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Accounting for Public Expenditures on Education: An International Panel Study*

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1. Introduction

Expenditures on a specific good or service are often explained in terms of income, relative prices, and other factors that systematically influence demand. Following in this tradition, national public expenditures on education are examined over the last thirty years across a sample of 60 countries. Education is distinct, however, from many commodities, such as food, fuel, clothing, etc., because it is viewed as an investment in human capital in addition to being an item of consumption. Although the factors that would motivate demand for public educational services might differ somewhat if those services are viewed as only consumption or capital, the estimates reported below are interpreted as a reduced-form relationship that embodies both the demand parameters for schooling as well as the technology parameters that constrain the cost of producing schooling.

Because only a few salient explanatory variables are to be analyzed, omitted variables are likely to be important in explaining which countries have relatively high or low public expenditures on education. The share of

expenditures on the private school system is one such country specific factor that is not examined here (Levy, 1986; James, 1987). To deal with the limitation of not being able to analyze jointly expenditures on private and public schools, two strategies are adopted. Public educational expenditures per school aged child are first decomposed into four multiplicative parts: enrollment rates, classroom size, expenditures per teacher, and physical capital intensity, examining the determinants of each separately at the primary and secondary school levels. Only the expenditure data is lacking for the private school system, and therefore the other components should be less affected by the lack of private school expenditures. The second strategy of the analysis exploits the panel feature of the data, by comparing estimates based on cross-country variation, or "between" estimates, and alternative estimates based on the more limited information available on change over time "within" countries that should be unbiased by fixed country effects. Specification tests of the between and within models confirm that the between estimates are likely to be biased by correlation between the regressors and country-specific effects. Strategies for dealing with this econometric problem are consequently explored. On balance, the cross sectional and time series data available from national educational systems are consistent on several crucial issues. These data confirm the usefulness of the unrestricted reduced form framework that views social demands for public schooling as being constrained by the endogenous price of teachers, population composition, as well as income.

2. Trends and Issues

Public expenditures per school-aged child (6-17) and expected years of schooling are two summary measures of the input into the educational system and its output in physical units. They are reported in Table 1 for five regions of

Table 1

Regional Trends in School Enrollments and Public Expenditures

	Enrollment Rates			Expected Year of Schooling	Public Expenditures on Education Per Child Age 6-17
	Primary (Age 6-11)	Secondary (Age 12-17)	Higher (Age 18-23)		UNESCO Estimates $1970
	(1)	(2)	(3)	(4)	(5)
World (excluding China and DPR Korea)					
1960	62	38	8	6.48	-
1970	68	46	14	7.68	158.
1980	74	51	18	8.58	259.
1985	77	55	19	9.06	213.
Africa (excluding Arab States)					
1960	30	17	1	2.88	-
1970	39	26	3	4.08	15.
1980	59	44	6	6.54	52.
1985	64	52	9	7.50	25.
Latin America and Caribbean					
1960	58	36	6	6.00	-
1970	71	50	12	7.98	61.
1980	82	63	23	10.08	148.
1985	84	71	25	10.80	90.
Asia (excluding Arab States, China, and DPR Korea)					
1960	55	25	4	5.04	-
1970	62	32	8	6.12	23.
1980	70	37	10	7.02	63.
1985	73	42	12	7.62	56.
Arab States and North Africa					
1960	40	18	4	3.72	-
1970	52	30	9	5.46	49.
1980	69	42	16	7.62	186.
1985	74	51	19	8.64	178.
High Income Industrial Countries					
1960	91	69	15	10.50	-
1970	92	76	27	11.70	640.
1980	92	81	31	12.24	1200.
1985	92	86	34	12.72	1090.

Notes and Sources

Enrollment rates are estimates drawn from the UNESCO Statistical Yearbook of 1987, Table 2.11 (columns 1,2,3) and column (4) is six (years) times the sum of columns (1), (2), and (3). Public expenditures on education in column (5) are estimated in current US dollars by UNESCO by region as of 1987 and then expressed in constant U.S. dollars by deflating to 1970 by the U.S. GNP deflator (UNESCO Yearbook 1987, Table 2.12, and Statistical Abstract of the United States 1987, Table 699). If purchasing power parity price deflators were used from the ICP rather than IMF foreign exchange rates, expenditures on education would be increased relatively in low income regions by a factor of two to four.

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the world. The expected years of education in column (4) is a synthetic cohort measure, defined as the sum of the three preceding age-specific enrollment rates--associated approximately with the primary, secondary and higher educational levels--weighted by the six year length of the age intervals.[1] In the quarter century from 1960 to 1985 this indicator of exposure to the educational system advanced 160 percent in Africa and 132 percent in the Arab states, both of which started from quite low levels, while in Latin America and Asia they advanced 80 and 51 percent, respectively, from intermediate levels. The high income industrially advanced countries advanced 21 percent from their high initial level of 10.5 years. Although the number of children between the ages of 6 and 17 more than doubled in the less developed regions from 1950 to 1980, these countries have been able to expand sufficiently their educational systems to accommodate an ever increasing fraction of their children.[2] Despite the uneven economic growth, particularly in subSaharan Africa and Latin America in the last decade, school enrollments have continued to increase in most countries, though at very different rates.

A less rosy picture of the world educational establishment is drawn from recent data on expenditures (Coombs, 1985; World Bank, 1986). Public expenditures on education as a share of GNP stabilized in developed countries after 1975 and decreased in many African and Latin American countries. But this indicator of inputs does not relate expenditure to the beneficiary population of school aged children, which has varied widely as a share of the population across countries and over time, due to the demographic transition in low income countries and the baby boom (and dearth) in high income countries. Consequently, Table 1 reports the real public school expenditures per child 6 to 17 as estimated by UNESCO (column 5), expressed in 1970 US dollars. Central government expenditures on education are also collected by the IMF and may be a

more reliable indicator of educational outlays. These IMF data also document in many countries decreases in public expenditures on education, expressed in real terms per school aged child (Schultz,1987).

