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Public spending and outcomes: Does governance matter? ☆

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Abstract

This paper studies the links between public spending, governance, and outcomes. We examine the role of governance–measured by the level of corruption and the quality of bureaucracy–in determining the efficacy of public spending in improving human development outcomes. Our analysis contributes to our understanding of the relationship between public spending, governance and outcomes, and helps explain the surprising result that public spending often does not yield the expected improvement in outcomes. We show empirically that the differences in the efficacy of public spending can be largely explained by the quality of governance. Public health spending lowers child mortality rates more in countries with good governance. Similarly, public spending on primary education becomes more effective in increasing primary education attainment in countries with good governance. More generally, public spending has virtually no impact on health and education outcomes in poorly governed countries. These findings have important implications for enhancing the development effectiveness of public spending. The lessons are particularly relevant for developing countries, where public spending on education and health is relatively low, and the state of governance is often poor.

JEL classification: E62; O23
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1. Introduction

The role of good governance as a key to development effectiveness has been emphasized in recent years.[1] It has been argued that merely allocating public resources for the right goods and services may not lead to desirable outcomes if budget institutions–involving budget formulation, execution and monitoring–are malfunctioning (World Bank, 2003). While this proposition seems straightforward and difficult to disagree with, no serious empirical work has been done to support it. In this paper, we study the impact of public spending on outcomes at different levels of governance.[2] The basic idea is to

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[1] The recently outlined Anticorruption and Governance Strategy of the World Bank (2007) provides a comprehensive case of why governance matters for development and poverty reduction.

[2] According to World Bank (2007), good governance is epitomized by predictable, open, and enlightened policy making (that is, transparent processes); a bureaucracy imbued with a professional ethos; an executive arm of government accountable for its actions; and a strong civil society participating in public affairs; and all behaving under the rule of law.

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examine the link between specific budgetary allocations and outcomes, and to see how these relationships are affected by improved governance.

A number of past studies (see Section 2 for references) have looked at the link between public spending and outcomes (e.g., impact of public spending on economic growth or on other outcomes such as health status or education attainment). In cases where public spending is found to have low or negligible impact, two explanations are given: first, it is argued that the link between public spending and development outcomes could be severed because an increase in public provision could lead to a "crowding out" of private sector provision. This line of reasoning does not question the efficacy of public spending per se; instead, it contends that due to the substitution of public for private spending, additional public provision in many cases has a negligible net marginal effect. The second set of possible reasons for the ineffectiveness of public spending includes poor targeting and/or institutional inefficiencies such as leakage in public spending and weak institutional capacity.

Poor budget management has frequently been cited as one of the main reasons why governments in developing countries find it difficult to translate public spending into effective services (World Bank, 2003). A reasonable proposition, therefore, can be made: managing public resources to promote development requires well-trained, skillful personnel, working in an institutional setting with an incentive system that reduces fraud and promotes cost efficiency. The main objective of this paper is to empirically examine a testable version of this proposition. More specifically, we address the following question: what is the impact of good governance–as measured by the level of corruption and the quality of bureaucracy–on the effectiveness of public spending on health and education?

We show empirically that governance is central in determining the efficacy of public spending. In particular, a 1 percentage point increase in the share of public health spending in GDP lowers the under-5 mortality rate by .32% in countries with good governance (as measured by a corruption index), .20% in countries with average governance, and has no impact in countries with weak governance. Similarly, a 1% point increase in the share of public education spending in GDP lowers the primary education failure rate by .70% in countries with good governance, and has no discernable impact in countries with weaker governance. These findings provide one possible explanation to the surprising result that public spending often does not yield the expected improvement in human development outcomes.

The remainder of this paper is organized as follows: in Section 2 we provide a brief review of the links between public spending and development outcomes that have been studied in the past. This section also provides the motivation behind our research. In Sections 3 and 4 we discuss our experiments with institutional variables that affect the spending-outcome link in the health and education sectors, respectively. Section 5 looks at the efficacy of public spending at different levels of governance. Section 6 looks at the robustness of our empirical results. Finally, Section 7 presents our concluding remarks.

2. Public spending and outcomes: what do we know?

There is a fair amount of research on the relationship between public spending and outcomes. The research on endogenous growth in the 1990s had produced several models linking public spending with the economy's long-term growth rate. Aschauer (1989), Barro (1990, 1991), Levine and Renelt (1992), Easterly and Rebelo (1993), Devarajan et al. (1996), Mittnik and Neumann (2003), and De la Croix and Delavallade (2006), among others, have studied the relationship between public spending and economic growth. A number of these studies find conflicting results regarding the growth impact of different types of sectoral spending. For example, Easterly and Rebelo (1993) show that public investment in transport and communication in developing countries is positively correlated with growth with a very high coefficient. On the other hand, using data from 43 developing countries over 20 years, Devarajan et al. (1996) find that capital spending–in particular, public investments in transport and communication–has a negative correlation with real per capita GDP growth.

In addition to the work on the relationship between public spending and economic growth, many researchers have examined the link between sectoral public spending (mostly in the health and education sectors) and outcomes in those sectors. For example, Harbison and Hanushek (1992) examined 12 studies on developing countries that look at the association between public education spending and educational outcomes. Six of these studies report a statistically significant positive relationship between the two; others found no evidence of any measurable impact of spending on outcomes. Hanushek (1995), Mingat and Tan (1992, 1998), and Wolf (2004) also find that that there is little if any relationship between public education spending and educational outcomes. Using a sample of 70 countries, Gupta et al. (2001) note that the relationship between public spending and the health status of the poor is

stronger in low-income countries than in higher-income countries. Filmer and Pritchett (1999) provide a good survey of studies linking public spending with health outcomes. In their own work, they find that the two are very tenuously related. According to their results, doubling public spending from three to six percent of GDP would improve child mortality by only nine to 13%.

What do these weak links between public spending and development outcomes indicate? Does it mean that the governments (mostly in developing countries) are spending on unproductive activities? Should they not be spending on education and health? Generally, it is difficult to draw such policy conclusions from cross-country data as much depends upon the country-specific situation. However, it is possible that these studies do not shed light on the "true" relationship between public spending and development outcomes. The link between public spending and desirable outcomes may, in practice, be severed when there is no incentive mechanism in the public sector to use available funds for productive purposes. In explaining the negative link between capital spending and per capita growth, Devarajan et al. (1996) note that this may reflect a problem in the link between public spending and service delivery. They argue that while public capital stocks in developing countries have been shown to be associated positively with economic growth, it may be the case that public spending–as measured by official figures in countries' budget documents–does not create any productive capital.

Surveying the literature on the link between public spending and outcomes, Pritchett (1996) notes that all of the negative or ambivalent findings on public spending could potentially be a reflection of differences in the efficacy of spending. These differences could arise due to a variety of reasons including corruption and patronage, and need not necessarily be attributed to bad economic policy. In other words, a unit's worth of public spending does not necessarily buy a unit's worth of service.[3]

Yet another reason the link between public spending and outcomes could be broken is the displacement of private sector effort by public spending. This argument is eloquently made in Filmer et al. (2000). Commenting on the weak links that several studies have found between public spending on health and health status, the authors argue, "…changes in the price or availability of government interventions may induce a private supply response that can mitigate any actual impact on health outcomes." Thus, if an increase in public spending on health "crowds out" private sector provision of such services then the likely impact of an additional unit of public spending on health status may be minimal. While this could be a plausible reason affecting the efficacy of public spending, our research does not address this question.

