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More on the Effectiveness of Public Spending on Health Care and Education: A Covariance Structure Model

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Abstract

Using data for a sample of developing and transition countries, this paper estimates the relationship between government spending on health care and education, and social indicators. Unlike previous studies, where social indicators are used as proxies for the unobservable health and education status of the population, this paper estimates a latent variable model. The findings suggest that public social spending is an important determinant of social indicators, particularly in the education sector. Overall, the latent variable approach was found to yield more adequate estimates of social production functions, with larger elasticities of social indicators with respect to income and spending on education than the traditional approach, providing stronger evidence that increases in public spending have a positive impact on social indicators. The study also finds that the millennium goal of universal primary education enrollment by 2015 could be achieved through an increase by one-third, on average, in education spending.

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I. Introduction

Recognizing that high-quality growth is necessary for poverty reduction, the Fund replaced the Enhanced Structural Adjustment Facility (ESAF) in 1999 with the new Poverty Reduction and Growth Facility (PRGF) and the other elements of a new poverty reduction strategy. Poverty reduction strategy papers (PRSPs), prepared by the countries themselves, identify and prioritize key social and sectoral programs and structural reforms, taking into account the need for efficient, well-targeted spending in the PRGF-supported reforms. In these programs, human development is a major focus of strategies to reduce poverty and encourage economic growth.

Social programs such as health care and education are generally believed to influence human development, and, consequently, increased government spending in those programs is expected to result in better social outcomes. However, recent empirical studies have noted that government spending on social programs has a weak impact on social indicators, both in developed and developing countries. In general, income per capita has been shown to be a more powerful determinant of school enrollment and immunization rates, for instance, than the resources spent by the government on these programs.

In the health care sector, many studies based on data for both developed and developing countries show that income is the major determinant of the population's health status, while the ratio to GDP of public spending on health care, as well as the share of public outlays in total health care spending, are seldom significant factors in explaining cross-country differentials in health indicators (Filmer and Pritchett, 1999; Filmer, Hammer, and Pritchett, 2000; Jack, 1999). Recent research carried out for developed countries, however, suggests that there is a positive, albeit weak, relationship between public spending on health care and premature mortality, in a sample of OECD countries (Or, 2000).

In the education sector, a stronger relationship is often reported between public spending and social indicators when cross-country differences in per capita income and sociodemographic indicators are taken into account (Flug, Spilimbergo, and Watchenheim, 1998). However, in general, income tends to dominate the correlation between public spending and education outcomes. These empirical results are consistent with the finding that, as most researchers suggest, what matters is not only the level of social spending in relation to GDP, total government expenditure, and/or the rate of growth of public social spending over time, but also the overall efficiency and efficacy of public programs. Gupta, Verhoeven, and Tiongson (2002) show that both the level and the composition of spending on education, proxying for the efficiency of government spending, are important determinants of enrollment rates, persistence rates through grade 4, and primary school dropout rates.

The usual culprits for the generally weak estimated relationship between social indicators and public spending are data deficiencies (e.g., exclusion of private and subnational outlays in total spending data, exclusion of disaggregated data on the distribution of indicators by income class, and data inconsistencies) and econometric problems (e.g., ill-specified, reduced estimating equations, and poorly defined identification tests). This paper focuses on the latter issue and seeks to address econometric problems in two ways. First, our discussion expands the conventional cross-sectional approach to incorporate a time dimension in the data.[2] Second, our analysis measures social indicators using a latent variable model (covariance structure model), which, to our knowledge, has not been used in the empirical literature.

The main argument in this paper is that the relationship between public social spending and social indicators is better estimated using a latent variable model, which accurately treats the outcome of social spending as unobservable, than using the traditional approach. Based on the latent variable model, we find stronger evidence that public spending affects school enrollment positively. Moreover, both real income and the intrasectoral allocation of public spending on education tend to have a larger positive elasticity than in the traditional approach. Another finding of the paper is that unfavorable initial conditions, such as high illiteracy rates, reduce the effectiveness of social spending. On health care, the empirical results are less clear cut. In general, the elasticity of public spending on health outcomes is lower than in the traditional approach. Although the standard determinants, such as income and fertility rates, have the expected impact on health outcomes, public spending on health is generally not significant in our latent variable regressions. There is, however, a significant nonlinear negative relationship between public spending and mortality rates, with the estimated elasticity of spending being larger for a subsample of low-income countries. These results are in line with claims that the poor benefit more from public spending on health care, and that the relationship between public spending and the health status of the poor is stronger in low-income countries than in higher-income countries.[3] In addition, the effect of initial enrollment rates becomes stronger and income elasticities tend to be smaller in poorer countries.

This paper is organized as follows. Section II briefly describes the methodology for estimating the latent variable (or covariance structure) model. Section III presents the data and the results of both cross-sectional and panel regressions, using the traditional approach. Section IV reports the results of the latent variable model. Section V concludes and presents some policy implications.

[2] An earlier attempt to use panel data regressions to analyze the effects of public spending on social indicators can be found in Corbacho, Guin-Siu, and Yamada (1998). Other empirical research using panel approaches to study the determinants of social indicators have not included the level and intrasectoral composition of social spending. For instance, Owen and Wu (2001) use a panel of 139 countries and find evidence of a positive relationship between a country's openness to international trade and several health indicators, particularly in developing countries, but they do not include any spending variables.

[3] Using disaggregated data on the distribution of indicators by income class in order to analyze the impact of public health spending on the poor, Gupta, Verhoeven, and Tiongson (2001) and Bidani and Ravallion (1997) find that the poor are affected more favorably by public spending on health care than the nonpoor.

II. Covariance Structure Models

The estimation of the relationship between health and education status and government spending, treating social indicators as outputs and public spending on social programs as an input in a social production function, has become the conventional approach in the empirical literature. The problem with this approach is that the true outputs in this production function are not observable and, therefore, the use of intermediate health and education indicators as direct proxies of health and education outcomes biases parameter estimates to the extent that these proxies are poor correlates with the unobservable output variable (Jack, 1999). The use of nonparametric estimators in the empirical analysis does not solve this problem, because it does not address the issue of the correct measurement of the dependent variable.[4] To overcome this problem we argue in this paper that the social production function should be estimated using the latent variable model.[5] In a nutshell, this methodology differs from the traditional approach, because instead of regressing observable social indicators on government spending and control variables, it uses these indicators as determinants of an unobservable, latent variable. Subsequently, the information available in the covariance matrix of both the usual regressors and the social indicators is used to estimate the empirical association between government spending and the unobservable output variable.[6]

Covariance structure models are useful statistical tools in the estimation of structural relationships involving unobservable, latent variables such as, for instance, well-being, trust, and happiness,[7] and when the relevant variables define multidimensional concepts, such as poverty or the population's health and education status.[8] Covariance structure models can be interpreted as a synthesis of two different models (Long, 1983b): (1) a measurement or confirmatory factor model, which has been widely used in social sciences, and (2) a standard structural equation model, when the relevant variables are not affected by measurement errors, as in the standard regression analysis. The factor model assumes that a vector of p

[4] For empirical studies on nonparametric estimations of social production functions see, for instance, Tulkens and Van den Eeckaut (1995).

[5] See Alesina and La Ferrara (2000), for a recent example of an application of latent variable methodology to economic problems.

[6] If data are available for a set of observable variables that are known to be associated with the latent variable, covariance structure models allow for estimating the relationship between the unobserved variables and the set of observable regressors. This can be done by decomposing the covariance matrix of the observable variables, or the correlation matrix when the observable variables are standardized, according to a model capturing the association among the latent factors measured by the observable variables.

[7] Covariance structure models are also useful in dealing with variables measured with error, and in statistical problems involving simultaneity and interdependence among the relevant variables. See Goldenberger and Duncan (1973) for more information.

