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The impact of foreign aid in education growth: How relevant is the heterogeneity of aid flows and the heterogeneity of aid recipients?

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Research Paper No. 2007/60

The Impact of Foreign Aid in Education Growth

How Relevant is the Heterogeneity of Aid Flows
and the Heterogeneity of Aid Recipients?

Elizabeth Asiedu¹ and Boaz Nandwa²

September 2007

Abstract

This paper examines whether foreign aid in education has a significant effect on growth. We take into consideration the heterogeneous nature of aid as well as the heterogeneity of aid recipients—we disaggregate the aid data into primary, secondary and higher education, and run separate regressions for low-income and middle-income countries. We find that the effect of aid varies by income as well as by the type of aid. Thus our results underscore the importance of the heterogeneity of aid flows as well as the heterogeneity of recipient countries when analysing the effect of aid on growth.

Keywords: education, foreign aid, growth

JEL classification: F34, F35, I20, O19

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Acronyms

CIDA	Canadian International Development Agency
CRS	Credit Reporting System (of OECD-DAC)
DAC	Development Assistance Committee
GMM	general method of moments
MDGs	Millennium Development Goals

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We [the United Nations] ... resolve to ensure that by the year 2015, *children everywhere*, boys and girls alike, will be able to *complete a full course of primary schooling* and that girls and boys will have equal access to all levels of education...

United Nations Millennium Declaration, September 2000

1 Introduction

The Millennium Declaration adopted by the member states of the United Nations in September 2000, identified eight Millennium Development Goals (MDGs) that had to be achieved by the year 2015. A summary of the MDGs are:

- eradicating poverty and hunger;
- achieving universal primary education;
- promoting gender equality;
- reducing child mortality;
- improving maternal health;
- combating HIV/AIDS and other diseases;
- promoting environmental sustainability; and
- developing a global partnership for development.

Not surprisingly, the adoption of the MDGs has revived the debate about the effectiveness of foreign aid, in particular whether foreign aid promotes economic growth.

This paper contributes to the discussion on the effectiveness of aid by focusing on the second MDG—i.e., the provision of universal primary education. Specifically we test the (intuitive) hypothesis: *does foreign aid in education enhance economic growth?* This question, although important, has not been addressed in the literature.¹ Indeed, aid in education has increased substantially over the past decade. For example, over the period 1993-96 to 2002-04 the average annual aid in education from the Development Assistance Committee (DAC) member countries increased from US\$2.5 million to US\$25.5 million—an increase of over 1,322 per cent (OECD 2006).² It is therefore important to analyse whether the increased aid has had any effect on growth in recipient countries.

¹ A few studies have examined the effect of education aid on more specific outcomes, such as educational attainment and enrolment (e.g., Dreher, Nunnenkamp and Thiele 2006; Michaelowa and Weber 2006). See Dreher Nunnenkamp and Thiele (2006) for a detailed discussion.

² There are 22 DAC members: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

With regards to the literature, we note that a large number of papers have examined the effect of foreign aid on growth.³ However, many of the studies do not take into account the *heterogeneity of aid recipients*. Specifically, data from low- and middle-income countries are pooled together and the estimated relationships are assumed to be the same for countries in both income groups. This is problematic because as we find in our regressions, the effect of education aid on growth is different for the two income groups.⁴ Another limitation of the aid-growth literature is that most of the studies employ aggregate data on aid and therefore do not take into account the *heterogeneous nature of aid*.⁵ Again, this is problematic because intuitively, one would expect different types of aid (e.g., education aid, food aid and military aid, etc.), to have different effects on growth.⁶ Another caveat of using aggregate data is that the analyses have limited policy implications. Specifically, the analysis precludes one from identifying the types of aid that enhance growth. Such information is crucial to donors since it helps determine which sectors to allocate aid to.⁷

This paper extends the existing studies in two important ways. First, to the best of our knowledge, this is the first study that utilizes sectoral data on aid *disbursements* to examine the relationship between foreign aid and growth. Second, we take into consideration the heterogeneous nature of aid as well as the heterogeneity of aid recipients. Specifically, we disaggregate the aid data into primary, secondary and higher education, and analyse the effect of each component of education aid on growth for low-income and middle-income countries. Thus, by quantifying the growth effects of aid in education, the paper provides some guidance to donors on how to effectively allocate aid.

