International Journal of Educational Development 48 (2016) 37–52

Contents lists available at ScienceDirect

International Journal of Educational Development

journal homepage: www.elsevier.com/locate/ijedudev

Making aid work for education in developing countries: An analysis of aid effectiveness for primary education coverage and quality

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ARTICLE INFO

Article history:
Available online 22 December 2015

JEL classification:
O20, I21

Keywords:
Aid effectiveness
Educational enrolment
Education quality

ABSTRACT

This paper examines the effect of education aid on primary enrolment and education quality. Using the most recent data on aid disbursements and econometric specifications inspired by the general aid effectiveness literature, we find some evidence that donors' increase in funding has substantially contributed to the successful increase in enrolment over the last 15 years. The most robust effect is obtained by aid for education facilities and training. In addition, we find complementarities between aid for primary and secondary education. Our qualitative comparative analysis of education quality also highlights the relevance of a balanced mix of educational expenditures.

1. Introduction

While aid effectiveness with respect to overall economic development has been studied for many years, looking at individual sectors is a more recent phenomenon. For education, initial studies by Michaelowa (2004), Michaelowa and Weber (2007, 2008), Wolf (2007), as well as Dreher et al. (2008) were followed by a number of complementary studies with further differentiations of the dependent variable, varying methods to deal with potential endogeneity, and a distinction between bilateral and multilateral aid (Arndt et al., 2011; Breitwieser and Wick, 2012; Christensen et al., 2010, 2011, 2012; D'Aiglepierre, 2011; D'Aiglepierre and Wagner, 2010; Findley et al., 2009; Gyimah-Brempong and Aziedu, 2008). Perhaps this fast development of the literature is due to the fact that looking at this sectorial analysis is somehow more rewarding than looking at aid in general. A more direct link between input and outcome variables facilitates the conceptualization of the impact chain and circumvents some of the thorny issues regarding, notably, the adequate temporal relationship (cf. the debate on 'early impact aid' by Clemens et al., 2012). While it is certainly interesting to see whether aid for education also has an indirect effect on growth, education is an objective in itself, and – especially at the basic level – an important dimension of empowerment and poverty reduction. Thus universal primary education was prominently listed within the Millennium Development Goals (MDGs), and the simple quantitative goal was augmented by a consideration of education quality in the Dakar Framework for Action adopted by the World Education Forum in 2000. The recently agreed Sustainable Development Goals (SDGs) that replaced the earlier MDGs in September 2015 explicity include the quality perspective and aim for: "inclusive and equitable quality education" (Goal 4).

Just as the literature cited above, this paper focuses on the direct link between aid and educational outcomes. Starting with the specification in Michaelowa and Weber (2007), we replace the aid commitment data in our structural (five-year) panel by the more appropriate Development Assistance Committee (DAC) disbursement data, for which a sufficiently long time series is now available. Moreover, we simplify the estimation procedure drawing upon the arguments by Clemens et al. (2012) regarding the literature on aid and growth. In addition, we go beyond the existing literature by distinguishing between different types of education aid, and by considering that there may be a quality–quantity trade-off that should also be considered. The idea is to get as concretely as possible to the analysis of questions with direct relevance for aid allocation decisions, namely the question which types of aid (or which combinations thereof) have been particularly useful in order to improve primary education coverage and quality. While we focus on primary education, it will become clear that this educational sub-sector cannot be considered in isolation, but depends on the functionality of the education system as a whole.

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http://dx.doi.org/10.1016/j.ijedudev.2015.11.008

The remainder of this article will be organized as follows. Section 2 presents some initial descriptive statistics and a brief literature review on aid effectiveness in education. Section 3 provides our econometric analysis of the effect of overall education aid on primary enrolment. Section 4 presents additional results for sub-categories of education aid, using Qualitative Comparative Analysis (QCA), an empirical method specifically designed for small samples. Section 5 proceeds with an analysis of education quality. Section 6 concludes.

2. Setting the stage: a first glance at the data, and an overview of the existing literature

In his article 'The cartel of good intentions', Easterly (2002, p. 45) shows a graph strongly suggesting that economic development is negatively correlated to foreign aid. While such a simple presentation of uncontrolled time series may be misleading, it provides an initial starting point for further analysis. Looking specifically at the education sector, the initial comparison of trends looks rather favorable (see Fig. 1).

For all regions in the lower part of the graph, primary education coverage – measured here in terms of net enrolment rates (NER) – increases more or less steadily along with a rise in education aid. For the regions in the upper part of the graph, enrolment rates did not increase much or did not increase at all, but this simply reflects that for most of the countries covered, the NER has been at or close to its maximum of 100% right from the beginning. In these cases, a further increase can obviously not be expected, and education aid presumably focused on either the increase in education quality or on other levels of education (cf. the discussion of aid sub-categories in Sections 4 and 5).

While parallel trends do not directly imply any positive causal effect of aid on education outcomes, most of the existing econometric literature cited above has confirmed the generally positive link between education aid and education outcomes, and claims to have established causality by a variety of methods of instrumentation.[1] While the magnitude and the significance of the effect vary substantially between different studies (as does the interpretation of how large the effect must be in order to be considered as 'substantial'), a consensus about an overall positive effect is emerging much more clearly than for development aid more generally. The only two studies initially reporting fully insignificant or even negative effects (Christensen et al., 2010; Findley et al., 2009) have been further elaborated upon by (some of) the authors to consider potential selection effects and related endogeneity, and now provide some positive evidence, at least for bilateral aid (Christensen et al., 2011, 2012). The availability of DAC aid disbursement data by sector since the early 1990s has further increased the precision of more recent estimations which reinforce the tentatively positive results of the earlier literature (D'Aiglepierre, 2011; D'Aiglepierre and Wagner, 2010). Results of the existing literature also indicate that it is useful to disaggregate education aid even further (Christensen et al., 2010, 2011; Findley et al., 2009).

While the existing studies use a variety of different indicators for education outcomes (e.g., enrolment rates, completion rates, or years of schooling) all of these indicators are strongly related and basically measure the same concept, namely education coverage (quantity). However, spending several years at school does not necessary imply that children are able to read and understand even a simple text. Seurat (2012, p. 65), for instance, compares the literacy information provided by different household surveys to the information on years of schooling, and finds that in five out of eight sub-Saharan African (SSA) countries considered, even after five years of primary education, the ability to read a few simple sentences is below 50%. Since international policy goals refer to both, education quantity and quality, it may be even more surprising that hardly any studies have attempted to address this question in the context of aid effectiveness so far.

The problem is related to the lack of appropriate large-N internationally comparable survey data on education quality in developing countries. While there are two studies that do attempt to capture some aspects of education quality, they need to rely on more or less questionable proxies. D'Aiglepierre and Wagner (2010) use repetition rates and pupil–teacher ratios (PTR), but acknowledge that these variables are at best crude measures of the quality of education. Indeed, education production function estimations based on student surveys in Africa show that the relationship between class size and student achievement is generally rather weak (see, e.g., Michaelowa, 2001). Such a relationship is even less obvious for repetition rates. More convincingly, Wolf (2007) uses youth literacy rates, but this is not necessarily linked to improvements in the education system as literacy may also be acquired outside school. Moreover, using literacy rates again raises the question of how much time should be allowed for aid to become effective before a measurable effect can be expected.

In fact, in the economic literature, there seems to be a broad consensus that the best available information on education quality can be drawn from the international achievement tests, such as Program for International Student Assessment (PISA) or Trends in International Mathematics and Science Study (TIMSS). Hanushek and Woessmann (2009) compile the information available from different tests into a large panel database. Unfortunately, those data do not cover many poor developing countries and focus on secondary rather than primary education. Altinok and Murseli (2007) use a similar approach including information on primary education and for a higher number of developing countries, but rely on the additional and rather implausible assumption that the variance in test scores is entirely driven by the population tested, rather than by the design of the tests.

While the lack of appropriate data thus excludes a reliable panel data analysis for developing countries, student assessment programs do exist, even for sub-Saharan Africa, and they even provide repeated country-level information for up to three different survey periods. The largest coverage is provided by the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ). SACMEQ includes repeated information for 15 country cases which is sufficient to carry out a basic QCA using logical links rather than statistical associations. This data will be used in Section 5.

3. The effect of education aid on primary enrolment

To start our analysis, we estimate a series of general regression models relating overall education aid to primary enrolment rates. The extent, to which aid earmarked for primary education or for other specific purposes related to the primary level shows a stronger effect, will be discussed in Section 4. For the moment, we start from the perspective that in their internationally agreed objectives, donors highlighted the relevance of primary education outcomes. If the allocation of funds within education aid does not correspond to this objective, this may be one of the inefficiencies we might want to detect.

We start with a replication of the regressions of Table 1 in Michaelowa and Weber (2007), applying just a few changes in data

[1] Dreher et al. (2008), for instance, use GMM methods (for an explanation, see Section 3), or, alternatively, governance indicators and child mortality as instruments in a two-staged least squares approach. D'Aiglepierre and Wagner (2010) use the adoption of the Fast Track Initiative. These and other instrumentation strategies will be further discussed below.

