Education sector foreign aid and economic growth in Africa

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Abstract

This paper explores whether education sector foreign aid influences economic growth in Africa based on a panel of 32 countries over the period 2005 – 2017. The major novelty of the study is that on the supply side the major dependent variable, education aid flows, are disaggregated by education level. On the demand side, the recipient economies are accorded their income groups to account for capacities that complement the effects of human capital development on economic growth as well as the benevolent complementary or destabilizing effects of different political systems of government. The key findings are that: (i) education aid in aggregate form and primary education aid both enhance economic growth in low income countries; (ii) in middle income countries higher education aid is more important for economic growth than primary and secondary education foreign aid; (iii) democracies have a stronger tendency to allocate more education sector foreign aid to primary education, while in autocracies the orientation is towards higher education. The findings imply that low-income autocracies that allocate more education sector foreign aid to higher education than to primary education do so at the expense of economic growth. The same applies to middle-income democracies whose allocation orientation is more towards primary education compared to higher education.

Key words: Africa, Education, Foreign Aid, Growth, Political System.
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1. Introduction

Much of the contention surrounding international aid from donors to recipients has emanated from the motives of the supply side as well as the expected net benefits on the demand side. Military aid would perhaps be the most brazen where the benefits to both sides are seen in clear short and long-term perspectives including sales of military technology, political and military leverage, dependence and related economic ties. This implies some cost to the recipient at some point in time, which is why after a recent Tsunami, India declined international humanitarian assistance because payback would be in the form of lowered international creditworthiness. Outside the military and within the so-called Overseas Development Assistance (ODA), education aid is among the most enigmatic as far as motivation is concerned – at least to ordinary citizens and tax-payers in donor countries. But donor governments can see strong and long-term economic motivations brokered via political influence or even cultural ties with costs to the recipients and so the benefits to them would also need to be assessed.

A direct objective of education sector foreign aid to developing countries would be to contribute towards the accumulation of their human capital as an investment which should spur economic growth for them and demand for imports from the donating countries. This transmission mechanism would be implied and incorporated in endogenous growth models of Lucas (1988) and Romer (1990) as well as the augmented Solow exogenous growth model of Mankiw et al. (1992), which postulate a positive relationship between education and economic growth. Several empirical studies have also found that the stock of human capital and the level of investment in education are positively associated with economic growth (see McMahon, 1998; Keller, 2006; Asiedu, 2014).

Education aid in recipient countries in sub-Sahara Africa would mainly be utilized for school infrastructure, training and recruitment of teachers, and procurement of teaching and learning materials, all of which tend to be in short supply. These expenditures can influence the quality and quantity of education outputs. They also have the potential to impact GDP growth through increases in investment in education and the enhancement of the stock of human capital. From the perspective of endogenous growth models, more and better education improves the quality, innovativeness, adaptability and productivity of labour as a factor of production.

The effects of education on economic growth are expected to be different for the three levels of education, namely primary, secondary, and higher education. For the longer term, the decline in fertility and mortality rates would likely be more influenced by primary education whereas technological spill-overs would be a more relevant and direct transmission route to growth via higher education especially when complementary inputs such as physical capital and technological know-how are also available. This suggests that the growth effects of education can be mediated by the level of economic development and can therefore differ between low and middle income countries.

Previous studies have tended to overlook the fact and importance of the heterogeneous nature of education aid as well as that of aid recipients both of which could influence economic growth. The oversight may explain the lack of robustness of the effect of aid on growth found in some of the previous empirical studies. Clemens et al. (2004) show that different components of aid, as opposed to aggregate aid, are important when assessing the effect of aid on growth-related

macroeconomic variables such as developing countries' creditworthiness. In their study Harms and Rauber (2004) found that aid improves countries' standings vis-a-vis international capital markets. Importantly, the strength of this effect of aid differs across types of aid and country income groups. The relevance of recipient heterogeneity can be extended beyond income levels to whether any aid effectiveness is neutral to political governance: could (and how) democratic as opposed to autocratic political regimes mediate aid effectiveness?

The present study uses panel data from 32 African countries covering the 13-year period from 2005 to 2017 to examine whether foreign aid in the education sector has a significant effect on economic growth. The significant contributions are that on the supply side the major dependent variable, education aid flows are disaggregated by education level. On the demand side the recipient economies are accorded their income groups (to account for capacities for human capital development complementarities) as well as different political systems of government (to account for the benevolent/destabilizing complementarity for economic growth). In order to concretely ascertain the importance of heterogeneity of aid and of recipients, the estimated results from these disaggregations are benchmarked against those based on pooled or aggregated aid and recipient data (i.e. where heterogeneity is ignored).

The remainder of the paper is organized as follows: Section 2 reviews theoretical and empirical literature. Section 3 discusses the data, model and methodology. Section 4 presents the results and enters into preliminary interpretations. Section 5 offers an in-depth discussion of the results and section 6 concludes.

2. Literature review

2.1. Theoretical perspective

Theory suggests that foreign aid promotes economic growth by supplementing limited domestic savings of recipient developing countries. Early influential literature based on the Harrod-Domar model of economic growth includes the work of Chenery and Strout (1966). The three elements of the Harrod-Domar model are income (growth), investment (savings) and the capital-output ratio, which links the former two and representing the marginal amount of investment necessary to produce an additional unit of output. With the capital-output ratio remaining constant, the rate of economic growth will be directly determined by the rate of investment. With investment assumed to be equal to savings, this implies that a poor country, with low savings, will have low investment and low growth potential. It is thus expected that a supplementation of domestic savings by foreign aid would support an increase in investment, and hence economic growth. Chenery and Strout base their analysis on the case where resource limits on skills and savings are important, and describe this scenario as 'investment limited growth,' where the Harrod-Domar model is taken as the limiting case of no foreign assistance. Calculation of the savings gap is made possible from the Harrod-Domar equations. A savings gap occurs when the quantum of domestic savings available is less than the amount of investment required to attain the target growth rate, and this gap can be filled by foreign aid.

Over time, further growth theories have emerged contesting some of the postulations of the Harrod-Domar model such as the models employed in the assessment of the impact of aid on economic growth. The crucial ones have been the neoclassical and endogenous growth theories. The neoclassical model is largely inspired by the Solow model of long-run growth, which assumes

a continuous production function relating output to the inputs of capital and labour which (as opposed to the Harrod-Domar model) are substitutable and exhibit diminishing returns to scale.

The endogenous growth theory whose key proponents are Arrow (1962), Romer (1986) and Lucas (1988) acknowledges the importance of endogeneity of capital in the growth process with the prospects of increasing as opposed to diminishing returns to capital typical in the neoclassical growth theory.

In all the above, savings and investment (in capital and labour) are fundamental to economic growth. In the endogenous growth theory the assumption of increasing returns to capital implies that effects of foreign aid on growth can be long-run.