Three important questions emerge from the above discussions:

- i) How and why does education aid affect growth?
- ii) Why should aid for different levels of education (primary, secondary and higher) have a different impact on growth?; and
- iii) Why should the impact of education aid in a middle-income country be different from that of a low-income country? To answer these questions we

³ For a recent survey of the literature, see Clemens, Radelet and Bhavnani (2004) and Harms and Lutz (2004).

⁴ Gomanee, Sourafel and Morrissey (2003) examine the effect of aid on poverty alleviation and conclude that the impact of aid varies by the level of development and that aid is more effective in poorer countries.

⁵ The studies that take into account the heterogeneity of aid generally focus on the difference between project and programme aid, multilateral and bilateral aid, and grants versus loans (e.g., Mavrotas 2005; Odedokun 2004; Ram 2003). See Mavrotas (2005) for a detailed discussion.

⁶ Harms and Lutz (2004) and Clemens, Radelet and Bhavnani (2004) assert that not taking into account the heterogeneity of aid flows may explain the lack of robustness of the effect of aid on growth.

⁷ The donor communities have in the past few years increased their resolve to provide more aid to poor countries. For example the call for more aid is the United Nations Millennium Declaration where member states resolved 'to grant more generous development assistance' to poor countries. Indeed, aid to developing countries has increased. Thus, given the resolve of the donor community to increase aid to developing countries, the relevant issue for donors is not whether to provide assistance to poor countries, but rather, how aid can be allocated so that it will be growth enhancing.

draw from the education-growth studies. We also draw from the empirical studies that examine the effect of education aid on enrolment rates.

The new endogenous growth and augmented Solow models stipulate a positive relationship between education and growth (e.g., Nelson and Phelps 1966; Lucas 1988; Romer 1990; Mankiw, Romer and Weil 1992). Also, several empirical studies find that the stock of human capital and the level of investment in education are positively associated with growth (e.g., McMahon 1998; Keller 2006).⁸ In answering the first question, we argue that education aid affects growth because it raises the stocks of human capital and also increases investment in education in recipient countries. Our assumption that education aid enhances human capital accumulation is not unreasonable. First note that by supplementing the educational budget of the government, aid can increase investment in education in recipient countries. Furthermore, by providing resources to finance education (e.g., build schools, hire and train teachers, free textbooks and other school supplies for pupils), education aid can improve the quality of education in recipient countries. Indeed, anecdotal evidence from several countries suggests that aid in education reduces absenteeism and boosts enrolment and retention rates.⁹ The positive association between education aid and enrolment rates is also consistent with the empirical findings of Michaelowa and Weber (2006) and Dreher, Nunnenkamp and Thiele (2006).

In answering questions (ii) and (iii), we note that education can enhance economic growth through several channels such as increasing productivity and technological progress, facilitating technological spillovers and the diffusion of knowledge, reducing the effect of diminishing returns to physical capital and improving health outcomes, such as lowering fertility and mortality rates (Nelson and Phelps 1966; Lucas 1988; Romer 1990; Mankiw, Romer and Weil 1992; Appiah and McMahon 2002). Clearly, the mechanism by which education affects growth will be different for the three stages of education.¹⁰ As a consequence, one would expect different stages of education to exhibit different growth effects. Another important point is that the contribution of labour to growth depends on the availability of complementary inputs such as physical capital and technological knowhow. Clearly, the availability of complementary inputs varies by the level of development—suggesting that the growth effects of education will be different for low- and middle-income countries. Finally, we note that several empirical studies find that the growth-enhancing effect of education is different for the three stages of education and also varies by the level of development (e.g., Petrakis and Stamatakis 2002; Keller 2006). Petrakis and Stamatakis (2002) take a more formal approach by constructing and estimating an endogenous growth model that allows the effects of education to vary by the stage of education as well as the level of

⁸ See Krueger and Lindahl (2001) for a review of the literature.