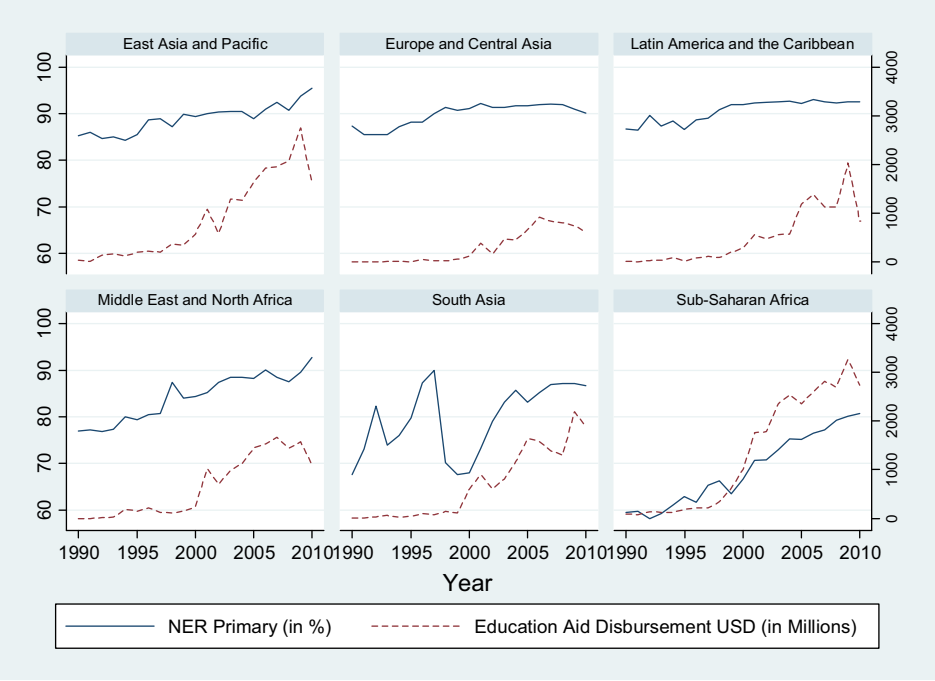

Fig. 1. Aid for education and primary enrolment rates, by region. *Notes*: the vertical axes to the left show enrolment rates while the ones to the right measure aid disbursements. Some caution is required when interpreting these graphs: (1) the measurement of NER is based on regional averages and (due to some missing values) the countries included in this average calculation are not always the same. This explains the irregularities of the curves and notably their periodical downturns. For South Asia, no information at all was available for 1996 and 1997. The corresponding values are based on extrapolation using information on enrolment in 1990; (2) until the early 2000s, reporting by individual donors to the OECD's Creditor reporting system (CRS) was incomplete leading to data coverage of less than 60% before 2002 for aid disbursements as a whole. It must be assumed that the education sector, too, suffers from severe underreporting. From 2002 onwards, however, coverage has reached at least 90% except for the last year (2010) for which information gathering might not have been complete in November 2012 when this analysis was carried out.
Source: See Appendix, Table A1.

coverage and in the operationalization of education aid that will be outlined below. Our dependent variable is the net primary enrolment rate (NER, in %). The central explanatory variable EDUCAID includes all aid disbursements for education as reported to the Organization for Economic Co-operation and Development (OECD) Creditor reporting system (CRS), in constant 2010 US$. The value is expressed in per capita of the recipient country population in order to take into account that large countries need more resources to improve their education coverage than small countries do.

Control variables include the lagged NER (L.NER) that reflects the enrolment situation at the start of each period and thus allows us to take into account that it should be much more difficult to reach a high level of enrolment from a low starting point. Moreover, we include the recipient governments' own expenditure on education as a share of GNI (EDUCEXP) because governments are sometimes co-funding the investments supported through development assistance, so that omitting this variable might unduely inflate the coefficient of aid.[2] Other controls reflect structural characteristics of the education system, namely the prevailing pupil–teacher ratio (PTR), and the share of the population under 15 years of age (YOUNG POP). Both indicate structural difficulties a country may have in increasing enrolment rates. A similar argument can be made for GDP per capita since GDP constrains the government's own budget and hence its possibility to invest in education. Finally, we control for economic and political governance using the budget surplus or deficit (BUDGET), INFLATION, openness to trade (OPEN), and the mean value of political freedom and civil liberties FREE. While good governance is generally correlated with development-oriented government preferences that can be expected to influence educational outcomes, it also affects donors' propensity to grant development assistance.

Variables were imputed by linear imputation based on other, closely related variables (e.g., gross enrolment rates as a predictor for NER, or expenditure per student as a predictor for EDUCEXP) or on values for adjacent years. Missing value indicators were created to capture any systematic difference of observations for which the value of any of the right-hand side variables was missing before imputation. They are systematically included as controls in all our regressions although they are not listed in the corresponding tables in order not to distract the reader from the more substantial variables. For further details on all variables including descriptive statistics and data sources, see Appendix, Table A1.

In the first step of our analysis, the only change with respect to our earlier work is that we now use more recent data, which in turn allows us to use aid disbursements, rather than commitments. Data on official development assistance (ODA) disbursements are more appropriate, because commitments do not necessarily turn into actual spending, and if they do, this does not happen immediately. Over the last 20 years donor reporting on disbursements has improved considerably reaching full reporting by 2007, and 90% coverage since 2002. Considering the trade-off between the number of years available for the analysis and data coverage, we decided to start our time series in the mid-1990s, covering the period from 1996 to 2010. Just as in our earlier paper, we aggregate this information over five-year periods in order to capture the structural change of those variables that only change slowly over time. We average all variables except NER over the

[2] As sector budget aid has become more popular in recent years, there may be some overlap between EDUCEXP and EDUCAID. However, we consider that most aid is still project or program funding that is not accounted for in national budgets. For this reason, we keep EDUCEXP as a control. General budget support is covered by a different category in the OECD/DAC data. In any case, alternative regressions without EDUCEXP yield very similar results regarding the effect of aid.

Table 1
The effect of education aid on primary school enrolment (countries with initial NER < 80%).[a]

Variables	(1) System GMM[b] NER (%)	(2) FE[c] NER (%)	(3) FE[c] NER growth (%)	(4) FE[c,d] NER growth (%)
L.NER	0.32**	−0.04		
	(0.04)	(0.64)		
EDUCAID per capita	0.04**	0.05***	−0.01	5.63*
	(0.01)	(0.01)	(0.79)	(0.09)
EDUCEXP	−0.06	0.38	0.52	7.72
	(0.88)	(0.12)	(0.55)	(0.42)
PTR	−0.26**	−0.20	−0.17	−9.68
	(0.01)	(0.17)	(0.64)	(0.55)
YOUNG POP	−0.22	0.35	−2.02*	−53.25
	(0.24)	(0.48)	(0.07)	(0.16)
GDP per capita	−0.00	−0.00***	−0.00	−5.38
	(0.61)	(0.01)	(0.92)	(0.65)
BUDGET (surplus)	0.12	0.20	1.85***	1.51***
	(0.63)	(0.48)	(0.00)	(0.00)
INFLATION	−0.02	−0.02	−0.49**	−6.53**
	(0.24)	(0.73)	(0.03)	(0.03)
OPEN	0.04	0.07	−0.10	−3.17
	(0.11)	(0.10)	(0.48)	(0.82)
FREE	−1.13**	−3.02	−11.02**	−10.45**
	(0.03)	(0.12)	(0.01)	(0.02)
Observations	260	260	260	257
Countries	110	110	110	110
R^2 (within)		0.51	0.30	0.32
Wald	$chi^2(18) = 584.9$			
	(0.00)			
Hansen	$chi^2(6) = 4.03$			
	(0.67)			
AR1	$z = -0.916$			
	(0.36)			
AR2	.			

Source: See Appendix, Table A1.
[a] Constant or fixed effects (as relevant, see below), and missing value indicators for imputed variables are included but not shown. The prefix 'L.' denotes a lagged variable. Robust *p*-values in parentheses.
[b] Replication of Michaelowa and Weber (2007, Table 1, Regression 4) with new dataset (see also Appendix Table A3).
[c] Including both country and period fixed effects.
[d] Explanatory variables and controls are all in logs except for BUDGET (because of the numerous negative values) and FREE, which is a categorical variable.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

five-years in each period, and relate their values to the dependent variable at the end of the period. This leaves us with three periods of observation for the explanatory and control variables (1996–2000, 2001–2005, and 2006–2010), and four periods for the dependent variable, for which we need an additional observation due to the dynamic structure of our model.

Methodologically, in this initial step, we do not change anything as compared to our earlier analysis. As in Michaelowa and Weber (2007), we use generalized method of moments (GMM) regressions that were specifically developed to avoid bias related to the inclusion of the lagged dependent variable (here: L.NER) in the setting of a dynamic panel model, and simultaneously instrument for other potentially endogenous variables. The idea of these models is to make use of lagged differences (Arellano and Bond, 1991) and, in addition, lagged levels (system GMM, see Blundell and Bond, 1998) as instruments for these endogenous variables. While they are usually reasonably well correlated with the right-hand side variables, they are assumed not to affect the dependent variable directly, and not to suffer from the same endogeneity problems as the variables for whose instrumentation they are used.

The results of this initial replication are presented in the Appendix (Table A2). In line with Michaelowa and Weber (2007, Table 1) we run five regressions, varying in the method used (Arellano&Bond or Blundell&Bond; robust standard errors; ENERGYAID as an additional instrument), and in the variables considered as endogenous. Along with L.NER, EDUCAID is always considered as endogeneous because the current NER may reversely cause the amount of education aid (and some reverse causality may persist despite the control for lagged NER). In a similar way government expenditure for education may be driven by need reflected in the current NER. ENERGYAID was considered as potentially interesting to increase the predictive power of the set of instruments because, in the earlier sample based on commitment data, aid across sectors appeared to be highly correlated (while at the same time, the reverse causality problem with respect to the NER should not exist).

In a second step, we consider that progress over time allowed many countries to approach full primary enrolment already in the early 1990s, so that there was not much leeway for further improvements in primary education coverage. We therefore limit the dataset to countries with an initial NER below 80%. Table A3 in the Appendix presents the results, which are similar to those of Table A2, but still show some changes in coefficients and significance levels. As we believe that this restricted dataset should lead to more precise results regarding primary education outcomes, this also represents the selection of observations for the main tables in Sections 3 and 4.