2.2. Empirical perspective

A fairly large number of empirical studies have been conducted to ascertain the theoretical construct of the aid-growth relationship at individual country (over time) and cross-country levels. Close variations of the following regression specification have been estimated at cross-country level by Hansen and Tarp (2001), Dalgaard et al. (2004) and Gomanee et al. (2005):

$$\Delta y_i = \beta_0 + \beta_y ln y_{0i} + \sum_{j=1}^{n} \beta_j Z_{i,j} + \varepsilon_i \qquad (1)$$

where Δy_i is the average growth rate of per capita output for country i, between some initial date t_0 and a second date t_1, lny_{0i} is the log of per capita output of country i, at time t_0, and ε_i is an error term. $Z_{i,j}$ represents a number of other variables deemed relevant by the researcher and can include some measure of the initial level of human capital or its rate of change. It could also include a variety of variables related to government policies and institutions, such as the share of government spending in GDP, the inflation rate, an index of the rule of law, to name just a few.

To examine the relationship between foreign aid and growth in real GDP per capita, Hansen and Tarp studied a panel data set comprising 56 countries across Africa, Asia and South America for the 20 year period 1974 – 1993. They found that foreign aid increased the growth rate of real per capita GDP and this result was not conditional on 'good' policy. Their findings contradicted observations by Burnside and Dollar, who proposed that aid has a positive impact on growth in developing countries conditional on a policy index (i.e. aid has a positive impact in countries with good fiscal, monetary, and trade policies). Burnside and Dollar's study comprised a panel dataset with 56 countries from Sub-Saharan Africa, Latin America and South Asia for the 24 year period 1970 – 1993. Hansen and Tarp further observed that the estimated effectiveness of aid is highly sensitive to the choice of estimator and the set of control variables included in the regression. Their study also reconfirmed the empirical support for the hypothesis that aid influences growth via the investment transmission mechanism. Dalgaard et al. reached a similar conclusion to Hansen and Tarp that aid is generally effective even in 'bad policy' environments. Their study comprised a panel dataset with 65 countries across Sub-Saharan Africa, Central America and East Asia for the 24 year period from 1974 – 1997.

Gomanee investigated aid effectiveness in a panel of 25 Sub-Saharan African countries in the 28 year period 1970 - 1997 by focusing on hypothesized transmission mechanisms through which aid

impacts growth. The results indicated a highly significant positive effect of aid on growth and that investment was the most important transmission mechanism suggesting that Africa's poor growth record should not be attributed to aid ineffectiveness.

The studies mentioned above have a number of features in common. First, they all conclude that aid positively and significantly influences economic growth. Second, they each studied foreign aid in aggregate form, hence ignoring the possibility that different sectoral orientations of foreign aid could influence economic growth with varying degrees of efficacy. Third, all the studies did not consider the heterogeneity of the governance regimes of the countries, which could affect aid effectiveness and impact on growth. The main contribution of the present study is to address omissions of earlier studies of the aid-growth nexus by accounting for the orientation of aid and the governance regimes of recipient countries.

2.3. The education aid-growth nexus and political governance systems

Researchers have debated whether foreign aid is good for economic growth, has no effect, or even a hindrance to progress (see Hansen and Tarp (2001); Burnside and Dollar (2000); Easterly (2003)). Some agreement has formed around the argument that aid works more effectively under specific political and economic conditions that enable foreign aid to have the greatest impact on poverty reduction and promotion of growth.

The arguments against democratic political systems were earlier proposed by Galenson (1959) and Huntington (1968) who argued that democracy generates an explosion of demands, which unleash pressures for immediate consumption. These demands, through union-driven wage demands, threaten profits, negatively impact investment and retard growth, implying that democracy is seen as inimical to economic growth. On the other hand, dictatorships would be better able to force savings for the huge investments in personnel and material required to launch economic growth (Rao, 1984). Such investment programs imply cuts or foregoing current consumption that would be painful for the low-income in developing societies and require strong measures to enforce them. Such a course would not likely survive a popular vote.

Scholars have attributed state autonomy for the superior economic performance of the four Asian Tigers since the 1960s in comparisons to Latin America. State autonomy has been defined as the capacity of the state to pursue developmentalist policies while being insulated from particularistic pressures e.g. originating from large firms or unions which could result in collective suboptimal behaviour and demands leading to underinvestment (Przeworski and Limongi, 1993).

On the other side of the argument, Wittman (1989) and North (1990) view state autonomy as harmful for economic performance because, through the phenomenon of "state capture" the state is always ready to prey on the society and only democratic institutions can constrain it to act in the general interest. From this view, dictatorships would be a source of inefficiency.

Selectorate Theory presented by de Mesquita (2003) supports the notion that democracy is ideal for promoting economic growth through the provision of more public goods to the population than autocracies. In the context of foreign aid, it would be logical to assume that compared to autocracies, democratic leaders in less developed countries would allocate more foreign aid and domestic resources to public and merit goods for the needs of the wider population. This would be more effective in alleviating poverty and engendering sustainable economic growth.

From the foregoing it would be instructive to assess whether disaggregated foreign aid in the education sector would have a greater positive and significant impact in promoting growth in democratic regimes in Africa than in autocratic states.

3. Data, model and methodology

3.1. Characteristics of the sampled countries and data sources

This study includes 32 African countries and spans 13 years from 2005 to 2017. The countries have been divided into four groups as follows: Group 1: Low-income democratic countries; Group 2: Low-income autocratic countries; Group 3: Middle-income democratic countries; and Group 4: Middle-income autocratic countries. Table 1 summarizes the composition of the groups.

Table 1 Categorization of Countries Included in the Study

	GDP per capita (USD)	GDP per capita growth (%)	Total ODA (% GDP)	Primary net enrolment rate (%)	Primary net enrolment rate growth (%)	Tertiary gross enrolment ratio (%)	Tertiary gross enrolment ratio growth (%)
Group 1: Low-income democracy							
Benin	646	1.3	9.0	88	0.7	10.3	5
Liberia	312	0.5	66.9	36	0.9	8.4	6.7
Madagascar	381	-0.3	11.3	70	0.6	4.8	3.3
Malawi	342	2.0	14.9	91	0.1	0.5	4.6
Mali	593	1.1	11.7	60	1.2	6.3	7.5
Mozambique	451	4.2	21.8	81	3.3	3.5	12.1
Tanzania	657	2.9	11.1	85	1.7	4.7	12.7
Uganda	512	3.2	10.6	92	0.4	4.1	3.9
Group average	***486.8***	***1.9***	***19.7***	***75.4***	***1.1***	***5.3***	***7.0***
Group 2: Low-income autocratic							
Chad	876	5.7	5.9	66	1.6	3.8	9.3
DRC	265	2.6	16.4	n.a.	3.6	8.2	9.8
Comoros	742	-0.2	10.3	77	1.1	9.3	7.1
Gambia	469	0.3	13.3	73	0.3	3.1	8.6
Guinea	427	0.1	7.8	67	1.3	7.7	12.4
Rwanda	468	4.7	17.1	93	1.1	5.7	9.7
Togo	473	0.8	8.6	88	0.2	6.1	6.4
Zimbabwe	754	-2.4	6.3	86	0.1	5.4	4.2
Group average	***559.3***	***1.5***	***10.7***	***78.6***	***1.2***	***6.2***	***8.4***
Group 3: Middle-income democracy							
Ghana	1167	3.9	7.4	75	1.8	10.3	5.2
Kenya	1072	2,4	4.2	82	2.4	5.5	4.4
Lesotho	1069	3.7	6.3	84	-0.3	7.4	9.3
Mauritius	7002	3.6	1.2	95	0.3	27.3	5.6
Namibia	4473	3.3	2.3	88	-0.4	10.4	4.1
Senegal	1052	2.2	8.7	70	0.4	8.6	5.9
South Africa	5905	1.8	0.5	87	-0.2	16.9	4.8
Zambia	1210	4.8	10.1	86	1.9	n.a.	n.a.
Group average	***2868.8***	***3.3***	***5.1***	***83.4***	***0.7***	***12.3***	***5.6***
6Group 4: Middle-income autocratic							
Algeria	4044	2.3	0.4	96	0.3	25.3	5.2
Angola	3166	0.3	1.7	83	0.4	4.2	2.7
Cameroon	1101	0.9	4.6	85	0.8	8.9	5.2
Egypt	2171	2.2	1.3	96	0.6	28.8	0.4
Gabon	8645	0.7	0.8	n.a.	n.a.	12.6	4.8
Ivory Coast	1118	0.5	4.7	63	0.5	7.1	8.8
Morocco	2602	3	1.6	92	0.4	15.2	4.3
Swaziland	3342	1.2	2	80	0.8	4.8	3.1
Group average	***3273.6***	***1.4***	***2.1***	***85.0***	***0.5***	***13.4***	***4.3***