⁹ For example in January 2006, Ghana started implementing the NEPAD School feeding programme—a programme funded by foreign aid which provides ‘each primary school child, with a decent nutritious and well balanced meal a day on each school attendance day.’ Initial results indicate that enrolment has more than doubled and absenteeism has declined substantially since the inception of the programme. For more information see www.ghanadistricts.com/home/?=14&sa=3019&PHPSESSID=5ffdf1c6be03c4b136f4e7d89f6e9504.

¹⁰ For example, the decline in fertility and mortality rates as a channel by which education affects growth is more relevant for primary education whereas technological spillovers is a more pertinent transmission mechanism for higher education.

development.¹¹ They find that the differences in growth effects are statistically significant: overall primary and secondary education are more relevant for growth in less developed countries while higher education is more pertinent in developed countries.

The rest of the paper is organized as follows. Section 2 provides a brief review of the literature that is related to our work and section 3 describes the data and the variables included in the regressions. Section 4 presents the empirical results and section 5 concludes.

2 Brief review of related literature

As pointed out earlier, most of the studies that examine the effect of aid on growth employ *aggregate* data on aid. We found only two papers, Clemens, Radelet and Bhavnani (2004) and Rajan and Subramanian (2005), that are closely related to our work in that they use aid data disaggregated by sector. Clemens, Radelet and Bhavnani (2004) disaggregate aid into three components: (i) emergency and humanitarian aid; (ii) short-impact aid, defined as aid that stimulates growth within four years (includes budget support, infrastructure, banking, agricultural and industry); and (iii) long-impact aid, which refers to aid that affects growth over the long term (includes technical assistance, democracy, environment, health, education). Their analysis focuses on short-term aid and they find that short-term aid has a positive and robust effect on growth. They assert that using aggregate data and thereby disregarding the heterogeneity of aid may explain the insignificant effect of aid on growth found in previous studies. This view is challenged by Rajan and Subramanian (2005). The authors analyse the effect of short-term aid as well as long-term, economic, social and food aid on growth, and conclude that none of these types of aid has a robust effect on growth.¹² Both studies have two limitations. First, the studies employ data on aid *commitment* (i.e., commitments by donors to recipient countries), probably because data on aid *disbursement* are not readily available at the sectoral level. This is problematic for several reasons. Note that not all commitments made to countries are honoured by donors. Even when commitments are honoured, the funds are typically disbursed over several years. For example, the Canadian International Development Agency (CIDA) committed in 1997 to finance an education project in Bangladesh. However the funds were disbursed over a 7-year period, from 1998 to 2004.¹³ The issue of the mismatch between the periods of commitment and disbursement is particularly relevant when the empirical analysis employs data on aid commitment averaged over four or five years, as in Clemens, Radelet and Bhavnani (2004) and Rajan and Subramanian (2005). Thus, if

¹¹ They consider three groups of countries—advanced OECD countries, developed OECD countries and less developed countries and test two hypotheses: (i) whether the growth effects of each stage of education differs significantly *within* each country group; and (ii) whether the growth effect of each stage of education differs significantly *across* the three country groups.

¹² Social aid includes aid in education, health, population programmes, government and civil society, water supply and sanitation; economic aid includes aid in transport and storage, communications, energy and financial services.

¹³ The breakdown of the amount disbursed in thousands of dollars is as follows: \$0 in 1997, US\$433.43 in 1998, US\$512.29 in 1999, US\$880.08 in 2000, US\$619.11 in 2001, US\$642.04 in 2002, US\$139.96 in 2003 and US\$22.29 in 2004 (OECD 2006).

the amounts of aid commitments differ significantly from the amounts disbursed, or the years between commitment and disbursement are fairly long, then it will be inappropriate to use data on aid commitment to analyse the effect of aid on growth. The second caveat of the two studies is that although the level of disaggregation is an improvement over previous efforts, the sectors considered are still broad and therefore the problem of aggregation bias remains a concern. Furthermore, the analysis has little policy relevance because lumping together many sectors provides donors with little guidance as to which sector to fund. This paper addresses these two limitations by using data on aid *disbursement* and also focusing on a specific sector, *education*.

Our work is also related to the voluminous literature on the determinants of growth. Specifically, we draw from the literature that analyses the robustness of the explanatory variables often included in growth regressions. In their influential paper, Levine and Renelt (1992: 943) note that:

the cross-country statistical relationships between long-run average growth rates and almost every particular policy indicator considered by the profession are fragile: small alterations in the ‘other’ explanatory variables overturn past results.