Table 1 presents our new analysis. As a baseline, Regression (1) is a copy of the preferred model in the specification of the replication table based on the final dataset (Appendix, Table A3, Regression (4)). The specific model is preferred to the other GMM models in Michaelowa and Weber (2007) because: (i) it uses Blundell and Bond's system GMM thereby including some of the information on levels for the instruments (rather than differences only); (ii) it is careful with respect to the definition of potentially endogenous variables (considering not only L.NER and EDUCAID, but also EDUCEXP as endogenous); and (iii) it restricts the number of instruments to one per variable and lag distance (=25 in total) as an attempt to improve the general test statistics.

Despite this reduction to a minimum of instruments, the times series available for disbursement data is so short that the general regression statistics for Regression (1) (and all regressions in Tables A2 and A3 in the Appendix) are not very meaningful. First order autoregression is present by default, but cannot be detected here; second order autoregression tests cannot even be computed. In fact, these problems also plague the other regressions in Tables A2 and A3, i.e., the replication of Michaelowa and Weber (2007) based on the shorter disbursement dataset.

In general, the use of GMM models has been widely debated in recent years because they tend to be highly sensitive to slight changes in the specification. Indeed, the lack of robustness was already noted in Michaelowa and Weber (2007), and the problem is evident when considering Tables A2 and A3 in the Appendix. Moreover, Monte Carlo analysis suggests that bias due to the lagged dependent variable in a normal fixed effects (FE) regression model is largely concentrated on the coefficient of this variable itself (Judson and Owen, 1999, p. 12). Thus as long as we are not interested in the interpretation of the effect of lagged dependent variable (L.NER), this might not be too much of a concern.[3]

Regression (2) thus presents the results of a simple FE regression including both country and period fixed effects. While

[3] At the same time, if the coefficient of L.NER cannot be interpreted, we do not know whether the effects measured for the other variables relate more to the level of education or to its change (the closer the true coefficient is to one, the more the model refers to the change in outcomes rather than the level). Overall, the proper interpretation of the relevant coefficients, too, may thus represent a problem even if only the coefficient of L.NER is biased. The additional GMM regression is thus helpful at least to assess the actual effect of L.NER.

there is some change in the coefficients of other variables, the coefficient and significance of EDUCAID is remarkably stable.

Nevertheless, the problem remains that EDUCAID may not be exogenous to the enrolment rates (despite the fact that it refers to a period prior to the measurement of the dependent variable and the fact that L.NER is controlled for). As mentioned above, Michaelowa and Weber (2007), suggest energy aid as a possible instrument since for the 1970–2000 commitments data, it was reasonably correlated to education aid data. However, unfortunately, using the new disbursement data, the correlation with education aid drops dramatically, and energy aid is not significant at all in the first stage of a standard instrumental variable FE regression.[4] Other types of aid that are more closely correlated to education aid (e.g., health aid) are not convincing in terms of exogeneity. D'Aiglepierre and Wagner (2010) use the year of the Fast Track Initiative (FTI) endorsement as an instrument. However, as this initiative has been primarily targeted toward countries that are lagging behind in terms of educational outcomes, it is again endogenous to NER. Similarly, instruments based on donors' political interest – often used in general aid effectiveness regressions – have been shown to be problematic as they reflect only a specific, less development-oriented type of aid (Dreher et al., 2014). As noted in Clemens et al. (2012), instrumenting with such bad instruments may lead to results that are even more misleading than a simple FE regression.

We thus decide to avoid the introduction of such instruments. In any case, it should be noted that in the context of Regression (2), reverse causality would lead to a downward bias of our estimates, so that the coefficient in our regression can be considered as some kind of a lower bound for the actual size of the effect.

Nevertheless, there may be a way to get closer to a plausibly unbiased estimation, not only regarding EDUCAID but also regarding some of the controls, notably EDUCEXP. Clemens et al. (2012) argue that regressions related to aid effectiveness for growth can be considered as more or less unbiased, once country and time FE have been introduced. Obviously, the risk of endogeneity would have been much larger if income levels rather than growth had been the dependent variable. In our case, the dependent variable is specified in terms of the level of education coverage. Using education growth rates instead should equally reduce potential bias. In Regressions 3 and 4, we therefore introduce the rate of change in enrolments (in %) as the new dependent variable. This also avoids the above mentioned problems related to the inclusion of the L.NER by simply moving this variable to the other side of the equation.

Regression (3) shows that with this change, EDUCAID loses all of its significance. However, this seems to be largely related to a non-linear relationship between aid and growth in enrolments. When specifying the right-hand-side variables in logs (all except BUDGET because of the high number of negative values, and FREE because it is a categorical variable), EDUCAID again becomes significant (Regression (4)). As a rough approximation, the coefficient indicates that doubling annual education aid per capita for a period five consecutive years implies a 5.6% increase in net enrolment rates.

It should be recognized, however, that the coefficient is significant only at the 10% level, and oscillates around this limit depending on specification. In a replication of all regressions of Table 1 for the dataset with all countries (not limited to those with NER $< 80\%$), the coefficient of EDUCAID in Regression (4) only has a p-value of 0.13 (see Appendix, Table A4). In regressions omitting our standard indicator variables for imputed values (see note 1 in Table 1), EDUCAID again turns significant.

As mentioned above, using data from 1996 onwards also raises concerns regarding data coverage for the EDUCAID variable. It is important to avoid spurious correlations due to the rise of enrolments happening simultaneously with an increase not in the actual aid but in reporting. Indeed a comparison between CRS and DAC statistics for overall aid shows that in our first period, CRS coverage is only 30%. We thus proceed with some additional robustness checks for Regression (4).

First, we shorten the period of analysis to the years 2002–2010, for which data coverage is much more complete. However, any structural panel leaving some time for enrolments to adjust to the inflow of new funding is then restricted to two periods at best. In this context we do not find any significant effect any more.

Second, we keep the three periods of analysis as before, but inflate EDUCAID in the first period using the relationship between overall aid disbursements from the DAC statistics, and the sum of disbursements by sector as reported by the CRS. Coverage for overall aid disbursements was 30% for period one in our sample (1996–2000), 80% for period two (2001–2005), and close to 100% for period three (2006–2010). Assuming that relative under-reporting is the same across sectors and countries, we thus multiply EDUCAID by 10/3 in the first period, and by 10/8 in the second CRS (for details on this approach, see also Michaelowa and Weber, 2007, p. 4). This hardly changes any of our results, and EDUCAID is significant as before.[5]

We conclude that the results of Regression (4) in Table 1 do not reflect a spurious correlation related to improved reporting to the CRS, but the actual effect of education aid on primary school enrolment. Yet, as the general discussion has shown, the significance of this effect is not robust to variations in regression specification, and notably to variations in sample size. This may be related to the fact that the time period with comprehensive and reliable sector specific disbursement data is still very short (2002–2010).

Another more substantive reason for the relatively low level of precision could be that we have so far looked at total education aid, rather than at aid specifically directed toward primary education. This will be examined in the next section.

4. Aid for different educational purposes and their effect on primary enrolment

While donors have committed themselves to the MDGs and the Dakar Framework of Action, in practice, they may still have prioritized categories of education aid that do not directly affect the primary or basic level of education. This is one source of inefficiency already suggested by Michaelowa and Weber (2007), and by Christensen et al. (2010) who argue that other education spending may even negatively affect primary enrolment.

Fig. 2 shows the development of education disbursements since the mid-1990s, for all sub-categories listed in the OECD's CRS. While many areas have received a substantial increase in funding especially since the year 2000, i.e., after the Dakar Conference, tertiary rather than primary education clearly dominates. Primary education comes second, but donor support for tertiary education is almost 50% higher. Obviously, the cost for both teachers and equipment are much higher at tertiary level, but nevertheless, given that the declared objectives strongly focus on the primary level, this is a somewhat surprising result. It is in line with the findings by Thiele et al. (2007) who find that education aid lacks a clear focus on the priorities of the MDGs.

At the same time, the category 'primary education' does not seem to encompass total financial support to this level of education. The categories 'education facilities and training' as well as 'teacher training', may in fact be largely targeted at the

[4] This also implies that with the new data, Regression (5) in Appendix Tables A2 and A3 is not a very convincing specification.

[5] Results not shown here but available from the authors upon request.

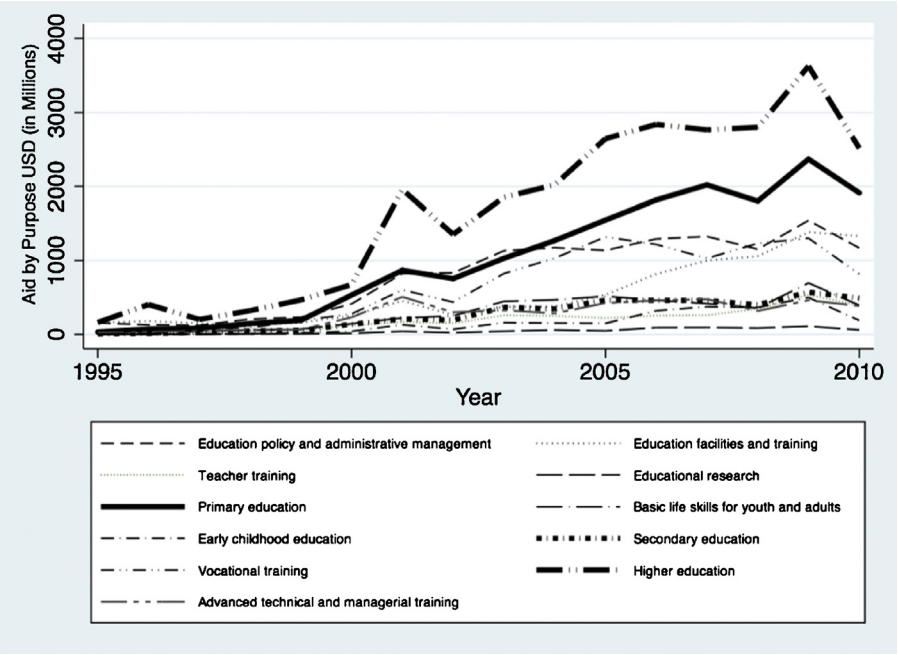

Fig. 2. Aid for education by sub-sectorial purpose. *Notes*: As described in the notes to Fig. 1, data until 2001 may suffer from significant underreporting by DAC donors, and data for the very last year (2010) might also not be fully complete.
Source: OECD (2012).

primary level. Given the strong involvement of donors, notably in the building of new schools, this interpretation appears rather plausible. Adding these categories to primary education puts the relationship to tertiary education in a different perspective.