Source: World Bank World Development Indicators Database

Note: Figures appear as averages for the 13-year period from 2005 – 2017

The study has adopted World Bank's categorization of economies according to GDP per capita as of 2015 as follows: low income – US$ 1,045 or less; middle income – US$ 1,046 to US$ 12, 735, and; high income – US$ 12,736 or more. Summary features are as follows:

Low-income countries:

- Combined average GDP per capita of US$ 523 in the 13-year sample period.
- Average GDP per capita growth for democracies at 1.9% was slightly higher than for autocracies at 1.5% for the 13-year period.
- The ODA as a proportion of GDP received by democracies was nearly double that received by autocracies.
- Primary net enrolment and tertiary gross enrolment ratios were lower for democracies compared to autocracies.

Middle-income countries:

- Combined average GDP per capita of US$ 3,071 in the 13-year sample period.
- Average GDP per capita growth for democracies was more than double that of middle-income autocracies.
- Average ODA as a proportion of GDP received by democracies was more than double that received by autocracies
- Primary net enrolment and tertiary gross enrolment ratio were higher for autocracies.

For categorization of countries between democratic or autocratic systems of government, this study has employed definitions from three different sources: (i) Polity IV Project: Political Regime Characteristics and Transitions, 1800 – 2013 database by Marshall and Jaggers (2014); (ii) database of the index of democracy and dictatorship by Cheibub et al. (2010) and (iii) the democracy index constructed by publications of the Economist Intelligence Unit. It was rigorously verified that none of the countries included transitioned from one type of political system of government to another between 2005 and 2017 based on the definitions from these three sources. Definitions that have been used for categorization of countries between democracy and autocracy use indicators grouped in different categories measuring competitiveness and openness of elections, pluralism, civil liberties, and political culture.

For the rest of the study, data sources were as follows: World Economic Outlook database of the International Monetary Fund (IMF), International Development Statistics database of the Organization of Economic Cooperation and Development (OECD), and World Development Indicators database of the World Bank.

3.2. Model and methodology

Burnside and Dollar (2000), Hansen and Tarp (2004), Dalgaard et al. (2004) and Gomanee (2005) in their studies based on panel datasets, used a regression specification similar to the one in equation (1) and entered aid in their models endogenously. The main reason for this is that it is difficult to perceive aid as being independent of the level of income. Empirically, a negative relationship between aid and income per capita is well established (see Trumbull and Wall (1994) and Alesina and Dollar (2000)). However, Endogeneity of aid with respect to income per capita can contribute to simultaneity bias in aid-growth regressions, and thus lead to misleading conclusions about the impact of aid. In addition to this, unobserved country specific factors can cause estimates from aid-growth regressions to be biased. The linear dynamic panel General Method of Moments (GMM) estimator proposed by Arellano and Bond (1991) to overcome these

problems uses lagged levels of the first difference of the variables as instruments. However, as pointed out by Arellano and Bover (1995), lagged levels are often poor instruments for first differences, thus the difference GMM is said to suffer from the "weak instruments" problem (Kazuhiko, 2007; Asiedu, 2014). Blundell and Bond (1998) proposed a more efficient estimator, the system GMM estimator, which mitigates the weak instruments problem. Simulation results by Kazuhiko (2007) show that the system GMM is less biased than the difference GMM. Consequently, the preferred estimation procedure for this study is the more efficient and less biased estimator, the system GMM.

The dynamic panel data model of economic growth used in this study is based on the Lucas (1988) human capital accumulation endogenous growth model, which stipulates a positive relationship between education and economic growth. Similar to the model specifications used by Burnside and Dollar (2000), Hansen and Tarp (2004), Dalgaard et al. (2004) and Gomanee (2005), the regression specification of this study enters aid endogenously as an enhancer of capital accumulation which affects economic growth. The general specification is as follows:

$$\Delta y_{it} = \gamma ln y_{it-1} + \varphi Aid_{it} + \sum_{j=1}^{k} \beta_j x_{jit} + \alpha_t + \mu_{it} \quad (2)$$

Where Δy_{it} denotes the average growth rate of GDP per capita, being a proxy for economic growth; lny_{it-1} denotes initial level of per capita GDP in log form, which is lagged, capturing conditional convergence effects; Aid_{it} denotes official development assistance to education expressed as a percentage of GDP, representing education foreign aid; x_{jit} are the k additional or control variables that are also determinants of growth; α_t is a constant term, and μ_{it} is the error term.

The aid effectiveness literature has generally relied on the key assumption that aid has a solely contemporaneous effect on growth because of endogeneity of aid flows (Minoiu and Reddy, 2010). Bobba and Powell (2007) uncover strong and robust evidence that aid can have a positive contemporaneous effect on recipient countries' average growth.

Masanjala and Papageorgiou (2003) have come to the conclusion that the critical explanatory variables for African economic growth are different from the rest of the world. Among the six critical explanatory variables were: initial per capita GDP and investment as a percentage of GDP. Barro (1996) found that the growth rate of real per capita GDP is enhanced by maintenance of the rule of law, smaller government consumption, lower inflation, improvements in terms of trade, and lower initial levels of real per capita GDP. Sala-i-Martin et al. (2004) examined the robustness of explanatory variables in cross-country economic growth regressions in 98 countries spread across all seven continents. They found that the initial level of real GDP per capita, investment, and primary school enrolment had the most important effect on real GDP per capita growth. In the present study the following variables were included as control variables in the general equation (2): initial GDP per capita in log form, inflation as measured by the consumer price index in log form, general government consumption as a percentage of GDP, the sum of exports and imports as a percentage of GDP (i.e. trade as a percentage of GDP) and investment as a percentage of GDP (i.e. total spending on fixed assets and inventories of raw materials which provide the basis for future production, expressed as a percentage of GDP). Following indications that the aid-

investment transmission mechanism exists (see Appendix), INVRES was constructed to replace investment and represent that part of investment that is not attributed to education foreign aid.

