DISCUSSION PAPER / 2024.01

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January 2024

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Abstract

Foreign aid has been the subject of a rather intense and often highly politicized debate for many years with particular emphasis on aid effectiveness issues. The sub-Saharan Africa region has been a major recipient of aid flows for many years, and this has attracted a lot of interest by many researchers in order to investigate the impact of aid on growth in the countries concerned. Against this background, this paper seeks to investigate whether different forms of donor aid affect economic growth differently in a panel of 39 sub-Saharan African countries over the period 2002 to 2020. Our estimation strategy includes both static (ordinary least squares, fixed effects and random effects) and dynamic (system generalized method of moments-GMM) models, and in order also to capture possible endogeneity issues via the GMM estimator. Our findings seem to indicate that while total aid positively affects growth in SSA, growth reacts differently to the different aid modalities received and the sectors and sub-sectors to which such aid is directed. In particular, we find that while project aid and technical assistance have the potential to boost growth, budget support and humanitarian assistance stifle growth. We further realize that while social infrastructure and environmental protection aid boost growth in all conditions, economic infrastructure aid has a rather inconsistent influence on growth. Finally, we find that biodiversity aid significantly depresses growth, while the other forms of environmental aid are largely statistically insignificant. Our results point to the centrality of aid disaggregation approach in aid effectiveness research work, since the use of a single figure for aid (a key feature for the bulk of aid effectiveness literature for many years) do not allow us to consider the differential impact of different types of aid on growth in aid-recipient countries, and thus forming the emerging policy recommendations accordingly.

Keywords: foreign aid, aid heterogeneity, aid effectiveness, economic growth, Sys-GMM, sub-Saharan Africa.

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1. Introduction

The debate on the effectiveness of aid and whether aid works or not is as old as aid giving itself. It has been an alive and kicking debate for many years, but at the same time a deeply politicized and unhealthy at times debate that goes beyond academic circles crucially influencing public opinion, aid recipients and aid donors alike. Furthermore, although aid issues are still dominated by politics and ideology in many cases and a tendency to 'return to the scene of the crime', the overall context in which foreign aid is now perceived and assessed is dramatically different.

Earlier assessments of whether aid works (Cassen 1986; Mosley 1987; Riddell 1987; World Bank 1998 among others) dominated the research and policy agenda for many years without providing a rather conclusive evidence for various reasons (e.g. inadequate aid data, neglect of aid heterogeneity issue, not paying enough attention to aid volatility/unpredictability issues, problematic econometrics, to mention just a few). The last 2 decades however, have witnessed a new generation of aid effectiveness studies which provide us with a more convincing as well as pluralistic evidence on aid effectiveness issues along with some recent assessments on aid effectiveness (see Sachs 2005; Easterly 2007; Riddell 2008; Lahiri 2007; Collier 2007; Moyo 2008; Doucouliagos and Paldam 2009; Mavrotas 2010, 2015; Banerjee and Duflo 2011; Ramalingam 2013; and Edwards 2014, among others for a an overview and a detailed discussion).

Specific areas in the 'new' aid literature include more clarity on the overall nexus between aid, domestic policies and growth (Hansen and Tarp 2001; Easterly et al. 2004; Dalgaard et al. 2004; Baliamoune and Mavrotas 2009), more emphasis on the importance of reducing aid volatility in difficult periods for aid budgets (Kharas 2008; Bulíř and Hamann 2008; Fielding and Mavrotas 2008; Agenor and Aizenman 2010; Hudson 2015 among others), specific attention on the role of aid hererogeneity in order to delve deeper into aid effectiveness issues and on how different types of aid really work (Mavrotas 2002a,b, 2005; Clemens et al. 2012; Mavrotas and Nunnenkamp 2007), the political economy dimension of foreign aid (Remmer 2004; Molenaers et al. 2015) and the role of public opinion on aid issues (Eger et al. 2022), linking together aid and debt relief (Cassimon and Van Campenhout 2007; Cassimon and Essers 2017), the issue of structural vulnerability and aid to fragile states (Guillaumont 2010; Guillaumont et al. 2017) and the need for more smart and innovative financing in the context of the 2030 Agenda (OECD 2023, 2021), to mention just a few.

Many years back, scholars such as Lewis (1954) and Nurske (1953) argued that foreign aid provides the essential capital to help developing countries achieve sustainable economic growth. Such analysis also assumes that aid contributes to poverty reduction through its impact on growth (Burnside and Dollar, 2000; Guillaumont and Wagner, 2014). To Farahmand (2021), foreign aid has always been a critical resource for helping developing countries to grow, and foreign aid can help countries finance social and economic infrastructure, education, agriculture, health, and other manufacturing and service industries (Yiew and Lau, 2018).

According to the Organization for Economic Co-operation and Development (OECD, 2022), total ODA increased by 4.4 per cent in real terms in 2021 compared to 2020, with the growth attributable mainly to DAC members' funding for COVID-19 operations. OECD statistics for 2022 show that the United States maintained its place as the largest donor of ODA among DAC members in 2021, contributing up to $42.3 billion, followed by Germany ($32.2 billion), Japan ($17.6 billion), the United Kingdom ($15.8 billion) and France ($15.4 billion). Needless to say, the overall donor performance is dramatically different when the most appropriate indicator is used, namely aid as a share in Gross National Income (GNI), with the Scandinavian donors performed the best and surpassing the UN 0.7 target.

Turning the sub-Saharan African region, given the region's various and colossal investment needs with regards to service delivery, physical infrastructure, human capital, and reconstruction and rehabilitation, sustaining and improving growth in the region depends importantly on the extent to which domestic and external resources are mobilized for investment (Anyanwu, 2011). In view of this, the Commission for Africa (2005) estimated that at least an extra US$25bn a year by 2010 and a further US$25bn by 2015 was required for meeting commitments of 0.7 percent ODA as a ratio of GNI. According to Ogundipe et al. (2014), over $500 billion in foreign aid channelled into Africa between 1960 and 2000, and Sub-Saharan Africa (SSA) has comparatively received more aid than any other region, with inflows of about ten times in 1990 and fifteen times in 2010. The authors also argue that the share of aid in state budgets has risen steadily since 2000, with Uganda, Tanzania and Ghana having budgets more than 50% dependent on aid.

This type of aid dependency has raised of course various issues by many authors in the aid effectiveness literature, particularly in the case of SSA region. In fact, Moyo (2008) and Ogundipe et al. (2014) challenged the theoretical arguments surrounding aid effectiveness, arguing that billions of dollars in donor aid to African countries have neither reduced poverty nor increased growth, as poverty levels have continued to rise, and growth rates have steadily declined in many cases. Rather, overreliance on aid has not only ensnared poor countries in a vicious cycle of aid dependency, but has also led to market distortion, greater corruption, and deeper poverty (Ogundipe et al., 2014).

At the same time, it appears that the more foreign aid most Sub-Saharan African countries have received, the more aid dependant they have become, as growth has declined despite enormous aid flows, and foreign aid has trapped them in a debt trap (Mallik, 2008). According to Ferreira and Simões (2013), the increase in aid dependence of SSA countries between the 1970s and the 1990s is partly attributed to their declining GNI. Ayodele et al. (2005) believe that African economies have tainted the logic of aid, as the region consistently fell short in the past of the specific Millennium Development Goals of decreasing poverty, child mortality, and boosting education despite massive aid flows and mineral wealth. According to Gerhardt (2010), Africa's fifty-year aid influx has instead rendered the continent more debilitated, resulting in one of the most disappointing outcomes of development collaboration.