Secondary education has benefitted much less from the recent rise in education aid. The line is hidden among many other lines in the lower part of Fig. 2. Between primary education that has attracted donors' support due to the direct link with poverty reduction and empowerment, and tertiary education that may be of direct interest to the donors (creating ties with future leaders of the country), the secondary level seems to have been somewhat neglected. Yet, with strongly rising primary enrolment rates, this level might become the future bottleneck.

Relatively large amounts have been spent on vocational training and on the support of education policy-making and administrative management. For each, disbursements have been about twice as much as for secondary education.

Obviously, even those areas without a direct link to primary enrolment, may have an indirect effect. A well-functioning secondary (or even tertiary) education system can enhance students' incentives to complete primary school. In principle, this could also be true for other complementary areas of education such as vocational and technical training if this is considered as sufficiently attractive by the targeted youths. Another complementary area could be early childhood education. A number of studies have established a link between pre-primary education and the ability to cope well during later years of schooling, a consequence that simultaneously tends to reduce drop-out rates (UNESCO, 2007, p. 17). In addition, a sound university system may be beneficial for primary education through the training of good teachers. However, this is a rather long-term perspective since in many poor developing countries only a minority of primary school teachers attends university.[6] A similar long-term perspective is presumably required to see the effect of educational research. We can thus not expect that these variables become significant within the short time frame we consider here.

Table 2 tests the effect of each of the available education aid sub-categories on direct or indirect effects on enrolment that may appear within the five-year period considered (Regressions (1)–(11)). The regression model used is the same as the one applied to overall education aid in Table 1, Regression (4). Again, all aid variables are expressed in per capita terms. Moreover, just as most of the control variables, they are entered as logs (see the notes under Table 2).

Due to strong multicollinearity, the individual sub-categories of education aid cannot be considered jointly. At the same time, there is also a risk in interpreting them individually as the coefficients may simply reflect the effect of other, omitted categories. In addition to the regressions with individual sub-categories, we thus carried out various regressions testing different combinations of these variables. Two of these regressions are presented in Table 2 as Regression (12) and (13). Regression (12) includes all categories that were significant individually in Regressions (1)–(11). Regression (13) replicates Regression (12), but leaves out tertiary education which has the highest variance inflation factor (VIF) among the different categories.

The variables that turn out to be positively significant individually are: primary education, education facilities and training, teacher training, basic skills, and tertiary education. The results for the first three of these confirm the above expectations that all these categories are directly relevant for primary education. As increased enrolment requires more teachers, the latter have often been trained in special fast-track programs, the duration of which was often less than a year. The visibility of an effect within a five-year framework is thus generally plausible.

The effect of disbursements for basic life skills (focusing on youth and adults) is less straight forward. One could even see such programs as competing with rather than supporting primary enrolment. And even more surprising is the significant and high coefficient for tertiary education. However, none of these remains

[6] See data collected by the Program d'analyse des systèmes éducatifs de la CONFEMEN (PASEC, see: http://www.confemen.org/le-pasec) or by the The Southern and Eastern Africa Consortium for Monitoring of Educational Quality (SACMEQ, see: http://www.sacmeq.org).

Table 2
The effect of education aid for different purposes on primary school enrolment.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Disbursements for specific purposes, per capita (in logs)															
Primary education	1.71*											0.41	0.80		2.63**
	(0.07)											(0.63)	(0.34)		(0.01)
Policy & Admin		1.83													
		(0.59)													
Facilities & training			2.66***									1.45	1.80**	2.61**	
			(0.00)									(0.11)	(0.05)	(0.04)	
Teacher training				1.42**								0.91	0.87	1.09	
				(0.04)								(0.20)	(0.21)	(0.16)	
Educational research					0.41										
					(0.23)										
Basic skills						1.15**						0.69	0.86		
						(0.03)						(0.25)	(0.11)		
Early childhood							−0.35								
							(0.51)								
Secondary education								1.07							1.78*
								(0.18)							(0.08)
Vocational training									−0.23						
									(0.81)						
Tertiary education										6.66**		3.05			
										(0.02)		(0.39)			
Advanced technical training											−5.25				
											(0.35)				
Facilities and training × teacher training														0.06	
														(0.55)	
Primary education × secondary education															0.23**
															(0.01)
Control variables (in logs, except BUDGET and FREE)															
EDUCEXP	7.17	7.13	7.15	7.97	6.89	6.97	5.84	8.05	6.52	8.35	7.73	8.89	8.31	7.66	7.70
	(0.46)	(0.46)	(0.46)	(0.41)	(0.48)	(0.47)	(0.56)	(0.40)	(0.51)	(0.39)	(0.44)	(0.35)	(0.38)	(0.43)	(0.41)
PRT	−9.71	−9.02	−4.31	−8.92	−11.20	−9.76	−9.02	−7.50	−9.71	−10.74	−6.90	−7.29	−6.14	−5.69	−12.41
	(0.56)	(0.59)	(0.80)	(0.60)	(0.48)	(0.55)	(0.59)	(0.65)	(0.56)	(0.51)	(0.66)	(0.67)	(0.71)	(0.74)	(0.46)
YOUNG POP	−55.71	−60.43	−57.68	−51.37	−62.76*	−46.42	−62.18*	−62.98*	−64.54*	−48.86	−61.12*	−34.25	−36.22	−50.02	−55.92
	(0.13)	(0.11)	(0.13)	(0.16)	(0.09)	(0.21)	(0.09)	(0.08)	(0.10)	(0.19)	(0.10)	(0.35)	(0.32)	(0.18)	(0.12)
GDP per capita	−4.50	−5.59	−4.92	−4.91	−8.12	−6.00	−6.26	−3.93	−5.67	−5.48	−3.06	−5.23	−5.03	−4.97	−7.24
	(0.70)	(0.64)	(0.68)	(0.68)	(0.47)	(0.60)	(0.61)	(0.73)	(0.64)	(0.64)	(0.79)	(0.66)	(0.66)	(0.67)	(0.55)
BUDGET (surplus)	1.45**	1.59***	1.90***	1.84***	1.74***	1.56***	1.66****	1.41**	1.65***	1.56****	1.66***	1.77***	1.78***	1.99***	1.47***
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
INFLATION	−7.54***	−6.63**	−6.84**	−7.60***	−6.43**	−7.22**	−6.86**	−6.65**	−6.87**	−6.43**	−7.14**	−7.54**	−7.93***	−7.15**	−6.71**
	(0.01)	(0.03)	(0.02)	(0.01)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)	(0.01)	(0.03)
OPEN	−2.46	−2.76	−1.95	−4.70	−3.42	0.18	−1.85	−1.08	−2.26	−3.60	−0.99	−2.65	−1.62	−3.38	−4.32
	(0.86)	(0.85)	(0.89)	(0.73)	(0.80)	(0.99)	(0.89)	(0.94)	(0.87)	(0.79)	(0.95)	(0.84)	(0.90)	(0.80)	(0.76)
FREE	−11.40***	−11.17**	−10.96**	−9.96**	−11.43***	−11.98***	−11.20**	−11.26**	−11.30**	−10.26**	−11.87***	−10.25**	−10.85**	−10.13**	−10.98**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Observations	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
Countries	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
R^2 (within)	0.32	0.31	0.34	0.33	0.31	0.32	0.31	0.32	0.31	0.33	0.31	0.36	0.36	0.35	0.34

Source: See Appendix, Table A1.
Notes: The dependent variable for all regressions is the same as in Table 1, Regression (4), i.e., the growth of net enrolment rates over the previous five-year period (in%). All right-hand-side variables except BUDGET (because of numerous negative values and FREE (which is a categorical variable) are in logs). As many purpose codes include 0-values, we added 0.000001 to all values for aid by purpose code before taking logs. In all cases ln(0.000001) is below the minimum value the variable takes otherwise. As sub-categories of the overall EDUCAID per capita variable, all individual aid disbursement variables are equally measured in per capita terms (before taking the logs for this regression). Country and period fixed effects, and missing value indicators for imputed variables are included but not shown. Robust *p*-values in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

significant when other education aid variables are added to the equation. When all significant variables are included jointly in Regression (12), only the facilities and training variable still comes close to significance at the 10% level. As indicated by the VIF, tertiary education is so highly correlated to other disbursement categories that its coefficient appears difficult to interpret. While there may be some positive effect, it is certainly largely overestimated in Regression (10). When excluding it from the regression, education facilities and training again become clearly significant, and disbursements for basic life skills almost recover significance at the 10% level (cf. Regression (13)). Perhaps one could imagine that the basic skills training for youth and adults can complement the children's enrolment by strengthening the focus on education in general, and by enhancing the chances of written communication or reading within the family or neighborhood.