An important question that arises is how to measure and compare the enhancement of the stock of human capital over time and between countries? The best measure would be in terms of the output of education. However, due to the difficulties of obtaining such consistent and comparable education output measures over time and among countries, input measures have instead been used as proxies (see Keller (2006) and Asiedu (2014)). In this study, education aid financing (which in many cases can be considered as investment in education) will be used as a proxy for education output.

By design, estimated growth models in previous studies such as those by Burnside and Dollar (2000), Hansen and Tarp (2001), Dalgaard et al. (2004) and Gomanee (2005) used foreign aid in aggregated form. This study seeks to isolate education aid, which is understood to contribute to human capital accumulation. This education aid is then further disaggregated by educational level for countries that are themselves disaggregated by level of income and political systems of government.

In a first step, the study will analyze a scenario in which education aid is aggregated and countries are pooled, thus disregarding income or political regime categories. The results of this pooled regression will be used as a benchmark for models in which education aid is disaggregated by levels (primary, secondary and tertiary) and countries are disaggregated by income group and political regime as in Table 1.

The three sub-sector levels of education aid will not be entered simultaneously in a single regression in order to avoid running into multicollinearity. By including only one measure of education aid at a time in the regressions there was the risk that estimations may suffer from the omitted variable bias problem. Indeed, in order to accurately capture the effects of each of the individual education aid variables on growth, the estimations should include all the three measures at one time. However, this approach also faces the risk of producing inaccurate estimates if there is multicollinearity, which was detected among the education aid variables used in this study. Pairwise correlation coefficients between the aid variables were all significant for each of the country categories. This justified the inclusion of a single measure of education aid at a time in the regressions. The system GMM estimator used for this analysis mitigates the potential omitted variable bias problem through the use of instrumental variables.

Based on the general growth equation (2), Table 2 summarizes the specific models to be estimated as separate regressions.

Table 2: Summary of regression models and variables used*

Variables	Regression 1: Pooled	Regression 2: Primary	Regression 3: Secondary	Regression 4: Higher
Dependent variable:				
GDP per capita growth	Δy_{it}	Δy_{it}	Δy_{it}	Δy_{it}
Aid variables (% of GDP):				
Aggregate education aid	A_Aid_{it}			
Primary education aid		P_Aid_{it}		
Secondary education aid			S_Aid_{it}	
Higher education aid				H_Aid_{it}
Control variables:				
Log of initial GDP per capita	$log(y_{it-1})$	$log(y_{it-1})$	$log(y_{it-1})$	$log(y_{it-1})$
Log (1+ inflation rate)	INF_{it}	INF_{it}	INF_{it}	INF_{it}
Investment (% of GDP)	INV_{it}	INV_{it}	INV_{it}	INV_{it}
Government consumption (% of GDP)	GVT_{it}	GVT_{it}	GVT_{it}	GVT_{it}
Trade (% GDP)	TRD_{it}	TRD_{it}	TRD_{it}	TRD_{it}

Note:* all the four models are estimated for each of the four country categories.

3.2.1. Estimation issues

With panel data, country matrices of time-series are staked so that models of the kind specified in equation (2) are characterized by an error term decomposed into $\mu_{it} = \vartheta_i + \varepsilon_{it}$ where ϑ_i represents time invariant, country specific characteristics (fixed effects), and disturbances, ε_{it}, which change across time and across countries. Use of ordinary estimation techniques such as Ordinary Least Squares (OLS) and the Instrumental Variable (IV) approach cannot handle these characteristics. Moreover, there are other issues in the dynamic specification of equation (2) and its specification application to the aid-growth context. Firstly, there is correlation between the lagged dependent variable y_{it-1} and the disturbance term for the fixed effects (ϑ_i). Secondly, a negative relationship between aid and income per capita has been noted (see Trumbull and Wall (1994) and Alesina and Dollar (2000)) implying endogeneity running from the dependent variable to aid in equation (2).

The two ways to work around the endogeneity problems are the Arellano – Bond (1991) Difference GMM estimator, and the Arellano-Bover (1995) and Blundell and Bond (1998) System GMM estimator. The problem with the Difference GMM is that it is inefficient in that it relies on transforming the variables through first differencing which removes the fixed country-specific effects as they do not vary with time. It also does not address the endogeneity problem and

differencing can introduce serial correlation where disturbance terms $\Delta\varepsilon_{it}$ may no longer be independent and could thus reduce accuracy ($\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1}$ can be correlated with $\Delta\varepsilon_{it-1} = \varepsilon_{it-1} - \varepsilon_{it-2}$ through the shared ε_{it-1} term).

To overcome the shortcomings of the difference GMM estimator, Arellano-Bover and Blundell and Bond proposed the use of extra moment conditions that rely on certain stationarity conditions of the initial observation. The resulting system GMM estimator has been shown to have much better finite sample properties in terms of bias and root mean squared error than that of the difference GMM estimator. The system GMM estimator for dynamic panel data models combines moment conditions for the model in first differences with moment conditions for the model in levels. It augments difference GMM by estimating simultaneously in differences and levels, the two equations being distinctly instrumented. Blundell and Bond argued that the system GMM estimator performs better than the difference GMM estimator because the instruments in the levels model remain good predictors for the endogenous variables in this model. They showed that for an autoregressive panel data model of order 1, the reduced form parameters in the levels model do not approach zero when the autoregressive parameter approaches one, whereas the reduced form parameters in the difference model do. Furthermore, this estimator is designed for panel datasets comprising many cross sectional units and few time periods (i.e. large N and small T), which is particularly suitable for this study.