An area in the aid effectiveness literature that has attracted a lot of attention and has also generated a hot debate is a particular strand of the literature which links together aid and growth in the presence of (macroeconomic) policies. Indeed, in the 1990s the focus of the discussion and debate regarding the impact of aid on growth shifted to a new research and policy area, namely, the aid–growth-policies nexus, particularly since the publication in 1997 of a World Bank policy research working paper entitled 'Aid, policies, and growth' by Burnside and Dollar (Burnside and Dollar, 1997) and which was subsequently published in the American Economic Review (Burnside and Dollar, 2000). The above paper has become since the late 1990s a very influential, although controversial, contribution to the debate on aid effectiveness. A central finding emanating from this study was that the positive impact of aid on economic growth depends on the presence of good policies (namely, good fiscal, monetary and trade policies). Needless to say, this finding had very important implications for aid allocation and resulted in the 'aid selectivity approach' almost widely adopted by the donor community. However, linking aid to policy can be controversial, to say the least. Indeed, several studies have shown that such link is empirically non-existent or is very weak once the sample, the control variables, or the specifications change (see for example, Hansen and Tarp, 2000, 2001; Dalgaard and Hansen, 2001; Lensink and White, 2001; Dalgaard et al. 2004; Easterly et al., 2004; Rajan and Subramanian, 2008; Antipin and Mavrotas, 2006; Baliamoune-Lutz and Mavrotas, 2009; and Minoiu and Reddy, 2010 among others).

Another major problem with most of the empirical studies on aid effectiveness (including the World Bank's 1998 influential but also controversial study, *Assessing Aid*) until rather recently was their neglect of the heterogeneous character of foreign aid. Indeed, a central feature of the vast quantitative literature of the effectiveness of development aid in recipient countries has for many years been the employment of a single figure for aid. However, this is very likely to provide misleading conclusions regarding the macroeconomic impact of aid in aid recipient countries, since we can distinguish at least four different categories of aid: project aid with a rather lengthy gestation period; programme aid which disburses rapidly as free foreign exchange; technical assistance (or technical cooperation grants); and food aid and other commodity aid which adds directly to consumption. To the above four types of foreign aid, emergency or relief aid could be added as a separate category, given its increasing importance in recent years.

There are three relevant points here: first, different types of aid operate in different ways (and with different lag-structure) in the recipient country thus resulting in different macro effects; second, because of different conditions relating to each in different countries (for example, the state of aid co-ordination may vary among aid recipients), there is also an extra reason to expect different effects of aid in each country – the ceteris paribus assumptions of the econometrics of aid may be disturbed by such considerations; and third, and perhaps more importantly, within an endogenous fiscal response framework, if the government attaches a different utility to each category of aid, using a single figure of aid would lead to aggregation bias in the results and conclusions reached (Mavrotas 2002a,b, 2005, 2010, 2015).

In view of the above, the central argument in the aid heterogeneity approach and thus on the need to disaggregate aid in empirical work is that the use of a single figure for aid, a typical feature of the aid effectiveness literature, cannot capture this aid heterogeneity, thus leading to aggregation bias in the empirical 'evidence' reported (see Cassen, 1994; Mavrotas, 2002a,b, 2010, 2015).[1] The neglect of the aid disaggregation issue in the voluminous aid effectiveness literature was the main motivation of the model developed by Mavrotas (2002a), which built on the fiscal response literature (see Heller 1975) by adding the neglected until then aid disaggregation approach The author provides strong empirical evidence, using time series data for Kenya and India, which clearly suggests the importance of aid disaggregation so that meaningful conclusions on the impact of aid on the fiscal sector can be derived. In recent years the aid heterogeneity approach gained momentum with the publication of a number of papers in this crucial area. Further contributions in this area include Mavrotas (2005), Ouattara (2006a,b), Mavrotas and Ouattara (2006a,b, 2007), Fielding and Mavrotas (2008) and Clemens et al. (2012).[2]

Against this background, in this paper we seek to investigate whether different forms of donor aid affect economic growth differently in a panel of 39 sub-Saharan African countries over the period 2002 to 2020. We do so by using data for all types of aid disbursements through various channels for each type of aid from the OECD-DAC database, along with data on growth and other variables from the World Bank's World Development Indicators, as well as data on institutional quality variables from the Worldwide Governance Indicators transformed into an institutional quality index through principal component analysis. Our estimation strategy includes both static (ordinary least squares, fixed effects and random effects) and dynamic (system generalized method of moments-GMM) models, and in order also to capture possible endogeneity issues via the GMM estimator. Our findings seem to indicate that while total aid positively affects growth in SSA, growth reacts differently to the different aid modalities received and the sectors and sub-sectors to which such aid is directed. In particular, we find that while project aid and technical assistance have the potential to boost growth, budget support and humanitarian assistance stifle growth. We further realize that while social infrastructure and environmental protection aid boost growth in all conditions, economic infrastructure aid has a rather inconsistent influence on growth. Specifically, in the social domains, we find that aid for education is significant and enhances growth; aid for water and sanitation significantly retards growth; and aid for health is negative but insignificant. In the case of economic infrastructure and governance aid, none of them significantly influences growth despite having a positive effect in the dynamic models. Finally, we find that biodiversity aid significantly depresses growth, while the other forms of environmental aid are largely statistically insignificant.

The remainder of the paper is structured as follows. Next section summarises the aid effectiveness literature while Section 3 discusses data and methodology issues. In Section 4 we report and discuss the empirical findings emerging from our econometric analysis and the final section concludes the paper.

[1] A notable exception to the general neglect of the disaggregation of aid in the first generation of empirical studies on aid effectiveness is the study by Levy (1987) (although in the context of a different aid disaggregation, that is between 'anticipated' and 'unanticipated' aid), which gave a strong indication that if we consider the macroeconomic impact of aid in a disaggregated framework, the standard conclusions of the existing studies could be altered dramatically. In Levy's study, the reported estimates, from the estimation of a consumption function for 39 countries over the period 1970–80, indicate different tendencies of anticipated (mainly project aid) and unanticipated aid (food aid, relief aid, and so on): unanticipated aid is fully consumed but more than 40 per cent of anticipated assistance is invested, thus contributing significantly to the growth process in recipient countries (Levy, 1987).

[2] See also the special issue in the Review of World Economics (Weltwirtschaftliches Archiv) in December 2007 (Mavrotas and Nunnenkamp, 2007) and the papers therein for a good discussion.

2. Literature Review

Several theoretical arguments have been advanced for the provision of foreign aid over time. These include the critical rate of growth and minimum effort thesis propounded by Leibenstein and Nelson, which argues that the minimum level of per capita income which must be obtained for sustained growth to take place can only be achieved with the help of additional investment either in terms of foreign aid or otherwise (Nelson, 1956); in Rostow's historical stage theory, foreign aid is seen as necessary for both the take-off and preconditions for take-off stages (Rostow, 1959 and 1961); the vicious circle of poverty theory (Nurkse, 1953) also stressed that foreign aid is required for heavy capital investment; and in the Harrod-Domar growth model, growth depends on investment financed by (domestic plus foreign) savings, among others.

In the three-gap model of Bacha (1990) it is assumed that, in addition to the domestic and foreign savings gaps associated with the two-gap model of Chenery and Strout (1966), the availability of public sector resources also constrains the growth of an economy's productive capacity (especially in developing countries). These form the basis of gap analyses (skills, savings/investment, foreign exchange, and fiscal gaps) that act as a justification for foreign assistance. To supplement the limits of the factors of production that arise from the skills, savings, and foreign exchange gaps, there is a need for foreign aid (Adegboye et al., 2020). This foreign aid is thought to be able to facilitate capital accumulation without domestic savings as well as help loosen foreign exchange controls, especially since aid constitutes a transfer of foreign exchange (Usui, 1996) and will eventually result in an increase in total output by gradually increasing limited factors of production (Adegboye et al., 2020), reducing gradually dependence on foreign capital (Bakare and Bashorun, 2014), and leading to economic development.

According to Todaro and Smith (2011), to ensure that aid funds are effectively utilized to spur economic growth in aid-recipient countries, financial assistance must be complemented by technical assistance in the form of high-level worker transfers. Furthermore, the ability of recipient nations to absorb aid funds and use them wisely and productively is a prerequisite for the potential of foreign aid to spur economic growth (Chenery and Strout, 1966). This capability is influenced by several variables, including the infrastructure already in place, the availability of skilled labour, and institutional and administrative quality (Mbah and Amassoma, 2014).

