergy of investments that count. Alternatively, the government can use investment subsidies that are widely distributed enough to generate a necessary critical mass of investment to support a large industrial push.

Regarding the estimations by the PMG/ARDL models, we first present the long-term effects. We are interested in the short-term effects (average effects common to countries). The results of the long-run effect estimates are also presented in Table 3 (columns 5–7). With negative and significant cointegration coefficients, the results of the estimates (columns 5–6) confirm the positive association between the growth rate of aid to the productive sectors and that of MVAPC. These results suggest that a 10 per cent increase in aid to these sectors is associated with an increase of between 0.31 and 0.35 per cent in MVAPC.

Although the simultaneous inclusion of aid to socio-economic infrastructure and services as control variables (column 7) causes the effect of aid to the productive sectors to become negative, but positive in the short term, this could be due to the sectoral allocation of disproportionate aid in favour of infrastructure and social services to the detriment of the productive sector.

[21] A large and concentrated population with homogeneous tastes and preferences is an important factor in industrialization (Murphy et al. 1989a).

It is noted that, in the long run, the effects of aid allocated to the productive sectors on the growth of the manufacturing sector are significant and positive unless aid to socio-economic infrastructure and services is jointly introduced as a control variable. It then seems that the effects of an increase in aid to the productive sectors on the growth of the manufacturing sector, in the long run, is consistent with the dynamic investment model, according to which an investment decision by a monopolist leads to increasing returns to scale that are realized with a time lag. The main consequence of a monopolist's investment is to reduce the demand for manufacturing products at a time when it is not relevant for investment and to increase the demand for manufacturing products of other companies in the next period, which is the key to their investment decisions (Murphy et al. 1989a). This can lead to a balance in which an economy can achieve a big industrial push.

In the short term, the results appear to be more contrasting, depending on whether aid to socio-economic infrastructure and services is added to the estimates as a control variable. First, the coefficient of the aid variable allocated to the productive sectors is either insignificant (Table 3, column 5) or negative and significant (Table 3, column 6). Conversely, this variable has a significant and positive coefficient (Table 3, column 7). It is positive and significant when aid to infrastructure and social and economic services are simultaneously included, and it is negative and significant when the aid to infrastructure and economic services is excluded. In sum, in the short run, it appears that aid to socio-economic infrastructure and services is the control variable that offers more prospects in the analysis of the effect of aid to productive sectors on manufacturing growth.

These results generally suggest that an increase in ODA targeted at the productive sectors as an investment is likely to contribute to manufacturing sector growth. Thus, 'if we invest enough today to adjust demand to production capacity, we will have to invest even more tomorrow because of the increase in capacity generated by investment' (Domar 1946).

6 Conclusion

Achieving SDG 9 by 2030, through target 9.2 to promote a sustainable and inclusive industry and as one of the five priorities of the African Development Bank's Agenda 2063, will require development of the manufacturing sector. This has therefore aroused a particular commitment by the international community to finance the sector through mobilization of the capital necessary to realize this goal. This paper examined whether aid to the productive sectors contributed to the growth of the manufacturing sector in 26 Africa countries over the 2000–13 period. The empirical results highlight a positive association between the growth rate of aid allocated to the productive sectors and that of MVAPC. According to the assumption made here, an increased and coordinated allocation of aid to the productive sectors in the form of investment could increase the productive capacity of the manufacturing sector with the direct effect of an increase in manufacturing output.

Moreover, beyond the direct effect of aid in this sector, it could lead to an increase in local demand for manufactured goods following an increase in employment income created and the joint effects of population growth accompanied by urbanization because factory employment is generally associated with work in cities with higher real wages (Lewis 1967; McArthur and Sachs 2019). This implies that targeted aid can be an important instrument for the development of the manufacturing sector.

Our results have policy implications for the allocation of aid by donor countries at the sectoral level, focusing on productive sectors that can generate growth in manufacturing and, in turn, industrial development. The analysis may also have implications for the role of government in the process of developing this sector through cross-sectoral coordination of ODA through a sound investment programme that considers the quantitative and qualitative aspects needed by the productive sectors, with a high return on investment impacting the growth of the manufacturing sector.

Due to a lack of detailed data for all countries, our study is limited by not being able to take account of factors that can have an effect on the development of the manufacturing sector at the level of infrastructure development. Such factors can be measured by the number of airports, bridges, roads, power plants, kilometres of asphalted road, rail and air networks, as well as the rate of internet penetration, significantly reduced transaction costs, increase in the productivity of industries, geographical position, climate, and distance from the main trade routes.

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Appendix A

Table A1: List of countries studied

Algeria	Mali
Benin	Mauritania
Botswana	Mauritius
Burkina Faso	Morocco
Burundi	Mozambique
Cameroon	Namibia
Comoros	Nigeria
Egypt, Arab Rep.	Rwanda
Gabon	South Africa
Kenya	Sudan
Lesotho	Tanzania
Madagascar	Togo
Malawi	Uganda

Source: author's compilation.