3.2.2. Accounting for double counting in the EAid and investment variables

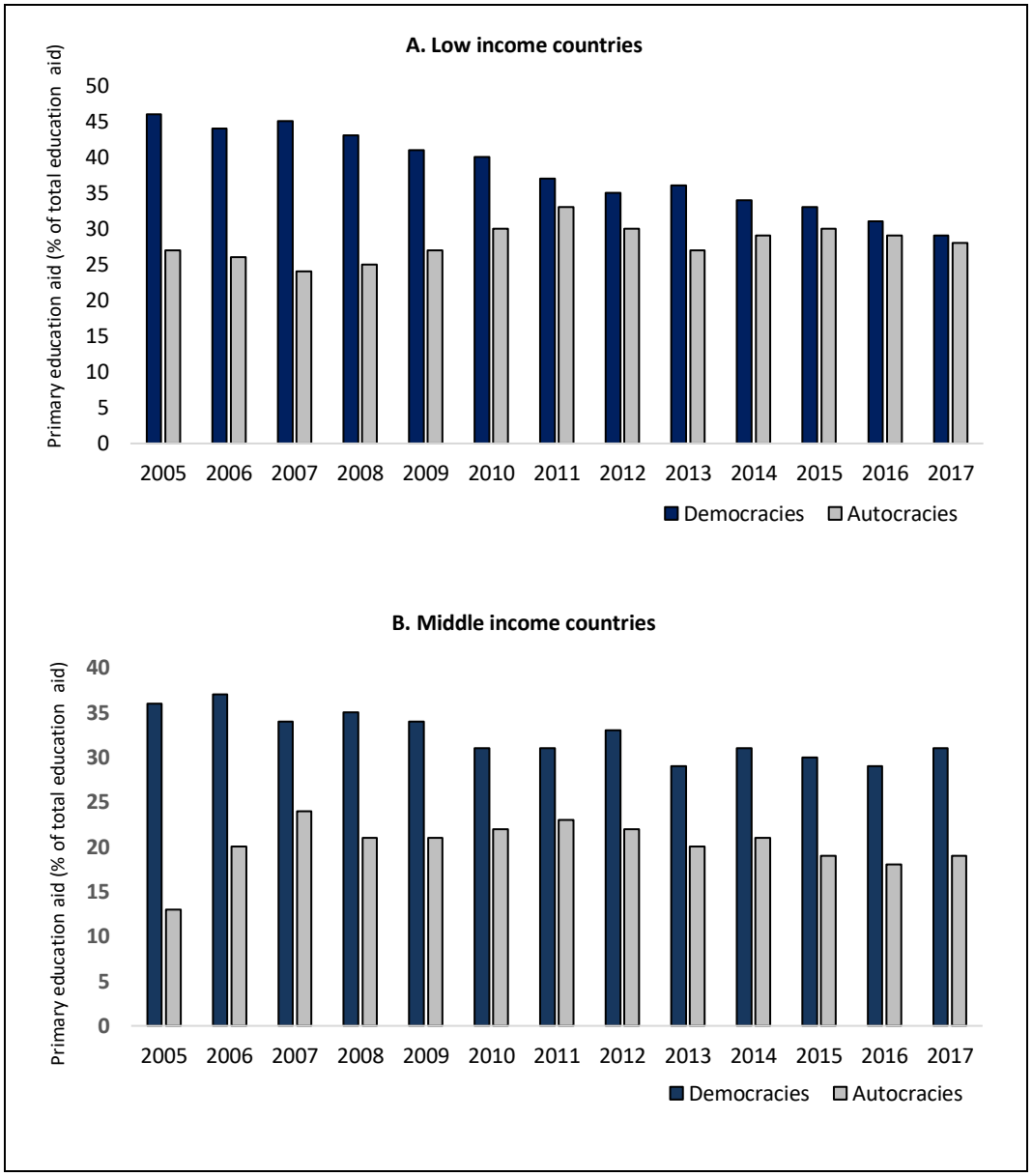
Before attempting to tackle the education aid - growth nexus, there is need to tackle the issue of double counting involving EAid (education aid) which is likely to be incorporated in the investment variable in the vector *k* in equation (2). Any double counting would lead to a biased coefficient for the EAid variable. To circumvent this by attempting to omit the investment variable would also lead to model specification error (see Feeny, (2005) and Gomanee (2005)). The Appendix provides results of a model linking EAid to aggregate investment, which suggests that there is a link whereby an increase in education aid by one percentage point raises the investment share in GDP by about 0.36 percentage points. The next step would then be to isolate and purge this effect from the investment variable in equation (2). This is done by creating another investment variable, INVRES which is estimated by using the residuals from an aid-investment bivariate regression, whereby investment is regressed on aid using the Residual Generated Regressors technique proposed by Gomanee (2005) and Feeny (2005). Finally, the investment variable used, INV_{it}, is assumed to be net of the EAid component.

4. Results

4.1. Orientation of disaggregated education aid in democratic and autocratic countries

Figure 1 shows average primary education aid as a percentage of total education aid for low and middle-income countries for the thirteen-year period from 2005 to 2017. Section A shows how low income democracies allocated more education aid to primary education compared to low income autocracies. Throughout the sample period, low-income democracies allocated an average of 38% of total education aid to primary education compared to an average of 28% by low-income autocracies but the trend in the former has been declining over time. Similarly, in Section B, throughout the sample period middle-income democracies allocated a higher proportion (an average of 32%) of total education aid to primary education compared to middle-income autocracies (an average of 20%).

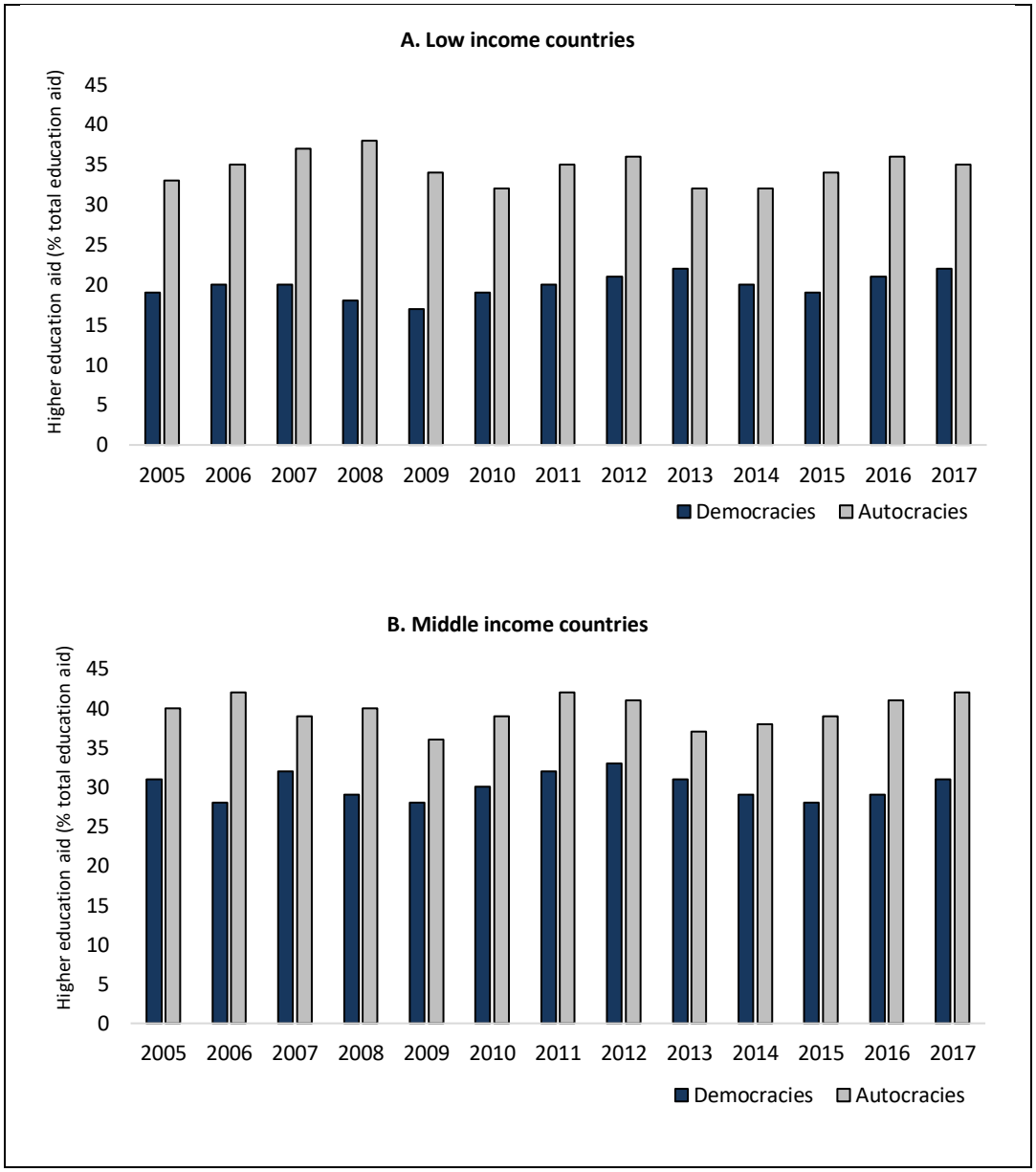
Figure 1: Average primary education aid (as % of total education aid)



