

# Achieving education for all: How much does money matter?

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**Abstract:** This paper explores the extent to which differences in the resources allocated to education explain differences in educational access and performance across countries. Cross-country regression analysis shows that the link between educational access and performance and public education expenditure is weak.. The paper suggests that levels of household spending, the effectiveness of the public expenditure management system and the composition of public education spending are important factors explaining this weak link. The results imply that the achievement of the education millennium development goals will require more than just increases in expenditure on primary education. This does not imply that resources are unnecessary, but that increasing resources alone is unlikely to be sufficient. The composition of resources and institutions that govern the use of these resources play a central role in translating resources into better schooling outcomes. A stronger focus on these aspects of education systems will be required if the Millennium Development Goals in education are to be achieved.

# 1 INTRODUCTION

This paper explores the extent to which differences in the resources allocated to education explain differences in educational access and performance across countries. It examines whether increases in the resources allocated to education by governments and the international donor community will be sufficient to move countries closer to achieving the Millennium Development Goals (MDGs).

In 2000 the international community committed itself to substantially reducing levels of poverty across the developing world, through a set of international development goals (United Nations, 2000). Education, and more specifically primary education, was seen as a crucial condition for achieving these development targets. Two of the eight MDGs committed signatories of the declaration to:

(i) ensure that by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

(ii) eliminate gender disparity in primary and secondary education, preferably by 2005, and at all levels of education no later than 2015

The World Education Forum restated these international commitments in its 2000 Dakar meeting and through the resulting Dakar Framework and the Education For All (EFA) goals went further and incorporated aspects of quality into the targets (World Education Forum, 2000). [1]

The mobilisation of national and international resources to increase investment in basic education is seen as critical to achieving these goals. The central importance of resources is highlighted by bold claims asserting that lack of resources will not be a constraint to achieving good quality primary education for all:

[1] The EFA goals included a separate goal for improving the quality of education to ensure recognised and measurable learning outcomes for all, especially in literacy, numeracy and essential life skills. The Dakar framework for action also included three additional goals based around early childhood and adult education which are not discussed here.

> We affirm that no countries seriously committed to education for all will be thwarted in their achievement of this goal by a lack of resources.
>
> (World Education Forum, 2000)

There has been much recent work exploring the costs of achieving the MDGs, and in particular those within the education sector (Brossard and Gacougnolle, 2000; Delamonica, Mehrotra *et al.,* 2001; Devarajan, Miller *et al.,* 2002; World Bank, 2002). These studies estimate that achieving primary education for all will require between $9 and $28 billion of additional resources to education annually.[2] This is equivalent to increasing the proportion of GNP spent on education from an average of 3.9 per cent to between 4 and 4.3 per cent in the less developed regions of the world (UNESCO, 2000b).[3] These figures have been used by many stakeholders to mobilise resources for education nationally and internationally.

It is clear that these studies and the Dakar framework treat increasing resources as a key strategy for achieving primary education for all. But the relationship between resources and education outcomes is less clear. Some countries which allocate lower than the regional average proportions of GNP to primary schooling achieve good education outcomes; in other countries, higher than average spending results in poorer outcomes. The aim of this paper is to explore whether differences in the resources allocated to education can explain differences in educational access and performance across countries. Will increases in the resources available to education move countries closer to achieving the education MDGs?

Section 2 reviews studies that have looked at educational outcomes and public spending across countries. Section 3 outlines the data and methodology used in the paper to analyse the relationship between resources and measures of access and performance currently being used to monitor progress towards the

[2] These figures represent the estimated total additional resources required and do not distinguish between domestic and external sources of additional financing. The World Bank (2002) estimates that an additional $2.5 billion would be required annually from external sources for 47 low income countries to achieve these goals.

millennium development goals. Section 4 details the results and Section 5 presents a brief discussion of some of the issues that may explain the absence of a strong link between resources and the selected measures. The final section offers some conclusions.

## 2 THE LINK BETWEEN PUBLIC EXPENDITURE AND EDUCATIONAL OUTCOMES: THE CROSS-COUNTRY EVIDENCE

The lack of appropriate data has meant that there have been relatively few studies exploring the relationship between resources and outcomes across countries. Work that has been undertaken on this issue has mainly involved micro-level studies, particularly in the United States. Recently, however, some studies have begun to look at this relationship across countries, using internationally comparable achievement surveys.

Indicators of both the volume and quality of education will be analysed in this paper. In many developing countries the quantity of education available is restricted, and it is therefore important to explore the impact of resources on improving access to schooling and on increasing the proportion of the school age population attending. Measures that can be used to explore the impact of resources on access to education at the cross-country level include primary gross and net enrolment rates. These types of measures are readily available for most countries.

Once children are in school, the quality of education they receive and their levels of achievement are also potentially influenced by the level of resources available in the schools they attend. Comparable data at the cross-country level on achievement and quality are less readily available, although a number of cross-national studies on school achievement have been undertaken, including studies undertaken since 1963 by the International Association for the evaluation of Educational Achievement (IEA). The IEA's most

[3] These figures are based on 1997 figures for regional estimates of public expenditure on education reported in

recent survey, the Third International Mathematics and Science Study (TIMSS) compares mathematics and science test scores for primary and secondary school students across 45 countries. Unfortunately, few developing countries are included, and even fewer African countries. More recent efforts to define internationally comparable indicators of achievement in developing countries specifically include the Minimum Learning Achievement Project and the SACMEQ project in Africa (see for example, Nassor and Mohammed, 1998; Nkamba and Kanyika, 1998; Chinapah, 1999). These studies have, however, generally included a small sample of countries, and are only available for a single year. In the absence of direct measures of learning outcomes, proxy variables have also been used at the cross-country level (Lee and Barro, 1997), most notably the primary school repetition rate, drop-out rates and these two indicators combined, in the form of primary school survival rates. These are used to measure the efficiency of the education system, and are included as indicators of progress towards the Dakar goals (UNESCO 2002; Cavicchioni, 2001).

Table 1 details econometric studies that have explored the relationship between resources and educational outcomes at the cross-country level. It should be noted that this relationship is not the primary focus for some of these studies.[4] The table only reports the dependent variable and resource variables used, although in most of the studies other independent variables are also included. For example, the Hanushek and Kimko (2001) study includes population growth and years of adult schooling as independent variables. The resource variables shown for each study are used in separate regressions with the exception of the Lee and Barro (1997) and McMahon (1999) studies, where the resource variables reported in Table 1 are all included in each regression.

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UNESCO (2000b).

4 For example, the main focus of Hanushek and Kimko (2000) is not the impact of resources on educational outcomes, but the impact of the quality of the labour force on economic growth. The link between resources and education quality is secondary, and the regressions in which this relationship is detailed are used to construct labour force quality measures for the main regressions reported in the paper.

*Table 1 about here*

The cross-country studies of school achievement reported in Table 1 show no consistent effect of resources on these outcomes. Studies using internationally comparable test scores tend to show that resources have a significant impact, but the direction of this impact differs across studies. In the Lee and Barro (1997) study, for example, the pupil-teacher ratio has a negative and significant impact on achievement. Using similar data, the Hanushek and Kimko (2000) study reports a positive but insignificant result, while the Wössmann (2000) study, using class size as the resource variable, reports a positive and significant impact. These latter two results suggest that larger class sizes are associated with better achievement and conversely, that the greater the level of resources available, the poorer the performance.

Other measures of resources used in these studies also show inconclusive or counter-intuitive results. The two studies that explore the impact of per pupil expenditures on test scores, for instance, find that higher levels of expenditure are associated with lower levels of achievement, although in only one of these studies is this effect significant (Lee and Barro, 1997; Hanushek and Kimko, 2000).[5] The main drawback of these studies is their lack of developing country coverage, and in particular of sub-Saharan Africa. TIMSS covered 45 countries in total, only 11 of which were developing countries. No low-income countries were represented, and only South Africa from the African continent. It is unclear, therefore, whether the absence of a consistent link between public expenditure and test scores would also be found in low-income developing countries, and in particular in sub-Saharan Africa.

The Lee and Barro (1997) study regresses the primary school drop-out and repetition rates on a set of resource variables. The results generally show that resources are an insignificant determinant of drop-out and repetition rates. However, the pupil-teacher ratio is positively and significantly associated with these

proxy measures of quality. These results, coupled with the results from the test score studies, suggest that larger pupil-teacher ratios are associated with poorer internal efficiency, but not necessarily poorer test scores. In addition to these results, the McMahon study looks at the impact of resources on grade five survival rates. This study shows that per pupil expenditures are a significant determinant of primary school survival rates: higher levels of per pupil expenditure tend to increase the persistence of primary school students.

One issue to bear in mind is that studies exploring the impact of resources on educational access tend to measure resources differently. The Schultz (1995) study shows a strong negative relationship between the relative price of teachers and the gross enrolment rate.[6] These results suggest that increases in resources per pupil (i.e. increases in the relative price of teachers) will reduce the enrolment rate (Schultz, 1995). However, it is not clear from these results whether changes in total public primary education expenditure will directly impact on primary school access. The McMahon study includes expenditure per primary pupil and total education expenditure as a proportion of GNP, and finds a negative and significant relationship between per pupil expenditures and the primary gross enrolment rate, and a positive and significant impact of total education expenditure as a proportion of GNP. The results of the McMahon study suggest that increasing primary education expenditure while holding per pupil expenditures constant, has a positive and significant impact on the primary gross enrolment rate. However, this study does not include income per capita as a separate explanatory variable, and it may be the case that these resource variables are proxying for income per capita. The Colclough with Lewin (1993) study includes an income per capita variable, and finds that expenditure as a proportion of GNP is not significant when entered separately.

The relationship between educational outcomes and resources thus varies across studies, and where resources are statistically significant the direction of the relationship is often counter-intuitive. This cross-

5 Wössmann reports that coefficients on per pupil expenditures are negative and statistically significant in his regressions although he does not report these results in his paper (see Wössmann, 2001: 25).