Many studies have been carried out regarding the aid-growth relationship in the voluminous aid effectiveness literature both at the country and regional (panel) level using different methodologies. As already mentioned, a very influential but also controversial study that mobilised a new literature of foreign aid, was the study by Burnside and Dollar (1997, 2000), which focussed on the aid-growth-policies nexus, to conclude that aid works in good policy environments. These findings were challenged by Easterly (2003) and Easterly et al. (2004). In Easterly et al. (2004), through a replication of the Burnside-Dollar methodology and by adding 3 additional years, the authors show that the crucial interactive term (of aid and policy) in the Burnside and Dollar paper was insignificant and even had the opposite sign. Since then, several other studies have challenged the Burnside and Dollar findings.

Hansen and Tarp (2001), by augmenting common cross-country growth criteria investigate the connection between growth in real GDP per capita and foreign aid. Their results showed that foreign aid accelerates economic growth, and this effect is independent of good policy, thus casting doubts on the Burnside and Dollar findings. Additionally, they find diminishing returns to aid, and the selection of the estimator and the set of control variables have a significant impact on the projected effectiveness of aid. Furthermore, the findings show that even while aid continues to influence growth through investment, no positive effect of aid is shown when investment and human capital are considered. Dalgaard and Hansen (2001) re-evaluated the effectiveness of donor aid using the Burnside and Dollar (2000) dataset. A key finding is that aid has a positive influence on growth regardless of the policy environment. This

debunks the conclusion that aid has a greater positive impact on growth in environments with sound policy because other conclusions can be drawn, particularly after changing the study's sample size, hence indicating the ambiguity of the relationship between sound policy and aid. However, their findings support the non-linear relationship between help and growth, which shows that aid has declining returns, as in Burnside and Dollar (2000).

In the spirit of Burnside and Dollar study, Ram (2004) analysed how recipient country's policies affect the impact of foreign aid on economic growth. The effect of recipient country policies on the impact of aid on growth is found to vanish once the equality constraint on the bilateral and multilateral aid is removed, but the policy has a significant role in enhancing the growth effects of aid when considering total (aggregated) aid. Gomanee et al. (2005) evaluated the ways in which aid affects economic growth using a sample of 25 Sub-Saharan African nations from 1970 to 1997 and found that foreign aid significantly boosts economic growth. They also found that the most important means through which donor aid promotes growth is through investment. Furthermore, by using annual data from the 1960s to 1997 for 71 developing countries, Karras (2006) examines the link between an increase in per capita GDP and donor aid and their results demonstrate that even when a different foreign-assistance measure is used, there is a positive, long-lasting, statistically significant, and sizeable impact of foreign aid on economic growth. By disentangling the effects of two aid components, namely developmental and geopolitical aid, Reddy and Minoiu (2006) further confirm this positive effect. Mallik (2008) uses cointegration analysis to analyse the impact of foreign aid on economic growth in the six most impoverished and aid-dependent African nations (Malawi, Sierra Leone, Central African Republic, Mali, Niger and Togo). The study's findings indicated that there is a long-term relationship between aid, per-capita real GDP, investment, and openness. However, for most of these countries, the long-term impact of foreign aid on growth was found to be negative.

The study by Baliamoune-Lutz and Mavrotas (2009) tried to shed light on the interactions between aid and institutional quality and social capital. The paper explores whether institutions and social capital could enhance the effectiveness of aid independently of 'good' policies, thus questioning the Burnside and Dollar (2000) results. The empirical results, using both the Burnside and Dollar (2000) and Easterly et al. (2004) datasets, indicate that both institutions and social capital could have an impact on the effectiveness of aid. More importantly, once the authors account for the effect of social capital or institutions on aid effectiveness, the impact of policy becomes statistically insignificant.

Gillanders (2010) used a vector autoregression model to analyse the effects of foreign aid on both economic and human development in a panel of Sub-Saharan African nations to discover that while human development responds to aid shocks in a small but positive way, economic growth only slightly increases after a significant aid shock. The analysis also reveals that economic growth responds more strongly to aid shocks in group of countries with superior economic policies, weak institutions, and significant aid dependence. Similarly, Anyanwu (2011) examined the association between aid and growth for African countries using panel data from 1958 to 2001 and the 2SLS estimator. A series of regression analyses revealed that aid had a considerable impact on growth in Africa, but there was no indication of diminishing returns from aid, and the interaction between aid and policy was mostly insignificant in explaining growth in Africa.

Tait et al. (2016) empirically investigate the effects of foreign aid in the SSA region from 1970 to 2012 based on a sample of 25 Sub-Saharan African countries. The study's findings show that aid has a considerable long-term positive influence on per capita GDP growth, an effect that is independent of the level of political freedom in the recipient nation and is not subject to diminishing marginal returns. Additionally, certain sectors, particularly those related to education and health, as well as general budget support, have a favourable, significant impact on growth when aid commitments are segmented by sector. These positive aid-growth

link is also established in other studies, including more recent ones, such as those of Hatemi and Irandoust (2005), Moreira (2005), Ekanayake and Chatrna (2010), Moolio and Kong (2016), Galiani et al. (2017), Rahnama et al. (2017) and Adusei (2020).

By using a sample of 86 developing countries, Ovaska (2005) investigated the effect of aid on economic growth over the years 1975 to 1998. The findings showed a negative link between development aid and economic growth, with growth being reduced more than proportionately following increments in aid flows. Contrary to Burnside and Dollar's (2000) findings, it was also discovered that aid given to countries with superior governance did not increase the effectiveness of aid. By drawing inspiration from the endogenous growth hypothesis and using a sample of 39 countries from different continents and subcontinents for the years 1975 to 2000, Duc (2006) evaluated the relationship between foreign aid and economic growth. The author observed that there is a negative correlation between foreign aid and economic progress in developing countries. The findings of Duc (2006) are in line with those of Djankov et al. (2006), who demonstrated that ODA has a detrimental, direct impact on economic growth in developing countries as it decreases investment and while increasing government spending. Similarly, Mbah and Amassoma (2014) used the Johansen Cointegration methodology on data from 1981 to 2012 and discovered a negative and insignificant association between foreign aid to Nigeria and GDP which confirms the earlier studies of Amakon et al. (2010) and Bakare (2011) for Nigeria.

Other studies either find inconclusive results or results that respond to changing analytical conditions. For instance, Islam (2003) discovered that while aid enhances growth rates in nations with stable political systems, it has little to no effect on growth in other nations, even when good policies are in place. The author also discovers that, on average, aid has a detrimental major influence on developing countries, albeit this effect appears to be unstable and greatly varies depending on the type of regime in question. This suggests that the effectiveness of foreign aid depends less on the effectiveness of a country's policies and more on the stability of its political system.

Applying the Burnside Dollar (2000) approach and OECD data for the years 1970 to 1993, Cordella and Dell'Ariccia (2003) assessed the effect of project aid and budget support on economic growth. The results of the GMM estimators repeatedly demonstrated that neither project aid nor budget support had a large effect on economic growth on their own. The two modalities, however, become relevant when they interact with policy, indicating that the relationship between the two modalities and growth is more dependent on the policy environment. In the study by Ouattara and Strobl (2004), the GMM systems estimator was employed to examine the impact of programme and project aid on growth using the Easterly et al. (2003) dataset for the years 1970 to 1997. They did this by adopting the Burnside and Dollar technique. They discovered that whereas program aid had a negative impact on growth, project aid had a positive impact. The results of their interactions between the two aid modalities and policy revealed that sound policies had no bearing on the effects of program or project help on growth. A similar approach and set of results were obtained by Janjua et al. (2018).

After adjusting for potential bias and using a solid framework that breaks down aid into time frames, periods, sources, and categories, Rajan and Subramanian (2008) looked at the effects of aid on growth in cross-sectional and panel data. Through the instrumental variable methodology, they were unable to find any solid proof of a connection between aid inflows and economic growth, an indication that certain types of aid are more effective as compared to others, or that there is any correlation (positive or negative) between aid and growth. Mallaye and Thierry (2013) used a sample of 34 sub-Saharan African countries between 1990 and 2010 to analyse the heterogeneous effects of aid on economic growth in Sub-Saharan Africa, utilizing evidence from stable and post-conflict countries. The results of the estimation show that, when the endogeneity of aid is considered, it only has a positive impact on growth when the

estimator is controlled for governance quality. Their findings also demonstrated that, in stable conditions, the key channels via which aid is transmitted to growth are governance and education, whereas in post-conflict settings, aid influences growth through investments in public capital. Finally, Neanidis (2012) used an overlapping generation model to study how humanitarian aid affects fertility and economic growth. Through dynamic panel data estimations, the study demonstrates that, on average, humanitarian aid has no impact on rates of fertility and per capita production growth over the years 1974–2007 for 66 aid recipient countries.