They conclude that the most robust determinant of growth is the ratio of investment to GDP. Rodrik, Subramanian and Trebbi (2004) find that institutional quality has a more robust effect on growth than geography and openness to trade. Specifically, they note that once institutions are controlled for, measures of geography and openness to trade cease to have a significant effect on growth. In a recent paper, Doppelhofer, Sala-i-Martin and Miller (2004) provide rankings based on the robustness of 32 explanatory variables often included in growth regressions. The log of initial GDP per capita ranked first among all the variables. Thus, to ensure that our results are robust, we include the following variables in our regressions as controls: domestic fixed investment as a share of GDP, the log of initial GDP per capita, and the effectiveness of the rule of law as a measure of institutional quality. We also include in our regressions two policy variables—the rate of inflation and government consumption as a share of GDP to capture the policy environment in the recipient country.¹⁴ Our aim is to test whether aid in education has a significant effect on growth after controlling for all these important determinants of growth.

3 The data and the variables

The data on education aid disbursement are from the 5-CRS/Aid Activities-Disbursements database, which is part of the OECD-DAC’s Credit Reporting System (CRS).¹⁵ The database has comprehensive information on education projects in

¹⁴ Burnside and Dollar (2000) argue that aid has a positive effect on growth only in countries that have a good policy environment. They consider three measures of good policies: inflation, budget deficits and openness. The data for budget deficit are not available for several of the countries in our sample. We therefore used government consumption in our regressions. Also, similar to Rodrik, Subramanian and Trebbi (2004), trade/GDP ceased to be significant after controlling for institutional quality, so we excluded trade/GDP, a measure of openness, from the estimations.

¹⁵ The data are available at: www.oecd.org/dataoecd/50/15/5037782.htm.

developing countries funded by DAC member countries. The data include information such as the names of the donor and recipient countries, name of the agency implementing the project (includes nongovernmental agencies and other agencies such as UNICEF, EC), a description of the project (teacher training, equipment), starting and ending dates of the project, the level of education being funded (primary, secondary or higher), the type of aid (grants or loans), amount committed by the donor, the year of commitment and the amount of funds disbursed each year. The data are available from 1990-2004. Based on the data, we constructed our variable of interest, which is the amount of aid disbursed to each recipient country every year.¹⁶

We point out two caveats of the aid data. First, years of coverage are few—the data are available for only 15 years.¹⁷ Second, the data do not capture all the education aid flows to the various recipient countries—the database does not have data on aid from non-DAC countries and important multilateral agencies such as the World Bank.¹⁸ We note, however, that aid from DAC countries constitutes over 85 per cent of official assistance to developing countries. For example, the breakdown of the gross official aid to developing countries in 2004 was 89.7 per cent for DAC countries, 8.7 per cent for multilateral agencies and 1.6 per cent for non-DAC countries (OECD 2006).¹⁹

With regards to the control variables, the measure of institutional quality reflects the impartiality of the legal system and the extent to which the rule of law is enforced. The data range from 0 to 6, a higher rating implies a more impartial legal system. The data are from the *International Country Risk Guide*, published by Political Risk Services.²⁰

Table 1
Summary statistics

Variable	Full sample		Middle-income countries		Low-income countries	
	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.
GDP per capita growth	1.498	3.656	2.171	3.623	0.438	3.463
Aggregate education aid/GDP (%)	0.101	0.228	0.040	0.099	0.196	0.323
Primary education aid/GDP (%)	0.048	0.131	0.012	0.044	0.106	0.189
Secondary education aid/GDP (%)	0.013	0.040	0.010	0.043	0.018	0.033
Tertiary education aid/GDP (%)	0.039	0.122	0.019	0.050	0.072	0.180
Rule of law	3.319	1.194	3.592	1.190	2.889	1.072
Fixed investment/GDP (%)	20.797	6.304	22.428	5.779	18.227	6.256
Log (initial GDP per capita)	8.001	0.880	8.595	0.454	7.066	0.487
Log (inflation)	4.224	0.579	4.214	0.502	4.241	0.684
Government consumption/GDP (%)	14.127	5.372	14.844	5.734	12.997	4.539

¹⁶ Thus, for each year, we calculated the sum of aid disbursements from all DAC members to each of the recipient countries.