6 Schultz uses instrumental variable estimation to account for the endogeneity of the relative price of teachers.

country evidence mirrors the micro-based evidence, particularly from the United States, which shows the lack of a systematic and consistent link between resources and achievement (Hanushek, 1996). It has been argued, however, that there may be a slightly stronger link between resources and achievement in developing countries, because education systems in developing countries tend to be so severely under-resourced compared to developed countries that marginal increases in resourcing are likely to have much larger impacts on education outcomes than in developed countries. Reviews of the micro-based literature do suggest that a greater proportion of studies in developing countries report a positive impact on education achievement than in developed countries (Fuller, 1987; Fuller and Clarke, 1994; Hanushek, 1995; Hanushek, 1996). Overall, however, the developing country literature still shows inconsistent effects of resources on achievement. The lack of low-income developing countries in cross-country test score studies means the evidence on the link between test scores and resources cannot currently be compared to the evidence from micro-based studies. Proxy measures of quality used at the cross-country level show similar results to those shown in Table 1 for test scores. Studies looking at educational access show a significant negative impact of resources per pupil on overall levels of access. However, studies that include the overall level of resources do not show a consistent significant impact of resources on the primary gross enrolment rate (Colclough with Lewin, 1993; McMahon, 1999).

There are a number of issues that this paper seeks to address which have not been explored consistently in the studies outlined in Table 1. Most importantly, this paper analyses how robust the results shown in Table 1 are to different specifications and different estimation techniques. For example, only one study accounts for the potential endogeneity of the resource variables in the regression analysis (Schultz, 1995). It is possible that countries with poor educational outcomes spend more on education than countries with better outcomes and this reverse causation results in endogeneity bias. This paper analyses whether the coefficient estimates on resources suffer from two-way causation or endogeneity bias, and whether correcting for this bias leads to different conclusions. The paper also explores whether the results are driven by influential country level observations, or remain the same even when these observations are controlled for. The studies reported in Table 1 that explored access to education did not in general explore

whether changes in overall resources would have a significant impact on enrolment. These studies generally showed that in high cost systems enrolment was low, and that in low cost systems, enrolments were high. But they generally failed to explore whether increases in overall public education expenditure would impact on enrolment. The next section details the data and methodology used in this study to explore the link between public expenditure and a selection of access and quality measures.

# 3 DATA AND METHODOLOGY

Four dependent variables are used in the analysis; the primary gross enrolment ratio, the primary net enrolment ratio, the survival rate to primary grade five and the primary school completion rate. The first two dependent variables are measures of quantity and access to primary education within each country, while the last two are measures of the internal efficiency of education systems and have been used as proxy measures of quality and performance. All of these variables measure different aspects of the education goals outlined in Section 1.

As measures of education access and quality these four variables are not without conceptual problems. Primary gross enrolment rates measure the number of primary school students as a proportion of the primary school-going age population. The gross rate does not indicate the proportion of children of primary school-going age who are currently in school, which means it is not possible to use this measure to determine whether all children of primary school-going age are in school. The net enrolment rate accounts for this by measuring the number of students of school-going age that are currently enrolled in primary school. This measure is, therefore, more useful when assessing a country's progress in providing education for all primary school-going age children. However, neither enrolment rate gives much sense of the number of years of education that students obtain. At the extreme, enrolment rates may be very high even though completed years of primary schooling are very low. In addition, enrolment rates provide no

information about the frequency of school attendance, which is potentially a more important measure of primary school participation than enrolment rates.[7]

Using the primary survival rate to grade 5 in conjunction with the net enrolment rate to some extent addresses this criticism. The survival rate measures the proportion of a cohort of pupils enrolled in the first grade of primary school who are expected to reach grade 5. However, this measure is calculated using the reconstructed cohort method and is based on single year repetition and drop-out rates. Repetition rates are often reported inaccurately, particularly when policies of automatic promotion are in place. How accurate the survival rate is will also depend on the stability of repetition and drop-out rates over time, and evidence suggests these rates vary considerably over the course of a primary school cycle. Finally, the primary school completion rate has the advantage that it combines a measure of completion rates with a measure of the proportion of primary school-going aged children completing. This recent measure is calculated as the number of primary school students successfully completing the last year of primary school as a proportion of children of official graduation age in the population (World Bank, 2002). To calculate these rates data on the number of students completing primary education are needed. While information on enrolment in the last grade is readily available across countries data on the number of these students successfully completing the last grade are not. In some cases primary completion rates are estimated on the basis of total enrolment in the last grade of primary with an adjustment for the number of repeaters.[8]

The different proxy measures of education quality and performance provide information on the characteristics of different education systems, but give no indication of levels of achievement or competencies across these systems. As the previous section highlighted, cross-country studies of learning achievement do not adequately cover developing countries. Furthermore, levels of numeracy and literacy

[7] A comparison between net enrolment rates and net attendance rates undertaken in UNESCO (2002) shows significant differences between the two measures.

[8] It is not clear from the World Bank study how many of the completion rates are estimated in this way.

of primary school completers are likely to vary across countries depending on the quality of their education systems. For example, a recent study in Bangladesh showed that only 64 per cent of primary school completers had basic literacy and numeracy skills (Ahmed *et al*, 2003).

While the indicators chosen for this paper have their limitations, they have been chosen primarily because they are being used by the international donor community to monitor progress towards the education millennium development goals. UNESCO uses gross and net enrolment and primary survival rates to measure progress, and the World Bank proposes the primary school completion rate as a monitoring indicator for its education fast track initiative (UNESCO, 2002; World Bank, 2002).[9] In terms of current support for financing primary education, therefore, it is important to determine whether these indicators are influenced by levels of spending.

Each of these dependent variables are regressed on a set of variables which includes a measure of public spending on primary education. These regressions illustrate how much of the cross-country variation in educational outcomes can be explained by differences in public spending. Drawing on the education production function literature, log-linear regressions are estimated.[10] A relatively large database for 1996 was assembled containing variables that had been identified previously in the literature as determinants of education outcomes. The database and the samples used in the regression analysis include many developing countries, in particular sub-Saharan African countries. Three different variables have been used to measure the impact of public spending on educational outcomes: public primary education spending as a proportion of GNP, primary expenditure per pupil, and the primary pupil-teacher ratio. These measures closely follow the resource measures used in the previous studies outlined in Section 2 (see Table 1). In addition to the resource variable, income per capita is also included in the regression analysis, as many studies have shown that countries with higher income per capita have better primary

[9] It should be noted that UNESCO are attempting to develop other indicators to measure progress towards the targets.

[10] For an outline of the education production function approach see Pritchett and Filmer (1999).

education access and internal efficiency indicators (see, for example, McMahon, 1999). A squared term for income per capita is also included in the regressions, to allow for non-linearities in the impact of income on the selected measures of access and internal efficiency.

In addition to the resource measure and income per capita a number of other explanatory variables were initially included in the specifications, and the significance and sensitivity of these independent variables were also explored. From this initial look at the data, levels of urbanisation, the Muslim population as a proportion of the total population, and a set of regional dummies were included as additional explanatory variables in the regression analysis. The dependent variables are likely to be affected by urbanisation because it is easier to provide educational services to more densely populated areas, and because household travel costs associated with school attendance may be lower in urban than rural areas. Some earlier results have suggested that countries with large Muslim populations tend to have poorer educational outcomes (Colclough with Lewin, 1993). The variables, data sources and descriptive statistics are listed in Table A1.

The regressions were first estimated using ordinary least squares (OLS) correcting the variance-covariance matrix for heteroscedasticity. It is common for the results of cross-country regression analysis to be very sensitive to changes in the specification and the sample of countries used to estimate the model. The sensitivity of the regression estimates is analysed using a number of techniques. Firstly, individual country observations with large residuals or high leverage are identified.[11] It is possible that these countries may be driving the results, and it is important to analyse how the coefficient estimates change when these country observations are controlled for. Therefore, a dummy variable is included in the regressions for each influential country, and the regression model is re-estimated to explore whether the coefficient estimates change. Secondly, individual country observations are dropped in turn, and the coefficient estimate on the

[11] Countries with high leverage or large residuals are identified using the DFIT statistic. For a general discussion of identifying country observations with large residuals or high leverage and different statistics that can be used for identification see Chatterjee and Price (1991).

resource variable is recorded to identify country observations that are influential in determining the coefficient estimate on the resource variable. Again, it is possible that the coefficient estimates on the resource variables are being driven by a small group of countries, and the relationship between public spending and the dependent variable amongst the other countries may be very different. Therefore differences in the coefficient estimate on the resource variable when these influential observations are controlled for are explored.[12] Finally, median regressions for all of the dependent variables and resource variables are estimated. Median regression is less sensitive to outliers or influential observations because the sum of the absolute residuals is minimised, rather than the square of the absolute residuals as in OLS. Undertaking analyses of this kind allows one to assess the robustness of the results presented in the paper.

After eliminating countries which lacked information on the variables of interest, the data set contained between 33 and 90 countries, depending on the dependent variable used. The countries covered in the data set include both developing and developed countries. All of the world regions are represented in the data set, and Table A1 describes the composition of the data set across regions for each regression model.

## 4 RESULTS

The results from the regression analysis are presented in Tables 2 and 3. Table 2 reports the regression estimates for the quantity dependent variables (i.e. the primary gross enrolment ratio and the primary net enrolment ratio). Table 3 reports the estimates for the efficiency indicators (i.e. the primary grade 5 survival rate and the primary school completion rate).[13] Each table reports three models for each dependent variable which use the different public expenditure variables described in the previous section.

[12] This is calculated by producing the DFBETA statistic, which is the difference between the regression coefficient on the resource variable with and without the i th country included divided by the standard error of the coefficient. Influential observations are identified if this statistic is greater than one.

[13] The primary school repetition rate was also used as a dependent variable although the results are not reported in the paper. These results follow closely the results for the other dependent variables reported in the paper.