Our overview of previous empirical studies shows that the relationship between growth and aid is mostly investigated by using aggregated aid data (with some notable exceptions using disaggregated aid data) with findings remaining rather mixed. Furthermore, relatively few studies (e.g., Rajan and Subramanian, 2008) attempt to conduct a sectoral study of the influence of aid on economic growth. Therefore, our paper tries to fill this knowledge gap regarding the differential effects of various types of aid on growth in selected SSA countries by taking inspiration from the aid disaggregation approach. This is done through the use of different aid modalities and the sectoral disaggregation of total aid into social, economic, and environmental aid in order to delve deeper into the effects of aid heterogeneity on economic growth in SSA.

3. Data and Methodology

3.1. Data Issues

The present paper makes use of panel data of 39 sub-Saharan African countries over a period of 19 years (2002 to 2020). The advantages for using panel data include the ability to learn about the intertemporal dynamics as well as the uniqueness of the entities involved and control the effects of variables that are missing or unobserved (Baltagi, 2005; Hsiao, 2014; Andrew et al., 2013), increases the effectiveness of econometric estimations as well as the possibility to evaluate unrestricted time-adjustment patterns by relying on inter-individual variances to lessen the collinearity between current and lag variables (Pakes and Griliches, 1984).

The data on foreign aid come from the OECD-DAC database. Precisely, totals of all types of disbursements through all channels for each form or modality of aid are considered. Data on growth (GDP) and other control variables (domestic investment and exports) is gathered from the World Bank's World Development Indicators (WDI). We also use data on variables of institutional quality obtained from the Worldwide Governance Indicators (WGI) database. The measures of institutional quality (dimensions of governance) according to the World Governance Indicators (WGI) are government effectiveness, regulatory quality, voice and accountability, political stability, rule of law and control of corruption (World Bank [WGI], 2022). These are the dimensions we have used in order to create an institutional quality index through Principal Component Analysis (PCA).

PCA is a technique for reducing the number of dimensions in high-dimensional data while preserving as much information about the original data as possible. Therefore, it is frequently the case that looking at the reduced-dimension data set will make it much easier for the user to see inherent trends and patterns that characterize the data (Jolliffe, 2002). The PCA is useful when attempting to measure a lot of observable variables while also attempting to create a smaller set of artificial variables (principal components) that will largely explain the variance in the experimental variables. The eigenvalue-one criterion was used to decide how many components to keep for analysis. The Kaiser criterion (Kaiser, 1960), also referred to as the eigenvalue-one criterion, stipulates that only components with an eigenvalue greater than 1.00 be preserved and analyzed. This requirement is justified by the fact that the observed variable adds one unit of variance to the data set's overall variance. Coincidentally, only the first component has an eigenvalue (4.912) that is greater than 1.00, thus used to predict the index

of institutional quality.

The key variables on which data were collected, their description, measurement or units and sources are summarised in **Table 1** below, with all monetary variables measured in US dollars. Descriptive statistics for all variables used in the empirical analysis are also provided in **Appendix 1**. In the same Appendix we also report simple correlation statistics for the key variables used in the paper.

Table 1: Variable Descriptions, Units and Data Sources

Variable	Denotation	Description	Measurement/ Units	Source
Economic Growth	Growth	Gross Domestic Product (GDP)	Current USD	WDI
Domestic Investment	DI	Gross fixed capital formation	current US$	WDI
Exports	EX¨P	Exports of goods and services	current US$	WDI
Total Aid	TA	All types and channels (total disbursement)	Current Prices US$ (millions)	OECD
Budget Support	BS	"	"	OECD
Project Aid	PA	"	"	OECD
Humanitarian Aid	HA	"	"	OECD
Technical Assistance and expert support	TAE	"	"	OECD
Economic Infrastructure & Services Aid	EIS	"	"	OECD
Environmental Protection Aid	EPA	"	"	OECD
Social Infrastructure & Services Aid	SIA	"	"	OECD
Government and Civil Society Aid	GSA	"	"	OECD
Institutional quality	INSQ	Intuitional quality index derived from Principal Component Analysis of all six governance indicators	Index	WGI

Source: Authors

3.2. The Empirical Model

By building on the aid heterogeneity literature three models are specified and initially estimated in the context of the fixed effects static estimator. While model 1 examines the effect of total aid on growth alongside other control variables, model 2 looks at the disaggregated effect of aid by aid modality, while model 3 examines the effect of sectoral aid on growth.

Model 1: Total Aid and Growth

$$Growth_{it} = \pi_0 + \sigma_1 Growth_{it-1} + \pi_1 TAD_{it} + \pi_2 DI_{it} + \pi_3 EXP_{it} + \pi_4 INQ_{it} + \partial_i + \Omega_{it} \quad [1]$$

Model 2: Aid Modality and Growth

$$Growth = \beta_0 + \sigma_1 Growth_{it-1} + \beta_1 BS_{it} + \beta_2 PA_{it} + \beta_3 TAE_{it} + \beta_3 HA_{it} + \beta_4 DI_{it} + \beta_5 EXP_{it} + \beta_6 INSQ_{it} + \partial_i + \mu_{it} \quad [2]$$

Model 3: Sectoral Aid and Growth

Given that the predominant aid modality of donor aid in most SSA countries is project aid, we focus our analysis on project aid to three sectors modelled as follows:

$$Growth = \alpha 0 + \sigma 1 Growthit\text{-}1 + \alpha 1 SIAit + \alpha 2 EIAit + \alpha 3 GSAit\ \alpha 4 EPAit + \alpha 5 DIit + \alpha 6 EXPit + + \alpha 7 INSQit + \partial i + \xi it \quad [3]$$

Where: Growth=GDP; TA=Total Aid; BS=Budget support; PA=Project Aid; TAE=Technical Assistance; DI=Domestic Investment; EXP= Volume of exports; SIA=Social Infrastructure Aid; EIA= Economic Infrastructure Aid, GSA=Governance Support Assistance and EPA= Environmental Protection aid.

Model 4: Sub-Sectoral Aid and Growth

In addition to the above 3 models, in model 4 we further decompose the various forms of aid by their sub-sectors. Within the social, economic, governance and environmental sectors, aid to the following subsectors is considered:

- **Social infrastructure and services (**education, healthcare, water and sanitation).
- **Economic infrastructure and services (**primary activities agriculture, forestry, and fishing; transport; energy; industry and communication).
- **Government and civil society (**legal and judicial development, public finance management and democratic participation).
- **Environmental Protection (**biodiversity conservation, environmental policy and management, environmental research).

Hence, the final empirical model to be estimated is given as:

$$Growth = \gamma 0 + \gamma 1 X1it + \gamma 2 X2it + \gamma 3 X3it + \gamma 4 X4it + \gamma 4 DIit + \gamma 5 EXPit + \gamma 6 INQit + pit \quad [4]$$

Where: X1, X2, X3 and X4 are vectors of social infrastructure and services, economic infrastructure and services, governance and civil society and environmental protection donor aid, respectively. All the πs, β_S, α_s and γs are the parameters to be estimated while Ω, μ, ξ and p are the respective error terms.

3.3. Econometric Analysis

We estimate the parameters of each of the models in a stepwise manner, from static estimators to dynamic panel estimators. The static model estimators employed include the OLS, Fixed Effect, and Random Effect models, while the dynamic model estimator is the system Generalized Method of Moments (sys-GMM), especially as there are few time periods (19 years) and many individual units (39 countries).