While Findley et al. (2009) as well as Christensen et al. (2010) suggest that some aid sub-categories may also show negative effects, we do not find any significant negative coefficients. However, both vocational training and advanced technical training show an insignificant negative sign. This reduces the plausibility that these types of programs might increase the incentive for a sound elementary education at primary school. Indeed, in most developing countries, going to school is linked to aspirations of a

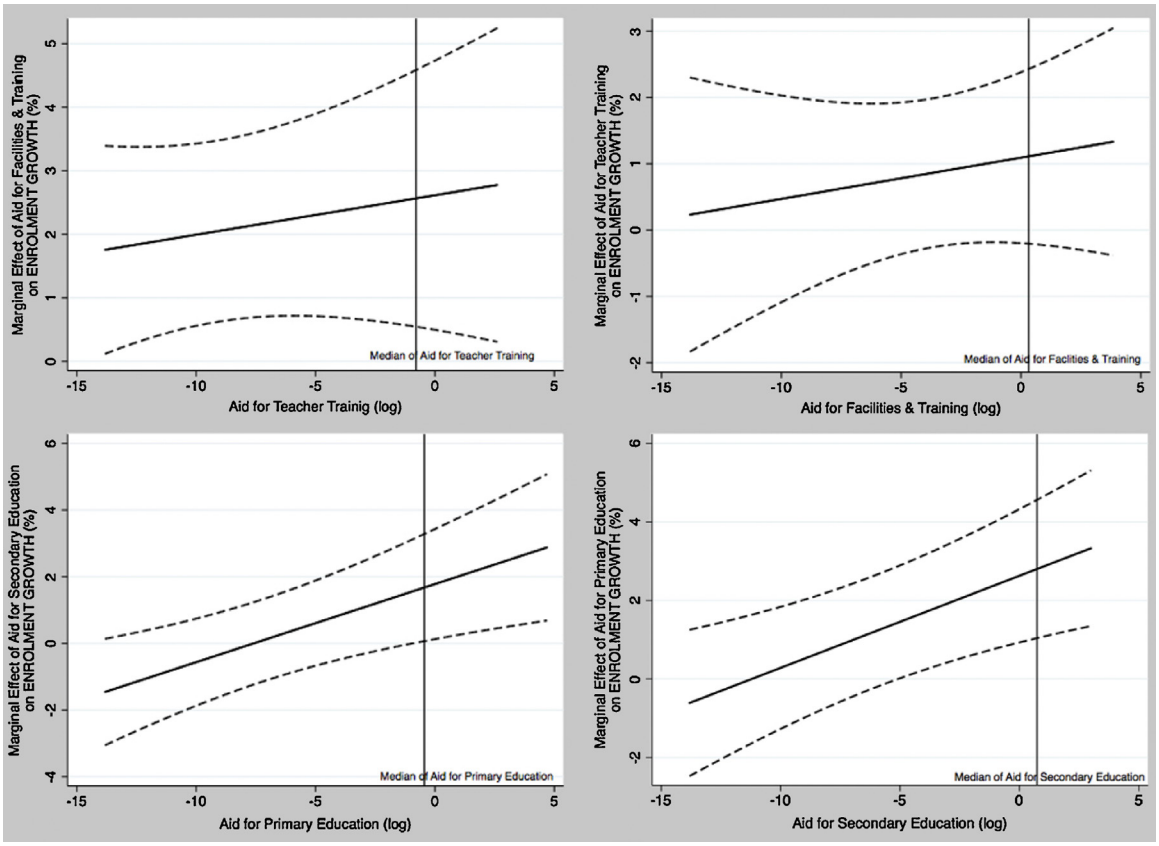

Fig. 3. Interaction effects (Table 2, Regressions 14 and 15). *Notes*: Dashed lines show the 90% confidence interval. All aid variables are in logs.
Source: See Appendix, Table A1.

white collar job, and the social valorization of professional, but technical work, is relatively low.

This is also consistent with the frequent evidence for developing (as opposed to industrialized) countries that educated youth tend to be unemployed more often than their uneducated peers (Michaelowa and Waller, 2003). Thus while these trainings may be very valuable by themselves, they do not seem to positively influence primary enrolment.

In a final step, we directly examine potential complementarities between individual aid categories. First, we expect that there may be some mutually reinforcing effect of the different types of aid directly focused on primary education, namely between the construction and equipment of schools on the one hand, and teacher training on the other hand. Second, we hypothesize that the prospects after primary school affect the incentive to attend and complete primary education in the first place. If the prospects of entering a vocational career do not appear to have any positive effect, students may aspire to further education. Since the immediate step after primary education is secondary education, we examine whether support for primary and secondary education may be mutually reinforcing. The interaction of aid for facilities and teacher training is examined in Regression (14), the interaction of aid for primary and secondary education in Regression (15). The results are further illustrated in Fig. 3.

In the first case (Regression (14), upper panel of Fig. 3), the direction of the effect is as expected, but the interaction is not significant. On the Figure to the left, one can make out that the marginal effect of aid for teacher training is very small and fully insignificant for small values of aid flowing into facilities while it gets much closer to significance when the facility variable increases and approaches its median. In other words, when moving from left to right on the *x*-axis toward the median of log (aid for facilities and training), the lower bound of the confidence interval (dashed line) is approaching zero from below. In contrast, facilities and training is always significant for primary enrolment, no matter what the amount spent on teacher training (upper panel, figure to the right).

One problem with this analysis may be the difficulty to clearly distinguish the facilities and equipment category from the teacher training category. The former, too, includes some training activities, which may make it difficult to observe potential complementarities in our data. The detailed OECD/DAC descriptions of the sub-sectors (cf. Table A1) do not provide much more insights on this aspect.

The lower panel of Fig. 3 and Regression (15) show the interaction between primary and secondary education aid. In this case, the interaction term is strongly and positively significant. This confirms our hypothesis on the complementarity of these two sub-sectors. The graph on the left hand side reveals that aid for primary education turns significant only when secondary education is also supported at least to a certain extent. At the same time, aid for secondary education shows itself a significant effect on primary enrolment if primary education simultaneously receives sufficient support. This provides some plausibility to our argument regarding the incentives related to further prospects within the education system.

5. Considering the quantity–quality nexus

While aid for education, in particular the support of facilities and training, and useful combinations of primary and secondary education, appear to be beneficial for primary enrolment, other policies may be necessary to ensure an improvement of education quality. In fact, in many countries, strong growth of enrolment has

simultaneously led to a reduction of education quality. Malawi for instance, which introduced free primary education in 1994, immediately experienced a dramatic increase in enrolment rates without any preparation of the education system for this rush of new students. Expanding facilities, training and engaging new teachers, and providing textbooks and other pedagogical material were not able to keep pace with this development (Chimombo et al., 2005; World Bank, 2004). A similar situation was faced by Mozambique and, albeit to a lesser extent, by Kenya in the mid-2000s. In all three cases, significant improvements in enrolment were accompanied by declining or stagnating national reading scores (see Table 3). Similar evidence is also available for large parts of Western Africa, where primary enrolment often more than doubled within a decade (see, e.g., CONFEMEN, 2009 for Burkina Faso). CONFEMEN (2009, p. 35) also shows that the decline in average test scores is, to a large extent, simply driven by changes in the student population, since children with less favorable socio-economic backgrounds have been integrated into the education system. For countries with important improvements in enrolment rates, raising or even simply maintaining education quality is thus a considerable challenge.

International donors have substantially supported such countries in building up the necessary physical and human resources. However, they have also put pressure on many governments to reduce teacher salaries and training requirements for access to the teaching profession, and to accept relatively high PTRs in order to be able to enroll more students (see, e.g., the benchmarks of the Education for All – Fast Track Initiative (EFA-FTI) (EFA-FTI Secretariat, 2006; MINEDAF, 2002)). From this perspective, some might argue that donors may have focused on quantity to the detriment of quality.

At the same time, a number of aid activities have been primarily focusing on education quality, and will not be duly acknowledged if we look at aid effectiveness in the education sector from a purely quantity oriented perspective. Support of teacher training, for instance, might be vastly underestimated in its effect if we measure outcomes only in terms of student enrolment. In the context of EFA-FTI the whole system of teacher education has been thoroughly reformed in many African countries. Moreover, new primary education curricula have been derived and supplemented by new teaching material. These are just a few examples.

To obtain a complete picture of the aid effectiveness in the education sector, we thus need to take into account developments in education quality. For this purpose, we consider a smaller sample of countries for which the SACMEQ program provides comparable student achievement data across countries and over time. SACMEQ is a consortium of 15 education ministries in Southern and Eastern Africa that evaluates the conditions of schooling and the quality of education, with technical assistance from the UNESCO International Institute for Educational Planning (IIEP). The focus is on monitoring student achievement toward the end of primary education (grade 6). Participants are selected through random sampling with a typical sample size of 2000–5000 pupils per country.[7] All scores for the second wave of the program (SACMEQ II) were standardized at an international mean of 500, and values for all other waves were adjusted accordingly. Table 3 presents average national reading scores.

As the sample at the country level is relatively small, our analysis cannot go beyond simple qualitative comparisons which, however, may still provide us with some relevant insights. We start by sorting the observations into four different categories: Group A includes all fully successful country-cases, i.e., countries that managed to increase both enrolment and achievement in the period considered. Group B contains those cases that reached higher enrolment, but no improvement of student achievement. Group C covers those countries that succeeded in increasing achievement, but not enrolment. And finally, Group D contains cases with no improvement on either side. These groups are listed in Fig. 4 along with the allocation of education aid (shares of total education aid) to the different sub-sectorial categories.

Table 3
Student reading achievement in Southern and Eastern Africa, national averages.

Country	SACMEQ I 1995	SACMEQ II 2003	SACMEQ III 2007
Botswana		521.1 (3.47)	534.6 (4.57)
Kenya	543.3 (4.53)	546.5 (4.96)	543.1 (4.92)
Lesotho		451.5 (2.92)	467.9 (2.86)
Malawi	462.6 (2.42)	428.9 (2.37)	433.5 (2.63)
Mauritius	550.2 (5.26)	536.4 (5.49)	573.5 (4.92)
Mozambique		516.7 (2.29)	476.0 (2.82)
Namibia	472.9 (4.65)	449.0 (3.12)	496.9 (2.99)
South Africa		492.4 (8.98)	494.9 (4.55)
Swaziland		529.6 (3.73)	549.4 (2.98)
Tanzania		545.9 (5.03)	577.8 (3.40)
Uganda		482.4 (6.12)	478.7 (3.46)

Source: SACMEQ (2012).
Notes: Standard errors in parentheses. Reading scores are also available for: Seychelles (2007) = 575.1 (3.10), Zambia (2007) = 434.4 (3.37), Zimbabwe (2007) = 507.7 (5.65). However, since these countries only participated in one SAQMEC panel, they are excluded from our analysis. Mathematics scores also exist for most countries, but the international coverage of reading scores is better, so that we focus on the latter. Achievement scores for both subjects are strongly correlated.