*Table 2 about here*

Focussing on the quantity dependent variable regressions reported in Table 2, the reported R-squareds suggest that the estimated models provide reasonably good fits to the data. There appears to be a relatively strong relationship between income per capita and the quantity outcomes included in Table 2. Access to primary education appears to be strongly related to per capita income, although enrolment rates tend to increase at a diminishing rate as income rises. For example, an increase in per capita income of PPP$50 when income per head is PPP$200 increases the primary gross enrolment rate by approximately 31 percentage points, compared to 12 percentage points when income per head is PPP$700.[14] The only regional dummy variable that appears to play a significant role in the regressions reported in Table 2 is the Francophone Africa dummy variable. These countries, on average, have lower primary enrolment rates than European countries in the reference category after controlling for the other variables included in the models. The primary gross enrolment rate appears to be lower in countries with larger Muslim populations, although the impact of this variable is very small. A 10 per cent increase in the size of the Muslim population leads to a two percentage point decline in the primary gross enrolment rate. This result may suggest that Muslim households have a lower demand for primary schooling, although it may also be driven by poorer educational provision for Muslim populations within countries.

From the expenditure variables included in Table 2, it is clear that coefficient estimates on these variables are generally very small and insignificant. Coefficient estimates on the public primary expenditures as a proportion of GNP (columns 1 and 4) and the primary pupil-teacher ratio variables (columns 3 and 6) are not significantly different to zero. This suggests that primary expenditures do not explain much of the difference in the cross-country variation in primary gross or net enrolment rates.

[14] A PPP$50 increase in income per head when income per head is PPP$200 increases the primary net enrolment rate by eight percentage points compared to two percentage points when income per head is PPP$700.

Primary expenditure per pupil is significant, although its impact on primary enrolment rates is very small and negative. For example, a 10 per cent increase in primary expenditure per pupil reduces the primary net enrolment rate by one per cent. This suggests that countries with low per pupil expenditures tend to have higher primary enrolment rates. It is not possible, however, from these regression results to ascertain whether an increase in overall primary expenditure will result in significant changes in enrolment rates, as only per pupil, and not total expenditures, are controlled for. Including public primary education expenditure as a percentage of GNP as an additional explanatory variable in these regressions increases the absolute size of the coefficients on per pupil expenditure marginally, but does not change the significance of these variables. The coefficient estimates in these supplementary regressions on the primary education expenditure as a proportion of GNP variable are positive, small and insignificant.[15]

An important question when using cross-country data relates to the robustness of the results. The diagnostic tests suggest that the error terms in the OLS results presented in Table 2 are not normal, and the functional form of the regressions are incorrect. Both issues appear to be related to a number of country outliers in the data. Two additional sets of regressions (described above) were run to explore the sensitivity of the results presented in Table 2. The first set of regressions controls for these influential observations while the second set estimates the models using median regression techniques. These results are presented in Table A2. They show that the results do not change when influential observations are controlled for, or when a different estimation technique is employed. It should be noted that no country appeared to be particularly influential in determining the resource coefficient estimates presented in this paper. Therefore, differences in the coefficient estimates on the resource variables when country observations are dropped in turn, are not reported in this section. Overall the sensitivity analysis of the regressions reported in Table 2 indicates that they are relatively robust.

[15] These results are available from the author on request.

Table 3 presents the regression results for the primary survival and completion rates outlined in the previous section. Income per capita does not appear to have a significant impact on primary survival or completion rates. Levels of urbanisation and the Muslim population share, however, have positive and significant impacts on primary school survival, although they are not significant in the primary school completion regressions. All regions tend to have poorer survival and completion rates than the reference category of European countries, once other explanatory variables in the regression models are controlled for. However, levels of statistical significance tend to vary between the survival and completion rate regressions. For example, Francophone African countries tend to have completion rates approximately 50 per cent lower than European countries, and this effect is statistically significant. While Francophone African countries also appear to have poorer survival rates, once the other variables in the regression model are controlled for, this effect is not statistically significant.

*Table 3 about here*

The education resource variables in Table 3 display a similar pattern to that shown in Table 2. Only primary expenditure per pupil appears to have a statistically significant effect on the primary survival rate. However, the results suggest that the effect of resources on these outcomes are small. A 10 per cent increase in per pupil expenditure increases the primary school survival rate by less than one per cent. An increase in expenditure per pupil of $PPP 45 would increase the primary survival rate by six percentage points from its sample average of 54 per cent.

It can be seen from Table 3 that the primary school completion rate regressions are based on a very small sample size, due to the lack of data for the explanatory variables in the model. It should also be noted that the primary school completion data are for 1999 or 2000 whereas data on the explanatory variables are for 1996. The primary school completion data were collected specifically for the World Bank study on EFA

and it was not possible to obtain data for the same year for the other explanatory variables. Therefore, it may appear that there is a mismatch between data for the dependent variable and data for the explanatory variables used in the regression analysis. However, the primary school completion rate measures the number of students that complete primary education and previous resource flows (when the students were in earlier grades) are likely to be as important to successful completion as more recent resource flows. In addition, the same World Bank study provided data on two of the resource measures used in this paper for the same year (public primary education expenditure as a percentage of GNP and the pupil-teacher ratio). Using these more recent measures in the regressions reported in Table 3 did not alter the main findings of this paper.[16]

The results presented in Table 3 also appear to be robust. Table A3 presents the estimates when dummy variables are included for the influential observations and for the median regression results. The size and significance of the coefficient estimates on the resource variables change only slightly. It appears, therefore, that the coefficient estimates of the various resource measures are relatively robust in these regressions, as well as in the regressions reported in Table 2.[17]

The previous section suggested that the resource variables may be endogenous, that is, the causation between resources and educational outcomes may run in both directions. For example, the regressions reported in Table 2 assume that enrolment rates are determined by the pupil-teacher ratio. It is suggested that high pupil-teacher ratios (low levels of resources) may lead to low enrolment. However, it could also be argued that enrolment levels determine the pupil-teacher ratio; high levels of enrolment represent high demand for education, which in turn leads to higher pupil-teacher ratios as similar number of teachers teach larger number of students. If this reverse causation is present, the coefficient estimates reported in

[16] The sample size increases to 37 countries when these more recent measures are used. The World Bank study also provides data on primary per pupil expenditure as a proportion of GNP per capita. This alternative resource measure is also not significant in determining primary school completion. These additional results are available from the author on request.

[17] No countries had a particularly influential role in determining the resource coefficients. As with the regressions reported in Table 3, the variations in these coefficients when individual countries are dropped are not reported.

Tables 2 and 3 would be biased. Instrumental Variable (IV) estimation can be used to purge the coefficient estimates of this reverse causation by using instrumental variables that determine the resource variables, but do not determine the educational outcome variables (i.e. the dependent variables). The secondary school pupil-teacher ratio, total education spending as a proportion of GNP and the length (in years) of the primary school cycle were used. These variables tended to determine resource levels but were exogenous with respect to the dependent variables used in this paper. Having found a set of valid instruments it is possible to test whether the resource variables in the regressions reported in Tables 2 and 3 are endogenous.[18] Generally, these tests did not reject the null hypothesis that the resource variables are exogenous,[19] suggesting that the coefficient estimates reported in Tables 2 and 3 do not suffer from endogeneity bias. The IV coefficient estimates are reported in Table A4 for completeness, and do not change the overall results of this paper.

It could be argued that the impact of resources on educational outcomes varies between low and high income countries. For example, additional resources may have a positive impact on education outcomes in low income countries but little or no impact in high income countries. Using a slope dummy variable on the resource variables (which equals one if the country is a low income country) allows this difference in the relationship between low and high income countries to be explored. The results of these regressions (not reported) show that the relationship between resources and outcomes are not very different across the two groups of countries. In addition, a slope dummy variable on the resource variables for sub-Saharan African countries was included to see whether the relationship between resources and educational outcomes differed in SSA countries compared to the rest of the sample. Again, no consistent relationships were found, and the main results of this paper were not affected by the inclusion of these additional variables.[20] Finally, spline functions were used to explore whether the relationship between resources and

[18] A Sargan test of instrument validity suggests that this set of instruments is valid. A Davidson and MacKinnon exogeneity test or a Hausman test can be used to test the exogeneity of the resource variables. The test statistics for these tests are reported at the bottom of Table A4.

[19] There are two exceptions: tests reject the null hypothesis that the per pupil expenditure (pupil-teacher ratio) variable is endogenous in the net enrolment rate (survival rate) regression. Only the IV estimate for the pupil-teacher ratio in the survival rate regression is significant. The effect is small; a 10 per cent increase in the pupil-teacher ratio reduces the survival rate by approximately four per cent.

[20] These results are not reported here but are available from the author on request.

outcomes were different across different ranges of the resource variables.[21] Again, these differences did not alter the main findings of this paper.

The cross-country regression analysis has shown that the link between educational outcomes and public education resources is at best weak. Three measures of resources were used in the analysis, and only per pupil expenditures appeared to be significant in explaining the cross-country variations in educational outcomes. But even in this case, the coefficient estimates were very small, suggesting that very large increases in per pupil spending would be required to improve primary school survival rates. Conversely, lower per pupil expenditures were associated with higher enrolment, but again very large changes in per pupil expenditures would be needed to effect very small changes in enrolment rates. The results have been shown to be robust to different specifications of the regression model, different estimation techniques and controls for influential observations. Furthermore, the relationship between resources and educational outcomes appears to be similar in high and low income countries as well as in SSA. The results are also broadly in line with the literature reviewed in Section 2 and summarised in Table 1.[22]

## 5 WHY IS THERE NO LINK?

The results presented in the previous section could be taken at face value to imply that resources are not important, and that increased resourcing will not lead to any marked improvements in education outcomes in developing countries. But this is counter-intuitive, given that increasing access to education to any significant extent evidently requires the building of new schools, training and remunerating new teachers, and providing additional textbooks and other important inputs. In this respect, improving educational outcomes will clearly require increased spending.

[21] Spline functions allows the resource coefficient to vary across different ranges of the resource variable.

[22] Similar findings have been found for public spending on health and health outcomes (see Filmer and Pritchett, 1999).