Data source: OECD

Figure 2 shows average higher education aid as a percentage of total education aid for low and middle-income countries for the study period. Here, autocracies consistently allocated a higher proportion of total education aid to higher education compared to democracies. Between 2005 and 2017 low-income autocracies allocated a group average of 35% of total education aid to higher education compared to 20% by low-income countries. Middle-income autocracies allocated a group average of 40% of total education aid to higher education compared to 30% by middle-income democracies.

Figure 2: Average higher education aid (as % of total education aid)



Data source: OECD

The data shows that democracies included in this study have a tendency to prioritize aid allocation to primary education while autocracies have a tendency to prioritize aid allocation to higher education.

4.2. The education aid-growth relation

Table 3 provides the education aid-growth regression output from the 20 system GMM growth regressions that were estimated. The table shows the estimated coefficients for the education aid variables and their P-values. In a first step to ascertain the importance of heterogeneity of aid flows and heterogeneity of aid recipients, the system GMM regression results from the pooled sample of countries are presented. This analysis uses aggregated data for education aid, country income

group, and system of government. These results are next compared with regression results from a second step using disaggregated data for education aid, country income group and political system of government (columns B, C and D). Table 4 summarizes the results from table 3 by showing the emerging patterns with the coefficient signs and significance levels.

Table 3: System GMM regression results

Country Category	A.	B.	C.	D.
	Aggregate aid	**Primary aid**	**Secondary aid**	**Higher aid**
Pooled sample	0.141	0.109	-0.088	0.151
	[0.133]	[0.137]	[0.225]	[0.285]
Low income	0.413**	1.367**	-1.055	0.569
democracies	[0.014]	[0.004]	[0.248]	[0.291]
Low income	0.384*	1.181**	-1.963	0.670
autocracies	[0.065]	[0.040]	[0.192]	[0.115]
Middle income	0.103	-0.724*	-0.655**	1.341**
democracies	[0.528]	[0.079]	[0.036]	[0.005]
Middle income	0.170	-0.831**	-0.749**	1.539**
autocracies	[0.339]	[0.048]	[0.019]	[0.004]

Notes: P-values in parentheses. * denotes significance at 10%; ** significance at 5%; *** significance at 1%.

Table 4: Education aid-growth regression results: Signs and statistical significance

Income group	Governance	Aggregate	Primary	Secondary	Higher	Comment
Pooled	Pooled					No impact, all countries, all aid
Low-income	Democracies	+**	+*			(+) for aggregate and primary
	Autocracies	+*	+**			
Middle-income	Democracies		-*	-**	+**	(-) for primary and secondary; (+) for higher
	Autocracies		-**	-**	+**	

Notes: * denotes significance at 10%; ** significance at 5%; *** significance at 1%.

4.2.1. The pooled sample

The pooled sample ignores the heterogeneity of aid recipients and the heterogeneity of education aid flows. The estimated coefficient of aggregate aid in row 1, column A of table 3 for the pooled sample is not significant suggesting that aggregate education aid does not have a significant effect on growth for the 32 countries pooled together whatever their income or governance status. The heterogeneity of education aid flows by disaggregating education aid data into primary, secondary and higher education aid but without considering the heterogeneity of aid recipients is reported in

row 1 under columns B, C, and D of table 3. None of the estimated coefficients are statistically significant. In short, no type of education aid has any significant effect on growth in African countries if recipients' heterogeneity is not taken into account. In the next step we examine the issue of recipient heterogeneity.

4.2.2. Low-income democracies vs. Low-income autocracies

For low-income countries both aggregate aid and primary level aid have a positive and significant effect on GDP per capita growth regardless of governance system. When the effects of other variables are held constant, a 1% increase in aggregate education aid increases GDP per capita growth by approximately 0.41% in low-income democracies and by 0.38% in low-income autocracies. A 1% increase in primary education aid will increase GDP per capita growth by approximately 1.4% in low-income democracies and by 1.2% in low-income autocracies on average. Higher and secondary education aid have no significant effect.

4.2.3. Middle-income democracies vs. Middle-income autocracies

For middle-income countries, democracies and autocracies alike, aggregate education aid has no significant effect on growth while primary and secondary aid have negative and significant effects. Other variables held constant, a 1% increase in primary education aid leads to approximately a 0.72% and 0.83% decline in growth in middle-income democracies and autocracies on average respectively, while for secondary level aid the declines would be 0.66% and 0.75% respectively. In both middle-income democracies and autocracies, higher education aid has a positive, significant and strong effect on GDP per capita growth. Holding other variables constant, a 1% increase in higher education aid leads to a 1.3% and 1.5% increase in growth on average in democracies and autocracies respectively.

4.2.4. Aid orientation and implications for growth in different political systems

Contrary to a priori expectation, aggregate education aid is seen to be important for growth in low-income countries. Conversely, middle-income countries conform to a priori expectation with respect to aggregate education aid not being statistically important for growth. Possible reasons for this will be discussed in the following section. For both low-income and middle-income countries, heterogeneity of education aid is seen to have important effects for growth. Specifically, primary education aid appears to be more important for increasing growth in low-income countries compared to secondary and higher education aid irrespective of the prevailing political system of government. Conversely, for middle-income countries, higher education aid appears to be more important for promoting growth than primary and secondary education aid irrespective of the prevailing political system of government. This suggests that it is in the interest of both low-income democracies and autocracies to skew their education sector financing (and education aid) to the primary education subsector. However, the data analysis in the section on orientation of disaggregated education aid in democratic and autocratic countries shows that low-income autocracies are less inclined to follow this path, to their detriment. On the other hand, low-income democracies have a preference for this type of prioritization, to their benefit (see figures 1 and 2). For middle-income countries in this study collectively, the empirical results show that it is more advantageous to skew education sector spending (and education aid) to higher education because that is where there are greater returns for economic growth. However, the data analysis shows that middle-income autocracies are more inclined to follow this path to their benefit compared to middle-income democracies (see figures 1 and 2).