¹⁷ Specifically, the data on education aid disbursements are not available prior to 1990.

¹⁸ To the best of our knowledge, data on education aid for non-DAC countries and multilateral agencies such as the World Bank are not readily available. Also, the total education aid to recipient countries is not readily available either. As a consequence, we are unable to estimate the proportion of education aid that comes from DAC countries.

¹⁹ The amounts are US\$92.254 million for DAC countries, US\$8.971 million for multilateral organizations and US\$1.6 million for non-DAC countries.

²⁰ See www.prsgroup.com/icrg/icrg.html.

Table 2
Correlations between education aid variables

Education variable	Full sample		Middle-income		Low-income	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
Secondary	0.4091*** (0.000)		0.553**** (0.000)		0.538*** (0.000)	
Higher	0.3639*** (0.000)	0.2968*** (0.000)	0.157** (0.013)	0.166** (0.008)	0.332*** (0.000)	0.485*** (0.000)

Table 3
List of countries in the sample

Middle-income countries		Low-income countries	
Albania	Jamaica	Bangladesh	Nicaragua
Algeria	Jordan	Burkina Faso	Niger
Argentina	Kazakhstan	Cameroon	Nigeria
Armenia	Latvia	Congo, Dem. Rep.	Pakistan
Azerbaijan	Lithuania	Congo, Rep.	Papua New Guinea
Belarus	Malaysia	Cote d'Ivoire	Senegal
Bolivia	Mexico	Ethiopia	Sierra Leone
Botswana	Morocco	Gambia	Sudan
Brazil	Namibia	Ghana	Tanzania
Bulgaria	Panama	Guinea-Bissau	Togo
Chile	Paraguay	Haiti	Uganda
China	Peru	India	Vietnam
Colombia	Philippines	Kenya	Yemen, Rep.
Costa Rica	Poland	Madagascar	Zambia
Croatia	Romania	Malawi	Zimbabwe
Czech Republic	Russian Federation	Mali	
Dominican Republic	Saudi Arabia	Moldova	
Ecuador	Slovak Republic	Mongolia	
Egypt, Arab Rep.	South Africa	Mozambique	
El Salvador	Sri Lanka		
Estonia	Syrian Arab Republic		
Gabon	Thailand		
Grenada	Trinidad and Tobago		
Guyana	Tunisia		
Honduras	Turkey		
Hungary	Ukraine		
Indonesia	Uruguay		
Iran, Islamic Rep.	Venezuela, RB		

The remaining variables, namely, GDP per capita growth, initial GDP per capita, inflation, investment and government consumption are from the *World Development Indicators* (2005) CD-Rom, published by the World Bank. The analysis covers 90 developing countries; 56 middle-income countries and 34 low-income countries over the period 1990-2004 and we average the data over three years.²¹ The years of coverage

²¹ The country classifications are from the World Bank and are based on the 2005 GNI per capita, calculated using the World Bank Atlas method. The GNI per capita for low-income countries is less than or equal to US\$875 and that for middle-income countries ranges from US\$876 to US\$3,465.

and the countries included in the analysis are determined by the availability of data. Table 1 presents the summary statistics of the variables and Table 2 displays the correlations between the various aid variables. The countries included in the analysis are listed in Table 3.

4 Empirical analysis

4.1 Estimation procedure

In their seminal paper, Hansen and Tarp (2001) assert that three factors may cause the estimates from aid regressions to be biased: (i) the joint effect of endogeneity of aid flows; (ii) unobserved country specific factors; and (iii) conditional convergence. The authors recommend using the dynamic panel general method of moments (GMM) estimator proposed by Arellano and Bond (1991) to overcome these potential problems. This estimator, often referred to as the ‘difference GMM’ estimator, uses lagged levels of first difference of variables as instruments. However, as Arellano and Bover (1995) point out, lagged levels are often poor instruments for first differences. This problem is mitigated by using the augmented version of the difference GMM estimator, the ‘system GMM’ estimator, proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Specifically, the system GMM combines both the level and first difference equations. Another advantage of the system GMM estimator is that it reduces finite sample bias by exploiting additional moment conditions where the autoregressive parameter is only weakly identified from the first-differenced equation. Since the number of observations of some of our subsamples is small, we use the system GMM estimator for our regressions.²² We also note that the estimates from this procedure are inconsistent in the presence of autocorrelation. Hence for each regression we report the test for autocorrelation as well as the test of over-identifying restrictions. For all the regressions, the p-values for the test for autocorrelation and the Hansen-J Statistic confirm the absence of autocorrelation and the validity of the instruments.