One explanation of the results presented here may be that they are driven by poor data. There has been much discussion of the reliability of the outcome and resource measures used in this study. A study of Tanzania documents clearly how different values of the same education expenditure measure are reported in different documents for the same year (Samoff, 1991).[23] In some countries a large proportion of education expenditure is not allocated to specific education sub-sectors and, in some cases this unallocated category includes expenditures that are in fact sub-sector specific. For example, textbook provision for all levels of the education system, in many sub-Saharan African countries, is centrally controlled, and this expenditure falls into the unallocated category as it is not always disaggregated by education level. Primary textbook provision may not, therefore, necessarily be included in statistics on total primary education expenditure for all countries.[24] While UNESCO attempts to ensure the resource measures it reports are comparable, it is likely that there is some variation in the definition of these resource variables across countries. Information on aid to education is treated differently in expenditure statistics depending on aid modalities. Where donors are providing direct budget support aid will be included in recurrent expenditure statistics. Where aid is primarily directed through the development budget of countries this expenditure will not be included in recurrent spending even though it may include items of expenditure that are recurrent.[25] Further inaccuracies in the education expenditure data may occur because expenditure recorded as being spent on education may in fact be diverted for other uses. For example, in Uganda a public expenditure tracking survey found that only 30 per cent of capitation grants intended for schools actually reached them (Ablo and Reinikka, 1998). These measurement errors are likely to bias the coefficient estimates in the regressions reported in Tables 2 and 3, including the coefficients on the resource variables.[26]

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[23] Samoff looks at total education expenditure as a percentage of total government expenditure.

[24] It is also sometimes unclear whether budgeted expenditure figures are reported rather than actual expenditures.

[25] For example, donor support to primary education in Bangladesh under the Primary Education Development Programme employed teachers who were paid as part of the development budget.

[26] Instrumental variable estimation is often used to remove this bias and therefore the IV estimates reported in Table A4 should be purged of measurement error problems. The IV coefficient estimates do not differ greatly from the OLS coefficients reported in Tables 2 and 3.

There may also be inaccuracies in how the dependent variables are reported. Most countries tend to have relatively good systems of collecting and reporting school data (e.g. total enrolment, enrolment by grade, repetition etc.), although in some cases there may be incentives to inflate school enrolment data. Three of the four dependent variables used in this paper rely on age-specific population data for their calculations (primary gross and net enrolment rates and the primary completion rates). Population data are usually estimated based on actual population data from the last census, and assumptions regarding population growth since the census. The accuracy with which these population projections predict actual population levels varies.[27] If these prediction errors are large then the regressions reported in Tables 2 and 3 will also be imprecisely estimated.

While the reliability of the data may in part explain the absence of a strong relationship between outcomes and resources, it is unlikely to explain it in full. The results presented in this paper are consistent with the results of similar studies reported in Table 1, which used different measures, sources, and years of data. The results presented here are also in line with studies undertaken within individual developing countries (Fuller, 1987; Fuller and Clarke, 1994; Hanushek, 1995; Hanushek, 1996). And the limited available evidence of these relationships across time within individual countries also shows no clear evidence of a link between resources and outcomes (Wössmann, 2001).[28] It is improbable that poor data alone explain these findings. The remaining discussion focuses on two possible explanations of why resource levels may be unhelpful in explaining the variation in education outcomes: (a) the omission of relevant variables and (b) the technical efficiency of education expenditure.

Due to the lack of cross-country data there are certain variables that may be expected to influence education outcomes which are not included in the regression analysis reported in the previous section. The omission of these variables is likely to bias the regression results. If these omitted variables are

[27] Errors in population projections most commonly manifest themselves through net enrolment rates that are greater than one (100 per cent).

correlated with the resource variables then the reported relationship between resources and education outcomes may be biased.

One omission in the cross-country analysis presented here is the lack of information on household spending on education. There may be a stronger relationship between total education expenditure (household and government) and education outcomes than between government expenditure alone and education outcomes. The proportion of total education expenditure represented by household spending tends to vary considerably across countries, and may be a substantial proportion of the total (Colclough *et al*, 2003; Mehrotra and Delamonica, 1998; Penrose, 1998). Furthermore, the costs of primary schooling faced by the household will partly determine whether they send their children to school. Therefore the weak link between public education expenditure and educational outcomes may be partly due to variations in household education expenditure across countries. This explanation is likely to be more important with respect to indicators measuring access and participation, where recent experience suggests that changes in the costs facing households have led to dramatic changes in primary enrolment rates in Africa. When fees were abolished at primary level in Malawi (1994) and Uganda (1997), reductions in the costs facing households led to massive increases in the number of children attending primary school. In Malawi, the primary gross enrolment rate increased from 93 per cent in 1993 to 134 per cent in 1997, and in Uganda from 83 to 134 per cent after primary fees were abolished.

The effectiveness of the public expenditure management system is also an important area in which the link between resources and outcomes is mediated. Unfortunately, no cross-country data are available to measure the effectiveness of public education expenditure. The budgetary process and the relationship between planning and budgeting are key to understanding the relationship between public expenditure and educational outcomes, and it has been argued that a major reason why education reforms have failed in the past is because they have neglected the budgeting process (Penrose, 1993). In many developing

[28] This evidence is based on a sample of OECD and East Asian countries. The relationship over time may be

countries, decisions regarding the composition of education expenditure are partly determined by budgetary outturns. When available resources fall short of planned expenditure it is easier to cut-back on textbook provision than on teachers' salaries, which leads to inefficient resource allocations. Differences in the effectiveness of public expenditure management systems across countries may, therefore, help explain the weak link between resources and outcomes.

Variables that account for the composition of public expenditure on education are also excluded from the regressions reported in Tables 2 and 3. Data available from UNESCO disaggregate total education expenditure into salary and non-salary expenditure, although the reporting of these data was relatively poor across countries. Teacher salaries as a proportion of total recurrent expenditure were initially included in the regression analysis, but proved to be insignificant and did not change the coefficients on the resource variables.[29] Information on other inputs that may have a stronger impact on education outcomes, such as textbooks, were unavailable; controlling for these inputs may explain the lack of a relationship between resources and education outcomes. But the micro-based evidence indicates that the current composition of expenditure across inputs does not strengthen the link between resources and outcomes. It may be that the current composition of education expenditure in most countries is technically inefficient.[30]

Altering the composition of this expenditure may, therefore, result in improved efficiency and marked improvements in outcomes. Pritchett and Filmer (1999) argue that current allocations of resources across different input categories (e.g. teachers, textbooks, etc.) are inconsistent with an output maximising model of input choice. They argue that if this composition is altered by, for example, spending additional resources in a different way, this spending would lead to better education outcomes. Their evidence from micro-based studies suggests that the cost-effectiveness of teacher salaries is low in comparison with other

different for developing countries.

[29] These results are available from the author on request.

inputs such as textbooks and other instructional materials (Pritchett and Filmer, 1999). This implies that additional resources concentrated towards non-salary inputs may have larger impacts on education outcomes.

Pritchett and Filmer suggest that the lower cost-effectiveness of teacher inputs is partly due to teachers being able to distort the composition of public expenditure in their favour.[31] Within national education systems there are other groups apart from teachers who determine the composition of public education spending, and may lead to inefficient allocations. For example, it may be more politically attractive to be able to demonstrate that many schools have been built than to claim that teachers have been well trained or that good instructional materials have been provided. Outcomes may be improved by reallocating existing resources in addition to increasing resources. But while it may be desirable to reallocate resources, it may not be easy: in a cross-country study on the politics of education reform, Corrales suggests that access reforms are easier to adopt and to implement compared with reforms to improve quality (Corrales, 1999).

## 6 CONCLUSIONS

The cross-country regression analysis reported in this paper shows that the link between public education expenditure and educational outcomes, as measured by a range of indicators, is at best weak. Given the absence of a clear, strong relationship, the use of cross-country averages to guide individual country education policy in resourcing decisions is unlikely to be meaningful. The results suggest, for example, that to use average levels of education spending in countries that have achieved schooling for all as targets for less successful countries, is not useful, and is almost certainly no substitute for detailed country level analysis.

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[30] For detailed African case studies looking at the composition of public spending and how changing the composition can potentially lead to increases in access see Colclough *et al* (2003).

[31] It should be noted that this argument does not suggest that teachers are currently paid too much.

The results presented in this paper show that the indicators selected to monitor the MDG and EFA goals have no close, consistent relationship to levels of expenditure across countries. While this may in part be due to data problems, it is also the case that these outcome measures do not measure some important aspects of these goals (see Section 3). In particular, the measurement of the quality of primary education relies on proxy measures. For a better understanding of learning outcomes across countries, it would be invaluable to have the capacity to monitor country progress more effectively. Initiatives such as SACMEQ and TIMSS should be expanded to include more countries, in particular countries that are as yet far from achieving the education targets.

A related issue is the lack of information on household expenditure on primary education. While household surveys within countries occasionally report household expenditures on education, these surveys are intermittent. Yet household spending on primary education is often high, and comparable to levels of public per pupil spending. Given that the EFA goals call for free primary education, levels of household spending would be an extremely useful variable to monitor, and may lead to a better understanding of the link between total resources (household and government) and educational access and performance.

The cross-country analysis in this paper suggests that the link between resources and educational indicators are weak and that the achievement of the Millennium Development Goals will require more than just increases in expenditure on primary education. This does not imply resources are unnecessary, merely that raising additional resources is unlikely to be sufficient for achieving the education goals. The composition of resources and institutions that govern the use of these resources play a central role in translating resources into better schooling outcomes. A stronger focus on these aspects of education systems will be required if the Millennium Development Goals in education are to be achieved.