If these figures are not very wide of the mark, they contain a paradox. How have the poorer countries been able to increase enrollments despite the evidence that central government outlays have not kept pace with population growth and inflation? Several possibilities can be ruled out. Private school expenditures are not known, but the share of enrollments in private schools is slowly declining in most low income countries (Roth, 1987, pp. 24-27). Thus, it seems unlikely that private school expenditures have been picking up the recent slack in public outlays. It also is difficult to imagine that technological economies of scale have emerged to reduce the physical input requirements for enrolling additional students. The possible explanations that warrant more study are that: (1) the quality of schooling per student declined; (2) the cost of inputs to schools declined relative to the general price level (i.e. GNP deflators); or (3) the underlying aggregate data are in error. Data for a sample of countries are examined below for which the public sector reports over time current and capital expenditures on education by level, teacher compensation and their number, enrollments, as well as GNP, deflators, and population composition. The data from this more restricted sample of about 50 countries are believed to be more reliable than the estimated aggregate trends reported for all countries in Table 1, but they may, of course, be less representative of the world. Before exploring these data to get at this paradox, a conceptual framework and a statistical model are developed.

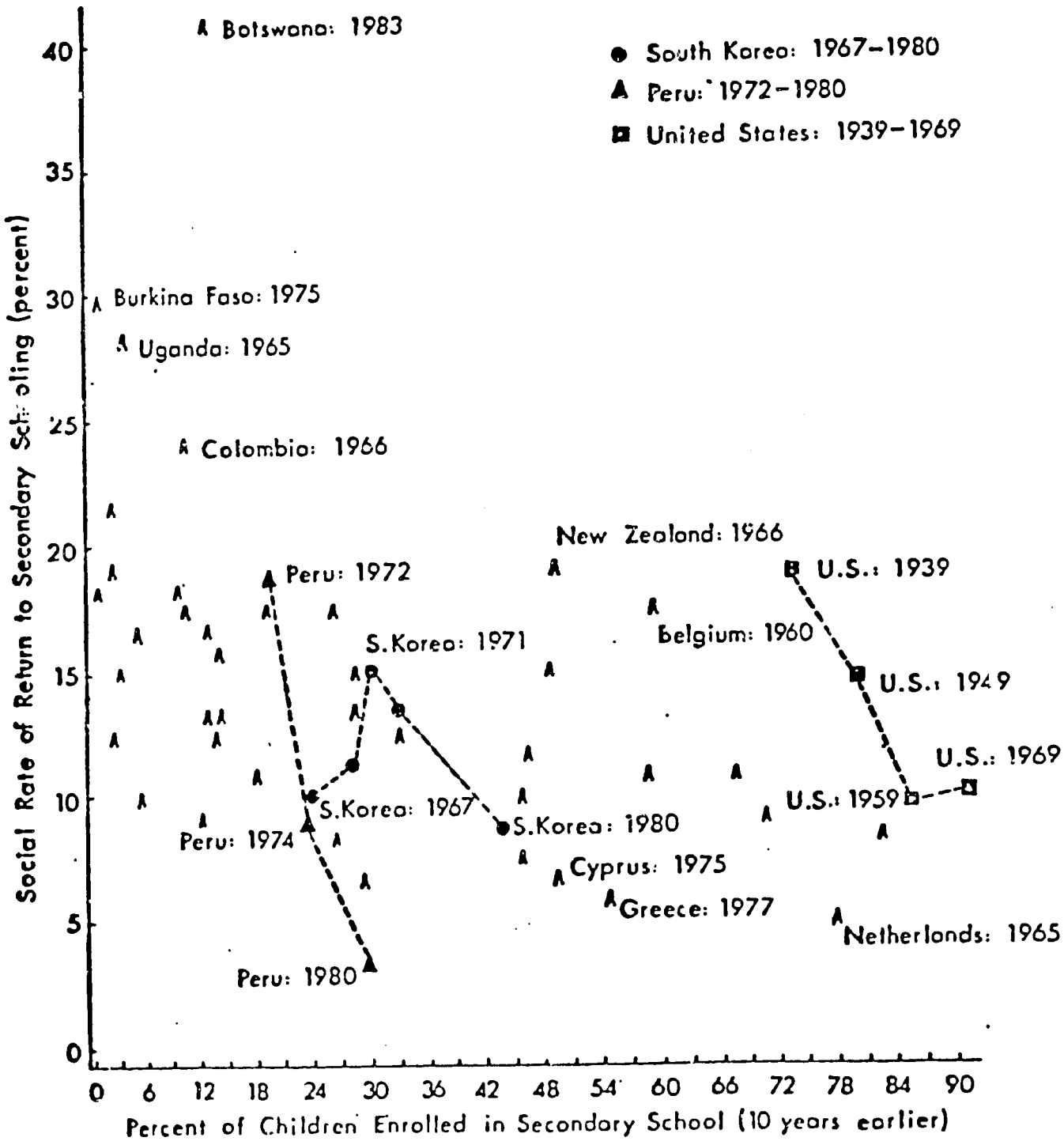
3. Market Dynamics for Educated Labor

The factor market for educated labor indicates in many countries the social rate of return to schooling lies between ten and twenty percent per year, and this return equals or exceeds the corresponding social return on physical capital. This disequilibrium is more frequent in countries that have expended less on public schools and report lower enrollment rates. For example, estimates of the social returns to secondary schooling collected by Psacharopoulos (1981, 1985) are plotted in figure 1 against secondary school enrollment rates ten years earlier.[3] These observations may be thought of as intersections of an upward sloping aggregation of individual (or family) supply functions of investments (and consumption) in secondary schooling, and a downward sloping aggregation of derived demands for secondary educated workers by firms and families. No empirical studies have identified these national schooling supply and derived demand schedules or their underlying determinants; nor is it clear what variables and working assumptions would provide a basis for firmly identifying this structure. Explanations of educational enrollments or expenditures, as reported in this paper, are thus interpreted as estimates of reduced forms and not of these underlying structural parameters.