4.2.5. Effect of control variables on GDP per capita growth

The sign of the estimated coefficient of initial GDP per capita in log form was not consistent across all estimations and the estimated coefficient was consistently statistically insignificant. This suggests that there was no evidence of convergence in the sample of countries in this study. Government consumption and inflation both had inverse and statistically significant relationships with per capita GDP growth across all estimations while investment consistently had a positive and statistically significant relationship with per capita GDP growth. Trade did not display a consistent relationship with growth. In conclusion, the results suggest that lower government consumption, lower inflation, and high investment promote economic growth in the sampled countries.

5. Discussion

On average, tax revenues covered approximately 84% of total public spending during the period 2005 to 2017 in the sample of low-income African countries in this study and 182% in the sample of middle-income countries (World Bank, 2017). ODA from bilateral and multilateral donors amounted to an average of 90% of total public spending for the sample of low-income countries between 2005 and 2017 compared to just 12% for the sample of middle-income countries (OECD, 2017; World Bank 2017). The greater reliance on ODA by the sample of low-income countries explains why the coefficient of aggregate education aid was positive and significant for low-income democracies and autocracies but insignificant for the middle-income counterparts.

A possible explanation for the significant and positive effect of primary education aid in low-income countries is that many of these countries have not achieved universal primary education due to inadequate capacity in terms of school infrastructure, teaching and learning materials, and teachers. These contribute to high repetition and dropout rates which mean that marginal productivity per dollar is high for primary education aid in low-income countries where the need for investment is high at primary level. Middle income countries would be closer to achieving universal primary and secondary education and therefore the marginal productivity per dollar is relatively lower for those levels of education. In addition, primary education is comparatively more relevant for economic activities characteristic of low-income economies such as the predominance of subsistence agriculture and informal enterprises.

Governments in low-income countries spent 169% more per pupil on average on higher education compared to middle-income countries (World Bank, 2017). This can largely be explained by average gross enrolment ratio of less than half that for middle-income countries over the sample period. Higher education is comparatively more important for middle-income countries than low-income countries. This is because as countries progress into middle-income status it is often the case that the share of agriculture in GDP declines while the shares of sectors that depend on higher education such as secondary and tertiary sectors expand. This incentivizes larger enrolments in higher education. This could explain the positive and significant effect of higher education aid for both categories of middle-income countries in this study.

6. Conclusion

In investigating the impact that foreign aid in the education sector has on economic growth in selected African countries, this study has made a distinction between low and middle-income countries as well as between democracies and autocracies. Furthermore, education sector foreign aid was treated heterogeneously. The results suggest that for low-income countries education aid

in aggregate form and primary education aid both enhance economic growth, while post-primary education aid has no significant effect. For middle-income countries, higher education aid was more important for promoting economic growth than foreign aid to primary and secondary levels.

In assessing whether foreign aid in the education sector has a greater impact in promoting growth in democratic regimes in Africa than in autocratic ones, the results suggest that democracies have a stronger tendency to allocate more education sector foreign aid to primary education. On the other hand, autocracies have a stronger orientation to allocate more education sector foreign aid to higher education. When low-income democracies have a stronger tendency to allocate more education sector foreign aid to primary education, this is generally beneficial to them because the returns to primary education are higher and this is confirmed in the econometric analysis. This also implies that low-income autocratic countries that allocate more education sector foreign aid to higher education than to primary education do so at their detriment with respect to economic growth. When autocracies have a stronger tendency to allocate more education foreign aid to higher education this is generally beneficial to middle-income countries where returns to higher education were seen to be higher. Middle-income democracies that allocate more education sector foreign aid to primary education compared to higher education also do so at their detriment.

The general counsel of wisdom from this study is that regardless of governance orientations and their implications, education aid in low-income countries is better oriented towards the primary level and towards higher levels for middle-income countries. An important and obvious weakness in this and related studies is the implicit assumption of efficiency: that an increase in aid expenditure implies the most education quantity and quality in time and across sample countries. These are dimensions that are not easy to measure and incorporate simultaneously.

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Appendix

The EAid-investment model used in the first step to tackle the EAid/investment double counting in the EAid-growth model

$$Inv_{it} = \delta_0 + \delta_1 Inv_{i,t-1} + \delta_2 Inf_{it} + \delta_3 Fre_{it} + \delta_4 lnCre_{it} + \delta_5 Aid_{it} + \varepsilon_{it}$$

Table 5: Pooled OLS investment regression

	Dependent variable: INV		
Variable	**Coefficient**	**t-Statistic**	**P-value**
$Inv(-1)$	0.748	3.79	0.001***
Inf	-0.058	-2.53	0.062*
Fre	-0.611	-2.14	0.088*
Cre	0.0246	0.046	0.657
Aid	0.358	1.997	0.044**
Constant	-3.017	1.029	0.516
Observations	416		
R-squared	0.77		
F-Stat	24.31		
Prob. (F-stat)	0.00		

Notes: * denotes significance at 10%; ** significance at 5%; *** significance at 1%.

where Inv_{it} denotes investment as a percentage of GDP. $Inv_{i,t-1}$ denotes one period lagged investment to account for dependence of current investment levels on physical capital. Inf_{it} denotes the inflation rate. Fre_{it} denotes the Freedom House Index, which takes values between 1 and 7, where higher values indicate less freedom and accounts for the political environment. $lnCre_{it}$ denotes the logarithm of credit to the private sector as a percentage of total domestic credit to account for the widely acknowledged view that finance is the key to private sector investment. Aid_{it} denotes foreign education aid.

Table 5 displays the pooled OLS regression output for the investment regression for the 32 African countries included in this study for the 13 year period from 2005 to 2017. There is evidence of a significant positive effect of education aid on investment. This suggests that aid significantly influences investment and therefore it is necessary to consider the double counting problem in the vector *k* of equation 2 and avoid biased results.

Systems GMM estimations: Effect of aid in education on GDP per capita growth

Table 6: Pooled sample

Variable	Regression No.1 [Aggregate]	Regression No.2 [Primary]	Regression No.3 [Secondary]	Regression No.4 [Higher]
Education aid variables				
Aggregate aid	0.141 [0.133]			
Primary		0.109 [0.137]		
Secondary aid			-0.088 [0.225]	
Higher aid				0.151 [0.285]
Control variables				
Log (Initial GDP per capita)	0.085 [0.682]	0.079 [0.736]	-0.092 [0.621]	0.089 [0.749]
Investment (% of GDP)	0.114** [0.013]	0.140** [0.022]	0.131* [0.076]	0.154** [0.036]
Government consumption (% of GDP)	-0.121* [0.081]	-0.113** [0.003]	-0.102* [0.093]	-0.142** [0.044]
Log (1+ Inflation rate)	-1.380*** [0.000]	-1.243*** [0.000]	-1.319*** [0.000]	-1.277*** [0.000]
Trade (% of GDP)	-0.017 [0.101]	-0.018 [0.119]	-0.013 [0.117]	-0.0010 [0.108]
Constant	4.205** [0.019]	3.789** [0.013]	2.033 [0.196]	4.490 [0.774]
Number of observations	384	384	384	384
Number of countries	32	32	32	32
Number of lags of variables used as instruments.	2	2	2	2
Number of instruments	26	26	26	26
Hansen test of joint validity of instruments [1] (P-value)	0.427	0.291	0.305	0.247
Arellano-Bond test for autocorrelation[2] (P-value)	0.353	0.261	0.304	0.292

Notes: * denotes significance at 10%; ** significance at 5%; *** significance at 1%.