[8] For a discussion of the multidimensional nature of health status see, for instance, Wang and others (1999).

observed variables x can be generated by a corresponding vector ξ of q unobserved variables with an error term δ:

$$\mathbf{x} = \mathbf{\Lambda}\boldsymbol{\xi} + \boldsymbol{\delta}, \tag{1}$$

where Λ is a matrix of factor loadings in which each $\lambda_{i,j}$ measures the correlation between the latent variable ξ_j and the observed variable x_i, $i = (1,...,p)$ and $j = (1,...,q)$.

For two vectors of observable variables (x and y), equation (1) can be defined as a system:

$$\mathbf{x} = \mathbf{\Lambda}_x\boldsymbol{\xi} + \boldsymbol{\delta} \text{ and } \mathbf{y} = \mathbf{\Lambda}_y\boldsymbol{\eta} + \boldsymbol{\varepsilon}, \tag{2}$$

where the observable variables in vectors x and y are defined as deviations from their means and the unobserved variables in vectors ξ and η are uncorrelated with the error terms. In addition, the error terms are assumed to be uncorrelated across the equations in the system.

The second part of the covariance structure model (the structural model) consists of defining the causal relationships among the latent variables defined in equation (2), the description of the causal effects, and the assignment of the explained and unexplained variances. This model can be written as

$$\boldsymbol{\eta} = \mathbf{B}\boldsymbol{\eta} + \mathbf{\Gamma}\boldsymbol{\xi} + \boldsymbol{\zeta}, \tag{3}$$

where η and ξ are the vectors of, respectively, endogenous and exogenous latent variables, defined in equation (2). $\boldsymbol{B}$ is a matrix of regression coefficients associated with the endogenous latent variables, with zero diagonal elements, and let $\boldsymbol{I} - \boldsymbol{B}$ be nonsingular. Finally, Γ is a matrix of parameters, capturing the effect of the exogenous latent variables on the endogenous latent variables, and ζ is a vector of random disturbances. All variables are defined as deviations from their means and the vector of exogenous latent variables is assumed to be uncorrelated with the random error terms.

The variance-covariance matrix of x and y can be expressed in terms of all the parameters of the system, given some necessary overall identification restriction (Jöreskog and Sörbom, 1989). The usual identification restrictions for structural equation models apply to equation (3) in the absence of measurement errors. The covariance structure model (2)–(3) can be estimated for a covariance matrix Σ defined as $E\,[zz']$, where z is a vector constructed by stacking the variables in y on the top of those in x. The predicted covariance matrix can be defined as

$$\mathbf{\Sigma} = \begin{bmatrix} \mathbf{\Lambda}_y\mathbf{A}\left(\mathbf{\Gamma\Phi\Gamma}' + \mathbf{\Psi}\right)\mathbf{A}'\mathbf{\Lambda}'_y + \mathbf{\Theta}_\varepsilon & \mathbf{\Lambda}_y\mathbf{A}\,\mathbf{\Gamma\Phi\Lambda}'_y \\ \mathbf{\Lambda}_x\mathbf{\Phi\Gamma}'\mathbf{A}'\mathbf{\Lambda}'_x & \mathbf{\Lambda}_x\mathbf{\Phi\Lambda}'_x + \mathbf{\Theta}_\delta \end{bmatrix}, \tag{4}$$

where $\boldsymbol{A} = \boldsymbol{I} - \boldsymbol{B}$, $\boldsymbol{\Phi}$ is the covariance matrix of ξ, $\boldsymbol{\Psi}$ is the covariance matrix of ζ, and $\boldsymbol{\Theta}_\delta$ and $\boldsymbol{\Theta}_\varepsilon$ are the covariance matrices of δ and ε, respectively.

Assuming that all variables are normally distributed, the parameters in equation (2) can be estimated by maximum likelihood, by minimizing the following expression:

$$tr\left(\boldsymbol{\Sigma}^{-1}\mathbf{S}\right)+\left[\log|\boldsymbol{\Sigma}|-\log|\mathbf{S}|\right]-(r+s), \tag{5}$$

where r and s denote, respectively, the number of endogenous and exogenous latent variables; and **S** is the observed covariance matrix.

Goodness-of-fit measures include (1) an χ^2 statistic, which can be used to test the estimated model against the alternative that the covariance matrix is unconstrained;[9] (2) an adjusted goodness-of-fit measure, which measures the share of total variance explained by the model; and (3) the root mean squared error, defined as the average of the fitted residuals, which can be used when the relevant variables are standardized.[10]

III. Data and Preliminary Findings

A. The Data

Data on public spending on health care and education, as well as the relevant social indicators, are available for a sample of 111 developing and transition countries in the period 1985–98.[11] The dataset contains information on three groups of variables: public social spending, social indicators, and a set of variables that are known to affect the relationship between social spending and outcomes.[12] Health status indicators include infant and child mortality rates, and DPT immunization rates (children aged 1 or less). Education attainment indicators include primary and secondary school enrollment rates, and persistence through

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[9] If the probability of the test is greater than classical significance levels, the null hypothesis is accepted and the model is a good representation of the real covariance matrix of the population.

[10] The significance of each parameter can be also tested using a z-statistic distributed as a t-ratio under multivariate normality.

[11] We used the World Bank's World Development Indicators data base as a source for social indicators and national statistical data for public spending on health and education.

[12] For the cross-sectional regressions, which were estimated using averages for the period 1996–98, missing values were inputted using multivariate median regression estimates. Regressions were run on the sample obtained by omitting the missing observations, using per capita income and regional dummies as exogenous variables. Thus, missing values for the latter observations were replaced by conditional estimates.

grade 5.[13] The control variables comprise sociodemographic factors (fertility rates, secondary enrollment rates for girls, and adult illiteracy rates), proxies for economic development (urbanization rates and GDP per capita), and sector-specific indicators (pupil-teacher ratios and the ratio of public spending on education per pupil in primary and tertiary education).

B. Exploratory Data Analysis

The dataset exhibits considerable dispersion in many indicators. Large differences between average and median values and high levels of both skewness and kurtosis indicate departure from normality in the univariate distribution of many variables in the sample, particularly per capita income, as expected, and the intrasectoral composition of public expenditures on education.

Principal component analysis (Bouroche and Saporta, 2002; Morrison ,1990) was used to assess the sources of variance in the data and to identify the potential outliers in the sample.[14] This method allows for the identification of a few multidimensional factors—defined as linear combinations of the original variables with weights proportional to the correlation coefficient between the variables and the principal components—that explain most of the variance contained in the original covariance matrix. In our sample, seven mutually independent factors were extracted: health status indicators, income per capita, public spending, the composition of public spending, access to safe water and sanitation, school enrollment rates, and educational attainment (persistence through grade 5). These factors account for more than 80 percent of total dispersion in the data, with the first three factors explaining more than 60 percent of the variation.

Based on the principal component results, the original sample of 111 countries was reduced to 94 countries, after eliminating 17 outliers.[15] The descriptive statistics of the reduced sample, reported in Table 1, show that, on average, in 1998, the public spending ratios are lower than those of high-income countries, as expected, but are in line with the middle-income country average (Chu and others, 1995). The standard deviations are high, at almost half of the mean for most of the variables. Also, spending per pupil is much lower for primary than tertiary education, suggesting that the composition of education spending is a factor that could contribute to the large differences in social outcomes in the sample. With

[13] The choice of indicators used to measure the efficiency of public spending on health care and education was guided by their appropriateness as proxies for education and health care performance and the availability of internationally comparable data for a wide range of countries. See Gupta and others (2000) for more information on international social development goals and performance indicators.

[14] The results of the principal component analysis are not reported for economy of space. They are, however, available upon request.