Nonetheless, the observations arrayed in figure 1 challenge the imagination, and to my view suggest that the supply of schooling may be shifting to the right with recent economic developments more rapidly than the downward sloped (and probably rightward shifting) demand schedule. The long run tendency of returns to fall as enrollments rise (e.g. U.S.) is, however, complicated by cyclical swings in aggregate demand mixed with foreign exchange crises (e.g. Peru and Korea). Changes in the composition of the labor force can also perturb the aggregate supply of educated labor, and influence markedly the returns to schooling (Murphy and Welch, 1988). A structural model is

Figure 1

Social Returns to Secondary Schooling and Lagged Enrollment Rates: Plot of Available Country Observations



Source: Single most recent observation on secondary schools from each country available in Psacharopoulos (1981, 1985). Repeated observations added for the United States, South Korea, and Peru to indicate within country variation.

needed to interpret data such as is shown in figure 1 and to progress research on the remarkable confluence of education and development in this century.

An unusual feature of the educational system is that it produces its own main input, teachers. It thereby affects by its past production the current wage required to retain the services of teachers and consequently the unit cost of producing further education, other things being equal. This feedback effect of output on future unit costs indicates that the optimal expansion path for education involves tradeoffs of intertemporal optimization and intergenerational equity, topics that are only implicit in the early educational planning literature (Bowles, 1969; Freeman, 1971). For example, to expand a school system rapidly from a very limited national educational base involves inevitably bidding up temporarily the cost of teachers and may even require the costly importation of trained teaching personnel. These high initial costs of expansion tend to decline as the pool of domestically trained secondary school graduates increases and these new graduates compete for available jobs as teachers. If the relative price of teachers declines, it then encourages, along with rising incomes, more private demand for public education.

The movement over time in the opportunity cost of teachers may account for an "infant industry" phenomena in school expansion in some low income countries. The high relative cost of teachers constrains the initial expansion and makes it very expensive, but as the increasing supply of secondary and normal school graduates catches up to the economy's derived demand for such labor, the school system experiences a period of decreasing unit costs of production.

4. A Reduced Form Model of the Educational System

The technological possibilities for producing school services are assumed to be identical across countries. This production function for school services is also assumed in the long run to exhibit constant returns. This does not seem to be an unrealistic assumption for at least primary and secondary school systems. If the elasticity of substitution between labor and capital is one, the production function may be expressed in standard Cobb-Douglas form:

$$X = Z\, L^{\alpha}\, K^{1-\alpha} \qquad (1)$$

where X is the output of school services, L is the labor input, K is the physical capital input, α is the share of wages in output, $1-\alpha$ is the capital share, and Z is a set of exogenous technological shifters that affect the unit costs of producing schooling in diff[illegible] environments but are neutral with respect to labor and capital productivity and use. One such technological factor might be the distribution or density of the population. Dispersed populations may incur greater private and public transportation costs, in terms of both time and money, to provide the same effective schooling services. It is also frequently assumed that rapid population growth, which increases the fraction of the population in the school age, strains the capacity of the government to provide desired school services in the short run, and might be described as temporarily raising the unit costs of delivering school services.

Analyses of the private demand for public goods have generally assumed that citizens know the costs of production and the benefits of government spending (e.g., Borcherding and Deacon, 1972). The political process is assumed to be more or less democratic, in the sense that entrepreneur-politicians seek 'election' by a majority of voters in order to deliver efficiently the public

goods and services that the people are willing to pay taxes for.[4] The notion is simply that public, as well as private, institutions tend to optimize their input allocation and production decisions in response to consumer incomes and the perceived benefits of public sector outputs, on the one hand, and technological possibilities and relative input prices, on the other (Binswanger and Ruttan, 1978).

If the educational sector thus minimizes its unit costs, that is, produces efficiently, the marginal cost or price of schooling services, P_x, can be expressed as a multiplicative function of the wage paid labor in the educational sector, W, and the social return, r, required on public capital (e.g., Borcherding and Deacon, 1972).

$$P_x = \left(\frac{1}{Z}\right) \left(\frac{W}{\alpha}\right)^{\alpha} \left(\frac{r}{1-\alpha}\right)^{1-\alpha} \qquad (2)$$

World capital markets are probably more effective than international labor markets for school teachers in equalizing factor returns. If rates of return on educational physical capital were equalized, the marginal cost of education across countries and over time would then be a function of the real wage paid to teachers, W, and the exogenous technological conditions denoted by Z. The price equation can then be rewritten as the following:

$$P_x = e^{\beta_0} Z^{\beta_1} W^{\alpha} e^{u_1} \qquad (3)$$

where β_0 is a constant, $\beta_1 = -1$, and u_1 is a multiplicative error in the production technology affecting unit costs.

Teacher salaries are the bulk of the recurrent expenses for most school systems. In recent years about 95 percent of current expenses in the primary school systems of low income countries are teacher salaries, whereas in high

income countries the proportion is somewhat lower or 75 percent (World Bank, 1983; p. 99). Compensation paid per teacher, neglecting quality and experience variation, is thus a reasonable indicator of labor costs for the educational system, but this price of teachers should also be treated as endogenous because the school system may exert the power of a monopsonist in the demand for educated workers.

Finally, the quantity of schooling demanded per child by the median voter, q, is assumed to be log-linear in the tax, t (or price), in the taxpayers' income, Y, and possibly in technological factors, Z:

$$q = Dt^{\eta}Y^{\delta}Z^{\epsilon}e^{u2}, \tag{4}$$

where u_2 is a multiplicative error in the demand relationship. If the demand for schooling were motivated by a desire to acquire productive skills, such demand for an investment good need not depend on income, as would be the case with a consumer good. But even demand for human capital may be constrained by household liquidity, which might depend on income. In any case, prices and the technological factors modeled here should have a similar bearing on the demand for schooling, whether the demand is for a productive investment or consumption good.