Following the aid-growth literature, we estimate the equation:

$$\text{Growth}_{it} = \alpha + \beta \text{aid/GDP}_{it} + \gamma \text{Controls}_{it} + \varepsilon_{it} \quad (1)$$

where Growth_{it} is the GDP per capita growth rate of country i in period t ; aid/GDP_{it} is foreign aid in education as a share of GDP (per cent); Controls_{it} are the control variables and ε_{it} is the error term. As is standard in aid-growth regressions, we treat the aid variable as endogenous. We also use all the control variables as additional instruments and do not put any restrictions on the number of lags to be used as instruments.

4.2 Effect of education aid variables on growth

In order to highlight the importance of the heterogeneity of aid flows and the heterogeneity of aid recipients, we first report the results where we use aggregate data on aid to estimate the pooled sample, and then compare them with the results where the

²² We also run regressions using the difference GMM and the main results were similar.

data is disaggregated by the level of education and income. Tables 4, 5 and 6 show the results for the full sample, low-income countries and middle-income countries respectively. To facilitate the discussion, we also report a summary of the results in Table 7 where we show only the estimated coefficients of the aid variables.

Column (1) of Table 4 (also see column (1) and row (1) of Table 7) shows the estimated coefficients for the regression for the pooled sample where we use data on aggregate education aid—i.e., the analysis ignores the heterogeneity of aid recipients and the heterogeneity of aid flows. Note that the estimated coefficient of aggregate aid is not significant, suggesting that overall education aid does not have a significant effect on growth for developing countries. We next take into consideration the heterogeneity of aid flows but not the heterogeneity of aid recipients by disaggregating the education aid data into primary, secondary and higher. Columns (2), (3) and (4) of Table 4 report the estimated coefficients for the three stages of education aid (also see columns (2), (3) and (4) of row 1 in Table 7). Similar to the regressions using aggregate aid, the estimated

Table 4
Effect of education aid on growth for the pooled sample

Variables	Aggregate (1)	Primary (2)	Secondary (3)	Higher (4)
Aid variables				
Aggregate education aid/GDP (%)	0.082 (0.797)			
Primary education aid/GDP (%)		0.967 (0.129)		
Secondary education aid/GDP (%)			-1.320 (0.609)	
Higher education aid/GDP (%)				0.299 (0.736)
Control variables				
Rule of law	0.675*** (0.000)	0.715*** (0.000)	0.631*** (0.000)	0.629*** (0.000)
Fixed investment/GDP (%)	0.184*** (0.000)	0.170*** (0.000)	0.158*** (0.000)	0.181*** (0.000)
Log (Initial GDP per capita)	-0.001 (0.994)	0.087 (0.637)	0.157 (0.271)	0.087 (0.636)
Log (Inflation)	-1.715*** (0.000)	-1.421*** (0.000)	-1.834*** (0.000)	-1.623*** (0.000)
Government consumption/GDP (%)	-0.118*** (0.109)	-0.112*** (0.002)	-0.125*** (0.289)	-0.107*** (0.000)
Constant	4.413** (0.038)	2.493 (0.251)	4.369** (0.034)	3.206 (0.114)
Number of observations	407	407	407	407
Number of countries	90	90	90	90
Hansen J-statistic ^(a)	0.503	0.192	0.545	0.472
Test for autocorrelation ^(b)	0.302	0.262	0.335	0.311

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

^(a) The null hypothesis is that the instruments are not correlated with the residuals.

^(b) The null hypothesis is that the error terms in the first difference regression exhibit no second order serial correlation.