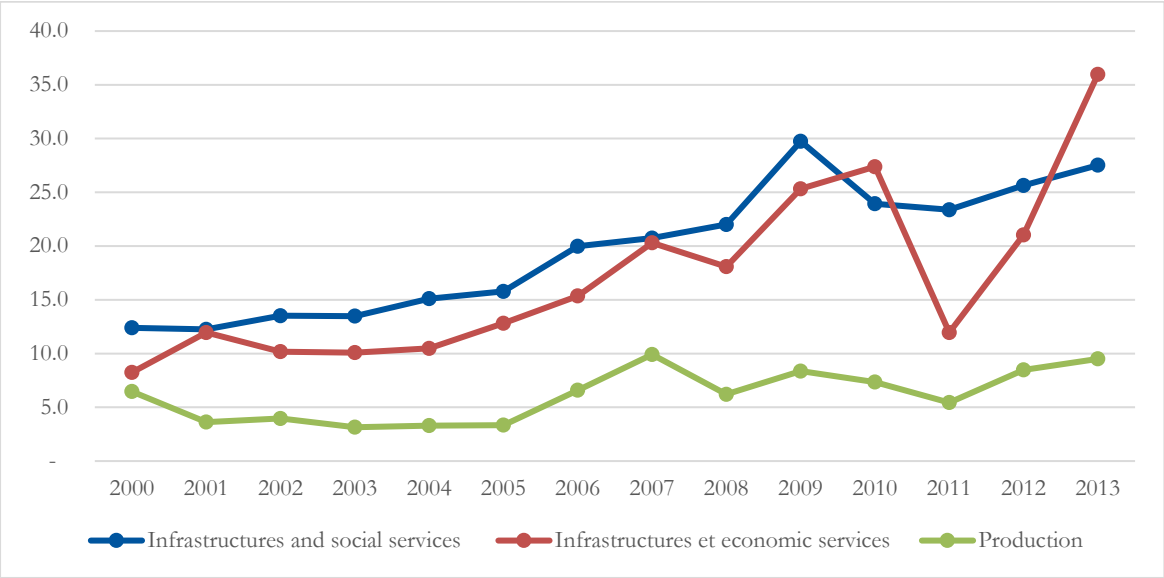
Table A2: Description of variables and sources

Variable	Sources
Growth rate of manufacturing value added per capita (%)	UNIDO
Growth rate of aid allocated to the productive sector (%)	AidData
Official development assistance for social infrastructure and services	AidData
Official development assistance for economic infrastructure and services	AidData
Population growth rate (%)	WDI
Urbanization rate (%)	WDI
Growth rate of household final consumption expenditure per capita (%)	WDI
Growth rate of gross capital formation (%)	WDI
Exports of manufactured goods (% of goods exported)	WDI
Foreign direct investment, net inflows (% of GDP)	WDI

Source: author's construction

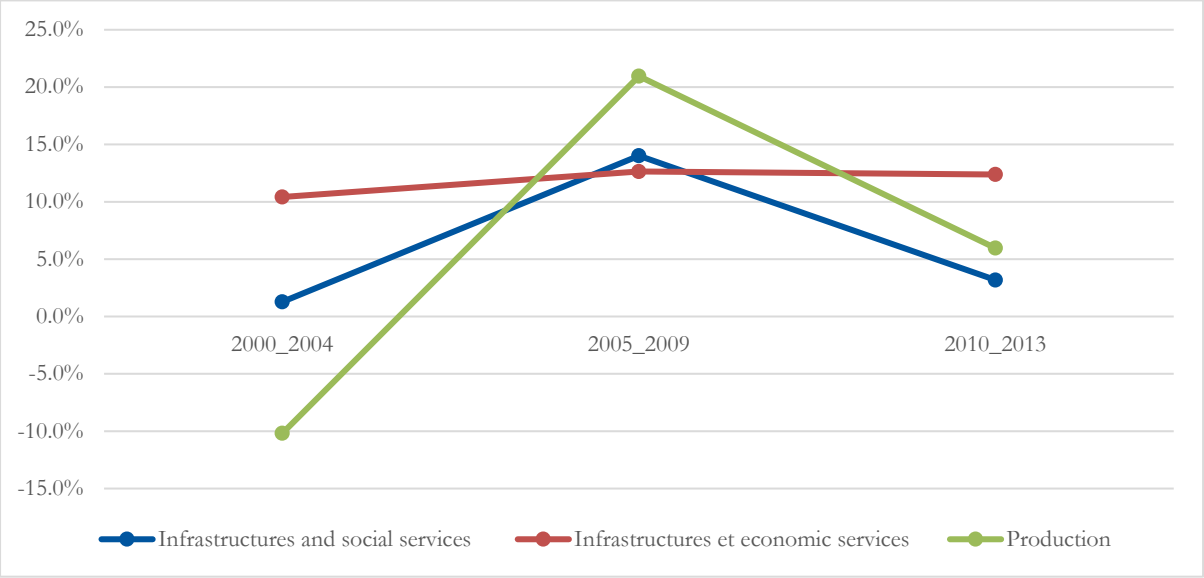
Appendix B

Figure B1: Evolution of aid shares allocated to each sector, %



Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset.