Expenditures per school aged child (E/P) are then obtained by multiplying quantity demanded by price, where the general tax rate is equal to the marginal price of school services:

$$E/P = DY^{\delta}\ P_x(\eta+1)Z^{\epsilon}e^{u2}. \tag{5}$$

Substituting from the production technology (3) for the price of school services, logarithms are taken of (5) and the partial effects of income per adult, relative prices (teacher wage), and technological shifters on public educational expenditures per child are expressed as a combination of underlying household demand and production technology parameters:

$$\ln (E/P) = b_o + b_1 \ln Y + b_2 \ln W + b_3 \ln Z + v, \qquad (6)$$

where
$$b_o = (\eta + 1)(\beta_o) + \ln D,$$
$$b_1 = \delta$$
$$b_2 = \alpha(\eta + 1)$$
$$b_3 = \beta_1(\eta + 1) + \epsilon.$$
$$v = u_1(\eta + 1) + u_2$$

The errors from the production technology and household demand relationships are combined in v, and are assumed to have two components:

$$v_{it} = \mu_i + e_{it} \qquad i = 1,\ldots,n \qquad (7)$$
$$t = 1,\ldots,r$$

where the subscript i refers to the country and t to the time period. The country-specific effect, μ_i, represents omitted factors and errors of measurement that are constant in each country during the period observed, while e_{it} is a random disturbance uncorrelated over time or across countries.

The basic econometric issue is whether or not to treat μ_i as parameters or as random variables. In the case of slowly evolving national educational systems, the omitted cultural, historical, and idiosyncratic factors specific to a country are likely to be largely persistent over a period of a decade or

two. Consequently, I treat μ_i as a fixed effect or parameters. If these country specific effects are uncorrelated with the vector of observed regressors, $R_{it} = [Y,W,Z]$, then their omission from the analyses does not bias the estimates based on intercountry variation (i.e. between) or indeed bias the point estimates obtained by simply pooling the time series of cross sections, as in an earlier study (Schultz, 1987). However, if the country effects are correlated with the regressors, cov $(\mu_i R_{it}) \neq 0$, then the between and pooled estimates are biased and inconsistent. One way to obtain consistent estimates under these conditions is to base them on only time series variation within countries (Nerlove, 1971; Mundlak, 1978; Hsiao, 1986). Tests of this specification assumption will be reported, since the consistent "within" estimates are much less efficient given the available data.

Knowledge of the labor share of inputs, α, permits the identification of the price elasticity, η. The net effect of income, δ, and of the Z factors--cohort size and urbanization--on educational inputs and outputs can also be inferred from estimates of the reduced form equation (6). Cohort size is closely associated with lagged fertility and family size, and these demographic outcomes are inversely correlated with investments in child schooling at the family level. To distinguish between these factors, the total fertility rate is also included in the vector of control variables denoted by Z (T.P. Schultz, 1987).

5. An Empirical Decomposition of Educational Expenditures

The composition of educational expenditures may also vary with price, income and demographic factors, in addition to the overall level of educational expenditures. To evaluate these compositional effects, it is informative to divide school expenditures per school-age child into a multiplicative function of four observable components:

$$\frac{E}{P} = \left(\frac{S}{P}\right)\left(\frac{T}{S}\right)\left(\frac{C}{T}\right)\left(\frac{E}{C}\right) \qquad (7)$$

The first term on the right-hand side is the ratio of students enrolled to the number of children of school age, the enrollment ratio, which can be computed in most countries for boys and girls separately. The second term is the teacher to student ratio, that is treated as one possible indicator of the human capital 'quality' of schooling (Pryor, 1968; Bowles, 1969; Jamison, 1982; Fuller, 1986), which may be contrasted with the 'quantity' response in terms of enrollments. The third term is current expenditures per teacher (Murnane, et al., 1987). The fourth and final term is the ratio of total expenditures to current expenditures, or an index of the physical capital intensity of the educational system. Logarithms of the four component ratios in question (7) regressed on the same income, price, technology, and population composition variables used to explain expenditures per child. The sum of the log-linear regression coefficients for each conditioning variable in these four component regressions is equal to that variable's coefficient in the overall expenditure per child function. In this way, the effect of income, price, and other factors on overall educational expenditures estimated from equation (6) may be decomposed into the additive effects of each conditioning variable operating on quantity, quality, teacher salaries, and capital intensity.[5]

Educational expenditures are deflated to constant local prices using the local GNP deflator and converted to 1970 U.S. dollars according to the prevailing average foreign exchange rate in 1969-71.[6] The 'average' teacher price is the public compensation per primary or secondary school teacher, which is then deflated by national productivity or GNP per working age adult. This relative price of educational services is determined simultaneously with production costs and consumer demands for schooling. Unexplained variation in

either production costs (u_1) or consumer demands (u_2) will thus tend to be correlated with the relative price of teachers. Consequently, instrumental variable (IV) techniques are employed in estimating equation (6) to take account of the endogeneity of the price of teachers. The instrumental variables identifying the price variable are secondary school enrollment rates, the female share of these enrollments, incomes, and urbanization, all lagged ten years, and the growth in numbers of teachers at the specific school level over the last decade as a proxy for the age and seniority distribution of teachers.[7]

Income is measured as GNP in local constant prices converted, as are educational expenditures, to 1970 dollars, and divided by the population of working age, 15 to 65. Population density is measured as the proportion of the population living in an urban area. The relative size of the school-aged cohort is the proportion of the population age 6-11 for primary school, and the proportion age 12-17 for secondary school, following UNESCO statistical conventions. Period fertility is measured by the total fertility rate, which is equivalent to the sum of age specific birth rates for women age 15 to 49.