[15] Defined as those units that had a standardized value more than three times their standard deviation for at least one factor.

Table 1. Descriptive Statistics
(In percent, unless otherwise specified)

Variable	Label	Mean	Median	Standard Deviation	Skewness	Kurtosis
Child mortality rate (per thousand)	CMR	70.3	39.3	60.1	1.0	2.7
Public expenditures on education (in percent of GDP)	EDY	4.3	4.0	1.9	0.8	3.6
Share of girls in secondary education	GENR	44.3	48.3	10.6	-1.6	6.7
Ratio of health to education expenditures	HED	51.8	50.2	24.7	0.7	3.8
Public expenditures on health care (in percent of GDP)	HY	2.2	1.9	1.3	0.8	3.3
Illiteracy rate	ILLIT	24.9	17.4	22.7	0.7	2.3
Immunization against DPT 1/	IMM	81.2	88.5	18.4	-1.3	4.1
Infant mortality rate (per thousand)	IMR	47.9	32.0	36.2	0.8	2.4
Gross primary enrollment rate	PENR	95.1	98.8	29.2	-0.8	3.7
Persistence through grade 5	PER5	82.9	85.2	10.6	-1.7	6.4
Pupil-teacher ratio3/	PUPT	30.7	27.8	11.1	0.8	3.1
Total public spending (in percent of GDP)	PY	28.8	27.2	10.6	0.7	3.9
Access to sanitation	SANIT	59.9	64.0	27.2	-0.2	1.7
Gross secondary enrollment rate	SENR	55.2	63.0	26.8	-0.2	1.9
Social spending (in percent of GDP)	SOCY	6.5	6.0	2.8	0.4	2.6
Spending per pupil in primary education 4/	SPPR	15.3	11.4	9.3	2.3	8.3
Spending per pupil in tertiary education 4/	SPTR	105.6	61.6	102.3	1.0	2.2
Total fertility rate (number of children per woman)	TFR	3.6	3.2	1.6	0.4	2.1
Percentage of urban population	URB	49.8	50.4	20.7	0.1	2.4
GDP per capita in US$ (in purchasing power parity terms)	GDP	4615.1	3533.6	3576.7	1.2	3.9

Notes: The sample size is 94. Overall, 17 outlier observations have been eliminated because the standardized value of at least one variable was higher than 3 times its standard deviation.

1/ Children below 1 year of age.
2/ Children below 5 years of age.
3/ In primary schools.
4/ In percent of per capita GDP.

regard to social indicators and control variables, gross school enrollment rates are much higher for primary education than for secondary education. The standard deviation of the ratio of public outlays to GDP, measuring government size, is high, reflecting the inclusion of transition economies and higher-income countries in the sample.

The raw correlations between the public spending ratios and the social indicators suggest that public spending on education correlates positively with school enrollment rates but the correlation between public spending and persistence through grade 5 is not statistically significant (Figure 1). Public outlays on health care correlate negatively with infant and child mortality, and correlate positively with access to sanitation and DPT immunization rates (Figure 2).[16] As expected, the ratio of public spending per pupil in tertiary education to that in primary education, measuring the intrasectoral composition of education spending, correlates negatively with both primary and secondary enrollment rates, and correlates positively with infant and child mortality rates.[17] These results highlight the existence of significant bivariate relations between social spending and social indicators. However, a more appropriate assessment of the link between these variables should be carried out in a multivariate framework that allows for causality testing.

C. The Conventional Approach: Cross-Sectional and Panel Data Results

The conventional approach to estimating the relationship between social spending and social indicators has been to use a social production function, as discussed above, in which health and education indicators are treated as outputs and public spending ratios are treated as inputs. Other exogenous variables, such as per capita income, are included in the equation to control for additional determinants of social indicators. The issue of multidimensionality in the outcome indicators is not dealt with explicitly and separate regressions are run for each indicator. The key testable hypothesis is that the government spending parameters are positive and significant at classical levels.

For a given time period, the conventional cross-sectional estimating equation can be defined as

$$y_i = \alpha + \beta\, GDP_i + \gamma\, S_i + \delta\, X_i + u_i, \qquad (6)$$

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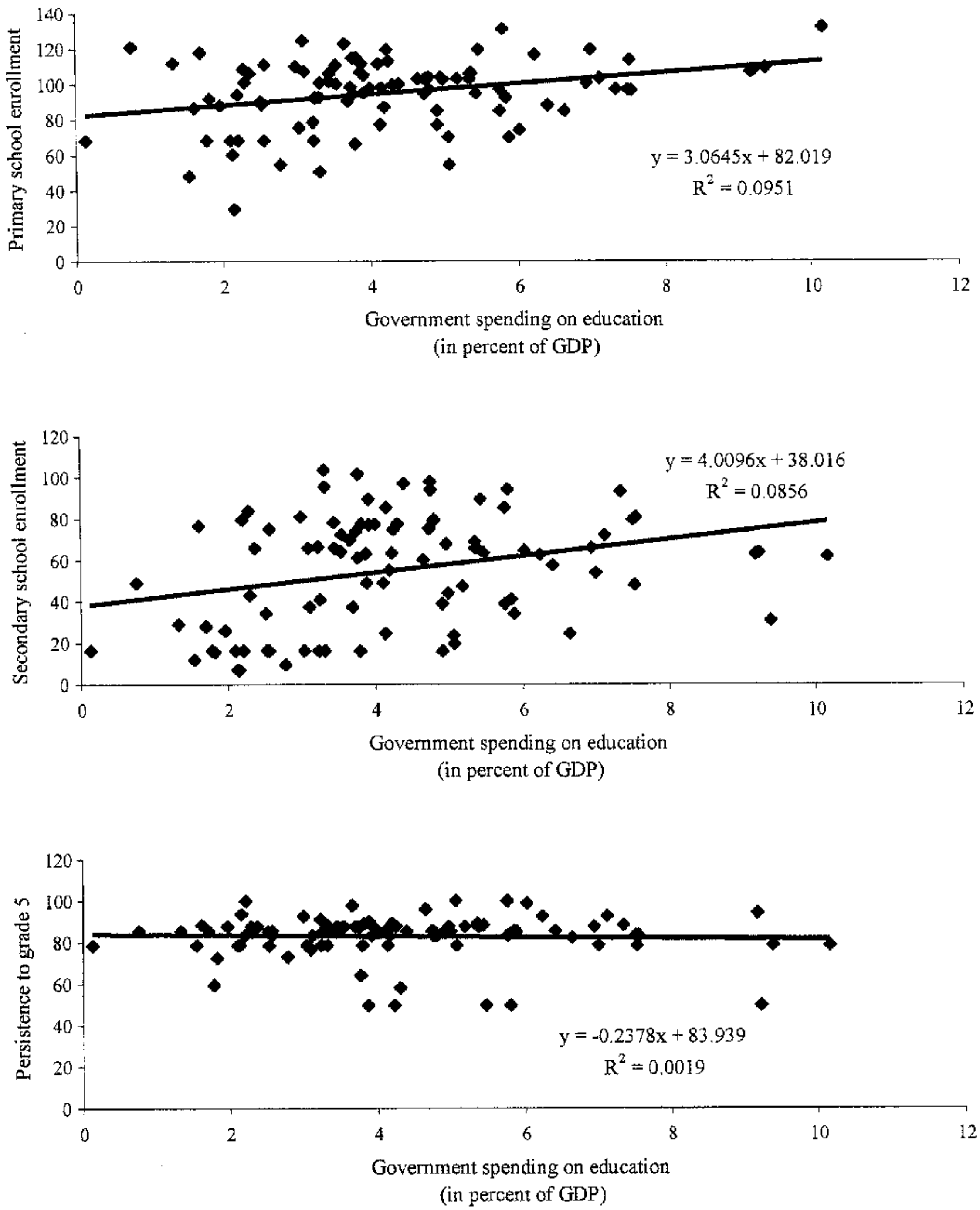
[16] Public outlays on health care are typically positively correlated with life expectancy at birth (Anderson and others, 2000; Or, 2000), although the correlation between public spending and income is much stronger (Pritchett and Summers, 1996; Filmer and Pritchett, 1999). Spending on health care is also usually negatively correlated with malnutrition rates (Peters and others, 1999).