When looking at the combination of countries in each of these groups, it becomes clear that for both groups with no improvement in quantity, educational coverage was quite high right from the beginning. Except for Lesotho, in all cases net enrolment rates were beyond 80% to start with. As discussed earlier, this makes it relatively hard to obtain further improvements on this dimension. It is not directly clear, however, why some of these countries managed to obtain improvements in quality while others did not (and even showed significant reductions in achievement scores). However, for both Mauritius and Namibia, we observe an improvement over time as they moved from Group D to Group C between the first and the second period included in the analysis.

Group B comprises the three countries Kenya, Malawi, and Mozambique already discussed above. Their initial enrolment levels were lower, and they succeeded in considerable improvements on this dimension while achievement scores stagnated (Kenya) or significantly decreased (Malawi, Mozambique). For Malawi, however, this represents only the first phase of the educational expansion process. During the time of rapid increases in educational coverage, the country did not manage to keep up with educational quality, but improvements on the quality dimension were made in the second stage where we find the country in Group C. Kenya, in contrast, managed to improve both quantity and quality during the first period (Group A), but falls back to Group B in the second period with no further improvements of student achievement. In addition to Kenya, Group A contains Botswana, Swaziland, and Tanzania.

In the following paragraphs, we will try to examine patterns of aid distribution that may be related to the placement of the observation in either of these groups. First, we notice that there is no apparent link with the overall allocation of aid to the education sector in the respective countries (EDUCAID denotes the annual average disbursements per capita during the relevant period). In fact, except for Botswana, the very successful countries of Group A receive relatively little aid overall. In addition, there is no obvious dominance of any individual aid category in Group A.

[7] Note that there are significant differences in country size which are reflected in sample size. Moreover, sample size (and thus precision) seems to have increased over time. During the third wave (SACMEQ III), the average number of students assessed was >4000.

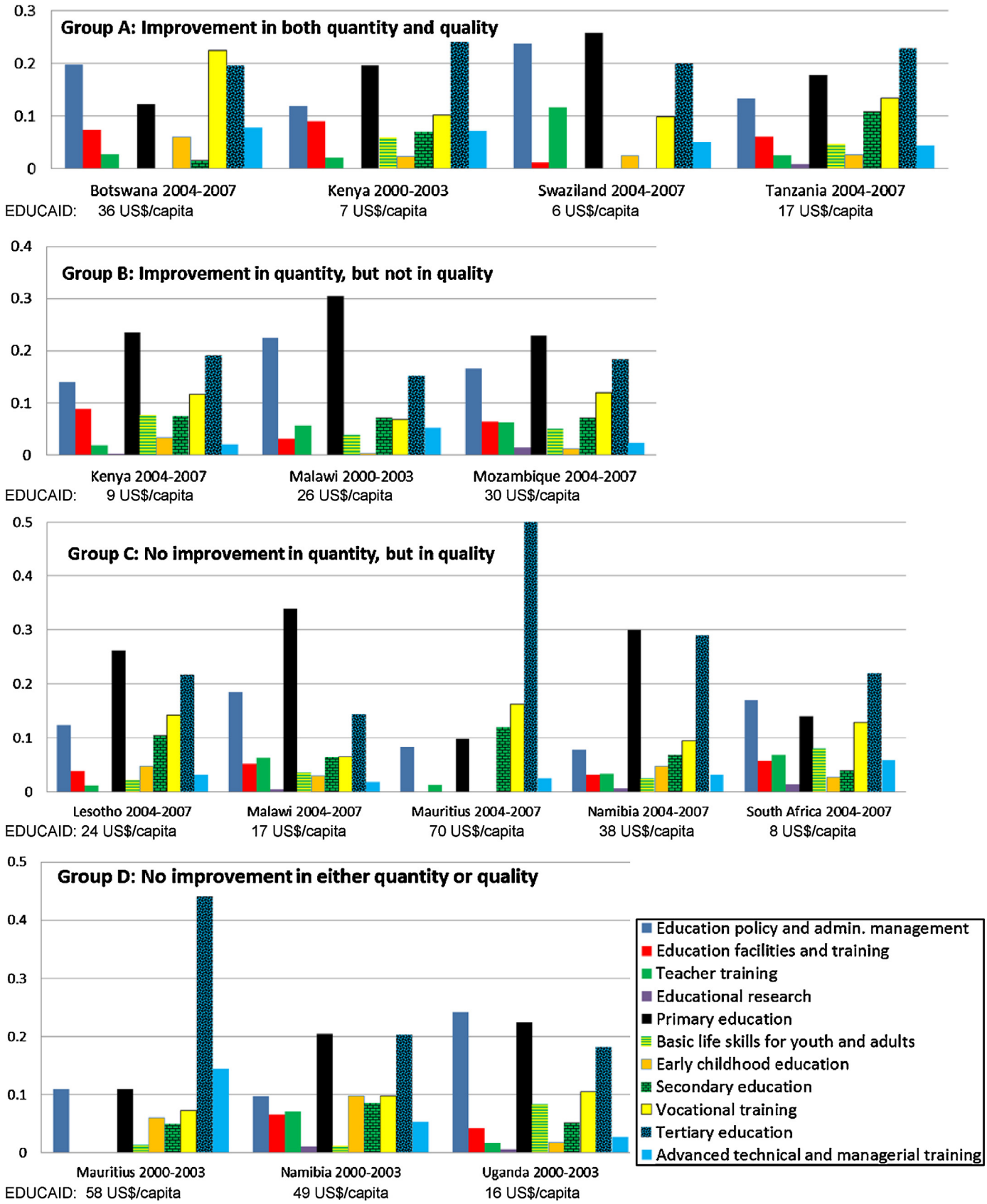

Fig. 4. Education aid by purpose for different groups of SACMEQ countries. *Notes*: Data refer to annual averages over the respective period, whereby we consider two periods of equal length (four years). While the difference in SACMEQ scores effectively refers to 1995–2003, rather than 2000–2003, for the first period, we assume that this does not change the general direction of the quality effect, i.e., the inclusion in the groups.
Source: OECD (2012).

In fact, it is in Group B rather than Group A that primary education aid seems to dominate the other aid categories. The most surprising case may be Kenya which received less primary education aid and more tertiary education aid during the phase in which primary achievement grew along with enrolment (2000–2003). Other educational funding remained relatively stable. It appears plausible to assume that primary education aid may have gone essentially into building school infrastructure and that this does not have a strong effect on education quality (at least after some of the most basic requirements are met).

At least at first glance, Fig. 4 suggests that quality improvements require a somewhat more equal distribution of funding across different areas. In other words, despite our interest in primary education outcomes, it may be relevant for aid not to focus on primary education alone, but to also cover other areas of education (like secondary education, tertiary education, vocational training, or education policy and administrative management) in a well-balanced way. Indeed as discussed in Section 4 with respect to student enrolment, for achievement, too, there may be important complementarities between the different areas. In analogy to what we discussed earlier, there may, for instance, be a certain incentive effect of further education prospects in a functioning secondary and tertiary education system.

We make use of these ideas in the framework of a more systematic comparative analysis using QCA, a method developed by Charles Ragin (1989) to combine the precise discussion of individual cases with a formalized tool that can be applied to a small number of observations. QCA uses Boolean algebra to establish necessary and/or sufficient conditions for certain outcomes. A detailed description of the statistical methodology of QCA is offered by Longest and Vaisey (2008). We use the most basic approach here in order to get around a lengthy introduction into this methodology and its specific terminology, and only present a short summary of the relevant parts of this framework.[8]

QCA evaluates the relationship between an outcome and any possible Boolean combination of prediction variables. In the simplest version of the method applied here, all of these are binary variables. Let us suppose that we want to explain a certain outcome Y (e.g., success = 1, 0 otherwise) with predictors A and B. QCA now examines which combinations of A and B produce the outcome. The predictor sets (A, B) can have four different configurations: both factors present, one factor present, the other factor present, both factors absent. The value 0 tells us that a factor was absent while 1 indicates that a factor was present. If the same combination of factors leads to opposing (or inconsistent) outcomes the corresponding cases are uninformative and cannot be used for the analysis. All other cases are explored to determine the relevant empirical patterns.

We are interested in establishing which combination of factors allows countries to (I) enhance the quality of their primary education, or, ideally, (II) improve both quality and coverage simultaneously. The above discussion leads us to consider that this may depend on three main factors. Regarding aid, we first conjecture that there should be a relatively equal spread between different aid activities, notably between those directly related to primary education and those related to higher levels of education. We thus construct a dummy variable that takes the value of one if these shares are approximately equal, and zero otherwise. For aid directly related to primary education, we add the amounts for the sub-categories 'primary education', 'facilities and training', and 'teacher training'. For higher levels of education we add aid for 'secondary education' and aid for 'tertiary education'. We further allow a deviation of up to 10% and still consider these shares as equal. This is a suitable choice because it separates relatively well between different spending patterns as no country is very close to this particular cut-off. In other words, varying the cut-off by using ±5% or ±15% instead does not change the country classification. This implies that results do not depend on small changes in the cut-off.

Second, we assume that countries already enjoying a high enrolment rate to begin with, will face more difficulties to improve further on the quantity dimension (or, in some cases, will not even require any improvements any more, since they have already achieved universal primary education). Just as in the context of the quantitative regression analysis, we draw the line at a NER of 80%. This splits the observations into two about equal-sized groups, and is also relatively robust to small changes (Botswana, with an initial enrolment of 83% in 2003, comes closest to the cut-off point.)