Data on all required primary school series were obtained for at least two years in 60 countries of a million or more persons, of which 19 were African, 14 Latin American, 13 Asian, and 14 European. The number of country-year observations including the requirement that all lagged instrumental variables are available is 191 for primary schools, whereas for secondary schools only 49 countries and 150 observations are available (see Appendix Table A-1). International statistics on school systems, as collected by UNESCO, undoubtedly suffer from many problems of comparability and accuracy, and consequently measurement errors may be a serious limitation to their analysis. The lack of data on private school expenditures is, in my view, the most worrisome (see

enrollment data, The World Bank, 1986). To the extent that private school expenditures are a fixed proportion of public expenditures, the within country panel estimates are not biased. Moreover, two of the four components of school expenditures in eq. (7) have the property of being a ratio that is not tied to expenditures: e.g. enrollment ratios and teacher-student ratios. They are not, therefore, affected even in the cross section by errors in the expenditure accounts. Intercountry and time series comparisons based on these aggregate data on educational systems warrant more analysis than they have received; this investigation provides only a starting point, from which improvements in the data and analytical framework will, I hope, follow.

There are substantial differences across regions in the size and resource intensity of primary and secondary school systems, which may stem as much from differences in relative prices as they do from differences in incomes. For example, primary enrollment ratios are 55 percent in Africa and 95 percent in Latin America, while the teacher student ratios and capital intensity are similar, .024 and .030, and 1.22 and 1.15, respectively. Primary school teachers are paid about the same in the two regions, but because GNP per adult is one third as large in Africa, the relative price of teachers is fully twice as high in Africa as it is in Latin America. Expenditure per primary school aged child is $20 in Africa compared with $51 in Latin America. The potential explanatory role of income and relative prices in determining school expenditures and achievements is suggested from even such gross regional comparisons. The large differences between enrollment ratios for boys and girls in Africa compared with Latin America may also stem to some degree from economic differences between regions (Schultz, 1987). The next section summarizes the fit of the multivariate production/demand relationships between and within country observations, and discusses the estimated magnitude of price and income effects, as well as those of urbanization and population growth.

6. Cross Section and Time Series Estimates

Country level averages of the panel observations for each country are the variables employed in the "between" country estimates. They neglect the possibility of a confounding country fixed-effect. Deviations of the panel observations from the country-specific averages are the transformed variables used to obtain the "within" country estimates (C. Hsiao, 1986). The between and within panel variation are thus constructed as orthogonal components of the total variance from the pooled sample. Introducing country specific dummy variables is another way to obtain the within estimates, which provides added information on the magnitude and regional clustering of the country fixed effects.

Between and within country instrumental variable estimates of the primary school system are reported in Tables 2 and 3, while analogous estimates for the secondary school system are shown in Tables 4 and 5.[8] The t statistics are corrected for the unbalanced form of the panel data under the assumption that data are randomly missing (Hsiao, 1986, p. 193).

The directly estimated coefficients on the country specific dummy variables (μ_i) are relatively large and "explain" most of the variation in the panel data on school expenditures and their components. Regressing these estimates of μ_i on R_{it} yields uniformly statistically significant multiple correlations, according to F tests. Mundlak (1978) and Hsiao (1986) propose a specification test for whether the random-effects model is acceptable, when the alternative hypothesis is that the fixed-effect specification is appropriate. Appendix Table A-2 reports these tests of the random-effects model, which is confidently rejected as misspecified for all dependent variables, both at the primary and secondary school levels. The fixed-effect (within) specification is thus the

Table 2

Between Country Estimates of Public Primary School Expenditures and Subcomponents[a]

Dependent Variable (in logarithms)	Income per Adult (log)	Relative Price of Teachers[b] (log)	Urban Share	Size of School Cohort	Total Fertility Rate	Intercept	R^2	Sample Size	Dependent Variable Mean	Dependent Variable Variance	Share of Pooled Variance[c]
1. Expenditures per child (E/P)	1.27 (18.4)	.0451 (.28)	-.628 (2.68)	-11.8 (4.69)	.0198 (.51)	-2.64 (4.15)	.941	59	4.11	2.300	.96
2. Enrollment ratio (S/P)	.132 (2.11)	-.580 (4.02)	-.163 (.77)	5.46 (2.40)	-.0970 (2.77)	-.902 (1.55)	.558	59	-.133	.214	.93
3. Teacher-student ratio (T/S)	.198 (3.19)	-.410 (2.85)	-.446 (2.12)	-4.74 (2.11)	.0373 (1.08)	-3.95 (6.89)	.691	59	-3.50	.126	.88
4. Current expenditures per teacher (C/T)	.901 (22.9)	.983 (10.9)	.0751 (.56)	-12.3 (8.60)	.0798 (3.64)	2.28 (6.33)	.833	59	7.6	.982	.94
5. Capital intensity (E/C)	.0391 (6.76)	.0478 (3.58)	-.109 (5.53)	-.171 (.81)	-.0023 (.71)	-.066 (1.23)	.131	59	.140	.00507	.56

Notes:

a Beneath coefficients in parentheses are reported the absolute value of the t ratio, computed from the variance-covariance matrix corrected for the urbalanced panel form of the data, where it is assumed to be due to randomly missing observations. See D. Chao (1986, pp. 36 and 193ff.).

b Endogenous variable estimated on the basis of the following instrumental variables: ten year lagged values of real GNP per adult, urban share, log of secondary enrollment rate, female share of secondary students, and the rate of growth of the number of teachers at this level of the school system in the preceding decade.

c The share of the variance of the pooled time series of cross sections accounted for by the cross section (i.e. between country component). It might be called the complement to the intra-class correlation coefficient (Fisher, 1930, pp. 179+).