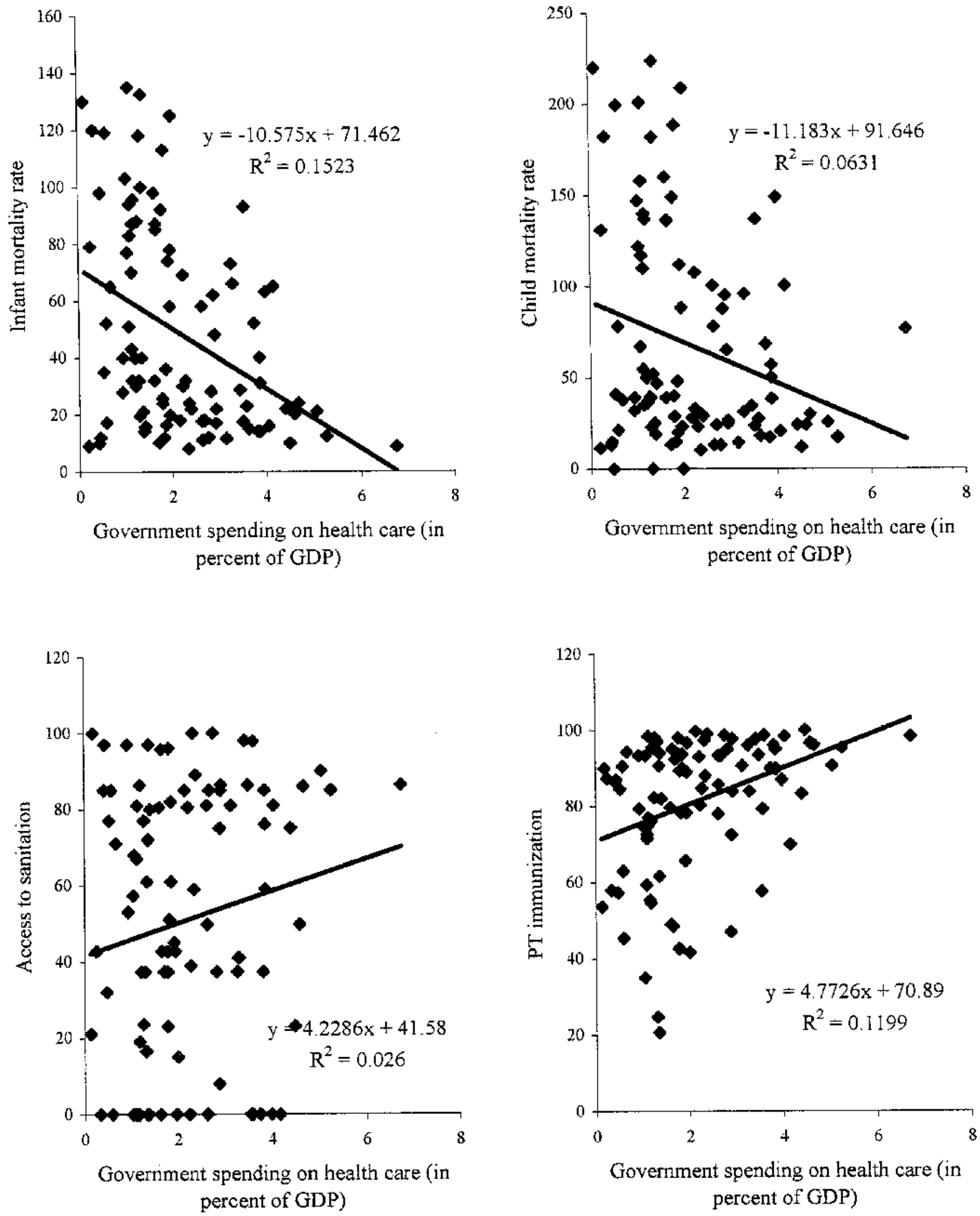
[17] Emphasis on curative health care to the detriment of basic and preventive services would affect mortality rates negatively. Due to data weaknesses, the intrasectoral composition of public spending on health care is proxied by that in the education sector assuming that, on average, countries that allocate more public funds to tertiary education also tend to allocate more public funds to curative health care services. Correlation coefficients vary between 0.5 and 0.7 and are all statistically significant at the 5 percent critical value.

Figure 1. Government Spending on Education and Indicators: Full Sample, 1998



Source: IMF and World Bank; IMF staff calculations.

Figure 2. Government Spending on Health Care and Indicators: Full sample, 1998



Source: IMF and World Bank; IMF staff calculations.

where y denotes the social indicator (e.g., mortality rates, school enrollment ratios), *GDP* is defined in real per capita terms, S denotes public social spending (e.g., health care and education as a percent of GDP), X is a vector of control variables, u is a random error term, and i identifies the countries in the sample. [18]

In the education regressions, gross primary and secondary enrollment rates are used as the dependent variables. Explanatory variables include GDP per capita in purchasing power parity (PPP) terms, the share of public spending on education in GDP, the ratio of public spending on tertiary education to public spending on primary education, the pupil-teacher ratio, the adult illiteracy rate, and the share of girls enrolled in secondary education. In the health care regressions, child mortality (0–5 year olds) and infant mortality (0–1 year olds) rates are used as the dependent variables. Explanatory and control variables include GDP per capita in PPP terms, the share in GDP of public spending on health care, the fertility rate, the urbanization rate, the input mix of government spending (proxied by the pupil-teacher ratio), and the intrasectoral allocation of public spending. With regard to the controls in both equations, economic development (measured by real GDP per capita), the urbanization rate, and the share of girls attending secondary school are expected to correlate positively with health and education outcomes. On the other hand, the intrasectoral composition of public spending, the adult illiteracy rate (capturing family background effects and past social policies), the illiteracy and fertility rates, and the pupil-teacher ratio are all expected to correlate negatively with health and education outcomes.[19] [20]

Preliminary analysis of the data was carried out by estimating equation (6).[21] The results, reported in Table 2, reinforce the findings in the literature. When equation (6) is estimated using the average of primary and secondary school enrollment rates as the dependent

[18] The logarithmic transformation of the variables (except for illiteracy rates) is preferred over alternative transformations. We tested this assumption against a linear specification using the RESET and the McKinnon, White and Davidson (MWD) tests and we could not reject the hypothesis that the best specification is the one used in the paper. The log-linear specification also yields the highest model fit. A typical feature of this model is that the parameter estimates can be easily interpreted as elasticities.

[19] In the panel regressions, because of missing values in several variables, linearly interpolated series were used for the following controls: adult illiteracy rates, fertility rates, share of population under 14 years of age, immunization against measles and child mortality rates (only when used as control for the education regressions). The averages of the true series and the interpolated series are very close, not diverging by more than ten percent except for child mortality rates. The parameters in the education regressions estimated with the true series are comparable to those estimated using the interpolated controls.

[20] For example, parents will not have adequate incentive to send their children to school or women will not be sufficiently informed about minimal hygienic and nutritional standards during their pregnancy, which could affect negatively the health status of the newborn.