Specifically, our analysis is improved by using a dynamic panel data model to esti-

mate the effects of other important variables, whether exogenous or potentially endogenous, on some observed outcomes, based on unobserved individual-specific heterogeneity and one or more lags of the response variable. The study achieves this by using the system GMM estimator which allows us to analyse the dynamic reactions of the selected nations while also allowing us to control for unobserved heterogeneity of those countries over time. We choose this because, as Bond (2002) emphasizes, estimating a static model in the face of dynamic interactions, such as those that characterize the aid-growth nexus, necessitates substantial misspecification and is likely to result in skewed and inconsistent estimates.

In order to address the potential endogeneity issue, we used the lagged instrumental variable method (lag values of total aid and various forms of foreign aid) in line with Dalgaard et al. (2004), Minoiu and Reddy (2010), Clemens et al. (2012), and in accordance with Labra1 and Torrecillas (2018) and Wang and Bellemare's (2019) justifications. Wang and Bellemare (2019) claim that given specified parameter values relative to the naive OLS example, the endogeneity difficulties are addressed by minimizing both bias and the root mean squared errors. We employ the Arellano and Bond estimator, which can utilise instruments at both difference and in levels. According to Lillo and Torrecillas (2018), this approach solely employs instrumental variables as lags in differences and prevents model overidentification and instrument proliferation problems (the existence of possible higher levels of instruments), although this may be uncommon with shorter panels like the one used in this paper.

In general, the GMM-centric literature justifies the use of limited elements in the conditioning information set if the goal is to get robust estimated coefficients and if this can solve the problem of sometimes biased estimated coefficients because there are so many instruments (Asongu and Odhiambo, 2020). The system GMM is further favoured by the fact that the number of countries is greater than the number of time-related observations from each country or investigated cross-section; the outcome variables are persistent, as evidenced by a strong correlation between their level and first level series (Tchamyou et al., 2019); and the GMM's ability to use internal instruments to handle endogeneity issues that may arise from reverse causality or endogenous covariates, as well as a number of other potential sources (Asongu et al., 2020). Finally, much policy emphasis is based on the Sys-GMM estimator as some of the basic assumptions of the static estimators, especially the OLS and the FE, were found to have been violated, and the introduction of lag growth for the dynamism of the analysis introduces the Nickell bias in the FE estimation (Nickell, 1981).

3.4. Identification and exclusion restrictions

To make the identification and exclusion restriction processes easier and complete, we combine the instrumental variable approach, in which the validity of the identification strategy is tested by rejecting the Sargan/Hansen overidentification restrictions test, with the GMM strategy, which uses forward orthogonal variations within the scope of the Hansen test. Specifically, the over-identification test of all instruments (the Hansen J statistic); the under-identification test (Kleibergen-Paap rk LM statistic); and the test for weak instruments (the Cragg-Donald Wald F statistic, the Kleibergen-Paap rk Wald F-statistic, and the Stock-Yogo weak ID test) were conducted. According to Baum et al. (2003), an instrument is valid in the GMM and all other instrumental variable-related estimation techniques such as the 2SLS if it is relevant (correlated with the included endogenous variable(s)) and exogenous (uncorrelated with the error term or orthogonal to the error process). In addition, we follow Asongu et al. (2020) in addressing the simultaneity difficulties associated with the modeling technique by adopting lagged regressors as instruments for forward-differenced variables to accommodate the fixed effects that are likely to influence the connections of interest. Finally, we conduct second-order tests such as tests for cross-sectional dependence (Breusch-Pagan LM and Pasaran CD tests), heteroscedasticity (Modified Wald test), and the test for unit root issues (Fisher-type tests).

4. Results and Discussion

Our empirical results are presented for the OLS, fixed effects (on the basis of the Hausman test), 2-step GMM (making use of heteroscedasticity robust standard error) and system GMM (Sys-GMM) estimators.

4.1. Total Aid and Growth

Table 2 shows the empirical results regarding the impact of total aid on growth. Column 1 reports OLS estimates without the control variables and the institutional variable; column 2 includes all control variables except the interactive term; and columns 5 and 7 contain the results of the 2-step GMM and the 1-step system GMM without the interactive variable, respectively. In general, the results show that aid has a positive effect on growth, regardless of whether good institutions are present or not.[3] Under dynamic situations (one-step system GMM), the changes in growth in response to increasing aid flows are higher (9.67%) and significant. We also see from the interaction term that countries with better institutions witness a drop in growth by about 7.69% following an increase in aid inflows, with the coefficient being significant. This implies that the effect of foreign aid on growth is positive and significant irrespective of the time dynamics, in line with prior studies like those of Gomanee et al. (2005), Reddy and Minoiu (2006), Karras (2006), and Mallik (2008), among others. This positive effect is theoretically explained by the resource gap-filling role of foreign aid (savings, skills, foreign exchange, and fiscal gap), as elaborated in the three-gap model discussed earlier. However, the coefficient of the interactive term between aid and institutional quality (AIDINSQ) changes from being positive in static situations to negative in a dynamic context. This seems to suggest that the effect of aid when institutional quality improves is still unclear, as Islam (2002) and Mallaye and Thierry (2013) have also found.

[3] This is an interesting finding which however needs some further discussion. In a situation where institutional quality is weak, the likelihood of growth may be strained. For instance if the control of corruption is weak, aid inflows may be embezzled and not used for intended purposes. Our results of the interaction between the total aid and institutional quality provide a clearer picture on this, as they show positive relationships across (except model 8 of the 1-step Sys-GMM), suggesting complementarity roles between the two variables.

Table 2: Total Aid and Growth

	Static Effects						Dynamic Effects			
		OLS		FE	2-Step GMM		1-step Sys-GMM		2-step Sys-GMM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth
LTA	0.618***	0.141***	0.147***	0.0389	0.0794*	0.0894**	0.122***	0.0967*	0.123***	0.0743
	(0.0340)	(0.0116)	(0.0116)	(0.0234)	(0.0412)	(0.0419)	(0.0349)	(0.0562)	(0.0329)	(0.0620)
LDI		0.456***	0.446***	0.351***	0.334***	0.337***	0.102	-0.0240	0.102	-0.0569
		(0.0238)	(0.0238)	(0.0364)	(0.0304)	(0.0290)	(0.137)	(0.164)	(0.148)	(0.124)
LEXP		0.370***	0.379***	0.432***	0.423***	0.420***	0.367***	0.461***	0.377***	0.477***
		(0.0211)	(0.0211)	(0.0440)	(0.0263)	(0.0261)	(0.0813)	(0.0872)	(0.0854)	(0.0900)
INSQUAL		-0.0219***	-0.0982***	-0.104**	0.00186	-0.115**	0.0782	0.490*	0.000617	0.230
		(0.00536)	(0.0233)	(0.0485)	(0.0122)	(0.0459)	(0.0736)	(0.277)	(0.0452)	(0.331)
AIDINSQ			0.0134***	0.0164**		0.0180***		-0.0769*		-0.0453
			(0.00399)	(0.00740)		(0.00686)		(0.0411)		(0.0606)
L.LGrowth							0.396***	0.454***	0.364***	0.462***
							(0.103)	(0.139)	(0.128)	(0.113)
Constant	19.21***	4.374***	4.368***	5.913***			3.060***	2.537***	3.572***	2.840***
	(0.215)	(0.163)	(0.162)	(0.689)			(0.725)	(0.964)	(0.935)	(0.919)
Observations	741	702	702	702	668	668	668	668	668	668
R-squared	0.309	0.954	0.955	0.885	0.857	0.859				
Number of country1				39	39	39	39	39	39	39

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: LTA=Total aid; LDI=domestic investment; LEXP=export; INSQUAL=institutional quality; AIDINSQ=total aid*institutional quality.