Table 5
Effect of education aid on growth for low-income countries

Variables	Aggregate (1)	Primary (2)	Secondary (3)	Higher (4)
Aid variables				
Aggregate education aid/GDP (%)	0.514* (0.065)			
Primary education aid/GDP (%)		1.674*** (0.001)		
Secondary education aid/GDP (%)			-6.070* (0.051)	
Higher education aid/GDP (%)				0.210 (0.642)
Control variables				
Rule of law	0.901*** (0.000)	1.033*** (0.000)	0.853*** (0.000)	0.927*** (0.000)
Fixed investment/GDP (%)	0.169*** (0.000)	0.194*** (0.000)	0.172*** (0.000)	0.202*** (0.000)
Log (INITIAL GDP per capita)	-0.252 (0.456)	-0.676* (0.054)	-0.631 (0.107)	-0.719*** (0.009)
Log (inflation)	-1.315*** (0.000)	-1.348*** (0.000)	-0.941*** (0.002)	-1.233*** (0.000)
Government consumption/GDP (%)	-0.153*** (0.003)	-0.131*** (0.004)	-0.152*** (0.000)	-0.173*** (0.003)
Constant	4.084 (0.121)	6.055*** (0.003)	5.579* (0.088)	6.650*** (0.007)
Number of observations	158	158	158	158
Number of countries	34	34	34	34
Hansen J-statistic ^(a)	0.619	0.501	0.500	0.788
Test for autocorrelation ^(b)	0.773	0.881	0.878	0.865

Notes: See notes to Table 4.

coefficients of primary aid, secondary aid and higher aid are not significant. Thus, based on these results, one may conclude, albeit erroneously, that all types of education aid do not have a significant effect on growth. However, as predicted by the education-growth literature (e.g., Petrakis and Stamatakis 2002), the results change when we run regressions for the different stages of education aid and different levels of income (see Table 7 or compare Tables 5 and 6). Specifically, Table 7 shows that the estimated coefficient of primary aid/GDP is positive and significant at the 1 per cent level for low-income countries, the estimated coefficient of secondary aid/GDP is negative and significant only at the 10 per cent level and the coefficient of higher aid/GDP is not significant: all else equal a one standard deviation increase in primary aid/GDP will increase growth by about 0.316 per cent in low-income countries. Thus, our results suggest that overall, aid in primary education boosts growth in low-income countries but aid in post-primary education does not have a significant impact on growth (see Tables 5 and 7).

For middle-income countries, aid in primary and secondary education has a negative and significant impact on growth while aid in higher education has a positive effect. All else equal, a one standard deviation increase in primary aid/GDP and secondary aid/GDP will decrease growth by about 0.293 per cent and 0.174 per cent, respectively. In contrast, a one standard deviation increase in higher aid/GDP will raise growth by about 0.395 per cent (see Tables 6 and 7). A plausible explanation for the adverse effect of primary aid and secondary aid on growth in middle-income countries is that most of the countries have achieved universal or almost universal primary and secondary

education. In addition, in these economies, basic education is less relevant for production. Also, unlike low-income countries where most of the aid takes the form of grants (i.e., there is no repayment requirement) aid to middle-income countries generally takes the form of loans. Thus, foreign aid in primary and secondary education to these countries is tantamount to borrowing to fund a project that generates very little socioeconomic returns. As a consequence, the overall effect of education aid in primary and secondary education on growth may be negative.

Finally, we note that by including only one measure of education aid at a time in our regressions, our estimations may suffer from the usual omitted variable bias problem. Indeed, in order to accurately capture the effects of each of the aid variables on growth, the estimations should include all the three measures of education aid. However, this approach will produce inaccurate estimates if there is multicollinearity.²³ That seems to be the case for our data. As shown in Table 2, the correlation coefficients between the aid variables are all significant, most of them at the 1 per cent level. Also, in regressions where we included all the three aid variables, the magnitudes of the estimated coefficients of some of the variables increased substantially. We however note that the dynamic panel estimator that we employ for our analysis mitigates the potential omitted variable bias problem.