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**Table 1 Cross-country estimates of the impact of resources on educational outcomes**

| Study | Type and year of data | Sample size | Schooling level | Dependent variable and source | Resource variables | Sign of coeffi-cient | Signifi-cance level |
|---|---|---|---|---|---|---|---|
| Hanushek and Kimko (2000) | Cross-country panel: 1965, 1970, 1988, 1991 | 70 | Primary and secondary | 1. IEA and IAEP mathematics and science tests | pupil-teacher ratio | positive | n.s. |
| | | 69 | | 2. IEA and IAEP mathematics and science tests | current education spend per pupil ($PPP) | negative | 1% |
| | | 67 | | 3. IEA and IAEP mathematics and science tests | total expenditure on education as a proportion of GDP | negative | 5% |
| Wössmann (2000) | Cross-country: 1995 | 39 | Primary and secondary | Test scores: TIMSS mathematics and science scores | class size | positive | 1% |
| Lee and Barro (1997) | Cross-country panel: 1964, 1970, 1982, 1984, 1990 | 214 | Primary and secondary | 1. Test scores: various sources | pupil-teacher ratio | negative | 5% |
| | | | | | average teacher salary ($PPP) | positive | 10% |
| | | | | | current education spend per pupil ($PPP) | negative | n.s. |
| | Cross-country panel: 1970, 1975, 1980, 1985 and 1990 | 337 | Primary | 2. Primary school repetition rates: UNESCO and Lockheed and Verspoor (1991) | pupil-teacher ratio | positive | 1% |
| | | | | | average teacher salary ($PPP) | negative | n.s. |
| | | | | | current education spend per pupil ($PPP) | positive | n.s. |
| | Cross-country panel: 1970, 1975, 1980, 1985 and 1990 | 346 | Primary | 3. Primary school drop-out rates: UNESCO and Lockheed and Verspoor (1991) | pupil-teacher ratio | positive | 5% |
| | | | | | average teacher salary ($PPP) | negative | n.s. |
| | | | | | current education spend per pupil ($PPP) | negative | n.s. |
| McMahon (1999) | Cross-country: early nineties | 44 | Primary | 1. Primary female gross enrolment ratio | Public recurrent expenditure on primary (%GNP) | positive | 1% |
| | | | | | Public recurrent expenditure per primary student (%GNP per capita) | negative | 1% |

**Table 1 Continued**

| Study | Type and year of data | Sample size | Schooling level | Dependent variable and source | Resource variables | Sign of coeffi-cient | Signifi-cance level |
|---|---|---|---|---|---|---|---|
| | Cross-country: early nineties | 44 | Primary | 2. Primary male gross enrolment ratio | Public recurrent expenditure on primary (%GNP) | positive | 1% |
| | | | | | Public recurrent expenditure per primary student (%GNP per capita) | negative | 1% |
| | Cross-country: early nineties | 49 | Primary | 3. Female fifth grade completion rate | Public recurrent expenditure per primary student | positive | 1% |
| | | | | | (1985 $US) | | |
| | Cross-country: early nineties | 50 | Primary | 4. Male fifth grade completion rate | Public recurrent expenditure per primary student | positive | 1% |
| | | | | | (1985 $US) | | |
| Schultz (1995) | Cross-country: 1965 – 1980 | Bet-ween – 60 | Primary | 1. Primary gross enrolment ratio: UNESCO | relative price of teachers (public teacher compensation as a prop of GNP per working age adult) | negative | 1% |
| | | With-in – 191 | Primary | 2. Primary gross enrolment ratio: UNESCO | relative price of teachers (public teacher compensation as a prop of GNP per working age adult) | negative | 1% |
| Colclough with Lewin (1993) | Cross-country: 1986 | 82 | Primary | 1. Primary gross enrolment ratio: UNESCO | Public recurrent expenditure on primary (%GNP) | positive | n.s. |
| | Cross-country: 1986 | 82 | Primary | 2. Primary gross enrolment ratio: UNESCO | Public recurrent expenditure per primary student (%GNP per capita) | negative | 1-5% |

Notes: Hanushek and Kimko (2000) results taken from Table 3, Wössmann (2000) taken from Table 1, Lee and Barro (1997) results taken from Table 3, McMahon (1999) results taken from p164 and p166, Schultz (1995) results taken from Tables 2 and 3, Colclough with Lewin (1993) results taken from Table 2.6a. Lee and Barro (1997) present other specifications but the results do not differ markedly. Colclough with Lewin (1993) also present results for developing countries and African countries separately although the results on the resource variables are similar.

## Table 2 OLS results for the primary gross and net enrolment ratios

| | Primary GER | | | Primary NER | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Public primary education expenditure (%GNP) | -0.021 | | | -0.014 | | |
| | *0.037* | | | *0.035* | | |
| Primary expenditure per pupil ($PPP) | | -0.120 *** | | | -0.112 ** | |
| | | *0.045* | | | *0.049* | |
| Primary pupil teacher ratio | | | 0.019 | | | -0.057 |
| | | | *0.077* | | | *0.075* |
| Gini coefficient | 0.003 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 |
| | *0.002* | *0.002* | *0.002* | *0.002* | *0.002* | *0.002* |
| Francophone Africa | -0.261 *** | -0.253 *** | -0.256 ** | -0.342 *** | -0.318 *** | -0.326 *** |
| | *0.093* | *0.081* | *0.104* | *0.108* | *0.097* | *0.112* |
| SSA | -0.040 | -0.060 | -0.053 | -0.112 | -0.115 | -0.095 |
| | *0.065* | *0.060* | *0.064* | *0.085* | *0.080* | *0.081* |
| GNP per capita ($PPP) | 0.803 *** | 0.795 *** | 0.808 *** | 1.182 *** | 1.104 *** | 1.202 *** |
| | *0.269* | *0.228* | *0.267* | *0.276* | *0.244* | *0.265* |
| GNP per capita ($PPP) squared | -0.045 *** | -0.036 ** | -0.045 *** | -0.066 *** | -0.053 *** | -0.068 *** |
| | *0.016* | *0.014* | *0.015* | *0.016* | *0.015* | *0.015* |
| Urban population (% total pop.) | 0.072 | 0.046 | 0.077 | 0.100 | 0.071 | 0.101 |
| | *0.062* | *0.049* | *0.065* | *0.071* | *0.061* | *0.072* |
| East Asia | 0.092 | 0.053 | 0.089 | 0.041 | 0.025 | 0.057 |
| | *0.068* | *0.064* | *0.072* | *0.056* | *0.055* | *0.055* |
| South Asia | 0.090 | 0.029 | 0.084 | 0.002 | -0.043 | 0.031 |
| | *0.104* | *0.097* | *0.109* | *0.081* | *0.076* | *0.087* |
| Arab States | 0.131 | 0.132 | 0.120 | 0.032 | 0.039 | 0.032 |
| | *0.110* | *0.098* | *0.109* | *0.116* | *0.105* | *0.111* |
| Latin America and the Caribbean | -0.018 | -0.053 | -0.023 | -0.134 ** | -0.140 ** | -0.123 ** |
| | *0.059* | *0.063* | *0.058* | *0.056* | *0.062* | *0.056* |
| Muslim proportion of the population | -0.205 * | -0.172 * | -0.217 * | -0.079 | -0.019 | -0.083 |
| | *0.120* | *0.098* | *0.124* | *0.127* | *0.107* | *0.129* |
| Constant | -3.687 *** | -3.432 *** | -3.654 *** | -5.323 *** | -4.895 *** | -5.130 *** |
| | *1.126* | *0.991* | *1.227* | *1.133* | *1.064* | *1.175* |
| Number of observations | 90 | 90 | 90 | 79 | 79 | 79 |
| R-Squared | 0.64 | 0.69 | 0.64 | 0.78 | 0.80 | 0.78 |
| Ramsey RESET Test | 10.34 *** | 14.57 *** | 10.09 *** | 9.50 *** | 12.35 *** | 9.58 *** |
| Normality Test | 7.80 ** | 6.00 ** | 7.49 ** | 3.82 | 0.46 | 4.55 |

Notes
1. Robust standard errors, adjusted for heteroscedasticity, are used in all cases.
2. Standard errors reported in italics
3. All continuous variables, apart from the gini coefficient, are logged.
4. Test of normality based on tests of skewness and kurtosis.
5. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

## Table 3 OLS results for primary survival and completion rates

| | Primary Survival Rate | | | Primary Completion Rate | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Public primary education expenditure (%GNP) | -0.003 | | | -0.033 | | |
| | *0.042* | | | *0.068* | | |
| Primary expenditure per pupil ($PPP) | | 0.075 * | | | -0.069 | |
| | | *0.044* | | | *0.072* | |
| Primary pupil teacher ratio | | | -0.094 | | | -0.013 |
| | | | *0.098* | | | *0.208* |
| Gini coefficient | -0.002 | -0.002 | -0.002 | -0.016 ** | -0.017 ** | -0.016 * |
| | *0.002* | *0.003* | *0.002* | *0.007* | *0.007* | *0.009* |
| Francophone Africa | -0.068 | -0.071 | -0.051 | -0.765 *** | -0.749 *** | -0.740 *** |
| | *0.092* | *0.090* | *0.097* | *0.142* | *0.132* | *0.147* |
| SSA | 0.033 | 0.045 | 0.067 | -0.149 | -0.156 | -0.155 |
| | *0.065* | *0.063* | *0.069* | *0.124* | *0.107* | *0.165* |
| GNP per capita ($PPP) | 0.475 | 0.538 | 0.501 | -1.816 | -2.295 | -1.805 |
| | *0.457* | *0.460* | *0.459* | *1.863* | *1.947* | *1.911* |
| GNP per capita ($PPP) squared | -0.022 | -0.031 | -0.024 | 0.144 | 0.183 | 0.143 |
| | *0.026* | *0.027* | *0.026* | *0.131* | *0.136* | *0.136* |
| Urban population (% total pop.) | 0.166 ** | 0.181 *** | 0.150 ** | -0.023 | -0.024 | -0.019 |
| | *0.069* | *0.058* | *0.067* | *0.094* | *0.090* | *0.098* |
| East Asia | -0.002 | 0.025 | 0.020 | -0.364 ** | -0.375 *** | -0.356 * |
| | *0.054* | *0.050* | *0.056* | *0.138* | *0.124* | *0.206* |
| South Asia | -0.244 ** | -0.204 | -0.205 | -0.489 *** | -0.495 *** | -0.474 * |
| | *0.121* | *0.128* | *0.132* | *0.144* | *0.133* | *0.256* |
| Arab States | -0.162 * | -0.160 * | -0.151 * | -0.410 *** | -0.419 *** | -0.414 *** |
| | *0.089* | *0.081* | *0.084* | *0.123* | *0.111* | *0.118* |
| Latin America and the Caribbean | -0.177 ** | -0.149 * | -0.143 * | -0.022 | -0.078 | -0.045 |
| | *0.075* | *0.080* | *0.074* | *0.170* | *0.187* | *0.190* |
| Muslim proportion of the population | 0.273 ** | 0.234 ** | 0.290 ** | -0.013 | 0.012 | -0.033 |
| | *0.130* | *0.112* | *0.128* | *0.162* | *0.146* | *0.174* |
| Constant | -2.447 | -2.743 | -2.219 | 5.939 | 7.870 | 6.068 |
| | *2.016* | *2.011* | *1.999* | *6.721* | *7.054* | *6.622* |
| Number of observations | 69 | 69 | 69 | 33 | 33 | 33 |
| R-Squared | 0.65 | 0.67 | 0.65 | 0.87 | 0.89 | 0.87 |
| Ramsey RESET Test | 3.31 ** | 3.04 ** | 3.55 ** | 1.71 | 2.02 | 1.90 |
| Normality Test | 1.45 | 1.69 | 2.16 | 1.15 | 1.63 | 0.76 |