4.2. Aid Heterogeneity and Growth

In **Table 3** we report the results of the various aid modalities in the context of the aid heterogeneity approach. We find that the coefficient of budget support is negative and insignificant in static situations but positive in dynamic conditions, while that of project aid is positive in either situation, indicating that project aid positively and significantly affects growth, increasing GDP by 10.7% in a static context and by 6.7% in dynamic situations. Meanwhile, the effect of humanitarian aid is positive under fixed effects but insignificant under the dynamic GMM estimator. The technical assistance coefficient is negative and significant in the static model, implying that increased technical assistance flows initially decrease growth but are positive though insignificant in the system GMM estimation. These modality-based findings are in line with those of Ouattara and Strobl (2004) and Janjua et al. (2018), who found that programme aid (budget support) hurt growth while project aid had a positive effect. We further argue that the insignificant effect of budget support is attributable to its inconsistent flow and small volume, while its negative effect may be partly attributed to corruption and inefficiency, conflicts, and political instability (Bräutigam and Knack, 2004), which are associated with foreign assistance directly under government control as in the case of budget support.

On the other hand, project aid tends to circumvent the government and directs resources towards sector policies and priorities as well as activities that accelerated growth and development (Cordella and Dell'Ariccia, 2003). So, even when governments are trying to balance their budgets, they cannot accidentally send aid to other places (Camara, 2004). Therefore, the use of such funds is more effective than budgetary support. This bolsters the argument made by Koeberle et al. (2006) that project aid is preferred in situations of feeble public finance management systems and unfavourable policy environments, typical of many SSA countries.

The effect of humanitarian aid is positive but insignificant under fixed effects and negative but significant under dynamic situations, and it is capable of reducing growth by 1.37% following a 100% increase in its inflows. According to the findings, in static situations (see fixed-effects results), humanitarian aid is seen to positively affect growth, though insignificantly. However, the dynamic estimator results show that humanitarian assistance has a negative but significant effect on economic growth. In addition to the fact that such aid is often short-term and that much is geared toward food aid rather than reconstruction and rehabilitation, the provision of humanitarian aid, particularly in conflict zones, may be politicized to the point where it either misses its intended recipients or favours rival parties. This not only discourages parties in dispute from finding long-term solutions but also intensifies some types of crises. Also, the economic benefits are not shared equally among the affected communities, and humanitarian aid has the potential to cause inflation, limit the supply of goods, and hurt local businesses, which may eventually close (Idris, 2016). According to Mosel et al. (2015), the distribution of food aid as part of the humanitarian response to the conflict in South Sudan destroyed the market for the crop in some areas of the nation, just as the distribution of food aid in Northern Mali was one of the factors cited as the reason for the decreased trade in millet (Idris, 2016). Having said that, other very recent studies seem to suggest that food aid to the SSA region may help in enhancing food and nutrition security, with governance quality playing also an important role in the final outcome (Cassimon et al., 2023).

The technical assistance coefficient is negative and significant under the static fixed effects estimator, implying that increased technical assistance flows initially decrease growth, but it is positive and insignificant under the system GMM estimator. Finally, the coefficients of domestic investment and export are both positive and significant, while the coefficient of institutional quality is negative and significant in both estimators. Finally, the effect of technical assistance is found to be ambiguous (i.e. negative and significant under the fixed effect model and positive but insignificant under the dynamic estimation). The results are not surprising however, because according to Cox and Norrington-Davies (2019), there is evidence

that technical support has not been as effective as anticipated in terms of reducing poverty and developing sustainable capacity. They further stress that donors offer technical assistance mainly for policies and reforms that they support, reflecting donor objectives rather than those of the recipient countries. Andrews et al. (2013) and Pritchett et al. (2012) further argue that there is a very real risk that aid interventions will encourage organizations in developing countries to adopt best practices in laws and policies that may appear impressive, especially when developed with the assistance of international experts, but are less likely to be efficacious in the national context. This can then result in tendencies where governments of developing countries repeatedly implement reforms to maintain legitimacy and continuous flows of foreign assistance but fail to significantly enhance their operations, rendering technical assistance less productive for recipient economies like those of SSA. Such failed examples are the cases of Public Finance Management (PFM) and anti-corruption reforms in Uganda (Cox and Norrington-Davies, 2019) and donor-supported PFM reforms in Malawi (Bridges and Woolcock, 2017).

Table 3: Aid Heterogeneity and Growth

	Static Effects				Dynamic Effects	
	OLS		FE	2-Step GMM	1- Step Sys-GMM	2- Step Sys-GMM
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth
L.LGrowth					0.542***	0.534***
					(0.0758)	(0.103)
LBS	-0.0153	-0.00134	-0.00284	-0.0265	0.00312	0.00190
	(0.0205)	(0.00604)	(0.00479)	(0.0192)	(0.00364)	(0.00797)
LPA	0.693***	0.128***	0.107**	0.531	0.0666***	0.0625**
	(0.0892)	(0.0285)	(0.0396)	(0.359)	(0.0238)	(0.0316)
LHA	-0.168***	-0.0209*	0.00453	-0.0608	-0.0137*	-0.0231
	(0.0330)	(0.0119)	(0.00784)	(0.0802)	(0.00744)	(0.0243)
LTAE	0.385***	0.0342	-0.0263*	0.0165	0.0197	0.0104
	(0.0682)	(0.0210)	(0.0133)	(0.146)	(0.0144)	(0.0212)
LDI		0.529***	0.276***	0.154	0.234***	0.257***
		(0.0349)	(0.0618)	(0.0972)	(0.0515)	(0.0604)
LEXP		0.325***	0.279***	0.199***	0.153***	0.156***
		(0.0304)	(0.0398)	(0.0573)	(0.0348)	(0.0450)
INSQUAL		-0.0351***	0.0493	0.0281	-0.0170*	-0.0376
		(0.00865)	(0.0304)	(0.0655)	(0.00930)	(0.0486)
Constant	18.53***	3.853***	10.59***		1.803***	1.537**
	(0.353)	(0.260)	(1.021)		(0.492)	(0.780)
Observations	390	380	380	320	380	380
R-squared	0.523	0.960	0.641	0.235		
Number of country1			39	36	39	39

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: LBS=log of budget support; LPA=project aid; LHA=humanitarian assistance; LTAE=technical assistance; LDI=domestic investment; LEXP=export; INSQUAL=institutional quality; and AIDINSQ=total aid*institutional quality.

4.3. Sectoral Aid and Growth

Turning to the empirical results of the sectoral aid model (**Table 4**), the coefficients of aid aimed at economic infrastructure and associated services are positive under the fixed effects model and the 2-step GMM estimator, meaning that when country specificities and endogeneity are accounted for, aid for economic infrastructure (transport, energy, industry, etc.) positively and significantly influences economic growth. However, the coefficient becomes negative under the dynamic model, indicating that increased aid for this purpose may decrease growth. Our results also show that aid flows for social infrastructure and related services increased growth (by 16.1% and 17.4%) in the static and dynamic model, respectively. The effects are more significant and larger under dynamic situations, in line with Tait et al. (2016). Such aid has a direct bearing on the human capital development of recipient countries, thereby ensuring long-term growth.

We also find that the coefficient of foreign aid aimed at improving governance and civil society is positive in both models, but significant only in the static model. A similar finding is reported for foreign aid aimed at protecting the environment. Furthermore, the coefficient of domestic investment remains positive and significant in the static model but turns to negative and insignificant when the dynamic estimator is used; exports generally remain positive and significant, while the institutional quality coefficient is negative in static situations and positive but insignificant in the dynamic model. Finally, in the presence of all these types of sectoral aid—domestic investment, exports, and institutional quality—it is found that previous growth remains a booster for subsequent growth.