Table 6
Effect of education aid on growth for middle-income countries

Variables	Aggregate (1)	Primary (2)	Secondary (3)	Higher (4)
Aid variables				
Aggregate education aid/GDP (%)	0.210 (0.736)			
Primary education aid/GDP (%)		-6.599*** (0.000)		
Secondary education aid/GDP (%)			-4.022** (0.017)	
Higher education aid/GDP (%)				7.938*** (0.007)
Control variables				
Rule of law	0.296* (0.091)	0.278** (0.010)	0.469*** (0.000)	0.504*** (0.002)
Fixed investment/GDP (%)	0.175*** (0.000)	0.147*** (0.000)	0.137*** (0.000)	0.142*** (0.000)
Log (initial GDP per capita)	-0.818* (0.099)	-1.101*** (0.004)	-0.837* (0.085)	-0.946* (0.052)
Log (inflation)	-1.401** (0.022)	-2.029*** (0.003)	-2.339*** (0.001)	-1.795*** (0.004)
Government consumption/GDP (%)	-0.078** (0.018)	-0.071** (0.032)	-0.088*** (0.006)	-0.078*** (0.005)
Constant	11.358** (0.012)	17.002*** (0.000)	16.010*** (0.003)	13.905*** (0.009)
Number of observations	249	249	249	249
Number of countries	56	56	56	56
Hansen J-statistic ¹	0.450	0.382	0.246	0.421
Test for Autocorrelation ²	0.089	0.087	0.078	0.100

Notes: See Table 4.

²³ See Leoning (2005) for a discussion of the collinearity problems associated with the variables that measure the various stages of education.

Table 7
Effect of education aid on growth: summary results

Sample	Aggregate aid	Primary aid	Secondary aid	Higher aid
Pooled sample	0.082 (0.797)	0.967 (0.129)	-1.320 (0.609)	0.299 (0.736)
Low income	0.514* (0.065)	1.674*** (0.001)	-6.070* (0.051)	0.210 (0.642)
Middle income	0.210 (0.736)	-6.599*** (0.000)	-4.022** (0.017)	7.938*** (0.007)

4.3 The effect of the control variables on growth

As pointed out earlier, the objective of this paper is to examine the effect of education aid on growth, and not to explain the determinants of growth. Therefore, in order to keep the paper focused, we'll discuss only the *overall* effect of the control variables. Our results support the assertion by Levine and Renelt (1992) that domestic investment has a robust and positive effect on GDP per capita growth—the estimated coefficient of investment is significant at the 1 per cent level in all the 12 regressions reported in Tables 4, 5, and 6. Our results are also consistent with those of Rodrik, Subramanian and Trebbi (2004) who conclude that institutions are important for growth: the estimated coefficient of law and order is positive and significant at the 1 per cent level in ten regressions, at the 5 per cent level in one regression and at the 10 per cent level in one regression. Overall, our results do not support the assertions of Doppelhofer, Sala-i-Martin and Miller (2004): the estimated coefficient of the log of initial GDP per capita is not significant in 6 regressions, negative and significant at the 10 per cent level in four regressions and negative and significant at the 1 per cent level in only two regressions. The policy variables performed quite well: inflation is negative and significant at the 1 per cent level in eleven regressions and at the 5 per cent level in one regression; government consumption is negative and significant at the 1 per cent level in nine regressions and at the 5 per cent level in three regressions. We also considered other variables used in previous studies, such as M2/GDP, as a measure of financial depth; the number of coups and assassinations as a measure of political instability; a measure of ethnic diversity and the share of trade/GDP as a measure of openness to trade. However, none of the variables displayed a consistent effect on growth after controlling for institutional quality, domestic investment, inflation and government consumption.

5 Conclusion

This paper has examined the effect of education aid on growth. We find that the effect of aid depends on the level of development of the recipient country (low and middle income) as well as the level of education at which aid is being targeted (primary, secondary or higher). Aid in primary education enhances growth in low-income countries but aid in post-primary education has no significant effect. For middle-income countries, aid in primary education and secondary education has an adverse effect on growth but aid in higher education enhances growth. Thus, our results highlight the

importance of taking into account the heterogeneity of aid and the heterogeneity of the recipient countries when analysing aid-growth relationships. With regards to policy, our results suggest that increased aid in primary education to poor countries will provide double dividends: promote economic growth and also help the countries to achieve the Millennium Development Goal of universal primary education.

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