[21] Several methods were used in the cross-sectional regressions, including ordinary least squares (OLS), weighted least squares (WLS), two-stage least squares (TSLS), and weighted two-stage least squares (WTSLS), to take into account of the possibility of endogeneity and heteroskedasticity in our data.

Table 2. School Enrollment and Public Spending in Education:
Cross-Section Regression

	Dependent Variable					
	Primary and secondary enrollment				Secondary enrollment	
	(1)	(2)	(3)	(4)	(1)	(2)
Constant	3.69 ***	3.69 ***	2.92 ***	2.90 ***	3.33 ***	3.33 ***
	(8.70)	(8.70)	(8.35)	(8.43)	(5.43)	(5.43)
GDP per capita	0.07 **	0.07 **	0.11 ***	0.11 ***	0.15 ***	0.15 ***
	(2.28)	(2.27)	(4.21)	(4.21)	(3.41)	(3.43)
Public expenditures on education	0.08 **	0.09 **	0.15 ***	0.16 ***	0.21 ***	0.20 ***
	(2.08)	(2.03)	(4.17)	(4.00)	(3.65)	(3.29)
Spending per pupil (tertiary/primary)	-0.06 ***	-0.06 ***	-0.06 ***	-0.06 ***	-0.18 ***	-0.18 ***
	(-2.82)	(-2.83)	(-2.94)	(-2.92)	(-5.33)	(-5.32)
Pupil-teacher ratio	-0.02	-0.02	0.07	0.07	-0.25 **	-0.25 **
	(-0.26)	(-0.26)	(0.91)	(0.89)	(-2.15)	(-2.15)
Illiteracy rate	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***
	(-5.77)	(-5.76)	(-5.77)	(-5.57)	(-5.45)	(-5.47)
Share of girls in secondary education	0.07 **	0.07 **	0.07 **	0.07 **	0.10 **	0.10 **
	(2.32)	(2.32)	(3.72)	(3.70)	(2.45)	(2.45)
F statistic	47.40	47.35	45.30	45.34	96.50	96.05
P-value	0.00	0.00	0.00	0.00	0.00	0.00
Adjusted R-squared	0.75	0.75	0.99	0.99	0.86	0.86
AIC	-0.60		-0.90		0.14	
Estimation method	OLS	TSLS	WLS 1/	WTSLS 1/	OLS	TSLS

Notes: Variables are means in period 1996–98. The number of observations is 94. Except for illiteracy, all variables are defined in logs. *T*-ratios are in parenthesis. (*), (**), and (***) denote significance at the 10, 5, and 1 percent level. The instruments used were log (public spending), log (social spending), and log (infant mortality). OLS, WLS, TSLS, and WTSLS, denote, respectively, ordinary least squares, weighted least squares, two-stage least squares, and weighted two-stage least squares. WLS and WTSLS were weighted by the level of public spending in education.

1/ White-consistent standard errors.

variable,[22] per capita income and public spending are found to be important determinants of social indicators. The intrasectoral composition of social expenditures also matters: public spending that favors tertiary education relative to primary education is negatively associated with school enrollment rates. As expected, adult illiteracy is negatively associated with school enrollment and a higher share of girls enrolled in secondary education contributes positively to higher enrollment rates for both males and females.[23] These results also hold when equation (6) is estimated using the secondary enrollment rate as the dependent variable and, in this case, the pupil-teacher ratio is statistically significant with the correct sign.

The findings of the health regressions, reported in Table 3, are less clear cut. As discussed in the literature, spending on health care is usually negatively associated with mortality rates, although not always at statistically significant levels, and per capita income is a more important determinant of health indicators than government spending. As expected, a higher fertility rate increases both infant and child mortality rates, but the urbanization rate is weakly correlated with infant mortality rates. The intrasectoral allocation of spending and the pupil-teacher ratio are not found to be correlated with mortality rates at classical levels of significance.

Equation (6) was also estimated to include a time dimension, and a linear double-log panel specification was used.[24] The dataset includes the same 94 countries in the 14-year period (1985–98). The dependent, explanatory, and control variables are the same as in the cross-sectional regressions to facilitate comparability. The findings are reported in the following Tables 4 and 5.

In the education equations, per capita income, public spending and its intrasectoral allocation, and the adult illiteracy rate are all correctly signed. However, the significance levels of the pupil-teacher ratio and the share of girls in secondary education are lower, and the parameter estimates switch signs across regressions. In the health regressions, the results are mixed: GDP per capita is not always significant across regressions. The government spending and intrasectoral allocation variables, as well as the control variables, are in general not statistically significant and the signs of the coefficients are not consistent across regressions.

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[22] The relevant parameters were not found to be statistically significant at classical confidence levels when the primary school enrollment rate was used as the dependent variable in equation (6). Instead, the average value of primary and secondary school enrollment rates was used. Persistence through grade 5 was also found to be weakly correlated with the exogenous variables included in the regression.

[23] See Appleton, Hoddinot, and McKinnon (1996) for more information.

[24] This specification is preferred as it provides ready elasticity estimates that are comparable to the cross-sectional results. The panel regressions were estimated by fixed effects (FE), random effects (RE), generalized least squares (GLS), feasible generalized least square (FGLS), and the generalized method of moments (GMM) (Baltagi, 2001).

Table 3. Mortality Indicators and Public Spending in Health Care: Cross-Section Regression

	Dependent Variable				
	Infant mortality				Child mortality
Constant	4.63 ***	4.61 ***	5.72 ***	5.73 ***	3.56
	(6.00)	(5.97)	(7.29)	(7.30)	(1.65)
GDP per capita	-0.21 **	-0.2 **	-0.34 ***	-0.34 ***	-0.21 **
	(-2.18)	(-2.12)	(-3.21)	(-3.22)	(-2.16)
Public expenditures on health care	-0.13 *	-0.15 *	-0.22 **	-0.22 **	-0.04
	(-1.75)	(-2.07)	(-2.24)	(-2.14)	(-0.43)
Total fertility rate	0.82 ***	0.82 ***	0.64 ***	0.64 ***	0.75 **
	(4.85)	(4.80)	(3.41)	(3.42)	(2.25)
Spending per pupil (tertiary/primary)	0.03	0.03	0.04	0.04	
	(0.49)	(0.53)	(0.60)	(0.60)	
Urbanization	-0.01 *	-0.01 *	0.00	0.00	0.00 *
	(-1.82)	(-1.83)	(0.44)	(0.44)	(-1.88)
Pupil-teacher ratio					0.47
					(0.74)
F statistic	36.15	36.34	50.99	50.94	40.67
P-value	0.00	0.00	0.00	0.00	0.00
Adjusted r-squared	0.65	0.65	0.92	0.91	0.69
AIC	1.41		1.39		0.14
Estimation method	OLS	TSLS	WLS 1/	WTSLS 1/	TSLS

Notes: Variables are means in period 1996–98. The number of observations is 94. Except for illiteracy, all variables are defined in logs. *T*-ratios are in parenthesis. (*), (**), and (***) denote significance at the 10, 5, and 1 percent level. The instruments used were log (public spending), log (social spending), and log (infant mortality). OLS, WLS, TSLS, and WTSLS, denote, respectively, ordinary least squares, weighted least squares, two-stage least squares, and weighted two-stage least squares. WLS and WTSLS were weighted by the level of public spending in education.

1/ White-consistent standard errors.