Table 4: Sectoral Analysis of Aid Effects on Growth

	Statistic Effects				Dynamic Effects	
	OLS		FE	2-Step GMM	1- Step Sys-GMM	2- Step Sys-GMM
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth
L.LGrowth					0.412***	0.338***
					(0.0911)	(0.0975)
LEPA	0.215***	0.0145	0.0425***	0.0647***	0.0123	0.0115
	(0.0394)	(0.0121)	(0.0149)	(0.0213)	(0.0154)	(0.0150)
LEIA	-0.235***	-0.0307***	0.0259*	0.0491***	-0.0148	-0.00980
	(0.0346)	(0.0112)	(0.0133)	(0.0178)	(0.0190)	(0.0167)
LSIA	1.370***	0.161***	0.102**	0.154***	0.174**	0.215***
	(0.0802)	(0.0290)	(0.0398)	(0.0398)	(0.0712)	(0.0763)
LGSA	-0.493***	0.0361*	-0.00703	-0.0312	0.0283	-0.00349
	(0.0585)	(0.0213)	(0.0219)	(0.0339)	(0.0566)	(0.0464)
LDI		0.426***	0.282***	0.244***	-0.0104	0.0134
		(0.0240)	(0.0369)	(0.0262)	(0.122)	(0.116)
LEXP		0.379***	0.396***	0.372***	0.395***	0.423***
		(0.0210)	(0.0436)	(0.0262)	(0.0722)	(0.0559)
INSQUAL		-0.0179***	-0.0111	-0.0192	0.0322	0.00715
		(0.00594)	(0.0247)	(0.0124)	(0.0446)	(0.0315)
Constant	18.01***	4.786***	7.726***		4.250***	4.716***
	(0.234)	(0.174)	(0.938)		(0.773)	(0.789)
Observations	736	699	699	663	665	665
R-squared	0.518	0.958	0.897	0.871		
Number of country1			39	39	39	39

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Where: LEPA= environmental protection aid; LEIA=economic infrastructure aid; LSIA=social infrastructure aid; LGSA=governance and civil society aid; LDI=domestic investment; LEXP=export; INSQUAL=institutional quality; and AIDINSQ=total aid*institutional quality.

Table 5: Sub-sectoral analysis of Aid Effects on Growth

	Static Effects				Dynamic Effects	
	OLS		FE	2-Step GMM	1- Step Sys-GMM	2- Step Sys-GMM
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth	LGrowth
L.LGrowth					0.296**	0.248
					(0.144)	(0.178)
LEDU	0.462***	-0.0225	-0.000862	0.0751	0.0411	0.0672**
	(0.121)	(0.0307)	(0.0342)	(0.183)	(0.0358)	(0.0323)
LHEAL	0.148	-0.0895***	0.0880***	0.439	-0.0290	-0.0152
	(0.0958)	(0.0231)	(0.0285)	(0.347)	(0.0307)	(0.0356)
LWSS	0.0832	-0.0572***	-0.00165	0.183	-0.0134	-0.0482*
	(0.0687)	(0.0170)	(0.0150)	(0.253)	(0.0295)	(0.0277)
LPRIM	-0.0222	0.00798	0.0181	-0.0518	-0.0105	-2.26e-05
	(0.0799)	(0.0197)	(0.0190)	(0.121)	(0.0208)	(0.0269)
LIND	-0.0928*	0.0227*	-0.00339	0.130	0.00877	0.00667
	(0.0500)	(0.0128)	(0.0132)	(0.202)	(0.0160)	(0.0187)
LTRANS	-0.0805**	-0.0170*	-0.000158	0.0333	0.00371	-0.00168
	(0.0388)	(0.00950)	(0.00729)	(0.0474)	(0.00897)	(0.0137)
LENE	0.153***	0.00469	0.0104	-0.150	0.00809	0.00593
	(0.0409)	(0.0101)	(0.00721)	(0.222)	(0.0107)	(0.00843)
LCOM	-0.103**	0.0100	0.0112*	0.0253	0.0197	0.000615
	(0.0404)	(0.00974)	(0.00598)	(0.0741)	(0.0193)	(0.0312)
LLJD	0.0608	0.0338***	-0.00256	0.0951	0.0196	0.0247
	(0.0470)	(0.0113)	(0.00791)	(0.163)	(0.0126)	(0.0179)
LPFM	-0.0538	-0.0103	0.00175	0.0186	0.00177	-0.00648
	(0.0405)	(0.00993)	(0.00965)	(0.0629)	(0.00871)	(0.0118)
LDPC	0.0134	0.0224	-0.0285**	0.0427	-0.0205	-0.00628
	(0.0747)	(0.0184)	(0.0129)	(0.147)	(0.0260)	(0.0234)
LBIOD	-0.170***	-0.0261**	0.00357	0.0266	-0.0342**	-0.0348**
	(0.0470)	(0.0115)	(0.00775)	(0.0585)	(0.0173)	(0.0172)
LEPAM	-0.0721	0.0173	0.0290**	-0.0181	-0.00559	-0.00165
	(0.0614)	(0.0147)	(0.0114)	(0.108)	(0.0150)	(0.0326)

	Static Effects				Dynamic Effects	
	OLS		FE	2-Step GMM	1- Step Sys-GMM	2- Step Sys-GMM
LEVR	-0.0729**	0.00394	0.00747	0.0521	-0.00517	-0.0115
	(0.0325)	(0.00801)	(0.00539)	(0.0965)	(0.0111)	(0.0101)
LDI		0.564***	0.301***	0.278**	0.152	0.206
		(0.0309)	(0.0298)	(0.124)	(0.144)	(0.170)
LEXP		0.318***	0.335***	-0.0832	0.379***	0.368***
		(0.0288)	(0.0321)	(0.485)	(0.0667)	(0.0737)
INSQUAL		-0.0368***	0.00587	-0.0864	-0.0584	-0.0402
		(0.00852)	(0.0268)	(0.132)	(0.0522)	(0.0633)
Constant	20.59***	4.599***	8.938***		4.775***	4.865***
	(0.503)	(0.236)	(0.669)		(1.255)	(1.569)
Observations	408	391	391	284	381	352
R-squared	0.204	0.956	0.905	0.300		
Number of country1			38	31	38	37

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: LEDU= Education aid; LHEAL= Healthcare aid; LWSS= water, and sanitation aid; LPRIM= primary sector aid to agriculture, forestry, and fishing; LIND= aid for industrial development; LTRANS= Transport system development; LENE= energy production; LCOM=communication; LLJD= legal development; LPFM= public finance management; LDPC= democratic participation; LBIOD= biodiversity conservation; LEPAM= environmental policy and management; LEVR=environmental research; LDI=domestic investment; LEXP=export; INSQUAL=institutional quality; AIDINSQ=total aid*institutional quality.

4.4. Sub-sectoral aid and Growth

Our empirical analysis regarding the overall nexus between sub-sectoral aid and growth (**Table 5**), seems to suggest that under the overall category of aid directed towards social infrastructure, the effects of aid for education and healthcare are growth-enhancing in the static model, while aid for water and sanitation seems to reduce growth under the dynamic estimator. Returns to education in particular, are generally expected to be positive, take a longer period to be felt and to have a long-term effect on growth (Tait et al., 2016).

Regarding economic infrastructure, the effects of aid directed towards primary sector activities (agriculture, forestry and fishing) were found to be insignificant in both models, while aid flows channeled to industrial, transport, energy, and communication sub-sectors were all inconsistent and sensitive to static estimators but on average positive though insignificant when the more robust dynamic estimator was employed. This seems to suggest that aid aimed at promoting industrial development, energy, and communication has the potential to enhance growth in SSAs.

From a governance quality perspective, we also find that none of the three forms of donor's aid was growth-enhancing in the dynamic model. However, we discovered that aid aimed at legal and judicial development enhances growth under static conditions. For environmental aid, both the static and dynamic estimators reveal a consistently negative and significant effect on growth of increasing aid directed towards biodiversity conservation, while the effects of other environmental sustainability-oriented aid are shown to be inconsistent for the static estimators, and largely negative and insignificant in the dynamic models. Given the trade-off nexus and intractable conflict between environmental conservation and economic growth, the negative and significant effects of biodiversity aid are rather anticipated. Moreover, until recently, most SSA countries have not sufficiently embraced green technology forms of biodiversity and environmental protection mechanisms, thus rendering aid to these domains less effective in enhancing sustainable growth.

5. Concluding Remarks

Foreign aid has been the subject of a rather intense and often highly politicized as well as unhealthy debate for many years with particular emphasis on aid effectiveness issues. The sub-Saharan Africa region has been a major recipient of aid flows for many years, and this has attracted a lot of interest by many researchers in order to investigate the impact of aid on growth in the countries concerned. Against this background, in this paper tried to examine whether different forms of donor aid affect economic growth differently in a panel of 39 sub-Saharan African countries over the period 2002 to 2020.