Table 3

Within Country Estimates of Public Primary School Expenditures and Subcomponents[a]

Dependent Variable (in logarithms)	Income per Adult (log)	Relative Price of Teacher[b] (log)	Urban Share	Size of School Cohort	Total Fertility Rate	R^2	Sample Size	Dependent Variable Mean	Dependent Variable Variance	Share of Pooled Variance[c]
1. Expenditures per child (E/P)	1.25 (9.24)	-.399 (1.58)	.000 (.01)	-8.36 (3.11)	.017 (.35)	.656	191	0	.0819	.04
2. Enrollment ratio (S/P)	-.0892 (1.05)	-1.02 (6.42)	-.003 (.10)	-.436 (.26)	-.0257 (.83)	.285	191	0	.0155	[illegible]
3. Teacher-student ratio (S/T)	.241 (2.85)	-.0488 (.30)	.896 (3.04)	-3.34 (2.00)	-.0084 (.27)	.372	191	0	.0172	.12
4. Current expenditures per teacher (C/T)	1.03 (7.15)	.782 (2.78)	-.006 (1.18)	-4.04 (1.35)	.0549 (.99)	.402	191	0	.0583	.06
5. Capital intensity (E/C)	.0228 (.45)	-.137 (1.46)	-.245 (1.39)	-.431 (.43)	-.0046 (.25)	.030	191	0	.00398	.44

Notes:

a Beneath coefficients in parentheses are reported the absolute value of the t ratio, computed from the variance-covariance matrix corrected for the unbalanced panel form of the data, where it is assumed to be due to randomly missing observations. See D. Chao (1986, pp. and 193ff.).

b Endogenous variable estimated on the basis of the following instrumental variables: ten year lagged values of real GNP per adult, urban share, log of secondary enrollment rate, female share of secondary students, and the rate of growth of the number of teachers at this level of the school system in the preceding decade.

c The share of the variance of the pooled time series of cross sections accounted for by the cross section (i.e. between country component). It might be called the complement to the intra-class correlation coefficient (Fisher, 1930, pp. 179+).

Table 4

Between Country Estimates of Public Secondary School Expenditures and Subcomponents[a]

Dependent Variable (in logarithms)	Income per Adult (log)	Relative Price of Teachers[b] (log)	Urban Share	Size of School Cohort	Total Fertility Rate	Intercept	R^2	Sample Size	Dependent Variable Mean	Dependent Variable Variance	Share of Pooled Variance[c]
1. Expenditures per child (E/P)	1.57 (13.6)	.358 (2.73)	-.601 (2.04)	-6.39 (1.76)	-.0570 (1.44)	-5.89 (5.57)	.899	47	3.78	2.684	.95
2. Enrollment ratio (S/P)	-.0273 (.15)	-1.27 (5.91)	.210 (.44)	-5.42 (.91)	.00313 (.05)	.344 (.20)	.933	47	-1.35	1.131	.93
3. Teacher-student ratio (T/S)	.400 (3.92)	.241 (2.08)	-.525 (2.01)	-2.45 (.76)	.0500 (1.43)	-5.60 (5.94)	.261	47	-2.95	.1362	.83
4. Current expenditures per teacher (C/T)	1.16 (10.6)	1.37 (10.9)	-.185 (.66)	1.75 (.51)	-.108 (2.88)	-.627 (.62)	.537	47	7.94	.8437	.92
5. Capital intensity (E/C)	.0397 (4.69)	.0249 (2.59)	-.101 (4.66)	-.271 (1.02)	-.0019 (.64)	-.0518 (.67)	.090	47	.148	.00555	.55

Notes:

a Beneath coefficients in parentheses are reported the absolute value of the t ratio, computed from the variance-covariance matrix corrected for the unbalanced panel form of the data, where it is assumed to be due to randomly missing observations. See D. Chao (1986, pp. 36 and 193ff.).

b Endogenous variable estimated on the basis of the following instrumental variables: ten year lagged values of real GNP per adult, urban share, log of secondary enrollment rate, female share of secondary students, and the rate of growth of the number of teachers at this level of the school system in the preceding decade.

c The share of the variance of the pooled time series of cross sections accounted for by the cross section (i.e. between country component). It might be called the complement to the intra-class correlation coefficient (Fisher, 1930, pp. 179+).

Table 4

Between Country Estimates of Public Secondary School Expenditures and Subcomponents[a]

Dependent Variable (in logarithms)	Income per Adult (log)	Relative Price of Teachers[b] (log)	Urban Share	Size of School Cohort	Total Fertility Rate	Intercept	R^2	Sample Size	Dependent Variable Mean	Dependent Variable Variance	Share of Pooled Variance[c]
1. Expenditures per child (E/P)	1.57 (13.6)	.358 (2.73)	-.601 (2.04)	-6.39 (1.76)	-.0570 (1.44)	-5.89 (5.57)	.899	47	3.78	2.684	.95
2. Enrollment ratio (S/P)	-.0273 (.15)	-1.27 (5.91)	.210 (.44)	-5.42 (.91)	.00313 (.05)	.344 (.20)	.933	47	-1.35	1.131	.93
3. Teacher-student ratio (T/S)	.400 (3.92)	.241 (2.08)	-.525 (2.01)	-2.45 (.76)	.0500 (1.43)	-5.60 (5.94)	.261	47	-2.95	.1362	.83
4. Current expenditures per teacher (C/T)	1.16 (10.6)	1.37 (10.9)	-.185 (.66)	1.75 (.51)	-.108 (2.88)	-.627 (.62)	.537	47	7.94	.8437	.92
5. Capital intensity (E/C)	.0397 (4.69)	.0249 (2.59)	-.101 (4.66)	-.271 (1.02)	-.0019 (.64)	-.0518 (.67)	.090	47	.148	.00555	.55

Notes:

a Beneath coefficients in parentheses are reported the absolute value of the t ratio, computed from the variance-covariance matrix corrected for the unbalanced panel form of the data, where it is assumed to be due to randomly missing observations. See D. Chao (1986, pp. 36 and 193ff.).

b Endogenous variable estimated on the basis of the following instrumental variables: ten year lagged values of real GNP per adult, urban share, log of secondary enrollment rate, female share of secondary students, and the rate of growth of the number of teachers at this level of the school system in the preceding decade.

c The share of the variance of the pooled time series of cross sections accounted for by the cross section (i.e. between country component). It might be called the complement to the intra-class correlation coefficient (Fisher, 1930, pp. 179+).