Figure B2: Evolution of aid growth rates, by sector



Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset.

Appendix C

Table C1: Development level by regions in 2019

Regions	GDP per capita (USD constant 2015)
Africa	1,779.3
African least-developed countries	603.3
Asia & Pacific	5,155.2
Europe	2,2938.5
Latin America	8,023.9
North Africa	3,103.5
North America	52,700.5
South Asia	1,248.3
Sub-Saharan Africa (developing)	1,437.9
World	9,281.9

Source: author's calculations based on data from World Development Indicators database

Table C2: Aid distribution, by year and by sectors between 2000 and 2013 (in billion USD constant 2011)

	Sectors				
Year	Infrastructure & social services	Infrastructure & economic services	Production	Other (debt services, multisectoral assistance, food aid)	Total
2000	12.4	8.2	6.5	21.6	48.7
2001	12.3	12	3.6	15.8	43.6
2002	13.5	10.2	4	21	48.7
2003	13.5	10.1	3.1	25.5	52.2
2004	15.1	10.5	3.3	26.4	55.3
2005	15.8	12.8	3.3	29.8	61.7
2006	20	15.4	6.6	34.8	76.7
2007	20.7	20.3	9.9	28.9	79.8
2008	22	18.1	6.2	23.3	69.6
2009	29.7	25.3	8.4	25.4	88.8
2010	23.9	27.4	7.3	17.4	76.1
2011	23.4	12	5.4	26.7	67.5
2012	25.6	21	8.5	25.4	80.6
2013	27.5	36	9.5	22.6	95.6
Variation 2000–05 (%)	27.3	55.5	-48.3	37.8	26.7
Variation 2006–10 (%)	19.8	78.3	11.5	-49.9	-0.8
Variation 2000–13 (%)	122.0	336.4	47.0	4.6	96.2

Source: author's calculations based on data from AidData's Core Research Release Version 3.0 and AidData's Global Chinese Official Finance Dataset.

Table C2: Economic indicators by regions

	Sub-Saharan Africa	North Africa and the Middle East	North America	Latin America and the Caribbean	East Asia and the Pacific	South Asia	Europe and Central Asia
Gross domestic savings (% of GDP)	22.3	37.3	17.9	20.6	34.1	27.8	24.1
Adjusted savings: consumption of fixed capital (% of net income)	12.8	10.4	15.5	12.3	20.3	10	16
Gross fixed capital formation (% of GDP)	21.3	21.3	22.8	21.2	19.4	19.4	30.7
Gross capital formation per capita (constant USD 2010)	304.1	1,814.8	10,444,00	1,783.7	2,382.2	415.3	5,177.9
Gross capital formation (% of GDP)	21.7	27.1	21.3	20.2	31.4	32.1	21.7
Share of net FDI inflows (% of GDP	2.5	2.5	1.9	3.5	2.3	1.6	4.5
Net ODA received (% of gross capital formation)	15.4	2.9	0	1	0.2	2.1	0.2
Net ODA received per capita (constant USD)	43.7	47.6	0	14	3.8	7.1	8.4

Source: author's calculations based on data from World Development Indicators database.

Table C3: Status of Chinese project to Africa between 2000 and 2013

Status	Amount in USD 2011 constants	%
Completion	24,478,425,568	17.7
Implementation	54,573,504,255	39.6
Pipeline : Commitment	28,150,000,923	20.4
Pipeline : Pledge	30,729,806,534	22.3
Total	137,931,737,280	100

Source: author's calculations based on AidData's Chinese Official Finance to Africa, 2000–2013, version 1.2 database

Table C4: Disbursement's rate aid to Africa distribution for 2000-2013 period

Year	Total commitments	Total disbursements	Disbursement rate in %
2005	29,312	24,669.06	84.16
2006	37,572	31,666,01	84.28
2007	29,164	24,662,2	84.56
2008	36,236	27,378,58	75.56
2009	35,745	28,192,37	78.87
2010	33,451	29,140,29	87.11
2011	32,953	32,523,06	98.69
2012	33,217	30,271,15	91.13
2013	33,055	30,054,77	90.92
2014	32,497	29,050,13	89.39
2015	32,246	26,877,19	83.35
2016	33,091	27,213,32	82.24
2017	34,547	29,776,4	86.19

Source: author's calculations based on OECD database for 2000-201