Turning to governance, does it affect development outcomes? There is now a large empirical literature on the relationship between a variety of governance indicators and development outcomes.[4] The majority of these studies show that improved governance leads to better development outcomes. These studies have analyzed the effects of corruption and institutions on, among other variables, economic growth, public investment, foreign direct investment, and social infrastructure. Kaufmann et al. (1999) and Kaufman et al. (2004), show that governance indicators (including voice and accountability, political stability and violence, government effectiveness, regulatory burden, rule of law and graft) have a strong *direct* negative impact on infant mortality. Gupta et al. (1999) find that countries with high corruption have high child and infant mortality rates. De La Croix and Delavallade (2006) find that countries with high corruption invest more in housing and physical capital in comparison with health and education. The associated rent seeking in physical capital hampers economic growth.

Overall, the research that links public spending with development outcomes, and governance with development outcomes, captures only a part of the full picture. The reality is that public spending, governance and developent outcomes are interlinked, and it is this impact that we seek to assess empirically in our research.[5] Our analysis shows that differences in the efficacy of public spending in improving health and education outcomes can be explained by the quality of governance.

In a paper that appeared since the working paper version of our work, Jayasuriya and Wodon (2007) use a

[3] A good example supporting this theory comes from a public expenditure tracking survey done in Uganda, a poor sub-Saharan African country. In a survey of 250 primary schools in Uganda, Ablo and Reinikka (1998) found that on average these schools received only 13% of the budgetary allocation for non-wage expenditures; the remaining amount–en route from the finance ministry to the facilities–either disappeared or was used for purposes unrelated to primary school education. If a researcher were to use such budgetary information on primary school expenditures from government accounts, she may find that there is very little, if any, impact of public primary education spending on the attainment of primary-school children. In reality, such a result would reveal little about the true worth of a unit of expenditure on primary education that actually reaches the intended sector. At the same time, it is difficult for the researcher to find out, over a period of time and across countries, what is the "true" amount of spending on public programs.

[4] Kaufmann et al. (1999) provide a brief survey of this literature.

[5] In this paper we measure governance by two specific indicators: quality of bureaucracy and level of corruption.

stochastic frontier estimation methodology to study the interplay of public resources and efficiency measures in explaining why education and health outcomes are worse in some areas within a country as compared to others. Using provincial and state-level data for Argentina and Mexico they argue that the error structure from their estimation methodology allows them to "assess whether some areas lag behind others due to lack of resources, or a lack of efficiency in using existing resources." In their analysis efficiency is a number that is estimated and they do not explain what factors are behind that inefficiency. Our regression analysis, on the other hand, attempts to analyze specific governance factors that could be responsible for affecting the efficacy of spending.

Finally, another strand of literature has looked at the efficacy of public spending using the randomized experiment methodology. This line of research analyzes the impact evaluation of a particular experiment on outcomes. For example, a number of randomized evaluation studies (see Glewwe and Kremer, 2006, for a review of this work) have shown that spending on items like textbooks, additional teachers and flip charts has no impact on children's test scores. While this research is based on a powerful methodology, the generalization from one experiment in one particular setting is as difficult as offering a generalized interpretation of structural parameters from a cross-country regression. Both methodologies offer valuable information, but of a different kind. One is of a very specific variety, i.e., whether randomized variations in numbers of teachers, textbooks and other items lead to higher mathematics scores in rural India. The other provides more general information, i.e., whether countries with better governance systems have higher efficacy of public spending.

3. Efficacy of public health spending

Every country–rich or poor, developed or underdeveloped–undertakes public health spending with a single dominant objective: to improve the health of its citizens. Different countries adopt different approaches to meet this objective. Some spend more public resources than others; some spend more on preventive than curative care; and some countries rely more on the private sector for service delivery. There is also wide variation in public health spending across countries, ranging from less than 1 percent to more than 8% of GDP.

Our approach in this paper is to interact a public health spending variable with a governance indicator. This is similar to the approach used by Burnside and Dollar (2000) in asking the question whether foreign aid has a stronger (positive) impact on growth in countries with good policies.[6] This analysis allows us to empirically examine whether public health spending is more effective in improving health status in countries with good governance.

3.1. Empirical specification

We estimate the following functional form:[7]

$$\ln(\mathrm{HS}_{i,t}) = \delta_0 + \delta_1 \ln(\mathrm{PCGDP})_{i,t} + \delta_2 \ln(\mathrm{PHSGDP})_{i,t} + \delta_3 G_{i,t} + \delta_4 G_{i,t} * \ln(\mathrm{PHSGDP})_{i,t} + BX_{i,t} + \varepsilon_{i,t} \quad (1)$$

where the variables for country i are: HS — health status as measured by the under-5 (child) mortality rate; PCGDP — per capita GDP measured in purchasing power parity adjusted dollars; PHSGDP — share of public health spending (defined as recurrent and capital spending from government [central and local] budgets, external borrowings and grants) in GDP;[8] G — a measure of governance (index of corruption or quality of bureaucracy); X — a vector of non-health related country specific factors; B — a vector of coefficients of X; and ε — an error term. In order to capture the direct and the indirect effects that governance may have on health status, the variable G_i enters into the model both as an independent variable and interacted with the share of public health spending in GDP.

3.2. Data and choice of variables

Our empirical analysis uses annual data for 1990, 1997 and 2003 (see the Data Appendix for more information including data sources). These are years for which data are available across a sizeable sample of countries. Moreover, there is considerable variation over this time period in many variables including the ones on governance. The years selected also facilitate comparability with the results of Filmer and Pritchett (1999) who also used 1990 as the year for their cross-national study,

[6] While the Burnside and Dollar (2000) methodology remains popular, their empirical results have been challenged by Easterly, Levine and Roodman (2004), among others. It is claimed that their results do not hold when the data set is expanded to include other countries.

[7] In estimating a functional form, most studies use log of mortality as the dependent variable. The specification of the right-hand side variables varies. For a discussion on functional forms used in this literature, see Filmer and Pritchett (1999).

[8] One could argue that outcomes in time t are not just affected by spending undertaken in that period, but also by spending taken in the previous years. Including the lagged spending variables, however, does not change our results.

Table 1A
Summary statistics on public health spending, governance and outcomes (data from 91 countries over three years: 1990, 1997 and 2003)

Variables	Observations	Mean	Std. Dev.	Min	Max
Under-5 mortality rate	228	68.9	71.3	3.6	290.2
Public health spending (share in GDP)	228	3.31	2.09	0.18	8.68
Per capita GDP (in PPP adjusted 2000$)	228	9728	10,576	495	64,299
Index of corruption (least corrupt=6)	228	3.24	1.41	0	6
Quality of bureaucracy (highest=4)	228	2.31	1.20	0	4

Note: The 91 countries in the sample are listed below. In the case of countries with less than 3 observations (i.e. less than 3 years of data), the number of observations is given in parentheses. The countries are: Angola (1), Argentina, Australia, Austria, Bahamas (2), Belgium (2), Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Congo (2), Democratic Republic of Congo (1), Cote d'Ivoire, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador (2), Finland, France (2), Gabon (1), Gambia (2), Germany (2), Ghana, Greece (2), Guatemala, Guinea, Guinea-Bissau (2), Haiti (2), Honduras, Hungary (2), Iceland (2), India, Indonesia, Iran (1), Ireland, Israel, Italy (2), Jamaica, Japan, Jordan (2), Kenya (2), Lebanon (1), Luxembourg, Madagascar (2), Malawi (2), Mali (2), Mexico, Morocco (2), Mozambique, Netherlands, New Zealand, Nicaragua, Niger (2), Nigeria, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland (1), Portugal (2), Romania (2), Saudi Arabia (1), Senegal, Sierra Leone (2), South Africa (2), Spain (2), Sweden, Switzerland, Tanzania, Thailand, Togo (2), Trinidad and Tobago, Tunisia (2), Turkey, Uganda (2), United Kingdom (2), United States, Uruguay, Venezuela (2), Yemen, Zambia (2).

though our sample number of countries is smaller as data on governance are not available for several of the countries included in Filmer and Pritchett.