Table 5

Within Country Estimates of the Public Secondary School Expenditures and Subcomponents[a]

Dependent Variable (in logarithms)	Income per Adult (log)	Relative Price of Teacher[b] (log)	Urban Share	Size of School Cohort	Total Fertility Rate	R^2	Sample Size	Dependent Variable Mean	Dependent Variable Variance	Share of Pooled Variance[c]
1. Expenditures per child (E/P)	1.83 (8.91)	-.251 (1.46)	-.415 (.38)	-3.13 (.82)	-.102 (1.61)	.715	150	0	.1326	.05
2. Enrollment ratio (S/P)	.547 (3.29)	-1.04 (7.44)	2.41 (2.71)	6.26 (2.03)	-.0299 (.58)	.725	150	0	.0900	.07
3. Teacher-student ratio (T/S)	.105 (.91)	.0647 (.48)	-.841 (.98)	-8.98 (3.02)	.0080 (.16)	.153	150	0	.0271	.17
4. Current expenditures per teacher (C/T)	.953 (4.41)	.919 (5.07)	-.738 (.64)	-.161 (.04)	-.0628 (.95)	.460	150	0	.0773	.08
5. Capital intensity (E/C)	.186 (2.86)	-.197 (3.61)	-1.25 (3.59)	-.238 (.20)	-.0172 (.86)	.173	150	0	.00457	.45

Notes:

a Beneath coefficients in parentheses are reported the absolute value of the t ratio, computed from the variance-covariance matrix corrected for the unbalanced panel form of the data, where it is assumed to be due to randomly missing observations. See D. Chao (1986, pp. 32 and 193ff.).

b Endogenous variable estimated on the basis of the following instrumental variables: ten year lagged values of real GNP per adult, urban share, log of secondary enrollment rate, female share of secondary students, and the rate of growth of the number of teachers at this level of the school system in the preceding decade.

c The share of the variance of the pooled time series of cross sections accounted for by the cross section (i.e. between country component). It might be called the complement to the intra-class correlation coefficient (Fisher, 1930, pp. 179+).

more reliable statistical specification compared to the random effect or between or pooled specifications. Nonetheless, the fixed effect estimates exploit only 5 to 17 percent of the variance in the pooled sample, with the exception of the least well measured capital intensity variable (see last column of Tables 3 and 5) and measurement error may become relatively larger (Griliches and Hausman, 1984).

There are at least four reasons why the "between" and "within" estimators could differ. The bias introduced by the correlation between the fixed effect and the regressors is the first source of a difference confirmed by the Mundlak specification test. Second, the more limited information available for the within estimator may lead to great imprecision in these estimates, and the appearance of a difference. Third, the size and composition of public educational expenditures may only partially adjust to changes in the conditioning variables over five or ten years, and within estimates may therefore approximate short-run responses and underestimate long-run responses that would ideally be observed in the cross-section equilibria (Kuh, 1959). Finally, the within estimates will be free of the bias from omission of private school expenditures, which are not observed, if the ratio of private to public school expenditures does not vary over time within countries, a reasonable first approximation (Roth, 1987).

The between and within country estimates of the income elasticity of overall primary school expenditures per child (row 1) are similar 1.25 and 1.27. The income elasticity of secondary school expenditures is larger; the within country estimate is 1.83, whereas the between estimate is 1.57. In short, the share of income expended at each level tends to increase with the level of real GNP per adult over time or across countries. Efforts to better approximate this strong income relationship with higher order terms in income were not statistically significant. The constant income elasticity functional form of the relationship cannot be rejected.

The relative price of teachers exerts its principal effect on the school system through its regulation of the quantity of schooling demanded, namely on enrollments. The within country estimates of the price elasticity of enrollments is minus one at both the primary and secondary levels. Variation between countries implies an absolutely lower figure for the price elasticity of primary (-.6) and higher for secondary enrollments (-1.3). Substitution toward using teachers more intensively in production in response to lower effective teacher prices is not confirmed by these estimates. Only the between country estimates for the primary schools suggest rising teacher-student ratios as the price of teachers declines. Between estimates also point to a tendency for capital intensity to be higher where teachers are relatively most costly, but the more reliable within country estimates do not confirm even this limited degree of factor substitution.

The elasticity of total public expenditures on primary schools with respect to the relative price of teachers is about zero, based on the between country estimates that are probably upward biased.[9] The preferred within estimate is -.40, but imprecise. At the secondary level the biased between estimate is .36 and is statistically significant, whereas the within estimate is again negative and imprecise.

The components underlying these strong income and mixed price effects on total public expenditures per school aged child are different according to school level. At the primary level, the unbiased within country estimates suggest current expenditures per teacher increase slightly faster than income per adult (1.08), while the quality margin of education, reflected in an increase in the teacher-student ratio, increases 24 percent with a doubling of incomes. No significant increase in capital intensity and a small imprecise decrease in enrollments are also associated with the income variable. The between country estimates are not very different.

At the secondary school level (Tables 4 and 5) the within-country effect of income on school expenditures are concentrated on increasing enrollments (.55), while the increase in quality, proxied in the teacher-student ratio, accounts for only .15, and is not statistically significantly different from zero. The income elasticity of the capital index is more substantial, .19, and current expenditures per teacher increase somewhat less than proportionately with income. The probably biased between country estimates attribute more of the income induced increase in expenditures to the quality, capital intensity, and current expenditures per teacher, and none to enrollment growth.