Table 4. School Enrollment and Public Spending in Education: Panel Data Regression

	Dependent Variable							
	Primary and secondary enrollment				Secondary enrollment			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	-0.47	0.72	2.51 ***	0.00	0.47	1.04	2.89 ***	0.00
	(-0.47)	(0.89)	(2.77)	(-0.07)	(0.32)	(0.79)	(2.53)	(0.44)
GDP per capita	0.07 **	0.09 ***	-0.01	-0.02	0.04	0.09 **	0.17 ***	-0.02
	(2.20)	(3.07)	(0.56)	(-0.50)	(0.75)	(1.97)	(4.59)	(-0.71)
Public expenditures on education	0.10 ***	0.06 **	0.02	0.62 **	0.21 ***	0.21 ***	-0.03	0.07 *
	(2.89)	(1.98)	(1.07)	(2.16)	(4.33)	(4.33)	(-0.51)	(1.76)
Spending per pupil (tertiary/primary)	0.01	0.01	0.01	-0.02	0.00	-0.02	-0.11 ***	-0.01
	(0.90)	(0.10)	(1.47)	(-1.50)	(0.06)	(-0.78)	(-5.99)	(-0.77)
Pupil-teacher ratio	0.23 ***	0.15 **	0.12 ***	0.26 **	0.16	0.04	-0.18 ***	0.12
	(3.33)	(2.28)	(3.15)	(3.00)	(1.51)	(0.43)	(-2.88)	(1.04)
Illiteracy rate	-0.01 *	-0.01 **	-0.01 ***	-0.01	-0.03 ***	-0.02 ***	-0.01 ***	-0.01
	(-1.94)	(-2.37)	(-4.56)	(-1.16)	(-4.07)	(-4.49)	(-4.82)	(-0.96)
Share of girls in secondary education	0.57	0.61 ***	0.16	-0.84 ***	0.75 **	0.55 *	0.16	0.00
	(0.74)	(3.38)	(0.99)	(-0.44)	(2.41)	(1.85)	(0.62)	(0.00)
Lagged dependent variable				0.68 ***				0.75 ***
				(6.20)				(6.55)
F-statistic	15.69				18.49			
P-value	0.00				0.00			
Wald- χ^2		97.22	45.99	286.5		129.6	415.89	217.9
P-value		0.00	0.00	0.00		0.00	0.00	0.00
Adjusted r-squared	0.50	0.51			0.54	0.57		
Log-likelihood			308.4				154.4	
F test of significance of fixed effects	51.27				90.16			
P-value	0.00				0.00			
Hausman test		37.39				69.06		
P-value		0.00				0.00		
Arellano-Bond test of autocorrelation				-1.26				-1.62
P-value				0.21				0.11
N	132	132	125	76	132	132	125	76
Estimation method	FE	RE	FGLS	GMM	FE	RE	FGLS	GMM

Notes: Variables are means in period 1996–98. The number of observations is 94. Except for illiteracy, all variables are defined in logs. *T*-ratios are in parenthesis. (*), (**), and (***) denote significance at the 10, 5, and 1 percent level. FGLS estimates based on the assumption of AR(1) distribution of the error term. GMM uses the Arellano and Bond estimator and robust standard errors. The Arellano-Bond test is for AR (1) residual serial correlation.

Table 5. Mortality and Public Spending on Health: Panel Data Regression

	Dependent Variable							
	Infant mortality				Child mortality			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	7.64 ***	6.53 ***	5.74 ***	0.01	12.55	6.46 ***	7.89 ***	-0.03 *
	(4.88)	(6.88)	(7.71)	(0.98)	(1.16)	(3.68)	(4.34)	(-1.73)
GDP per capita	-0.35 ***	-0.45 ***	-0.58 ***	-0.57 ***	-0.08	-0.49 ***	-0.27	-0.23 **
	(3.78)	(-6.03)	(-10.07)	(3.95)	(-0.39)	(-3.97)	(-1.54)	(-2.17)
Public expenditures on health care	0.05	0.02	0.06 *	0.03	0.29	-0.09	-0.28 **	-0.14 ***
	(1.18)	(0.44)	(1.92)	(0.62)	(0.19)	(-0.79)	(-2.28)	(-2.84)
Total fertility rate	0.17 *	0.26 ***	0.44 ***	-0.78 ***	-0.07	0.22	-0.29	-1.26 ***
	(1.70)	(2.67)	(5.75)	(-4.24)	(-0.20)	(1.22)	(-1.21)	(-7.18)
Spending per pupil (tertiary/primary)	-0.06	-0.02 **	0.07 ***	0.16 ***	0.02	0.04	0.19 ***	0.21 ***
	(-1.61)	(-0.59)	(3.56)	(4.83)	(0.29)	(0.63)	(2.57)	(7.43)
Urbanization	-0.49	-0.20 **	0.19 ***	-6.70 ***	-2.25 ***	-0.13	-0.68 **	-5.04 **
	(-1.18)	(-1.54)	(-3.35)	(-4.10)	(-0.89)	(-0.72)	(-2.07)	(-2.07)
Pupil-teacher ratio	0.59	0.33 **	0.32 ***	-0.18 ***	0.16 **	0.49 *	0.31	-0.36 ***
	(0.74)	(2.21)	(3.11)	(4.82)	(0.47)	(1.82)	(1.16)	(-4.21)
Lagged dependent variable				0.00				-0.05
				(-0.01)				(-0.76)
F-statistic	9.92				0.40			
P-value	0.00				0.87			
Wald- χ^2		191.00	1212.23	2415.30		126.3	580.57	11688.0
P-value		0.00	0.00	0.00		0.00	0.00	0.00
Adjusted r-squared	0.58	0.79			0.17	0.56		
Log-likelihood			67.49				-42.3	
F test of significance of fixed effects	60.40				17.77			
P-value	0.00				0.00			
Hausman test		17.43				10.09		
P-value		0.00				0.12		
Arellano-Bond test of autocorrelation				-0.88				-1.41
P-value				0.38				0.16
N	88	88	75	24	42	42	26	12
Estimation method	FE	RE	FGLS	GMM	FE	RE	FGLS	GMM

Notes: Variables are means in period 1996–98. The number of observations is 94. Except for illiteracy, all variables are defined in logs. *T*-ratios are in parenthesis. (*), (**), and (***) denote significance at the 10, 5, and 1 percent level. FGLS estimates based on the assumption of AR(1) distribution of the error term. GMM uses the Arellano and Bond estimator and robust standard errors. The Arellano-Bond test is for AR (1) residual serial correlation.

Extensions to the baseline panel regressions improved the parameter estimates only marginally.[25] Noteworthy is the inclusion of the lagged dependent variable, which produces statistically significant and correctly signed coefficients of the spending and per capita income variables. This finding suggests a more complex dynamic relationship between government spending and social indicators than that traditionally considered in the panel analysis. For example, the assumption that long- and short-run elasticities are the same, implicitly adopted in these models, may not be appropriate.

IV. The Latent Variable Models

The findings discussed above are in line with those reported in the conventional production-function literature on the relationship between public spending on social programs and the relevant social indicators. However, since no single output indicator perfectly captures the multidimensional nature of unobserved variables such as the population's health or education outcomes, our alternative approach takes into account the relationship between the observable social indicators, the unobservable latent variables, and the exogenous determinants in equation (6), using the covariance structure models described in Section II.

The model to be estimated below is a Multiple Indicators Multiple Causes model (MIMIC) that can be derived from the general covariance structure model by setting $\mathbf{x} \equiv \xi$ and $\boldsymbol{B} = \boldsymbol{0}$. The MIMIC model equations are defined as

$$\eta = \Gamma \mathbf{x} + \zeta \text{ and } \mathbf{y} = \Lambda \eta + \varepsilon . \qquad (7)$$

Equation (7) can be estimated using equation (4). This MIMIC model is estimated separately for health and education indicators, using the input correlation matrix reported in Table 6.