We study the impact of public health spending on child (under 5) mortality. However, unlike previous researchers, we model the interaction between public spending and governance indicators in assessing this impact. Like Filmer and Pritchett (1999), our key spending variable is total public health expenditure, which is available for a large cross-section of countries from the World Development Indicators compiled by the World Bank. Unfortunately, data on the composition of spending across different health inputs are not available for most countries. On governance, we use two measures–corruption and bureaucratic quality–to interact with public health spending. Corruption is measured on a scale of 0 to 6, and bureaucratic quality ranges from 1 to 4. Both indicators are available on a monthly basis and are compiled by the US-based Political Risk Services Group, which provides information on a regular basis for international businesses. The index of corruption measures corruption within the political system, which among other things reduces the effectiveness of government. The index of bureaucratic quality measures the soundness of institutions and the quality of the civil service. It assesses the strength and expertise of bureaucrats. Other non-health related variables that we use in the regressions are standard in the literature;[9] they include ethno-linguistic fractionalization, the percentage of the population that is Muslim, the percentage of females aged 15 and above that are literate, the percentage of the population living in urban areas, and the Gini coefficient a measure of income inequality. We also include a demographic variable—the percentage of the population under the age of 5.

3.3. Empirical results

Our health status regressions use a sample of 228 observations over three years (1990, 1997 and 2003) from 91 developed and developing countries (see Table 1A). Dummy variables for two of the three years are included to allow for independent trends in health status over time. The mean value of child mortality (per 1000 live births) is 68.9. The average share of public health spending in GDP is about 3.3%, and ranges from less than 0.5% to over 8% of GDP. The mean values for the governance indicators–the corruption index and quality of bureaucracy index–are 3.24 (out of a scale of 0–6) and 2.31 (out of a scale of 0–4), respectively. Finally, on average, a typical country in our dataset has a per capita GDP (in 2000 dollars, purchasing-power-parity adjusted) of 9728.

3.3.1. Ordinary Least Square (OLS) regressions: factors affecting health status

We begin by running regressions of our model given in Eq. (1), using the method of OLS but with the error variance structure modified in the following way: The error terms for country i and for years 1990, 1997 and 2003 are denoted as ε_{i0}, ε_{i1} and ε_{i2} respectively, and it is assumed that:

(i) $\text{Var}(\varepsilon_{i0}) = \text{Var}(\varepsilon_{i1}) = \text{Var}(\varepsilon_{i2}) = \sigma^2$ for all i;
(ii) $\text{Cov}(\varepsilon_{i0}, \varepsilon_{i1}) = \text{Cov}(\varepsilon_{i1}, \varepsilon_{i2}) = \text{Cov}(\varepsilon_{i0}, \varepsilon_{i2}) = \rho$ for all i; and
(iii) $\text{Cov}(\varepsilon_{is}, \varepsilon_{jt}) = \text{Cov}(\varepsilon_{it}, \varepsilon_{js}) = 0$ for all $i \neq j$

where s and t can each take the value 0, 1 or 2.

This allows for correlation between error terms over time for the same country. This formulation is aimed at

[9] For a survey, see Filmer et al. (2000).

Table 1B
Summary statistics on public primary education spending, governance and outcomes (data from 57 countries over three years: 1990, 1997 and 2003)

Variables	Observations	Mean	Std. Dev.	Min	Max
Primary education failure rate	101	21.27	23.01	0.01	77.86
Public primary education spending (share in GDP)	101	1.54	0.74	0.39	4.4
Per capita GDP (in PPP adjusted 2000$)	101	8629	8184	510	35,341
Index of Corruption (least corrupt=6)	101	3.27	1.33	0	6
Quality of Bureaucracy (highest=4)	101	2.25	1.1	0	4

Note: The countries in the sample (with the number of observations listed in parentheses if less then 3) are: Austria (2), Bangladesh (2), Bahrain (2), Bolivia (1), Botswana (1), Brazil (1), Bulgaria (1), Burkina Faso (1), Cameroon (1), Chile, China (2), Colombia, Congo (1), Cote d'Ivoire (2), Costa Rica, Ecuador (1), Finland, France (2), Gambia (1), Greece (2), Guatemala (2), Haiti (1), Hungary (1), Israel (2), Italy (2), Jamaica (2), Ireland, Malawi (2), Mali (1), Mexico, Morocco (2), Mozambique (1), Namibia (1), New Zealand (1), Nicaragua, Niger, Norway (2), Pakistan (1), Panama (2), Paraguay (2), Poland, Romania (1), Saudi Arabia (1), Senegal (2), Slovenia (1), South Korea, Sudan (1), Sweden (1), Syria (2), Thailand (1), Togo (2), Tanzania (1), Trinidad and Tobago (2), Tunisia, Uruguay (2), Venezuela (2), Zimbabwe (1).

capturing country-specific effects that persist over time.[10]

Table 2 contains the OLS estimates of our model given in Eq. (1). Regression (2.1) presents the results from estimating a simple version of Eq. (1)—one that does not include the governance variable. It indicates that a one percentage point increase in per capita GDP at the margin is associated with a .42% reduction in child mortality, that is, the estimated elasticity of mortality is .42. At the same time, a one percentage point increase in the share of public health spending in GDP is linked with a .18% reduction in child mortality. These two and other non-health related variables explain 94% of the variation in cross-national child mortality rates.[11]

We now interact public health spending with the index of corruption and include this as an additional regressor. To capture the direct effect of corruption on health status, we also include the index of corruption independently. The results of regression 2.2 are reported in Table 2. The key result here is that spending interacted with corruption has a significant coefficient of −.09 (with a *t*-statistic of −3.11). Among other regressors, ethno-linguistic fractionalization is positively and significantly correlated with child mortality. In countries where more adult women are literate, child mortality is lower. Countries with a higher percentage of population under age 5 have higher child mortality rates. A similar result (see Regression (2.3)) is obtained when the spending variable is interacted with the quality of bureaucracy index: the coefficient on spending alone is positive and insignificant, but the interaction term has a significantly negative coefficient.[12, 13]

Overall, our results in Table 2 support two basic hypotheses: (1) rich countries have lower child mortality; and (2) the link between public health spending and child mortality is negative, but the efficacy of public spending in lowering child mortality is positively related with the level of governance. The first is a fairly consistent result in the literature (see Filmer et al., 2000). The second finding confirms what proponents of good governance have been arguing: well-functioning public institutions are critical for translating public spending into effective services.

4. Measuring the efficacy of public education spending

As discussed in Section 2, past research on the link between public education spending and measurable outcomes also yielded mixed results. In studying this relationship, our aim is again to examine how the efficacy of public spending on education outcomes is affected by the quality of governance.

[10] It is possible that variables may be correlated over time and without appropriate adjustments, using three years of data would then be similar to multiplying the number of observations by three, resulting in artificially high *t*-statistics. Since we allow the error terms to be correlated over time for a country–essentially similar to a random effects specification–we adjust the standard errors appropriately.

[11] When estimated in a rather parsimonious form–with only two regressors: per capita GDP and public health spending–the model explains 88% of the variation in cross-national child mortality rates. Moreover, both variables are statistically significant and have the expected signs.