Notes
1. Robust standard errors, adjusted for heteroscedasticity, are used in all cases.
2. Standard errors reported in italics
3. All continuous variables, apart from the gini coefficient, are logged.
4. Test of normality based on tests of skewness and kurtosis.
5. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

# APPENDICES

## Table A1 Descriptive statistics

| Variable and Source | Primary Gross Enrolment Ratio Regressions | | | | Primary Net Enrolment Ratio Regressions | | | | Primary School Survival Rate Grade 5 | | | | Primary Completion rate regressions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev | Min | Max | Mean | Std. Dev | Min | Max | Mean | Std. Dev | Min | Max | Mean | Std. Dev | Min | Max |
| Primary Gross Enrolment Rate (UNESCO 2000a; UNESCO 2001) | -0.08 | 0.26 | -1.24 | 0.27 | | | | | | | | | | | | |
| Primary Net Enrolment Rate (UNESCO 2000a; UNESCO 2001) | | | | | -0.23 | 0.3 | -1.43 | 0 | | | | | | | | |
| Primary School Survival Rate (UNESCO 2000b; UNESCO 2000a) | | | | | | | | | -0.21 | 0.24 | -0.92 | 0 | | | | |
| Primary Completion Rate (World Bank 2002) | | | | | | | | | | | | | -0.61 | 0.46 | 2.94 | 4.6 |
| Public primary current education expenditure (%GNP) (UNESCO 2000b; UNESCO 2000a; UNESCO 2001) | -4.21 | 0.55 | -5.81 | -3.06 | -4.22 | 0.54 | -5.81 | -3.06 | -4.22 | 0.54 | -5.81 | -3.10 | -4.23 | 0.66 | -5.81 | -3.06 |
| Public primary current education expenditure per pupil ($PPP) (UNESCO 2000b; UNESCO 2000a; UNESCO 2001) | 6.15 | 1.32 | 3.14 | 8.94 | 6.15 | 1.3 | 3.14 | 8.87 | 6.11 | 1.17 | 3.14 | 8.646 | 4.91 | 0.76 | 3.14 | 6.35 |
| Primary pupil-teacher ratio (UNESCO 2000b; UNESCO 2000a; UNESCO 2001) | 3.24 | 0.45 | 2.21 | 4.69 | 3.23 | 0.42 | 2.21 | 4.277 | 3.24 | 0.41 | 2.3 | 4.277 | 3.6 | 0.4 | 2.77 | 4.69 |
| Gini coefficient (WIDER Database) | 40.31 | 10.09 | 19.43 | 61.30 | 40.44 | 9.76 | 19.43 | 60.90 | 40.79 | 9.86 | 24.22 | 60.90 | 42.63 | 8.63 | 28.97 | 61.30 |
| Francophone Africa | 0.13 | 0.34 | 0.00 | 1.00 | 0.13 | 0.33 | 0.00 | 1.00 | 0.13 | 0.34 | 0.00 | 1.00 | 0.30 | 0.47 | 0.00 | 1.00 |
| SSA | 0.23 | 0.43 | 0.00 | 1.00 | 0.22 | 0.41 | 0.00 | 1.00 | 0.20 | 0.41 | 0.00 | 1.00 | 0.55 | 0.51 | 0.00 | 1.00 |
| GNP per capita ($PPP) (World Bank 2000) | 8.27 | 1.04 | 6.16 | 10.5 | 8.30 | 1.03 | 6.16 | 10.19 | 8.26 | 0.90 | 6.16 | 10.06 | 7.17 | 0.48 | 6.16 | 8.00 |
| GNP per capita ($PPP) squared | 69.50 | 17.29 | 37.96 | 110.4 | 69.91 | 17.03 | 37.96 | 103.8 | 69.06 | 14.91 | 37.96 | 101.2 | 51.65 | 6.83 | 37.96 | 64.0 |
| Urban population (% total pop.) (World Bank 1998) | -0.76 | 0.53 | -2.55 | -0.10 | -0.76 | 0.54 | -2.55 | -0.10 | -0.76 | 0.50 | -2.24 | -0.10 | -1.17 | 0.53 | -2.55 | -0.37 |
| East Asia | 0.10 | 0.30 | 0.00 | 1.00 | 0.11 | 0.32 | 0.00 | 1.00 | 0.12 | 0.32 | 0.00 | 1.00 | 0.12 | 0.33 | 0.00 | 1.00 |
| South Asia | 0.06 | 0.23 | 0.00 | 1.00 | 0.05 | 0.22 | 0.00 | 1.00 | 0.07 | 0.26 | 0.00 | 1.00 | 0.09 | 0.29 | 0.00 | 1.00 |
| Arab States | 0.08 | 0.27 | 0.00 | 1.00 | 0.09 | 0.29 | 0.00 | 1.00 | 0.09 | 0.28 | 0.00 | 1.00 | 0.06 | 0.24 | 0.00 | 1.00 |
| Latin America and the Caribbean | 0.20 | 0.40 | 0.00 | 1.00 | 0.22 | 0.41 | 0.00 | 1.00 | 0.23 | 0.43 | 0.00 | 1.00 | 0.09 | 0.29 | 0.00 | 1.00 |
| Muslim proportion of the population (CIA and Weekes) | 0.18 | 0.27 | 0.00 | 0.69 | 0.18 | 0.27 | 0.00 | 0.69 | 0.19 | 0.28 | 0.00 | 0.69 | 0.29 | 0.28 | 0.00 | 0.69 |

**Table A2 Other Regression Results For Quantity Outcome Dependent Variables**

| | Primary Gross Enrolment Ratio | | | | | |
|---|---|---|---|---|---|---|
| | OLS including dummy variables for influential observations | | | Median Regression | | |
| Public primary education expenditure (%GNP) | -0.024 | | | -0.005 | | |
| | *0.036* | | | *0.041* | | |
| Primary expenditure per pupil ($PPP) | | -0.101 *** | | | -0.104 * | |
| | | *0.034* | | | *0.060* | |
| Primary pupil teacher ratio | | | 0.044 | | | 0.072 |
| | | | *0.057* | | | *0.075* |
| Gini coefficient | 0.004 ** | 0.003 | 0.002 | 0.004 | 0.001 | 0.002 |
| | *0.002* | *0.002* | *0.002* | *0.003* | *0.003* | *0.003* |
| Francophone Africa | -0.321 *** | -0.309 *** | -0.333 *** | -0.202 | -0.358 ** | -0.201 *** |
| | *0.071* | *0.063* | *0.078* | *0.152* | *0.158* | *0.169* |
| SSA | -0.016 | -0.020 | -0.020 | -0.080 | -0.036 | -0.062 |
| | *0.063* | *0.056* | *0.061* | *0.109* | *0.092* | *0.115* |
| GNP per capita ($PPP) | 0.989 *** | 0.783 *** | 0.919 *** | 0.673 * | 0.827 *** | 0.684 *** |
| | *0.191* | *0.167* | *0.198* | *0.346* | *0.310* | *0.346* |
| GNP per capita ($PPP) squared | -0.056 *** | -0.037 *** | -0.052 *** | -0.037 * | -0.038 ** | -0.036 *** |
| | *0.011* | *0.010* | *0.012* | *0.020* | *0.019* | *0.019* |
| Urban population (% total pop.) | 0.095 * | 0.100 ** | 0.093 | 0.038 | 0.047 | 0.056 |
| | *0.057* | *0.042* | *0.057* | *0.089* | *0.095* | *0.105* |
| East Asia | 0.090 | 0.085 | 0.095 | 0.104 | 0.105 | 0.092 ** |
| | *0.069* | *0.058* | *0.070* | *0.118* | *0.104* | *0.117* |
| South Asia | 0.013 | 0.059 | 0.087 | 0.115 | 0.078 | 0.076 |
| | *0.098* | *0.071* | *0.073* | *0.165* | *0.152* | *0.149* |
| Arab States | 0.115 | 0.104 | 0.083 | 0.111 | 0.059 | 0.093 |
| | *0.083* | *0.078* | *0.082* | *0.170* | *0.121* | *0.144* |
| Latin America and the Caribbean | -0.051 | -0.040 | -0.017 | 0.003 | 0.041 | 0.014 |
| | *0.058* | *0.050* | *0.056* | *0.083* | *0.084* | *0.079* |
| Muslim proportion of the population | -0.168 * | -0.124 * | -0.125 | -0.101 | -0.038 | -0.091 |
| | *0.098* | *0.073* | *0.095* | *0.160* | *0.134* | *0.142* |
| Constant | -4.478 *** | -3.371 *** | -4.211 *** | -3.178 ** | -3.565 ** | -3.431 *** |
| | *0.831* | *0.745* | *0.836* | *1.521* | *1.458* | *1.591* |
| Number of observations | 90 | 90 | 90 | 90 | 90 | 90 |
| R-Squared | 0.83 | 0.88 | 0.83 | 0.3193 | 0.36 | 0.33 |
| Ramsey RESET Test | 2.92 ** | 2.86 ** | 4.32 *** | | | |
| Normality Test | 1.69 | 0.27 | 0.16 | | | |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
2. Test of normality based on tests of skewness and kurtosis.
3. Influential observations determined by computing DFIT statistics and including a dummy variable in the regression for observations with DFIT values greater than 2*(k/n)^0.5 where k is the number of variables in the regression and n is the number of observations in the sample.
4. Standard errors for median regression are estimated using bootstrap methods. 100 replications are used to estimate the standard errors.
5. R-squared shown for the median regression is a pseudo R-squared.
6. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