The results of the estimation of the MIMIC model are reported in Table 7.[26] Primary and secondary school enrollment rates are used in the estimation of Model 1. Model 2 includes the two school enrollment rates, as well as persistence through grade 5, as indicators of education status, the unobservable latent variable. Control variables include, as in the cross-sectional and panel regressions, per capita income, spending per pupil in tertiary education relative to primary education, and adult illiteracy rate. The parameter estimates suggest a positive and statistically significant association between public spending on

[25] For instance, regional dummies were added to control for geographical differentials in the status of health and education; a time trend (both linear and nonlinear) was included to address potential biases in the presence of trends in the dependent variables; lagged variables were added to explore the dynamic responses of social indicators to social spending over time; instrumental variables were used to correct potential reverse causality biases; and several other control variables were used to explore whether they have important effects on social indicators.

[26] Estimates were obtained using LISREL 7 (Jöreskog and Sörbom, 1989).

Table 6. Raw Correlation Matrix

	CMR	IMR	SENR	PENR	GDP 1/	HY	ILLIT	TFR	EDY	SPTR
CMR	1.00									
IMR	0.94	1.00								
SENR	-0.74	-0.75	1.00							
PENR	-0.43	-0.44	-0.75	1.00						
GDP 1/	-0.69	-0.68	0.73	0.52	1.00					
HY	-0.22	-0.28	0.31	0.25	0.23	1.00				
ILLIT	0.67	0.65	-0.72	-0.41	-0.47	-0.25	1.00			
TFR	0.77	0.76	-0.77	-0.46	-0.62	-0.19	0.77	1.00		
EDY	-0.23	-0.27	0.40	0.28	0.31	0.61	-0.23	-0.16	1.00	
SPTR	0.67	0.65	-0.79	-0.54	-0.62	-0.08	0.68	0.72	-0.12	1.00

1/ See Table 1 for a description of the variables.

education and education status, with an elasticity of 20 percent. This elasticity is close to the upper range of the estimates of the traditional approach when secondary education is used as outcome variable. As in most empirical studies, per capita income is also positively signed and statistically significant with elasticity of 30 percent. This elasticity is also much higher than that estimated using the conventional approach. The factor loadings on the latent variable are positively signed and statistically significant,[27] except for persistence through grade 5.[28] In particular, the primary enrollment rate is positively correlated with education status, even if its impact on the latent factor is smaller than the effect of secondary school enrollment. The overall fit of the model is over 90 percent and the χ^2 test fails to reject the null hypothesis for both models.

Similar results are reported in Table 8 for the health care equations. In Model 1, child and infant mortality rates are used as indicators of the population's health status, whereas Model 2 uses immunization rates and access to sanitation as the determinants of the latent variable. In both cases, public spending on health care is correctly signed but not statistically significant at classical levels. Per capita income is always statistically significant, negatively correlated with mortality rates, and positively correlated with immunization and access to

[27] In order to set the metric of the latent variable, the factor loading of one observable indicator has been fixed to unity. The coefficient of secondary enrollment rate has been normalized in the estimate of Models 1 and 2.

[28] Importantly, persistence through grade 5 is supposed to capture the quality dimension of education attainment. According to the results, quality is not adequately reflected in the selected model. Thus, social spending on education and per capita income are more likely to have a considerable effect on the other dimensions of education status, other than attainment.

Table 7. School Enrollment and Public Spending in Education: LISREL Estimates

	Model (1)	Model (2)
Secondary enrollment rate	1.00	1.00
Primary enrollment rate	0.75 ***	0.75 ***
Persistence through grade 5		0.03
GDP per capita	0.30 ***	0.30 ***
Public expenditures on education	0.20 ***	0.20 ***
Spending per pupil in tertiary education	-0.41 ***	-0.41 ***
Illiteracy rate	-0.25 ***	-0.25 ***
ψ (education)	0.20 ***	0.20 ***
θ (primary enrollment)	0.43 ***	0.43 ***
θ (persistence through grade 5)		0.99 ***
χ^2	9.42	20.50
P-value	0.05	0.02
Goodness of fit	0.97	0.94
Adjusted goodness of fit	0.84	0.82
Root mean square residual	0.03	0.05
Total coefficient of determination	0.80	0.80

Notes: Maximum Likelihood estimates. (*), (**), and (***) denote significance of the *t*-test at the 10, 5, and 1 percent level.

Table 8. Health Status and Public Spending on Health Care: LISREL Estimates

	Model (1)	Model (2)
Child mortality	1.00	
Infant mortality	0.99 ***	
DPT immunization		0.80 ***
Access to sanitation		1.00
GDP per capita	-0.34 ***	0.50 ***
Public expenditure on health care	-0.05	-0.03
Illiteracy rate	0.18 *	0.01
Total fertility rate	0.41 ***	-0.37 ***
ψ (poor health status)	0.27 ***	0.14 **
θ (child mortality)	0.05 **	
θ (infant mortality)	0.06 **	
θ (access to sanitation)		0.26 ***
θ (DPT immunization)		0.53 ***
χ^2	3.68	11.32
P-value	0.30	0.01
Goodness of fit	0.99	0.96
Adjusted goodness of fit	0.91	0.74
Root mean square residual	0.01	0.04
Total coefficient of determination	0.97	0.79

Notes: Maximum Likelihood estimates. (*), (**), and (***) denote significance of the *t*-test at the 10, 5, and 1 percent level.

sanitation. The income elasticity is slightly higher than that estimated using the traditional approach, especially in the case of child mortality. In fact, the introduction of the latent variable increases the importance of income-related factors in the explanation mortality differentials among the countries in the sample. Illiteracy correlates positively with mortality but is a poor predictor of health status, when immunization rates and access to sanitation are used as the determinants of health status. Finally, as many previous studies point out, fertility is negatively related with health. The fertility coefficient is correctly signed and statistically significant in both models.

A more general covariance structure model would estimate both health and education status simultaneously, as in equation (2). The structural relationship between the exogenous variables and the factors is then specified as in equation (3) assuming that $\boldsymbol{B} = \boldsymbol{0}$ and that Ψ, the covariance matrix of vector ζ (random error), has only nonzero elements. The latter assumption means that cross-equation relationships (in health and education status) are accounted for by the error variance-covariance matrix. The assumption in the model is that worse education outcomes could have a negative impact on health status, reducing access to health services, and that health conditions, especially among children, may negatively affect school attendance.

The results, reported in Table 9, show that, as expected, infant and child mortality are negatively associated with good health, whereas primary and secondary school enrollment rates are positively associated with education status. Countries with lower per capita income have poorer health and education outcomes. Public spending on education is positively associated with the corresponding latent factor, but health spending does not seem to affect health status significantly, although the coefficient is correctly signed. The intrasectoral composition of education outlays is clearly an important determinant of education status: the higher the share of resources devoted to tertiary education relative to primary education, the lower the primary and secondary school enrollment rates. No significant correlation was found between the latent variables for health and education once the effect of the other covariates is considered. A possible explanation for this result is that, since income-related variables and the illiteracy rate have a direct significant impact on both mortality and school enrollment, this impact weakens the relationship between health and education status. However, countries that invest effectively in education programs to reduce adult illiteracy can also expect to have a positive impact on health conditions. The model's overall goodness of fit is 95 percent and the χ^2 test is significant at the 5 percent level.[29]

[29] An alternative specification of this model, where health status is measured by immunization and sanitation rates, in addition to child and infant mortality rates, produces similar parameter estimates: public spending on education is positively associated with education status, whereas health expenditures are not correlated with health status at classical levels of significance.