[12] The results are very similar when we use infant mortality, another indicator of health outcomes, as the dependent variable. For space considerations these results are not reported here. They are available from the authors.

[13] Our specification is essentially a random effects specification (i.e. allowing for correlation across the error terms for each country). An alternative would be to use a fixed effects specification (where there is no correlation across any error terms, but where a dummy variable is introduced for each country in the regression). We ran a Hausman test (Hausman, 1978) to verify that our approach is appropriate, for each regression reported in Table 2. The test showed that the random effects specification is indeed the preferred option (with the *p*-value well above the cutoff level of 5%) in all cases, giving consistent and efficient estimates.

Table 2
OLS regressions: factors affecting health status (White heteroskedasticity-corrected *t*-statistics in parentheses)

Dependent variables →	Under-5 mortality (natural log)		
Independent variables ↓	Regression (2.1)	Regression (2.2)	Regression (2.3)
GDP per capita in PPP adjusted 2000$ (ln)	−0.42(−5.33)	−0.37(−4.93)	−0.29(−3.31)
Public health spending (ln of share of GDP)	−0.18(−2.95)	0.083(0.91)	0.10(1.42)
Index of corruption (least corrupt=6)		0.03(0.64)	
Quality of bureaucracy (highest=4)			0.0008(0.02)
Index of corruption × public health spending (ln of share of GDP)		−0.087(−3.11)	
Quality of bureaucracy × public health spending (ln of share of GDP)			−0.12(−4.06)
Female education	−0.008(−2.45)	−0.009(−3.05)	−0.010(−2.95)
Income inequality	0.007(1.85)	0.005(1.29)	0.004(0.95)
Predominantly Muslim	0.003(3.03)	0.003(2.69)	0.003(2.84)
Ethnolinguistic fractionalization	0.59(4.22)	0.71(5.01)	0.76(5.32)
Access to safe water	−0.003(−1.07)	−0.003(−1.37)	−0.004(−1.56)
Degree of urbanization	−0.0004(−0.15)	−0.0004(−0.15)	−0.0004(−0.18)
Percentage of population aged under 5	0.094(3.91)	0.094(4.22)	0.097(4.37)
Distance from the Equator	0.04(0.12)	0.41(1.27)	0.31(0.96)
Dummy for year 1997	−0.10(−3.16)	−0.12(−3.51)	−0.10(−2.78)
Dummy for year 2003	−0.13(−2.42)	−0.18(−3.60)	−0.14(−2.66)
Constant	5.94(6.84)	5.56(7.07)	5.03(5.72)
R^2	0.94	0.95	0.95
Number of observations	228	228	228

4.1. Choosing a measure of educational outcome

One important difference between the health and education sectors is that it is difficult to find educational outcome measures that are consistent across countries. In education there is no equivalent to the child and infant mortality indicators used in the health sector. Data on enrolment rates are widely available, but they do not reflect quality differences across countries. Moreover, enrolment numbers, especially at the primary level, include repeaters as well as students that subsequently drop out of school. For example, Filmer and Pritchett (1999) report that in almost all countries in South America, enrolment in the first grade is nearly 100%, but due to high dropouts rates, a large proportion of those enrolled do not complete primary school education.

Educational *attainment* has been used by several researchers to measure outcomes (Barro and Lee, 1996, 2000). Attainment can be defined as the number or proportion of school-age children that enter *and complete* primary or secondary school, or a particular grade. This is a superior measure to enrolment because it excludes students that drop out of school prematurely and it is not affected by the number of repeaters. There is another advantage to using educational attainment: it has a strong inverse relationship with dropout rates, and the latter are, in turn, markedly affected by educational quality (Harbison and Hanushek, 1992; Barro and Lee, 1998). Holding other things constant, students who receive good education, as reflected by good instruction aided with textbooks and other instructional materials, are more likely to stay in school. Thus, high attainment rates indirectly reflect high educational quality.

4.2. Empirical specification, data and choice of variables

We estimate a similar model to that which was used for the health sector regressions:

$$\ln(\mathrm{EF}_{i,t}) = \delta_0 + \delta_1 \ln(\mathrm{PCGDP})_{i,t} + \delta_2 \ln(\mathrm{PESGDP})_{i,t} + \delta_3 G_{i,t} + \delta_4 G_{i,t} * \ln(\mathrm{PESGDP})_{i,t} + BX_{i,t} + \omega_{i,t} \quad (2)$$

where the variables for country i are: EF — proportion of those who fail to complete an adequate level of primary school education — a measure of educational failure;[14] PCGDP — per capita GDP measured in purchasing power parity adjusted dollars; PESGDP — share of public primary education spending in GDP; G — a measure of governance (index of corruption or quality of bureaucracy); X — a vector of non-education related country specific factors; B — a vector of coefficients of X; and ω — an error term. In order to capture the direct and indirect effects that governance may have on educational status, the variable G_i again enters into the model both as an independent variable and interacted with the share of public primary education spending in GDP.

[14] To be consistent with our mortality measures of the health sector, we use education non-attainment as our outcome measure.

Table 3
OLS regressions: factors affecting education outcomes (White heteroskedasticity-corrected *t*-statistics in parentheses)

Dependent variable →	Education failure rate (natural log)		
Independent variables ↓	Regression (3.1)	Regression (3.2)	Regression (3.3)
GDP per capita in PPP adjusted 2000$ (ln)	−1.27(−5.33)	−1.20(−5.21)	−1.01(−3.91)
Primary education spending (ln of share of GDP)	−0.28(−1.35)	0.63(1.28)	0.55(1.55)
East Asia dummy	−2.18(−4.96)	−2.34(−5.63)	−2.10(−4.35)
Adult illiteracy rate	0.01(1.08)	0.01(1.28)	0.016(1.64)
Index of corruption (least corrupt=6)		−0.05(−0.49)	
Quality of bureaucracy (highest=6)			−0.12(−0.93)
Index of corruption×primary education spending (ln of share of GDP)		−0.29(−2.24)	
Quality of bureaucracy×primary education spending (ln of share of GDP)			−0.36(−2.42)
Income inequality	0.01(0.95)	0.01(0.89)	0.009(0.70)
Predominantly Muslim	0.0008(0.22)	−0.0004(−0.12)	−0.0009(−0.26)
Ethnolinguistic fractionalization	−0.75(−1.58)	−0.75(−1.80)	−0.45(−1.04)
Degree of urbanization	0.011(1.28)	0.009(1.11)	0.011(1.29)
Percentage of population aged 6 to 12	0.009(0.17)	−0.008(−0.16)	0.003(0.05)
Dummy for year 1997	0.115(0.42)	0.016(0.06)	−0.008(−0.03)
Dummy for year 2003	−0.18(−0.52)	−0.42(−1.08)	−0.16(−0.47)
Constant	11.91(4.89)	11.96(4.81)	10.08(4.05)
R^2	0.67	0.68	0.68
Number of Observations	101	101	101

The measure of educational failure that we use is constructed as follows:

$$EF^{i,t} = 100 - \text{Attain}\,PS^{i,t} = 100 - \text{Intake}\,PS^{i,t} x\,\text{EComp}\,PS_{0,5}^{i,t}$$

Attain $PS^{i,t}$ is an estimate of the percentage of all children of official primary school entry age at time *t* who actually enter Grade 1 and are expected to continue and complete Grade 5. This estimate reflects two factors: (1) Intake $PS^{i,t}$ which is the proportion of all children of primary-school entry age who actually start school at time *t*; and (2) EComp ${PS_{0,5}}^{i,t}$ which measures the proportion of Intake $PS^{j,t}$ who are expected to continue and finish Grade 5. The measure EComp ${PS_{0,5}}^{j,t}$ is calculated using data on completion rates for students in Grade 1 through 5 at time *t* (for more details, see the Data Appendix). The cutoff point for the calculation of the completion rate is Grade 5 rather than the final grade in primary school, because the latter varies substantially across countries.[15]