We did so by using data for all types of aid disbursements through various channels for each type of aid from the OECD-DAC database, along with data on growth and other variables from the World Bank's World Development Indicators, as well as data on institutional quality variables from the Worldwide Governance Indicators transformed into an institutional quality index through principal component analysis. Our estimation strategy included not only static (ordinary least squares, fixed effects and random effects) models but also the more robust dynamic (system generalized method of moments-GMM) models in order also to capture possible endogeneity issues via the GMM estimator.

Our findings seem to indicate that while total aid positively affects growth in SSA, growth reacts differently to the different aid modalities received and the sectors and sub-sectors to which such aid is directed. In particular, we found that while project aid and technical assistance have the potential to boost growth, budget support and humanitarian assistance stifle growth. We further found that while social infrastructure and environmental protection aid boost growth in all conditions, economic infrastructure aid has a rather inconsistent influence on growth. More precisely, in the social domains, we found that aid for education is significant and enhances growth; aid for water and sanitation significantly retards growth; and aid for health is negative but insignificant. In the case of economic infrastructure and governance aid, none of them significantly influences growth despite having a positive effect in the dynamic models. Finally, we found that biodiversity aid significantly depresses growth, while the other forms of environmental aid are largely statistically insignificant.

Although our results provide a new dimension and contribution to the vast literature on aid effectiveness, it is also important to recognize that data is imperfect, especially on growth and aid inflows (see also the debate on aid disbursements versus aid commitments data in the aid literature) and mismeasurement can potentially lead to biased estimates. Furthermore, although the paper also uses the more robust GMM estimator to handle potential endogeneity issues, some doubts may still remain in view also of the rather conflicting results that have emerged over time in the vast aid literature. For example, could the result that humanitarian assistance stifle growth could be driven by reverse causality and dynamics that are not entirely captured by the GMM approach and the lag structure in the econometric model employed? Choosing the right control variables is also another daunting exercise. For example, institutional quality could be affected by aid (but also by growth and an interaction term).

Having said that, it is important to stress that our results point to the centrality of aid disaggregation approach in aid effectiveness research work, since the use of a single figure for aid (a key feature for the bulk of aid effectiveness literature for many years, with some few notable exceptions) do not allow us to consider the differential impact of different types of aid on growth in aid-recipient countries, and thus forming the emerging policy recommendations accordingly. This also seems to suggest that the right question to ask from a donor and aid-recipient perspective is not whether aid works but about which type of aid works better so meaningful policy recommendations can be derived for aid targeting.

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Appendix I: Descriptive Statistics

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TA	741	955.151	1141.007	9.591	12380.16
BS	572	145.36	202.238	-.009	1660.403
PA	737	478.636	655.76	.12	4004.115
HA	726	72.986	143.809	.001	951.597
TA	467	26.541	29.208	.06	207.088
EPA	737	11.74	15.254	.025	110.216
EIA	740	115.834	152.773	-2.136	1068.457
SIA	741	395.139	443.052	5.949	2355.138
GSA	741	78.527	91.562	.277	853.902
PRIM	740	52.321	68.867	.005	578.415
BIOD	702	3.244	4.655	-.001	40.513
COM	708	4.117	10.693	-8.716	163.287
DPC	730	8.701	10.732	.001	110.32
EDU	741	61.474	65.288	1.118	678.695
ENE	695	40.01	65.282	-.059	514.067
EPAM	729	6.487	10.362	-.121	91.071
EVR	511	.776	1.879	0	31.16
HEAL	739	89.617	122.419	0	817.14
IMC	723	11.066	18.21	-.545	159.931
LJD	697	4.563	6.106	0	39.199
PFM	714	15.419	32.694	0	389.593
TPR	660	4.487	10.061	-.094	98.221
TRANS	727	58.858	72.656	.001	514.303
WSS	731	40.033	47.523	.002	241.716
GDP	741	3.252e+10	7.803e+10	4.178e+08	5.467e+11
DI	703	7.082e+09	1.472e+10	30544092	1.156e+11
exp	721	8.719e+09	1.942e+10	37638994	1.437e+11

Appendix I: Correlation statistics

Pairwise correlations (with interaction term)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) LTA	1.000													
(2) LGrowth	0.556*	1.000												
	(0.000)													
(3) LDI	0.513*	0.964*	1.000											
	(0.000)	(0.000)												
(4) LEXP	0.371*	0.940*	0.933*	1.000										
	(0.000)	(0.000)	(0.000)											
(5) LBS	0.482*	0.197*	0.197*	0.129*	1.000									
	(0.000)	(0.000)	(0.000)	(0.002)										
(6) LPA	0.779*	0.524*	0.500*	0.361*	0.322*	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)									
(7) LHA	0.700*	0.287*	0.229*	0.126*	0.232*	0.614*	1.000							
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)								
(8) LTAE	0.745*	0.588*	0.555*	0.442*	0.355*	0.814*	0.534*	1.000						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
(9) LEPA	0.682*	0.538*	0.538*	0.416*	0.270*	0.644*	0.398*	0.656*	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(10) LEIA	0.817*	0.397*	0.401*	0.228*	0.414*	0.740*	0.526*	0.686*	0.691*	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(11) LSIA	0.934*	0.631*	0.586*	0.441*	0.408*	0.829*	0.684*	0.780*	0.692*	0.793*	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(12) LGSA	0.893*	0.440*	0.367*	0.229*	0.483*	0.723*	0.728*	0.674*	0.552*	0.745*	0.896*	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
(13) INSQUAL	-0.057	0.078*	0.186*	0.142*	0.092*	-0.059	-0.400*	0.092*	0.170*	0.131*	-0.008	-0.205*	1.000	
	(0.119)	(0.033)	(0.000)	(0.000)	(0.028)	(0.110)	(0.000)	(0.048)	(0.000)	(0.000)	(0.823)	(0.000)		
(14) AIDINSQ	-0.085*	0.074*	0.173*	0.131*	0.112*	-0.060	-0.431*	0.066	0.162*	0.107*	-0.027	-0.213*	0.975*	1.000
	(0.021)	(0.044)	(0.000)	(0.000)	(0.008)	(0.105)	(0.000)	(0.154)	(0.000)	(0.004)	(0.470)	(0.000)	(0.000)	

*** p<0.01, ** p<0.05, * p<0.1

Pairwise correlations (without interaction term)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) LTA	1.000												
(2) LGrowth	0.556*	1.000											
	(0.000)												
(3) LDI	0.513*	0.964*	1.000										
	(0.000)	(0.000)											
(4) LEXP	0.371*	0.940*	0.933*	1.000									
	(0.000)	(0.000)	(0.000)										
(5) LBS	0.482*	0.197*	0.197*	0.129*	1.000								
	(0.000)	(0.000)	(0.000)	(0.002)									
(6) LPA	0.779*	0.524*	0.500*	0.361*	0.322*	1.000							
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
(7) LHA	0.700*	0.287*	0.229*	0.126*	0.232*	0.614*	1.000						
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)							
(8) LTAE	0.745*	0.588*	0.555*	0.442*	0.355*	0.814*	0.534*	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(9) LEPA	0.682*	0.538*	0.538*	0.416*	0.270*	0.644*	0.398*	0.656*	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(10) LEIA	0.817*	0.397*	0.401*	0.228*	0.414*	0.740*	0.526*	0.686*	0.691*	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(11) LSIA	0.934*	0.631*	0.586*	0.441*	0.408*	0.829*	0.684*	0.780*	0.692*	0.793*	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
(12) LGSA	0.893*	0.440*	0.367*	0.229*	0.483*	0.723*	0.728*	0.674*	0.552*	0.745*	0.896*	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
(13) INSQUAL	-0.057	0.078*	0.186*	0.142*	0.092*	-0.059	-0.400*	0.092*	0.170*	0.131*	-0.008	-0.205*	1.000
	(0.119)	(0.033)	(0.000)	(0.000)	(0.028)	(0.110)	(0.000)	(0.048)	(0.000)	(0.000)	(0.823)	(0.000)	

*** p<0.01, ** p<0.05, * p<0.1

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