Table 9. Health Status, School Enrollment, and Social Spending: LISREL Estimates

	Model (1) Latent variable		Model (2) Latent variable	
	Poor health	School enrollment	Poor health	School enrollment
Child mortality	1.00		1.00	
Infant mortality	0.99 ***		0.99 ***	
DPT immunization			-0.67 ***	
Access to sanitation			-0.68 ***	
Secondary enrollment rate		1.00		1.00
Primary enrollment rate		0.75 ***		0.75 ***
GDP per capita	-0.35 ***	0.30 ***	-0.36 ***	0.30 ***
Public expenditure on health care	-0.05		-0.04	
Illiteracy rate	0.19 **	-0.26 ***	0.19 **	-0.26 ***
Total fertility rate	0.38 ***		0.38 ***	
Public expenditures on education		0.20 ***		0.20 ***
Spending per pupil in tertiary education		-0.41 ***		-0.40 ***
ψ (poor health status)	0.27 ***	-0.03	0.25 ***	
ψ (education)	-0.03	0.20 ***	-0.04	0.20 ***
θ (child mortality)	0.06 **		0.06 ***	
θ (infant mortality)	0.06 **		0.07 ***	
θ (DPT immunization)			0.57 ***	
θ (access to sanitation)			0.54 ***	
θ (primary enrollment rate)		0.43 ***	0.43 ***	
χ^2	27.63		115.37	
P-value	0.07		0.00	
Goodness of fit	0.95		0.83	
Adjusted goodness of fit	0.85		0.65	
Root mean square residual	0.03		0.08	
Total coefficient of determination	0.88		0.88	

Notes: Maximum Likelihood estimates. (*), (**), and (***) denote significance of the *t*-test at the 10, 5, and 1 percent level.

The parameter estimates reported above could be affected by the sizeable variability in per capita income levels among countries, as discussed earlier. To take these effects into account, Model 1 was reestimated for a subsample of low-income countries, where low income is defined as per capita income below the sample median. The results, reported in Table 10, are in line with the previous findings. Parameter estimates are of comparable magnitude. The elasticity of per capita income is still significant, but smaller in magnitude than for the full sample. The elasticity of public spending on education is also slightly lower, but statistically significant. At the same time, the intrasectoral composition of social spending, as well as adult illiteracy, plays a more important role in explaining education outcomes in the poor-country sample. The overall fit for the model is better than that for the full sample according to the χ^2 test. The coefficient of the health spending variable is negatively signed, as expected, but still not statistically significant.

V. Conclusions and Policy Implications

The empirical literature, focusing predominantly on cross-sectional evidence, has so far provided only partial justification for higher government spending on education and health care. Income alone usually explains the bulk of cross-country variations in health and education indicators, regardless of estimation techniques and sample sizes. Adding a time dimension to the analysis does not significantly shed light on this issue since the findings of the panel regressions are less conclusive than those of the cross-sectional regressions.

The main argument in this paper is that applied research on the links between public spending and social indicators has failed to deal with the econometric problems associated with the estimation of unobservable multidimensional variables, such as the education and health status of the population. This paper's main contribution is therefore econometric: it argues that using proxies for unobservable outcomes in social production functions is not the best way to estimate the impact of public spending on education and health care on social outcomes. The estimates of the government spending and income elasticities based on the covariance structure model are in general larger than those obtained in the traditional regression approach. The only exception to these results is government spending on health care, for which the traditional approach tends to yield larger elasticity estimates. Another significant result derived from the use of our approach is that unfavorable initial social conditions, such as illiteracy or gender inequality (as measured by the access of girls to secondary education) tend to worsen social indicators. In the case of education, for which the covariance structure model produces statistically significant elasticities for the public spending variable, **our estimates show that the millennium goal of universal primary education enrollment by 2015 could be achieved by increasing the current level of such spending, on average 4.3 percent of GDP in the countries included in the sample, by an average of one third.**

These results reinforce some policy prescriptions that have now become standard. First, health status and educational attainment are multidimensional concepts that cannot be

Table 10. Health Status, School Enrollment, and Social Spending:
LISREL Estimates for a Subsample of Low-Income Countries

	Latent Variable	
	Poor health	School enrollment
Child mortality	1.00	
Infant mortality	1.03 ***	
Secondary enrolment rate		1.00
Primary enrolment rate		0.77 ***
GDP per capita	-0.28 ***	0.25 ***
Public expenditure on health care	-0.13	
Illiteracy rate	0.27 **	-0.31 ***
Total fertility rate	0.34 **	
Public expenditures on education		0.17 **
Spending per pupil in tertiary education		-0.45 ***
ψ (poor health status)	0.19 ***	-0.04
ψ (education)	-0.04	0.18 ***
θ (child mortality)	0.15 ***	
θ (infant mortality)	0.10 **	
θ (primary enrolment rate)		0.41 ***
χ^2	26.15	
P-value	0.10	
Goodness of fit	0.91	
Adjusted goodness of fit	0.72	
Root mean square residual	0.04	
Total coefficient of determination	0.90	

Notes: Maximum Likelihood estimates. (*), (**), and (***) denote significance of the *t*-test at the 10, 5, and 1 percent level. The number of observations is 47.

directly measured by a single set of indicators. Social outcome should be seen as the result of a complex production process that involves interrelationships among many variables, including institutional factors and individual behavior (Evans and others, 2001; Or, 2000; World Bank, 2000). More important, increases in social spending alone do not ensure better social outcomes. Removing unfavorable initial social conditions, such as high illiteracy rates and/or sizable income and gender disparities in the access to basic public services, could lead to more rapid human development. Finally, the intrasectoral allocation of spending matters: the composition of education spending between primary and tertiary education is an important determinant of the education status of the population, especially in a subsample of poorer countries. For the latter countries, in particular, investing in basic education can have a positive direct effect on the education outcomes through reduced illiteracy and better access to public social services.

The main caveats in this type of empirical analysis are well documented. Important causal factors could have been omitted from the specification adopted in this paper. Cross-country equations do not allow for assessing the impact of micro determinants of social outcomes, such as school management indicators, class sizes, and quality of health services. Data on other important macro variables, including information on income distribution and benefit incidence of public social spending, teachers' and physicians' compensation, and private and regional outlays on education and health care, among others, are not readily available across countries. Moreover, we have omitted from this analysis several institutional factors that can have a direct impact on the link between public social spending and its outcome, including corruption and fiscal decentralization (Duret, 1999).

Finally, there could be significant lags between the implementation of social policy measures in the health and educational sectors and improvement in social indicators. Data deficiencies prevented a more detailed analysis of lags in policy response in our sample. However, even when these lags were adequately taken into account, the structural relationship between social spending and social indicators can shift over time as a result of changes in technology and individuals' preferences, among other factors (Jack, 1999).

List of Countries Included in the Paper

Albania
Algeria
Angola
Argentina
Azerbaijan
Belarus
Belize
Benin
Bhutan
Bolivia
Botswana
Bulgaria
Burundi
Cambodia
Cameroon
Central African Republic
Chad
Chile
Colombia
Costa Rica
Côte d'Ivoire
Cyprus
Dominican Republic
Ecuador
El Salvador
Eritrea
Estonia
Fiji
Gabon
Gambia, The
Georgia
Guatemala
Guinea
Guinea Bissau
Guyana
Honduras
Hungary
Iran, Islamic Republic of
Jamaica
Jordan
Kazakhstan
Kenya
Korea, Republic of
Kuwait
Kyrgyz Republic
Lao P.D.R.
Lebanon
Lesotho
Libya
Lithuania
Madagascar
Malaysia
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Morocco
Mozambique
Myanmar
Namibia
Nepal
Nicaragua
Niger
Nigeria
Oman
Panama
Peru
Philippines
Romania
Russian Federation
Senegal
Seychelles
Slovak Republic
Solomon Islands
South Africa
Sri Lanka
St. Kitts
St. Vincent and the Grenadines
Swaziland
Syrian Arab Republic
Tajikistan
Thailand
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Ukraine
Uruguay
Uzbekistan
Venezuela, República Bolivariana de
Yemen, Republic of
Zambia
Zimbabwe

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