There is ample anecdotal and empirical evidence that educational outcomes are affected by family factors such as parents' income, occupations and educational background (Psacharopoulos and Woodhull, 1985; Hanushek, 1995; Barro and Lee, 1998). These are reflected in three of our right-hand side variables: per capita income, the Gini coefficient (an indicator of income distribution), and the overall level of adult literacy.[16] Primary education spending is one of the key regressors in our analysis, along with the same two governance variables as in the health regressions: the level of corruption and of bureaucratic quality. Other right-hand side variables include ethno-linguistic fractionalization, the proportion of Muslims in the population, the level of urbanization, the proportion of the population aged 6 to 12, and a dummy variable for East Asia. The first three variables reflect racial, cultural and physical circumstances that may affect education provision and demand. The proportion of the population aged between 6 and 12 is a demographic factor that has been shown to be strongly correlated with educational outcomes (Mingat and Tan, 1998). A dummy variable for the countries in the East Asia Region is included as there seems to be a strong emphasis on the importance of education in these countries, probably due to cultural reasons (Stevenson, 1992; Barro and Lee, 1998).

[15] In principle, a similar technique could be used to compute attainment at the secondary and tertiary levels. In practice, however, the data required for this are not available for a sufficiently large number of countries. We tried using secondary school enrolment as a proxy for secondary level attainment, a reasonable procedure since secondary school dropout rates tend to be relatively low in many countries. The ensuing regressions did not, however, perform well. In this paper, we report only the results of regressions explaining variations in failure to attain five years of primary education.

[16] It is possible that the adult literacy variable is endogenous, as unobserved factors affecting it may also affect primary school attainment. While we do not address the possible endogeneity problem, we did check our results by performing each education regression twice: once with adult literacy as a right-hand side variable, and once without it.

Table 4
The impact of public spending on outcomes at different levels of governance

A. Results from regressions without the governance interaction term:

Impact on → Impact of ↓	Under-5 mortality (from Regression (2.1))	Primary education failure rate (from Regression (3.1))
Public health spending	−.18**	
Public education spending		−.28

B. Results from regressions with the governance interaction term G_i:

Impact on → Evaluated at G_i values → Impact of ↓	Under-5 mortality						Primary education failure rate					
	Corruption index (δ_2,δ_4 from Regression (2.2))			Quality of bureaucracy (δ_2,δ_4 from Regression (2.3))			Corruption index (δ_2,$\delta_4$from Regression (3.2))			Quality of bureaucracy (δ_2,δ_4 from Regression (3.2))		
	1.83^B	3.24^M	4.65^U	1.11^B	2.31^M	3.51^U	1.94^B	3.27^M	4.6^U	1.15^B	2.25^M	3.35^U
Public health spending × ($\delta_2+\delta_4 * G_i$)	−.08	−.20**	−.32**	−.03	−.17**	−.32**						
Public education spending × ($\delta_2+\delta_4 * G_i$)							.07	−.31	−.70**	.14	−.26	−.66**

Notes: (a) Evaluated at: ^{M}Sample mean; ^{B}One standard deviation below the mean; and ^{U}One standard deviation above the mean. (b) Based on a '*t*' test for functions of parameters: *Significantly lower than 0 at 10-percent level; **Significantly lower than 0 at 5-percent level.

4.3. Empirical results

Our education results are based on a sample that has 101 observations from 57 countries over the same three years as for the health regressions: 1990, 1997 and 2003. This sample size is considerably smaller than the one used for the health sector regressions as data on our measure of education attainment are available for fewer countries. Summary statistics presented in Table 1B indicate that on average, 21.3% of students of official primary school entry age failed to complete five years of primary education. The average share of public education spending at the primary level in GDP is close to 1.54%, and ranges from less than 0.5% to over 4%. The mean values for the governance indicators–the corruption index and quality of bureaucracy–are 3.27 (out of a scale of 0–6) and 2.25 (out of a scale of 0–4), respectively. The average purchasing-power-parity adjusted value of per capita GDP for this sample is 8629 measured in 2000 dollars—somewhat less than in the sample that we use for the health sector analysis.

4.3.1. Regressions: factors affecting education outcome

We begin with an OLS estimation of Eq. (2). The results of regression 3.1 are reported in Table 3. Again, as explained in detail in sub-section 3.3.1, in estimating this equation we allow for a correlation between any two error terms corresponding to observations for different years but for the same country. The most important factor explaining the variation in the failure to complete five years of primary school education is per capita GDP. A 1% point increase in per capita GDP is associated with a reduction of over 1 percent in the failure rate. This finding is consistent across all equations. Of course, this is not unexpected: students in rich countries have higher levels of education attainment.

Our primary interest, however, is in gaining a better understanding of public education spending and its interaction with indicators of governance. When estimated without the interaction term, as in regression 3.1, the coefficient on primary education spending has the expected sign, but is not statistically significant. When the term interacting primary education with the index of corruption is included–regression 3.2–the coefficient on the spending variable alone changes sign but continues to have a low *t*-value, while the interaction term has the expected sign and is highly statistically significant. Among other variables, the dummy for East Asian countries is, as expected, highly significant; countries in the East Asia Region are known to have high primary school attainment. The income inequality variable has the expected sign–countries with high inequality tend to have a higher failure rate–but has low statistical significance.[17, 18]

[17] Excluding the adult literacy rate does not make much of a difference to the results. The regression results without adult literacy are not reported here due to space considerations. They are available from the authors.

[18] As in the case of the child mortality regressions of Table 2, we ran a Hausman test to verify that our random effects specification is appropriate, for each education regression reported in Table 3. The test showed that the random effects specification is indeed the preferred option (with a high *p*-value obtained) in all cases, giving consistent and efficient estimates.

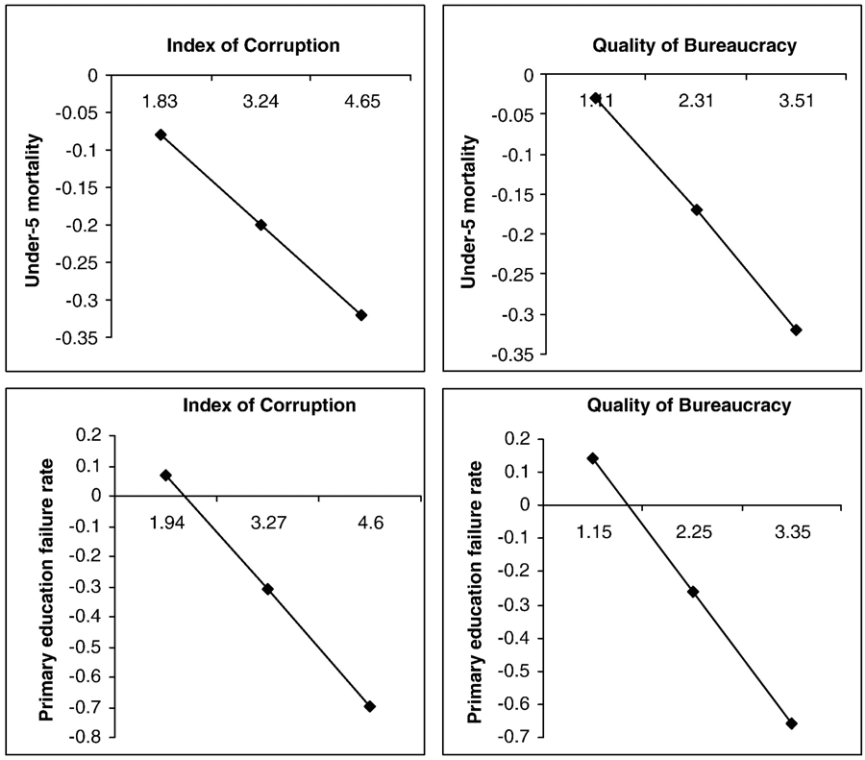

Fig. 1. The impact of public spending on outcomes at different levels of governance. Notes: (i) corruption is measured on a scale of 0 to 6; from most corrupt to least corrupt. Quality of bureaucracy is measured on a scale of 0 to 4, with a higher number indicating improved bureaucracy. (ii) The three points in each graph depict the impact on outcomes at three different levels of governance. The latter are at one standard deviation below the sample mean, the sample mean and one standard deviation above the sample mean, respectively (see Table 4).