[1] The null hypothesis is that the instrumental variables are uncorrelated with the residuals (i.e. the instruments as a group are exogenous).

[2] The null hypothesis is that the error terms in the first difference regression exhibit no second order serial correlation.

Table 7: Low-income democracies

Variable	Regression No.1 [Aggregate]	Regression No.2 [Primary]	Regression No.3 [Secondary]	Regression No.4 [Higher]
Education aid variables				
Aggregate aid	0.413** [0.014]			
Primary		1.367** [0.004]		
Secondary aid			-1.055 [0.248]	
Higher aid				0.569 [0.291]
Control variables				
Log (Initial GDP per capita)	-0.703 [0.442]	-1.221 [0.503]	-1.375 [0.549]	-1.324 [0.378]
Investment (% of GDP)	0.158*** [0.000]	0.183*** [0.000]	0.161*** [0.000]	0.190*** [0.000]
Government consumption (% of GDP)	-0.134** [0.008]	-0.142** [0.004]	-0.149** [0.009]	-0.151** [0.006]
Log (1+ Inflation rate)	-1.233*** [0.000]	-1.301*** [0.000]	-1.287** [0.003]	-1.326*** [0.000]
Trade (% of GDP)	-0.021 [0.122]	-0.032 [0.131]	-0.039 [0.125]	-0.028 [0.136]
Constant	5.221** [0.009]	4.008** [0.010]	5.322* [0.087]	3.710* [0.064]
Number of observations	96	96	96	96
Number of countries	8	8	8	8
Number of lags of variables used as instruments.	2	2	2	2
Number of instruments	7	7	7	7
Hansen test of joint validity of instruments (P-value)	0.334	0.402	0.379	0.362
Arellano-Bond test for autocorrelation (P-value)	0.221	0.341	0.274	0.35

Table 8: Low-income autocracies

Variable	Regression No.1 [Aggregate]	Regression No.2 [Primary]	Regression No.3 [Secondary]	Regression No.4 [Higher]
Education aid variables				
Aggregate aid	0.384* [0.065]			
Primary		1.181** [0.040]		
Secondary aid			-1.963 [0.192]	
Higher aid				0.671 [0.115]
Control variables				
Log (Initial GDP per capita)	-0.639 [0.318]	-0.833 [0.702]	-1.042 [0.695]	-0.781 [0.545]
Investment (% of GDP)	0.203** [0.002]	0.199** [0.007]	0.251** [0.006]	0.221*** [0.000]
Government consumption (% of GDP)	-0.256*** [0.000]	-0.196** [0.002]	-0.177** [0.009]	-0.240*** [0.001]
Log (1+ Inflation rate)	-1.448** [0.007]	-1.507*** [0.000]	-1.579*** [0.000]	-1.628*** [0.000]
Trade (% of GDP)	-0.031 [0.209]	-0.047 [0.189]	-0.019 [0.210]	-0.039 [0.229]
Constant	6.099** [0.022]	7.403* [0.092]	3.597 [0.103]	6.335* [0.086]
Number of observations	96	96	96	96
Number of countries	8	8	8	8
Number of lags of variables used as instruments.	2	2	2	2
Number of instruments	7	7	7	7
Hansen test of joint validity of instruments (P-value)	0.409	0.512	0.382	0.518
Arellano-Bond test for autocorrelation (P-value)	0.319	0.371	0.414	0.338

Table 9: Middle-income democracies

Variable	Regression No.1 [Aggregate]	Regression No.2 [Primary]	Regression No.3 [Secondary]	Regression No.4 [Higher]
Education aid variables				
Aggregate aid	0.103 [0.528]			
Primary		-0.724* [0.079]		
Secondary aid			-0.655** [0.036]	
Higher aid				1.341** [0.005]
Control variables				
Log (Initial GDP per capita)	0.781 [0.242]	0.873 [0.306]	0.939 [0.274]	0.891 [0.401]
Investment (% of GDP)	0.143*** [0.000]	0.173*** [0.000]	0.182*** [0.000]	0.175*** [0.000]
Government consumption (% of GDP)	-0.076** [0.019]	-0.081** [0.044]	-0.079** [0.008]	-0.089** [0.015]
Log (1+ Inflation rate)	-2.009*** [0.000]	-1.985*** [0.000]	-1.880** [0.005]	-2.039*** [0.000]
Trade (% of GDP)	-0.037* [0.061]	-0.049 [0.190]	-0.031 [0.115]	-0.043 [0.120]
Constant	5.021** [0.020]	6.219*** [0.000]	4.517* [0.055]	7.310* [0.079]
Number of observations	96	96	96	96
Number of countries	8	8	8	8
Number of lags of variables used as instruments.	2	2	2	2
Number of instruments	7	7	7	7
Hansen test of joint validity of instruments (P-value)	0.401	0.35	0.592	0.526
Arellano-Bond test for autocorrelation (P-value)	0.329	0.446	0.413	0.391

Table 10: Middle-income autocracies

Variable	Regression No.1 [Aggregate]	Regression No.2 [Primary]	Regression No.3 [Secondary]	Regression No.4 [Higher]
Education aid variables				
Aggregate aid	0.172 [0.339]			
Primary		-0.831** [0.048]		
Secondary aid			-0.749** [0.019]	
Higher aid				1.539** [0.004]
Control variables				
Log (Initial GDP per capita)	0.349 [0.162]	0.449 [0.184]	0.409 [0.176]	0.371 [0.201]
Investment (% of GDP)	0.227*** [0.000]	0.216*** [0.000]	0.294*** [0.000]	0.258*** [0.000]
Government consumption (% of GDP)	-0.054 [0.102]	-0.077* [0.092]	-0.063* [0.089]	-0.093** [0.048]
Log (1+ Inflation rate)	-1.772** [0.007]	-1.808*** [0.000]	-1.683** [0.011]	-1.885*** [0.001]
Trade (% of GDP)	-0.038* [0.078]	-0.062 [0.207]	-0.059 [0.194]	-0.07 [0.211]
Constant	7.295** [0.034]	8.172** [0.042]	5.891* [0.069]	6.208** [0.009]
Number of observations	96	96	96	96
Number of countries	8	8	8	8
Number of lags of variables used as instruments.	2	2	2	2
Number of instruments	7	7	7	7
Hansen test of joint validity of instruments (P-value)	0.547	0.42	0.619	0.553
Arellano-Bond test for autocorrelation (P-value)	0.409	0.515	0.426	0.539