Third, we examine overall education aid per capita disbursed to the different countries. While the initial impression from Fig. 4 did not suggest any direct link, the combination with either of the two variables mentioned above may change the picture. Notably, a clearer picture might emerge once those countries with already well-developed primary education coverage (and thus a sometimes strong focus of aid on tertiary education) are excluded. We again construct a dummy variable whereby all country-cases with disbursements above the median are considered as observations with high aid.

Table 4 lists all eight possible combinations of values for the three different explanatory variables considered, together with the number of observations for each combination and the observed outcome of the alternative dependent variables (I) and (II).

Note that there are situations in which different country-cases with identical combinations of values for the 'Equal shares', 'NER ≥ 80%', and 'EDUCAID ≥ median' variables yield different outcomes. As explained above, in these cases, the patterns do not lead to consistent results and must therefore be excluded from further analysis.

All consistent combinations are examined with respect to the possibility of logical simplification. We first consider the dependent variable 'quality improvement' (Group A or Group C). In this context, we have four combinations leading to the consistent outcome 'quality improvement' = 1. These combinations can be reduced as follows:[9]

$$(5)\,100 + (6)\,101 : \rightarrow 10^{\bullet}$$

$$(7)\,110 + (8)\,111 : \rightarrow 11^{\bullet}$$

$$10^{\bullet} + 11^{\bullet} : \rightarrow 1^{\bullet\bullet}$$

In other words, comparing line (5) and line (6) from the above truth table implies that for equal shares (factor 1 = 1) and low NER (factor 2 = 0), the positive outcome does not depend on the aid volume (factor 3). In addition, comparing (7) and (8) implies that for equal shares and high NER, the positive outcome does not depend on the aid volume either. From this first step, we thus conclude that all combinations with equal shares and low NER as well as all combinations with equal shares and high NER are associated with improvements in quality. This in turn implies that for equal shares, the positive outcome does not depend on NER either. This second reduction leads us to conclude that in our

[8] For details on this technique see Ragin (2000, 2006), Rihoux and Ragin (2009), Klüver (2010), and Longest and Vaisey (2008) who also programmed a corresponding Stata device.

[9] To correctly interpret this and the following lines, note that '(5) 100' indicates that we copy the combination of factors as indicated in Table 4, line 5: the first factor is present (1), the second and third are not present (0). Taking lines (5) and (6) together further indicates that the presence of the third factor is not relevant for the outcome. This is indicated by the dot in the reduced form (→ 10•).

Table 4
QCA truth table.

Possible combinations	Equal shares	NER ≥ 80%	EDUCAID per capita ≥ median	Number of cases	(I) Quality improvement (yes = 1, no = 0)	(II) Group A (yes = 1, no = 0)
(1)	0	0	0	2	Inconsistent	Inconsistent
(2)	0	0	1	1	0	0
(3)	0	1	0	3	Inconsistent	Inconsistent
(4)	0	1	1	4	Inconsistent	0
(5)	1	0	0	1	1	1
(6)	1	0	1	1	1	0
(7)	1	1	0	1	1	0
(8)	1	1	1	2	1	Inconsistent

Sources: OECD (2012) and SACMEQ (2012).

setting, the approximately equal distribution of aid disbursements on primary (including facilities, training, and teacher training) and higher levels of education is a sufficient condition for combined improvements in primary education quality and quantity.

For 'quality improvement' = 0, we have only one consistent combination, so that no further reduction is possible. This combination shows that at low initial enrolment and with an unequal distribution of aid across educational sub-sectors, high aid fails to enhance education quality. Clearly, once the educational coverage is satisfactorily dealt with, chances for (aid supported) quality improvements are higher (cf. the Malawi case discussed above).

We now consider the second dependent variable, i.e., our dummy for combined improvement of quantity and quality (membership in Group A). This time, we only have one combination leading to a consistent positive outcome, namely the combination of equal shares, low initial NER, and low aid.

However, we have four combinations yielding consistent negative results. They can be reduced as follows:

$$(2)\,001 + (4)\,011 : \rightarrow 0\bullet 1$$

$$(2)\,001 + (6)\,101 : \rightarrow \bullet 01$$

This implies that in our setting, high aid in combination with unequal shares is a sufficient condition for not reaching combined improvements of education quality and coverage (no matter the initial level of NER). Moreover, at equally high aid, when the NER is low to start with, the joint improvement (as opposed to the quality improvement alone) is not reached, even if disbursements are allocated evenly.

All in all, QCA does not suggest that the amount of total aid for education has played a relevant role for raising education quality. The distribution of aid, however, appears to be important. Nevertheless, it cannot guarantee the simultaneous growth in quantity and quality which appears to be a major challenge.

6. Conclusions

Overall, our results suggest that with respect to enhancing primary education outcomes, aid has been more relevant for improved enrolment (education quantity) than for increased achievement (education quality). Based on the most recent OECD sectoral disbursement data and a regression specification comparable to the preferred specification in the growth model elaborated by Clemens et al. (2012), we find that an increase of education aid by 1% increases the growth rate of primary enrolment by about 0.06 percentage points (or very roughly, a doubling of aid leads to an increase by 6 percentage points). This result is relatively modest, but non-negligible. When considering that donors have indeed tremendously increased their disbursements on aid in recent years, they can claim that a sizeable share of the progress toward universal primary education (and MDGs) is due to their financial support. Some caution is necessary, however, when interpreting these results because only since 2002 donor reporting of disbursements is reasonably comprehensive. Possibly related to this problem, the statistical significance of the effect of education aid is not robust to variations in the econometric specification, and notably in sample size.

When breaking down overall education aid according into individual DAC purpose codes, it appears that the observed positive effect is driven mainly by those sub-categories that are directly related to primary education. The most robust effect on primary enrolment is obtained by aid in the category 'education facilities and training'. In addition, there is evidence for complementarities between aid for primary and secondary education. The positive and significant interaction term implies that support for these different levels of education has a mutually reinforcing effect. If primary education obtains sufficient financial support, simultaneously supporting secondary education further increases primary enrolment. This may be due to an incentive effect that induces children to complete primary schooling if they see the prospects to continue at secondary level later.

Our QCA also shows the importance of the right balance between primary and higher levels of education, this time with respect to the improvement of primary education quality. The prospects of further education do not only seem to induce students to complete primary education but also to increase their learning effort.

Given the relatively low volume of aid currently invested in secondary education (both relative to the primary and to the tertiary level), a natural policy conclusion could be to focus more strongly on this sub-sector in the future. This is well in line with the broadened educational goal of the SDGs as compared to the more narrow perspective of the earlier MDGs. However, one might also need to consider the long-term dynamics here: providing attractive opportunities for studies at an always higher level of education will lead to a dead end at some point as long as graduates do not find appropriate jobs. In the long run, developing the labor market may thus be the most important complement to any support for the education sector. While the 2030 Agenda for Sustainable Development considers a wide range of complementarities between the multiple SDGs, the private sector and labor markets in developing countries might have deserved some more attention in this regard.

Acknowledgements

We thank Christopher Kilby and Miguel Niño-Zarazúa for many helpful comments and suggestions.

Appendix A

Table A1
Variable definitions, sources, and descriptive statistics.

Variable name	Definition	Sources	Observations[a]	Mean	Std. deviation	Min	Max
NER	Net enrolment rate for primary education (%)	WDI (World Bank, 2012)	501	82.46	16.62	23.02	100
EDUCAID per capita	Aid per capita allocated to education (disbursement, constant 2000 US$)/ population	OECD (2012), Creditor Reporting System (CRS)[2]	608	31.25	72.13	0	855.47
Sub-categories	Aid per capita allocated to specific educational purposes (disbursement, constant 2000 US$)/ population	OECD (2012), Creditor Reporting System (CRS)[2]					
- Policy & Admin	Education sector policy, planning and programs; aid to education ministries, administration and management systems; institution capacity building and advice; school management and governance; curriculum and materials development; unspecified education activities		608	4.26	9.40	0	99.58
- Facilities & Training	Educational buildings, equipment, materials; subsidiary services to education (boarding facilities, staff housing); language training; colloquia, seminars, lectures, etc.		608	3.08	7.49	0	72.05
- Teacher training	Teacher education (where the level of education is unspecified); in-service and pre-service training; materials development		608	1.03	2.69	0	34.52
- Educational research	Research and studies on education effectiveness, relevance and quality; systematic evaluation and monitoring		608	0.22	0.69	0	7.66
- Primary education	Formal and non-formal primary education for children; all elementary and first cycle systematic instruction; provision of learning materials.		608	5.33	14.12	0	143.75
- Basic skills	Formal and non-formal education for basic life skills for young people and adults (adults' education); literacy and numeracy training		608	1.45	4.14	0	45.59
- Early childhood	Formal and non-formal pre-school education		608	0.82	2.80	0	35.67
- Secondary education	Second cycle systematic instruction at both junior and senior levels		608	1.39	3.42	0	40.22
- Vocational training	Elementary vocational training and secondary level technical education; on-the job training; apprenticeships; including informal vocational training.0		608	3.38	8.57	0	85.89
- Tertiary education	Degree and diploma programs at universities, colleges and polytechnics; scholarships		608	8.82	23.48	0	386.72
- Advanced technical training	Professional-level vocational training programs and in-service training		608	1.47	4.24	0	58.51
EDUCEXP	Public spending on education (% of government expenditure)	WDI (World Bank, 2012)	596	15.77	4.75	-42.03	32.78
PTR	Pupil–teacher ratio in primary education	WDI (World Bank, 2012)	596	30.48	13.10	3.95	90.65
YOUNG POP	Population aged 0–14 (% of total population)	WDI (World Bank, 2012)	596	35.36	8.60	13.94	51.86
GDP per capita	GDP per capita (constant 2000 US$)	WDI (World Bank, 2012)	596	6266.75	7076.99	172.60	48894.64
BUDGET (surplus)	Cash surplus/deficit (% of GDP)	WDI (World Bank, 2012)	596	-1.71	4.24	-64.94	35.14
INFLATION	Inflation (consumer prices,% annual)	WDI (World Bank, 2012)	596	47.99	313.24	-6.90	6517.11
OPEN	Openness (export + import in% of GDP)	WDI (World Bank, 2012)	596	84.21	43.14	0.56	422.00
FREE	Freedom House (mean of political rights and civil liberties; lowest freedom = 7, highest = 1)	Freedom House (2011)	596	3.97	1.80	1	7

[a] *Notes*: Descriptive statistics refer to the full sample as used in the Appendix, Tables A2 and A4.