**Table A2 Continued**

| | Primary Net Enrolment Ratio | | | | | |
|---|---|---|---|---|---|---|
| | OLS including dummy variables for influential observations | | | Median Regression | | |
| Public primary education expenditure (%GNP) | 0.008 | | | 0.022 | | |
| | *0.025* | | | *0.048* | | |
| Primary expenditure per pupil ($PPP) | | -0.080 * | | | -0.064 | |
| | | *0.041* | | | *0.072* | |
| Primary pupil teacher ratio | | | -0.043 | | | -0.049 |
| | | | *0.053* | | | *0.091* |
| Gini coefficient | -0.0003 | -0.001 | 0.0001 | 0.00002 | -0.002 | -0.001 |
| | *0.002* | *0.001* | *0.001* | *0.003* | *0.002* | *0.002* |
| Francophone Africa | -0.428 *** | -0.379 *** | -0.417 *** | -0.259 | -0.471 ** | -0.234 |
| | *0.076* | *0.072* | *0.077* | *0.201* | *0.198* | *0.218* |
| SSA | 0.011 | 0.026 | 0.030 | -0.109 | -0.108 | -0.097 |
| | *0.053* | *0.048* | *0.047* | *0.125* | *0.155* | *0.144* |
| GNP per capita ($PPP) | 1.301 *** | 1.261 *** | 1.293 *** | 1.164 *** | 1.168 *** | 1.213 *** |
| | *0.181* | *0.179* | *0.179* | *0.435* | *0.440* | *0.428* |
| GNP per capita ($PPP) squared | -0.072 *** | -0.063 *** | -0.072 *** | -0.064 ** | -0.060 ** | -0.068 *** |
| | *0.011* | *0.012* | *0.011* | *0.025* | *0.026* | *0.025* |
| Urban population (% total pop.) | 0.116 ** | 0.105 ** | 0.116 ** | 0.072 | 0.056 | 0.070 |
| | *0.050* | *0.050* | *0.051* | *0.108* | *0.112* | *0.108* |
| East Asia | 0.058 | 0.053 | 0.070 | 0.022 | 0.052 | 0.036 |
| | *0.047* | *0.049* | *0.045* | *0.091* | *0.083* | *0.081* |
| South Asia | 0.067 | 0.037 | 0.090 | 0.048 | 0.013 | 0.068 |
| | *0.084* | *0.085* | *0.082* | *0.168* | *0.139* | *0.159* |
| Arab States | 0.107 | 0.109 | 0.117 | -0.036 | 0.042 | -0.028 |
| | *0.077* | *0.075* | *0.072* | *0.205* | *0.193* | *0.209* |
| Latin America and the Caribbean | -0.066 * | -0.047 | -0.056 | -0.082 | -0.076 | -0.047 |
| | *0.038* | *0.040* | *0.038* | *0.063* | *0.078* | *0.068* |
| Muslim proportion of the population | 0.005 | 0.051 | 0.011 | 0.026 | -0.003 | 0.063 |
| | *0.078* | *0.081* | *0.075* | *0.172* | *0.170* | *0.189* |
| Constant | -5.828 *** | -5.638 *** | -5.690 *** | -5.192 *** | -5.169 ** | -5.261 *** |
| | *0.749* | *0.744* | *0.728* | *1.858* | *1.964* | *1.828* |
| Number of observations | 79 | 79 | 79 | 79 | 79 | 79 |
| R-Squared | 0.92 | 0.93 | 0.92 | 0.45 | 0.45 | 0.45 |
| Ramsey RESET Test | 3.93 ** | 6.43 | 3.58 | | | |
| Normality Test | 0.03 | 2.38 | 0.13 | | | |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
2. Test of normality based on tests of skewness and kurtosis.
3. Influential observations determined by computing DFIT statistics and including a dummy variable in the regression for observations with DFIT values greater than 2*(k/n)^0.5 where k is the number of variables in the regression and n is the number of observations in the sample.
4. Standard errors for median regression are estimated using bootstrap methods. 100 replications are used to estimate the standard errors.
5. R-squared shown for the median regression is a pseudo R-squared.
6. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

**Table A3 Other Regression Results For Quality Outcome Dependent Variables**

| | Primary Survival Rate | | | | | |
|---|---|---|---|---|---|---|
| | OLS including dummy variables for influential observations | | | Median Regression | | |
| Public primary education expenditure (%GNP) | 0.001 | | | -0.016 | | |
| | *0.039* | | | *0.047* | | |
| Primary expenditure per pupil ($PPP) | | 0.103 *** | | | 0.094 | |
| | | *0.036* | | | *0.064* | |
| Primary pupil teacher ratio | | | -0.106 | | | -0.0774 |
| | | | *0.084* | | | *0.118* |
| Gini coefficient | -0.004 | -0.004 * | -0.002 | -0.0004 | 0.001 | -0.002 |
| | *0.003* | *0.002* | *0.002* | *0.004* | *0.004* | *0.004* |
| Francophone Africa | -0.045 | -0.068 | -0.017 | -0.065 | -0.038 | -0.056 |
| | *0.067* | *0.071* | *0.069* | *0.145* | *0.150* | *0.142* |
| SSA | 0.103 ** | 0.112 ** | 0.116 ** | 0.049 | 0.072 | 0.080 |
| | *0.049* | *0.051* | *0.051* | *0.102* | *0.101* | *0.099* |
| GNP per capita ($PPP) | 0.754 * | 0.553 | 0.834 ** | 0.463 | 0.506 | 0.608 |
| | *0.429* | *0.352* | *0.405* | *0.705* | *0.770* | *0.871* |
| GNP per capita ($PPP) squared | -0.038 | -0.034 | -0.044 * | -0.025 | -0.033 | -0.033 |
| | *0.024* | *0.021* | *0.023* | *0.039* | *0.044* | *0.049* |
| Urban population (% total pop.) | 0.180 ** | 0.210 *** | 0.179 ** | 0.290 ** | 0.283 *** | 0.237 ** |
| | *0.079* | *0.053* | *0.069* | *0.125* | *0.090* | *0.116* |
| East Asia | 0.036 | 0.072 | 0.050 | 0.005 | 0.009 | 0.017 |
| | *0.056* | *0.048* | *0.054* | *0.093* | *0.078* | *0.074* |
| South Asia | -0.209 *** | -0.166 ** | -0.163 ** | -0.152 | -0.091 | -0.137 |
| | *0.074* | *0.082* | *0.067* | *0.198* | *0.168* | *0.175* |
| Arab States | -0.104 | -0.113 ** | -0.100 * | -0.103 | -0.126 | -0.117 |
| | *0.064* | *0.053* | *0.060* | *0.141* | *0.123* | *0.124* |
| Latin America and the Caribbean | -0.125 | -0.054 | -0.136 * | -0.187 * | -0.178 | -0.121 |
| | *0.091* | *0.057* | *0.072* | *0.107* | *0.108* | *0.128* |
| Muslim proportion of the population | 0.264 ** | 0.258 *** | 0.251 *** | 0.185 | 0.177 | 0.262 |
| | *0.104* | *0.085* | *0.085* | *0.204* | *0.155* | *0.180* |
| Constant | -3.554 * | -2.742 * | -3.521 * | -2.097 | -2.496 | -2.443 |
| | *1.940* | *1.537* | *1.825* | *3.225* | *3.470* | *3.880* |
| Number of observations | 69 | 69 | 69 | 69 | 69 | 69 |
| R-Squared | 0.81 | 0.86 | 0.81 | 0.43 | 0.45 | 0.43 |
| Ramsey RESET Test | 4.42 *** | 6.43 *** | 4.35 *** | | | |
| Normality Test | 1.25 | 1.02 | 1.72 | | | |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
2. Test of normality based on tests of skewness and kurtosis.
3. Influential observations determined by computing DFIT statistics and including a dummy variable in the regression for observations with DFIT values greater than 2*(k/n)^0.5 where k is the number of variables in the regression and n is the number of observations in the sample.
4. Standard errors for median regression are estimated using bootstrap methods. 100 replications are used to estimate the standard errors.
5. R-squared shown for the median regression is a pseudo R-squared.
6. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