Thus, our results in Table 3 support two basic hypotheses: (1) students in rich countries have higher education attainment; and (2) the link between public education spending and education attainment at the primary level is strengthened with improved governance. The first result is common in the literature and is not surprising. The second result is more interesting as it again underscores the importance of good governance in seeking improved educational outcomes.

5. Efficacy of public spending at different levels of governance

Table 4 reports the net impact of public spending on outcomes by combining the results obtained through different regressions reported in Sub-sections 3.3.1 and 4.3.1.

The first part of the table–Section A, which is based on regressions without the interactive (public spending with governance indicator) variable–reproduces results reported in regression (2.1) in Table 2 and regression (3.1) in Table 3.

Our main finding, however, emerges from the bottom half of the table: Section B reports the total impact of public spending on health and educational outcomes when the model includes the interactive governance variable. The net impact from the different regressions with the interactive governance variable reported in Sub-sections 3.3.1 and 4.3.1, is calculated as follows:

$$\frac{\%\,\Delta \text{ in outcome}}{\%\,\Delta \text{ in public spending}} = \delta_2 + \delta_4 G_i$$

where δ_i are coefficient estimates of Eqs. (1) and (2), and G_i is the governance indicator—corruption index or quality of bureaucracy. In Table 4, this elasticity of mortality with respect to public health spending is calculated at different levels of governance, using the estimates of the coefficients δ_i from the regressions previously reported (in Table 2). Each time, a *t*-test is used to evaluate if the estimated elasticity is significantly different from zero (see Maddala, 1992, for more

Table 5A
Robustness checks for child mortality regression with corruption index (White heteroskedasticity-corrected *t*-statistics in parentheses)[a]

Dependent variables →	Under-5 mortality rate (natural log)			
Independent variables ↓	Regression (2.2)[b] (OLS)	Regression (2.2.1) (OLS)	Regression (2.2.2) (OLS)	Regression (2.2.3)[c] (2SLS)
GDP per capita in PPP adjusted 2000$ (ln)	−0.37(−4.93)	−0.36(−4.73)	−0.24(−0.57)	−0.31(−3.24)
Public health spending (ln of share of GDP)	0.083(0.91)	0.11(1.13)	0.08(0.85)	0.082(0.23)
Public health spending (ln of share of GDP), squared		−0.08(−1.88)		
Corruption Index(most corrupt=0, least corrupt=6)	0.03(0.64)	0.008(0.09)	0.029(0.61)	0.25(1.95)
Corruption idex, squared		0.00003(0.00)		
Corruption idex from plitical risk services×public health spending (ln of share of GDP)	−0.087(−3.11)	−0.085(−2.16)	−0.083(−2.52)	−0.26(−2.50)
GDP per capita in PPP adjusted 2000$ (ln)×public health spending (ln of share of GDP)			−0.008(−0.34)	
R^2	0.95	0.95	0.95	0.91
Number of observations	228	228	228	228

Notes: [a]Only key coefficient estimates presented; [b]Regression (2.2) is the same as that in Table 2; [c]Instruments are dummy variables for countries with British common law, French civil law, German civil law, Scandinavian civil law, Socialist law and Islamic law.

information on this procedure). For example, Section B shows that the elasticity of child mortality, obtained from the OLS regression (2.2), is −.20 (significant at the 5-percent level), when evaluated at corruption index level 3.24, which is the sample mean for this governance indicator. When evaluated at a corruption index value of 4.65 (a value one standard deviation above the mean value for this index and indicates that corruption is lower), the elasticity is −.32 and is significant at the 5-percent level. Finally, it is not significantly different from zero when the corruption index is 1.83—one standard deviation below the mean value. There is a clear pattern. In countries with low levels of governance (that is, countries which are rated as very corrupt or are rated to have a very ineffective bureaucracy), public health spending at the margin will be less effective.

In Table 4 we also present our overall results on the impact of primary education spending on the "education failure" rate. Once again we find evidence in support of the hypothesis that in countries with good governance, education spending is effective in lowering education failure rates; there is no evidence of this, however, in a country with bad governance. These findings, both for health and education outcomes with the governance interactive effects, are depicted in Fig. 1.

6. Empirical robustness

The empirical support for our hypothesis–the link between public spending and outcome strengthens with improved governance–comes from four key

Table 5B
Robustness checks for education outcome regression with corruption index (White heteroskedasticity-corrected *t*-statistics in parentheses)[a]

Dependent variables →	Education failure rate (natural log)			
Independent variables ↓	Regression (3.2)[b] (OLS)	Regression (3.2.1) (OLS)	Regression (3.2.2) (OLS)	Regression (3.2.3)[c] (2SLS)
GDP per capita in PPP adjusted 2000$ (ln)	−1.20(−5.21)	−1.25(−5.36)	−1.05(−5.14)	−1.21(−3.83)
Primary education spending (ln of share of GDP)	0.63(1.28)	0.48(1.09)	1.21(0.85)	2.61(1.38)
Primary education spending (ln of share of GDP), squared		0.62(2.16)		
Corruption index from political risk services(most corrupt=0, least corrupt=6)	−0.05(−0.49)	0.69(1.32)	−0.05(−0.52)	0.005(0.04)
Corruption index from political risk services, squared		−0.12(−1.45)		
Corruption index from political risk services×primary education spending (ln of share of GDP)	−0.29(−2.24)	−0.34(−2.76)	−0.32(−2.52)	−0.79(−1.99)
GDP per capita in PPP adjusted 2000$ (ln)×primary education spending (ln of share of GDP)			−0.02(−0.14)	
R^2	0.68	0.69	0.68	0.53
Number of observations	101	101	101	101

Notes: [a]Only key coefficient estimates presented; [b]Regression. (3.2) is the same as that in Table 3; [c]Instruments are the same as above.

regressions: (2.2) and (2.3) in Table 2 for child mortality, and (3.2) and (3.3) in Table 3 for education outcomes. An important question in this regard is: are these regression results robust? To test the validity of our conclusions, we subject each of these four key regressions to three robustness tests; the results are reported in Tables 5A and 5B.

6.1. Including higher-order terms for spending and governance variables

In the regressions discussed above, the relationship between the dependent variable and the spending variable, both expressed in log form, is assumed to be linear. It is possible that the true relationship is quadratic or is closer to some other nonlinear relationship. In such a case the interactive governance variable might be capturing the nonlinear effects of public spending on health and educational outcomes. To test that it is truly this interaction that is driving the results, and not omitted nonlinearities, we include different nonlinear spending and governance terms in our regression model.