Table A2
Replication of Michaelowa and Weber (2007, Table 1) with new disbursement data.

	(1)	(2)	(3)	(4)	(5)
Method	Arellano&Bond	Arellano&Bond, robust	Blundel&Bond, robust	Blundell&Bond, robust	Blundell&Bond, robust; additional IV: ENERGYAID
Variables considered endogeneous	L.NER EDUCAID	L.NER EDUCAID	L:NER EDUCAID	L.NER EDUCAID EXPEDUC	L.NER EDUCAID
Dependent variable	NER (%)	NER (%)	NER (%)	NER (%)	NER (%)
L.NER	−0.38	−0.19	0.48*	0.39**	0.45**
	(0.51)	(0.66)	(0.08)	(0.02)	(0.02)
EDUCAID per capita	0.05	0.05	0.03	0.04**	0.05*
	(0.25)	(0.21)	(0.19)	(0.01)	(0.07)
EDUCEXP	0.89	0.32	0.14	−0.29	0.06
	(0.25)	(0.11)	(0.35)	(0.42)	(0.67)
PTR	−0.07	−0.14	−0.23	−0.32***	−0.27***
	(0.77)	(0.44)	(0.11)	(0.00)	(0.00)
YOUNG POP	−1.67	−0.74**	−0.07	−0.07	−0.06
	(0.13)	(0.04)	(0.69)	(0.68)	(0.72)
GDP per capita	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.26)	(0.28)	(0.71)	(0.55)	(0.47)
BUDGET (surplus)	0.16	−0.02	0.24	0.29	0.31
	(0.65)	(0.95)	(0.29)	(0.19)	(0.16)
INFLATION	0.39	−0.03	−0.02*	−0.03**	−0.02**
	(0.44)	(0.71)	(0.07)	(0.03)	(0.04)
OPEN	0.00	0.09	0.02	0.03	0.03
	(0.97)	(0.12)	(0.57)	(0.19)	(0.25)
FREE	−2.19	−1.59	−0.89	−1.08**	−1.28***
	(0.37)	(0.52)	(0.11)	(0.02)	(0.01)
Observations	178	178	309	309	304
Countries	105	105	131	131	129
Wald	$chi^2(17) = 1.2e+06$	$chi^2(17) = 860872$	$chi^2(18) = 1416$	$chi^2(18) = 895.1$	$chi^2(18) = 681.5$
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Hansen	$chi^2(2) = 1.70$	$chi^2(4) = 3.21$	$chi^2(4) = 4.10$	$chi^2(6) = 4.74$	$chi^2(2) = 1.99$
	(0.43)	(0.53)	(0.39)	(0.59)	(0.37)
AR1	$z = 0.583$	$z = 0.364$	$z = -1.221$	$z = -1.154$	$z = -1.788$
	(0.56)	(0.72)	(0.22)	(0.25)	(0.07)
AR2	.	.	.	.	.
Instruments	19	21	23	25	21

Source: See Appendix, Table A1.
Notes: Missing value indicators for imputed variables are included as controls but not shown. The prefix 'L.' denotes a lagged variable. *p*-values in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

Table A3
Replication of Michaelowa and Weber (2007, Table 1 new data), initial NER < 80%.

	(1)	(2)	(3)	(4)	(5)
Method	Arellano&Bond	Arellano & Bond, robust	Blundel & Bond, robust	Blundell & Bond, robust	Blundell&Bond, robust; additional IV: ENERGYAID
Variables considered endogeneous	L.NER EDUCAID NER (%)	L.NER EDUCAID	L:NER EDUCAID	L.NER EDUCAID EXPEDUC	L.NER EDUCAID
Dependent variable	NER (%)	NER (%)	NER (%)	NER (%)	NER (%)
L.NER	0.05	0.12	0.30	0.32**	0.39*
	(0.77)	(0.51)	(0.18)	(0.04)	(0.08)
EDUCAID per capita	0.04	0.06*	0.05**	0.05**	0.08**
	(0.26)	(0.08)	(0.03)	(0.01)	(0.03)
EDUCEXP	0.88	0.32	0.15	−0.07	0.05
	(0.18)	(0.13)	(0.34)	(0.86)	(0.73)
PTR	−0.06	−0.19	−0.24**	−0.25**	−0.26***
	(0.75)	(0.19)	(0.02)	(0.02)	(0.01)
YOUNG POP	−1.35	−0.47	−0.25	−0.21	−0.16
	(0.12)	(0.22)	(0.23)	(0.25)	(0.49)
GDP per capita	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.19)	(0.20)	(0.80)	(0.68)	(0.63)
BUDGET (surplus)	0.56	0.37	0.03	0.11	0.17
	(0.13)	(0.12)	(0.87)	(0.66)	(0.49)
INFLATION	0.28	−0.07	−0.01	−0.02	−0.02
	(0.47)	(0.41)	(0.35)	(0.24)	(0.21)
OPEN	−0.04	0.05	0.04	0.04*	0.05
	(0.69)	(0.24)	(0.13)	(0.07)	(0.14)

Table A3 (*Continued*)

	(1)	(2)	(3)	(4)	(5)
Method	Arellano&Bond	Arellano & Bond, robust	Blundel & Bond, robust	Blundell & Bond, robust	Blundell&Bond, robust; additional IV: ENERGYAID
Variables considered endogeneous	L.NER EDUCAID NER (%)	L.NER EDUCAID	L:NER EDUCAID	L.NER EDUCAID EXPEDUC	L.NER EDUCAID
Dependent variable	NER (%)	NER (%)	NER (%)	NER (%)	NER (%)
FREE	−5.06** (0.02)	−3.59** (0.04)	−1.07* (0.05)	−1.10** (0.03)	−1.34** (0.02)
Observations	150	150	260	260	257
Countries	88	88	110	110	108
Wald	$chi^2(17) = 33244$ (0.00)	$chi^2(17) = 9936$ (0.00)	$chi^2(18) = 1180$ (0.00)	$chi^2(18) = 584.9$ (0.00)	$chi^2(18) = 346$ (0.00)
Hansen	$chi^2(2) = 0.84$ (0.66)	$chi^2(4) = 4.56$ (0.34)	$chi^2(4) = 3.32$ (0.51)	$chi^2(6) = 4.03$ (0.67)	$chi^2(2) = 1.45$ (0.49)
AR1	$z = -0.127$ (0.90)	$z = -0.531$ (0.60)	$z = -0.636$ (0.53)	$z = -0.916$ (0.36)	$z = -1.368$ (0.17)
AR2	.	.	.	.	.
Instruments	19	21	23	25	21

Source: See Appendix, Table A1.
Notes: Missing value indicators for imputed variables are included as controls but not shown. The prefix 'L.' denotes a lagged variable. *p*-values in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

Table A4
The effect of education aid on primary school enrolment, all developing countries[a] (as Table 1, but unrestricted set of countries).

	(1) System GMM[b]	(2) FE[c]	(3) FE[c]	(4) FE[c,d]
Variables	NER (%)	NER (%)	NER growth (%)	NER growth (%)
L.NER	0.39** (0.02)	−0.00 (0.96)		
EDUCAID per capita	0.04** (0.01)	0.04** (0.03)	−0.01 (0.73)	4.65 (0.13)
EDUCEXP	−0.29 (0.42)	0.38 (0.10)	0.42 (0.58)	6.30 (0.47)
PTR	−0.32*** (0.00)	−0.19 (0.25)	−0.18 (0.58)	−9.09 (0.52)
YOUNG POP	−0.07 (0.68)	0.30 (0.53)	−1.73* (0.09)	−45.64 (0.19)
GDP per capita	−0.00 (0.55)	−0.00** (0.01)	−0.00 (0.93)	−3.59 (0.72)
BUDGET (surplus)	0.29 (0.19)	0.26 (0.32)	1.74*** (0.00)	1.47*** (0.00)
INFLATION	−0.03** (0.03)	0.02 (0.81)	−0.40** (0.04)	−4.60 (0.11)
OPEN	0.03 (0.19)	0.07* (0.07)	−0.08 (0.52)	−1.41 (0.91)
FREE	−1.08** (0.02)	−1.84 (0.28)	−8.94** (0.02)	−8.26** (0.03)
Observations	309	309	309	305
Countries	131	131	131	131
R^2 (within)		0.44	0.28	0.30
Wald	$chi^2(18) = 895.1$ (0.00)			
Hansen	$chi^2(6) = 4.74$ (0.58)			
AR1	$z = -1.15$ (0.25)			
AR2	.			

[a] Constant or fixed effects (as relevant, see below), and missing value indicators for imputed variables are included but not shown. The prefix 'L.' denotes a lagged variable. Robust *p*-values in parentheses.
[b] Replication of Michaelowa and Weber (2007, Table 1, Regression 4) with new dataset (see also Appendix Table A3).
[c] Including both country and period fixed effects.
[d] Explanatory variables and controls are all in logs except for BUDGET (because of the numerous negative values) and PTR, which is a categorical variable.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

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