**Table A3 Continued**

| | Primary Completion Rate | | | | | |
|---|---|---|---|---|---|---|
| | OLS including dummy variables for influential observations | | | Median Regression | | |
| Public primary education expenditure (%GNP) | -0.064 | | | 0.062 | | |
| | *0.112* | | | *0.156* | | |
| Primary expenditure per pupil ($PPP) | | -0.134 * | | | 0.030 | |
| | | *0.076* | | | *0.135* | |
| Primary pupil teacher ratio | | | 0.112 | | | 0.082 |
| | | | *0.237* | | | *0.493* |
| Gini coefficient | -0.012 | -0.014 | -0.010 | -0.026 ** | -0.026 * | -0.024 |
| | *0.010* | *0.008* | *0.010* | *0.012* | *0.013* | *0.015* |
| Francophone Africa | -0.780 *** | -0.774 *** | -0.701 *** | -0.658 ** | -0.629 *** | -0.770 ** |
| | *0.176* | *0.138* | *0.160* | *0.261* | *0.194* | *0.275* |
| SSA | -0.186 | -0.178 | -0.304 * | -0.259 | -0.283 | -0.240 |
| | *0.134* | *0.116* | *0.173* | *0.337* | *0.224* | *0.416* |
| GNP per capita ($PPP) | -1.441 | -0.471 | 1.892 | -2.172 | -2.013 | -3.945 |
| | *3.281* | *3.300* | *3.898* | *6.165* | *5.845* | *5.765* |
| GNP per capita ($PPP) squared | 0.117 | 0.061 | -0.107 | 0.181 | 0.164 | 0.298 |
| | *0.236* | *0.229* | *0.271* | *0.435* | *0.411* | *0.404* |
| Urban population (% total pop.) | -0.085 | -0.012 | -0.036 | -0.118 | -0.110 | -0.133 |
| | *0.155* | *0.109* | *0.099* | *0.218* | *0.208* | *0.167* |
| East Asia | -0.472 ** | -0.350 ** | -0.385 | -0.515 | -0.476 | -0.491 |
| | *0.204* | *0.130* | *0.228* | *0.394* | *0.314* | *0.467* |
| South Asia | -0.412 * | -0.481 *** | -0.552 * | -0.717 * | -0.664 ** | -0.660 |
| | *0.221* | *0.161* | *0.277* | *0.392* | *0.311* | *0.566* |
| Arab States | -0.431 *** | -0.425 ** | -0.371 ** | -0.391 | -0.401 | -0.468 |
| | *0.136* | *0.154* | *0.176* | *0.486* | *0.315* | *0.363* |
| Latin America and the Caribbean | -0.041 | -0.108 | -0.151 | -0.200 | -0.096 | -0.099 |
| | *0.234* | *0.106* | *0.245* | *0.352* | *0.280* | *0.394* |
| Muslim proportion of the population | 0.065 | 0.164 | 0.047 | -0.181 | -0.059 | 0.027 |
| | *0.240* | *0.143* | *0.169* | *0.402* | *0.317* | *0.373* |
| Constant | 4.257 | 1.243 | -8.211 | 7.402 | 6.667 | 13.351 |
| | *11.441* | *12.171* | *14.076* | *21.985* | *21.033* | *20.385* |
| Number of observations | 33 | 33 | 33 | 33 | 33 | 33 |
| R-Squared | 0.89 | 0.93 | 0.91 | 0.67 | 0.66 | 0.66 |
| Ramsey RESET Test | 1.81 | 1.72 | 0.87 | | | |
| Normality Test | 0.78 | 1.49 | 0.67 | | | |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
2. Test of normality based on tests of skewness and kurtosis.
3. Influential observations determined by computing DFIT statistics and including a dummy variable in the regression for observations with DFIT values greater than 2*(k/n)^0.5 where k is the number of variables in the regression and n is the number of observations in the sample.
4. Standard errors for median regression are estimated using bootstrap methods. 100 replications are used to estimate the standard errors.
5. R-squared shown for the median regression is a pseudo R-squared.
6. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

**Table A4 Instrumental Variable (Two Stage Least Squares) Estimation Results**

| | Primary Gross Enrolment Ratio | | | Primary Net Enrolment Ratio | | |
|---|---|---|---|---|---|---|
| Public primary education expenditure (%GNP) | -0.029 | | | -0.029 | | |
| | *0.076* | | | *0.060* | | |
| Primary expenditure per pupil ($PPP) | | -0.021 | | | 0.015 | |
| | | *0.109* | | | *0.088* | |
| Primary pupil teacher ratio | | | -0.001 | | | -0.131 |
| | | | *0.113* | | | *0.086* |
| Gini coefficient | 0.002 | 0.001 | 0.001 | 0.0003 | -0.00001 | 0.001 |
| | *0.002* | *0.002* | *0.002* | *0.002* | *0.002* | *0.002* |
| Francophone Africa | -0.206 * | -0.192 | -0.193 | -0.257 ** | -0.246 ** | -0.219 * |
| | *0.122* | *0.123* | *0.124* | *0.119* | *0.118* | *0.112* |
| SSA | -0.070 | -0.082 | -0.083 | -0.133 | -0.147 * | -0.094 |
| | *0.074* | *0.063* | *0.078* | *0.091* | *0.082* | *0.079* |
| GNP per capita ($PPP) | 0.965 ** | 0.973 ** | 0.986 ** | 1.312 *** | 1.350 *** | 1.331 *** |
| | *0.423* | *0.424* | *0.409* | *0.434* | *0.471* | *0.409* |
| GNP per capita ($PPP) squared | -0.052 ** | -0.051 * | -0.054 ** | -0.072 *** | -0.075 ** | -0.074 *** |
| | *0.024* | *0.029* | *0.024* | *0.025* | *0.031* | *0.024* |
| Urban population (% total pop.) | -0.044 | -0.044 | -0.048 | -0.006 | -0.005 | -0.010 |
| | *0.076* | *0.074* | *0.071* | *0.081* | *0.080* | *0.079* |
| East Asia | 0.088 | 0.081 | 0.087 | 0.058 | 0.056 | 0.096 |
| | *0.062* | *0.067* | *0.074* | *0.055* | *0.058* | *0.060* |
| South Asia | 0.090 | 0.082 | 0.089 | -0.042 | -0.042 | 0.021 |
| | *0.075* | *0.080* | *0.100* | *0.083* | *0.086* | *0.090* |
| Arab States | 0.101 | 0.091 | 0.087 | 0.040 | 0.023 | 0.045 |
| | *0.105* | *0.099* | *0.106* | *0.111* | *0.105* | *0.104* |
| Latin America and the Caribbean | 0.016 | 0.008 | 0.016 | -0.080 | -0.083 | -0.047 |
| | *0.067* | *0.073* | *0.073* | *0.055* | *0.056* | *0.048* |
| Muslim proportion of the population | -0.148 | -0.156 | -0.158 | -0.056 | -0.082 | -0.066 |
| | *0.119* | *0.120* | *0.128* | *0.122* | *0.128* | *0.131* |
| Constant | -4.584 *** | -4.445 ** | -4.528 ** | -6.157 *** | -6.155 *** | -5.634 *** |
| | *1.709* | *1.926* | *1.778* | *1.779* | *2.075* | *1.704* |
| Number of observations | 73 | 73 | 73 | 67 | 67 | 67 |
| R-Squared | 0.59 | 0.61 | 0.59 | 0.73 | 0.72 | 0.74 |
| Sargan Instrument Validity Test | 0.38 | 0.47 | 0.48 | 0.47 | 0.79 | 0.21 |
| Davidson and McKinnon test for exog | 0.37 | 0.97 | 0.08 | 0.39 | 4.24 ** | 0.18 |
| Hausman test | 0.39 | 1.02 | 0.07 | 0.50 | 4.42 ** | 0.14 |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
2. Davidson and MacKinnon exogeneity test based on including the predicted values of the endogenous variable in the original model and testing whether the predicted values are significant in the original model.
3. Instruments used in two stage least squares are; secondary school pupil teacher ratio, total education spending as a proportion of GNP and the length in years of the primary cycle.
4. The null hypotheis for the Sargan instrument validity test is that the instruments are not correlated with the IV residuals and hence the instruments are valid.
5. *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level using two-tailed tests.

**Table A4 Continued**

| | Primary Survival Rate | | | Primary Completion Rate | | |
|---|---|---|---|---|---|---|
| Public primary education expenditure (%GNP) | 0.033 | | | 0.091 | | |
| | *0.081* | | | *0.070* | | |
| Primary expenditure per pupil ($PPP) | | 0.194 *** | | | 0.098 | |
| | | *0.072* | | | *0.153* | |
| Primary pupil teacher ratio | | | -0.390 * | | | 0.116 |
| | | | *0.199* | | | *0.249* |
| Gini coefficient | -0.001 | -0.0001 | -0.001 | -0.020 *** | -0.022 ** | -0.022 ** |
| | *0.002* | *0.003* | *0.002* | *0.006* | *0.009* | *0.008* |
| Francophone Africa | -0.037 | -0.043 | 0.017 | -0.681 *** | -0.704 *** | -0.804 *** |
| | *0.070* | *0.067* | *0.087* | *0.140* | *0.194* | *0.147* |
| SSA | -0.035 | -0.024 | 0.146 | -0.235 * | -0.215 | -0.223 |
| | *0.070* | *0.063* | *0.107* | *0.119* | *0.177* | *0.155* |
| GNP per capita ($PPP) | 0.858 * | 1.135 *** | 0.907 | -0.896 | -0.952 | -2.166 |
| | *0.464* | *0.386* | *0.608* | *2.666* | *3.247* | *3.320* |
| GNP per capita ($PPP) squared | -0.045 * | -0.075 *** | -0.051 | 0.090 | 0.089 | 0.175 |
| | *0.026* | *0.025* | *0.036* | *0.182* | *0.225* | *0.232* |
| Urban population (% total pop.) | 0.185 ** | 0.169 *** | 0.136 | -0.107 | -0.142 | -0.062 |
| | *0.074* | *0.051* | *0.085* | *0.077* | *0.116* | *0.082* |
| East Asia | -0.039 | 0.022 | 0.076 | -0.448 *** | -0.466 ** | -0.488 ** |
| | *0.055* | *0.061* | *0.099* | *0.138* | *0.203* | *0.211* |
| South Asia | -0.171 | -0.100 | 0.007 | -0.566 *** | -0.605 ** | -0.620 * |
| | *0.121* | *0.131* | *0.136* | *0.151* | *0.257* | *0.291* |
| Arab States | -0.221 *** | -0.216 *** | -0.156 * | -0.454 *** | -0.419 ** | -0.502 *** |
| | *0.082* | *0.064* | *0.080* | *0.086* | *0.146* | *0.113* |
| Latin America and the Caribbean | -0.210 *** | -0.156 * | -0.043 | -0.197 | 0.075 | -0.187 |
| | *0.072* | *0.078* | *0.108* | *0.166* | *0.266* | *0.181* |
| Muslim proportion of the population | 0.297 ** | 0.231 ** | 0.386 ** | 0.046 | 0.013 | 0.076 |
| | *0.117* | *0.093* | *0.148* | *0.181* | *0.303* | *0.190* |
| Constant | -3.839 * | -5.406 *** | -2.844 | 2.71 | 2.38 | 6.83 |
| | *2.079* | *1.680* | *2.466* | *9.644* | *12.226* | *11.539* |
| Number of observations | 59 | 59 | 59 | 23 | 23 | 23 |
| R-Squared | 0.71 | 0.75 | 0.64 | 0.95 | 0.92 | 0.95 |
| Sargan Instrument Validity Test | 1.69 | 0.44 | 0.37 | 0.46 | 0.55 | 1.04 |
| Davidson and McKinnon test for exog | 0.04 | 1.15 | 6.13 ** | 0.34 | 2.01 | 1.23 |
| Hausman test | 0.05 | 1.07 | 4.18 ** | 0.51 | 1.94 | 1.29 |

Notes
1. All continuous variables, apart from the gini coefficient, are logged.
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