In regressions (2.2.1) and (3.2.1) of Tables 5A and 5B, two additional regressors–squared terms of the spending and governance variables–are included. In both cases, the results show that the interaction effects continue to be statistically significant with a coefficient of a similar size as in the original regressions.

6.2. Governance vis-à-vis country size effect

An argument can be made that the link between public spending and outcomes is significant in our regressions not because of better governance, but rather because of some other factors correlated with governance. For example, spending on health or education may be more effective in countries with better-trained medical personnel or teachers; these countries can be expected, on average, to have higher income levels than others, and governance is generally better in richer countries. In order to determine the impact of such variables on our results we added another right-hand side variable—public spending interacted with per capita GDP—in our basic model.

This modification did not change our original results substantially.

6.3. Two-Stage Least Squares (2SLS)

Our empirical results are based on the OLS regression methodology, which assumes that public spending is exogenously determined. As previous researchers have noted, it is possible that the two main variables in our analysis, public spending and social outcomes, are jointly determined. There also exists the possibility of reverse causation. For example, it is likely that when faced with poor and/or deteriorating health status of their citizens, governments increase spending on health. A similar assertion can be made for education.[19]

To address the endogeneity problem, we use instruments for the public spending and interaction variables in a 2SLS regression. Our choice of instruments is based on the following propositions: (i) some societies are more "state-oriented" than others, that is, they have an inherently greater belief in the role of the state in, among other things, the provision of health and education to citizens; and (ii) countries with a common law system (mostly the United Kingdom and its former colonies) are, on average, less "state-oriented" than those with a civil law system (mostly the rest of Western Europe and its former colonies), which are in turn less "state-oriented" than the communist and ex-communist countries (David and Brierly, 1978; Elster, 1997; Finer, 1997; La Porta, 1998). This second proposition can be extended further: the civil law countries can be further subdivided into societies based on French, German and Scandinavian law—all of which differ somewhat in the degree to which they are "state-oriented" (Finer, 1997; La Porta et al., 1999).

We divided the countries in our sample into different categories, according to whether their systems are based on common law, French civil law, German civil law, Scandinavian civil law or Socialist (i.e. Communist or Soviet-based) law. That amounts to five categories, and a sixth was also included: countries with systems based to a significant degree on Islamic law, although there is no clear indication in the literature as to how "state-oriented" one would expect these countries to be. The classification is based on Wikimedia Foundation (2006) and Central Intelligence Agency (2006); more details are provided in the data appendix. A dummy variable was created for each of these categories, and these dummy variables were used as instruments for our 2SLS regressions.[20] Our 2SLS results broadly confirm our original OLS results. We report the results from the

[19] Good health could also be a major determinant of per capita GDP growth. Moreover, it is well known that governance and GDP are correlated. These together, it is possible, could introduce an intractable endogeneity problem in the regressions, that becomes extremely difficult, if not impossible, to solve.

[20] In doing so, we recognize that there may be flaws in these instruments; in particular, there are many factors that explain how "state-oriented" a country is other than its history in terms of its legal system.

regressions with the corruption index (see regressions 2.2.3 and 3.2.3 in Tables 5A and 5B); the term interacting spending and governance remains statistically significant at the 5% level in both the health and education regressions.

We know that there is no cross-national instrumentation in this case that will be compelling to all; ours is simply one attempt to identify and use a suitable set of instruments. The 2SLS regressions should be seen as a means of cross-checking the OLS results. We believe that the OLS methodology is a valid data descriptive tool, which shows how the key variables are correlated irrespective of whether or not the correlations are revealing causality. Moreover, there are no reasons to believe that the OLS results are biased in any particular direction due to endogeneity. Notwithstanding the possible imperfections of our results, we believe that ours is the best available evidence to date on the topic in question.

We also performed several other robustness checks. We tried performing the child mortality as well as education failure rate regressions without the developed countries in the sample. With the reduced samples,[21] the results were similar, but the statistical significance of the interaction term was reduced in the case of the education regressions.[22] We also tried alternative measures of governance using data from Kaufmann et al. (1999). Our results using the alternative measures of "control of corruption" and "government effectiveness" were generally similar, with no change in levels of statistical significance for the key right-hand side variables. Finally, to check if outliers or other influential observations could be driving our results, we re-estimated both the child mortality and education regressions repeatedly, dropping each country one at a time. Our key results continue to hold in all cases, although the level of significance varies.[23]

[21] In the reduced samples, there were 170 observations (from 69 countries) for the child mortality regressions, and 81 observations (from 47 countries) for the education failure rate regressions.

[22] The interaction term remains statistically significant at the 10% level, in both education failure rate regressions (one interacting with the corruption index, and the other with the bureaucratic quality measure). The interaction term in both child mortality regressions remains statistically significant at the 5% level. The reduced significance in the case of the education regressions could be because a large proportion of the higher-governance countries are dropped when developed countries are omitted from the sample. As table 4 indicates, changes in governance at the lower end of the governance scale seem to have little or no impact on the effectiveness of public education spending; all the "action" seems to be at the higher end of the governance scale.

[23] The detailed results are not reported due to space consideration. They are available from the authors.

7. Conclusion

The analysis above substantially improves our understanding of the links between public spending, governance, and outcomes. In particular, it helps explain the surprising result that public spending often does not yield the expected improvement in outcomes. Using data from a cross-section of countries covering 1990, 1997 and 2003, we found that public health spending has a stronger negative impact on child mortality in countries that have good governance. As the level of corruption falls or the quality of the bureaucracy rises, public spending on health becomes more effective in lowering child mortality. Our findings also indicate that in countries which are rated as very corrupt or are rated to have a very ineffective bureaucracy, public health spending at the margin will be ineffective. Similarly, increasing public spending on primary education is likely to be more effective in raising primary education attainment in countries with good governance.

These results have important implications for enhancing the development effectiveness of public spending. Simply increasing public spending on health and education is unlikely to lead to better outcomes if countries have poor governance. These findings are particularly relevant for developing countries, where there is an ongoing debate on how to achieve the Millennium Development Goals (MDGs).[24] In this debate it is often assumed, explicitly or implicitly, that the MDGs can be achieved by sufficiently increasing public spending in specific areas. For most of these countries, quantitative models have been developed to estimate the amount of additional public spending (including on health and education) needed to achieve the MDGs. But in these countries the average level of governance is quite poor. Increasing public spending on health and education may be an easier policy option than attempting to improve governance, but as our findings suggest, in the absence of better governance, the easier option frequently does not translate into the expected achievement of better health and education outcomes.

[24] Since their launch at the Millennium Summit held in New York in September 2000, the MDGs have become a widely accepted benchmark for measuring development progress. The MDGs set selected quantitative targets for poverty reduction and improvement in various aspects of social welfare from their 1990 levels that should be achieved by 2015. There are eight broad goals–reduction in child mortality and achieving universal primary education are two of them–and a selected list of indicators to monitor progress towards each of them.

Finally, our results show that the impact of public spending on outcomes is higher when there is good governance, but this impact could still be well below its true full potential. Public spending may still be relatively inefficient in improving outcomes in many countries even when there is good governance. The inefficiency in spending could be due to a variety of reasons including the possible substitutability between public and private spending. The efficiency question needs to be examined in future research.

Appendix A. Data Appendix

The following table provides details on the data used for this research

Variable	Description and source
Per-capita GDP (purchasing power parity terms)	Gross Domestic Product (GDP) per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the US dollar has in the United States. Data are in current international dollars. Source: World Development Indicators
Child (under-5) mortality	The number of newborn babies out of 1000 that will die before reaching the age of 5, if subject to current age-specific mortality rates. Source: World Development indicators
Education attainment	Constructed from data from the World Education Report from UNESCO, as explained in full below. (See the text after table.)
Public health spending	Recurrent and capital spending from government (central, state and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health funds. Source: World Development Indicators
Public primary education spending	Public spending on primary education plus subsidies to private education at the primary level. Source: World Development Indicators
Corruption index	Index measuring corruption in government, based on subjective ratings by experts. Low ratings indicate that "high government officials are likely to demand special payments" and "illegal payments are generally expected at lower levels of government" in the form of "bribes connected with import and export licenses, exchange controls, tax assessment, policy protection, or loans". Scale is from 0 to 6. Data come in the form of monthly ratings; annual figure is the average of monthly ratings. Source: International Country Risk Guide
Bureaucratic quality	Index measuring institutional strength and quality of the bureaucracy, based on subjective ratings by experts. High ratings are given to countries where "the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services", and where "the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training". Scale is from 0 to 4. Source: International Country Risk Guide.
Female education	Percentage of all females aged 15 and above that are literate Source: World Development Indicators
Income inequality	Gini income inequality measure, taken from comprehensive dataset compiling measures from a range of different sources. Source: World Institute for Development Economics Research (2006).
Predominantly Muslim	Percentage of population that is Muslim. Source: La Porta et al. (1999)
Ethnolinguistic fractionalization	Ranges from 0 to 1. Average values of 5 different indices, based on: (1) probability that two randomly selected people from a given country will not belong to the same ethnolinguistic group (index is based on the number and size of population groups as distinguished by their ethnic and linguistic status); (2) probability of two randomly selected individuals differing in their native language; (3) probability of two randomly selected individuals not speaking a common language; (4) probability of two randomly selected individuals not speaking the official language; and (5) the percentage of the population not speaking the most widely used language. Source: La Porta et al. (1999).
Access to safe water	The percentage of the population with reasonable access to an adequate amount of safe water (including untreated surface water and untreated but uncontaminated water, such as from springs, sanitary wells, and protected boreholes). In urban areas, the source may be a public fountain or standpipe located not more than 200 meters away. In rural areas, the definition implies that members of the household do not have to spend a disproportionate part of the day fetching water. An adequate amount of safe water is that needed to satisfy metabolic, hygienic and domestic requirements – usually about 20 liters a day. Source: World Development Indicators
Degree of urbanization	The share of the total population living in areas defined as urban by each country. Source: World Development Indicators
Percentage of population aged under 5	Based on actual population data as well as projections. Source: United Nations Population Division
Percentage of population aged 6 to 12	Based on actual population data as well as projections. Source: United Nations Population Division
Distance from Equator	Absolute value of the latitude of each country (taken from the Central Intelligence Agency World Factbook), scaled to take values between 0 and 1. Source: La Porta et al. (1999)

Much of the data come from the publicly available World Development Indicators database, put together annually by the World Bank. The governance variables are from the International Country Risk Guide series of indicators, and are based on subjective ratings made by experts at Political Risk Services (2007).

The education attainment variable in the regressions is computed using data on primary school intake rates as well as rates of completion of Grade 5, as explained below. These data are taken from various years of the *World Education Report* from UNESCO.

The expected completion rate measure $\mathrm{ECompR}_{0,5}{}^{t}$ used to compute the "failure rate" in the education regressions (see Section 4.2) is taken from UNESCO data. UNESCO computes it using the "Reconstructed Cohort Method." The method is explained in detail in Fredriksen (1991); it can be summarized by the following formula:

$$\mathrm{ECompPS}_{0,5}^{t} = \left(\mathrm{Comp}_{0,1}^{t-1}\right)\cdot\left(\mathrm{Comp}_{1,2}^{t-1}\right)\cdot\left(\mathrm{Comp}_{2,3}^{t-1}\right)\cdot\left(\mathrm{Comp}_{3,4}^{t-1}\right)\cdot\left(\mathrm{Comp}_{4,5}^{t-1}\right)$$

where $\mathrm{Comp}_{0,1}{}^{t-1}$ is the *actual* proportion of students entering and completing Grade 1 *only* between times $t-1$ and t; $\mathrm{Comp}_{1,2}{}^{t-1}$ is the *actual* proportion of students entering and completing Grade 2 *only* between times $t-1$ and t; and so on. These one-year actual completion rates for each grade individually can be computed from data on enrolment and repetition rates for Grades 1 through 5, at times $t-1$ and t. (These one-year completion rates allow for repetition, i.e. they measure the proportion of students entering and completing a particular Grade, with or without repetition.) Using the "Reconstructed Cohort Method" to compute expected five-year completion rates in this way is far less data-intensive than calculating actual five-year completion rates, which would require tracking of new students over five consecutive years (and more if there are repeaters). Data on the latter are available for only a few countries.

Another problem with the latter approach is that the actual Grade-5 completion rate for a cohort entering Grade 1 at time $t-5$, say, would be affected by the levels of income, public spending, adult literacy and so on not just at time $t-5$ or close to time $t-5$, but over five years or more starting from time $t-5$. This would have to be taken into account in the regressions, yet this would be very difficult or almost impossible to do in practice since very few countries have an unbroken series of annual data over a period of five or more continuous years for all relevant variables.

By contrast, as explained above, the expected completion rate measure that we use in the analysis is derived from $\mathrm{Comp}_{0,1}{}^{t-1}$, $\mathrm{Comp}_{1,2}{}^{t-1}$ and so on which rely on student flow measures between t and $t-1$ only. Thus, the expected completion rate measure is a "compressed" (in time) measure that one hypothesizes is affected by levels of income, public spending, etc. from period t and/or $t-1$ only. The other component of our educational attainment variable – the primary school intake rate – is also a measure that one can hypothesize, for time period t, to be affected by determinant variables from period t and/or $t-1$ only.

Finally on the subject of the calculations for the educational attainment rate variable, a question that arises is why we do not use a more direct measure for this variable, such as the number of students completing Grade 5 divided by the number of children who are old enough to be completing Grade 5. One problem with such a measure is that it is hard to determine how many children are "old enough" to be completing Grade 5; a considerable number of children could take well more than five years to complete Grade 5, because of repetitions. Another problem with this measure is similar to what has been described above; the value of the measure at any one point in time would be affected by the levels of income, public spending, adult literacy and so on over a period of five continuous years or more. And as noted above, most countries do not have an unbroken series of annual data on these variables spanning a period of five or more continuous years.

For the 2SLS regressions, following Wikimedia Foundation (2006) and Central Intelligence Agency (2006), all countries are divided into 6 groups based on the type of legal system that they predominantly have: (i) common law (Britain; Ireland; British ex-colonies outside the Middle East and excluding Botswana, Gambia, Namibia and Sudan; Israel); (ii) German civil law (Germany; Austria; Greece; Switzerland; Turkey; Japan; South Korea); (iii) Scandinavian civil law (Denmark; Sweden; Norway, Finland; Iceland); (iv) French civil law (other Western European countries; ex-colonies of France, Spain and Portugal outside the Middle East and North Africa; Indonesia; Philippines; Thailand; Lebanon; Syria; Botswana; Namibia); (v) Socialist law (Communist and ex-Communist countries); and (vi) Islamic law (Bahrain; Egypt; Gambia; Iran; Jordan; Morocco; Oman; Saudi Arabia; Sudan; Tunisia; Yemen). The latter category differs somewhat from the others in that it includes all countries where Islamic law is used to a significant degree, even if it does not dominate the legal system. For the other five categories, the classification is based on the predominant type of legal system in the country.

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