Urbanization is associated with reduced public expenditures on education across (between) countries, but not over time (within) countries. The cross sectional pattern is due to lower teacher-student ratios and less capital intensity in more urbanized countries. These patterns in the between estimates could be used to buttress the case for the efficiency of urban school consolidations that reduce unit costs of schooling (Kenny, 1982), but they may also be merely an artifact created by the omission of country specific factors [10] Studies of the balance of private and public school systems finds private schools are relatively more important in more urbanized populations (James, 1987). The cost reducing advantages in secondary schools of urban areas are more modest, according to the within country estimates, where only capital expenditures remain lower in countries that are urbanizing more rapidly. The within estimates also show that primary enrollments grow with urbanization, possibly as a consequence of reduced travel time and private opportunity cost of attendance. Nonetheless, improved data on private school enrollments and urban-rural disaggregations of school systems may ultimately be needed to confidently infer how population density and urbanization affect school expenditures and their composition.

The relative size of the school-aged population cohort, which is highly correlated with recent levels of population growth, is associated in all estimations with reduced public outlays on education per school aged child. This pattern is evident at both the primary and secondary levels. The expenditure effects of population growth via the age composition are somewhat larger based on between country variation than on within country changes. A standard deviation increase in the population proportion of primary school age of twenty percent, from the sample mean of .136 to .163, is associated in the cross section with a 32 percent reduction in public school outlays per child. Yet even within country estimates imply a decrease of 23 percent in primary school expenditures per child in this case. Secondary school effects are smaller, in which a standard deviation increase in cohort size by 20 percent is associated in the cross section with a 14 percent reduction in public expenditures per child, while within-countries the estimated effect is half as large, and no longer statistically significant. The expenditure depressing effects of increased cohort size is partly explained by larger classroom sizes and lower pay for teachers in both primary and secondary schools.[11]

Finally, introducing a control variable for fertility is relatively unimportant in the model's overall explanatory power or the size of the other coefficients. The estimated effect of cohort size is not merely a proxy for family size or current fertility levels. The total fertility rate is associated across countries with lower primary enrollment rates and lower current expenditures per teacher in secondary schools, but none of these partial effects of fertility are evident in the preferred within country estimates. As with urbanization and cohort size, changes in fertility occur gradually for the most part, and their impact may be difficult to appraise in the time frame analyzed here, even if one can maintain the working assumption that fertility is exogenous to school expenditures.

If the parameter estimates of the model are used in combination with recent changes in the regressors to simulate trends in education systems for the panel of countries, the within estimates of expenditure and enrollment changes in the period 1965 to 1975 follow closely country averages available in the sample. This is expected because the within estimates are based on the time series changes. The between country estimates underpredict expenditures and the recent growth in secondary school enrollments.

Cross sectional parameter differences in female and male enrollment rates (not reported here) suggest that increases in real income per adult and declines in relative prices of teachers both contribute to larger proportional gains in enrollments for girls than for boys (Schultz, 1987). This pattern reflects in part the near parity in male and female enrollment rates in the high income industrial countries and in Latin America, and the wide gap in schooling between men and women in low income Africa and South and West Asia. The larger absolute values of income and price elasticities for female than for male enrollments is less notable in the within country estimates that were shown to be more reliable. For example, the within country price elasticity of secondary school enrollment rates are similar for girls and boys, -1.03, and -1.09, and the respective income elasticities are .60 and .51. At the primary school level, price elasticities are -1.27 for girls and -.89 for boys, while income elasticities are negative and insignificantly different from zero for both girls (-.03) and boys (-.12). Demands for greater educational opportunities for women relative to men do not appear to evolve within countries at the pace one would expect using pooled (between) intercountry estimates (Schultz, 1987). Additional factors in many parts of the low income world, such as the limited labor market opportunities for educated women to work outside of the family and broadly based cultural restrictions on

occupations may help to explain the sluggish progress girls have made in achieving the same levels of schooling as boys.

7. Regional or Country Fixed Effects?

The pooled regressions estimated previously to describe national educational systems exhibited strong regional clustering of residuals (Schultz, 1987). East Asia and Africa expended more on public education and put through school a larger fraction of its youth than the model could account for in terms of income, prices, and population composition. Conversely, Latin America and particularly South and West Asia spent less on public schools and enrolled fewer students proportionately than the model could explain. These strong areal patterns in residuals were indeed one piece of evidence in support of the country fixed-effect model estimated in this paper. Perhaps the regional clusters would descriptively suffice and permit the intercountry differences within regions to be treated as a random effect and thereby to improve the efficiency of the parameter estimates. Since these are nested hypotheses, the joint F test for the statistical significance of the five regional fixed effects, and the country effects conditional on the regional effects were both computed. In every equation the regional effects were statistically significant at beyond the one percent level, as were the country effects after controlling for regions. Hence, greater parsimony achieved by modeling <u>only</u> the regional pattern of effects is not warranted in this case. Subsequent research should still seek an economic or perhaps political explanation for the source of the substantial country-specific effects in public educational investments.

8. Conclusions

Expenditures on public schooling are increasing in the world. The income elasticity of these public expenditures exceeds unity by a significant margin. More interesting is the negative unitary elasticity of enrollment rates with respect to the relative price of teachers. This price variable is an unusual construct, defined as public expenditures on teacher compensation per teacher, deflated by a proxy for national average workers' productivity or GNP per adult. This price is designed to represent the opportunity cost the average worker must sacrifice in terms of her or his own product, relative to the cost of hiring an average teacher to educate that worker's children. Clearly, this relative price is a large number, five to ten, in a poor country with few secondary school graduates, which may even have to import expatriate teachers to staff a new national school system. This was the case in many African countries in the 1960s, particularly in Francophone Africa. With the development of a local secondary school system, that adds to the pool of local citizens available to teach in the school system, the opportunity cost of teachers has tended to decline. What cannot be answered here is whether this decline in the price of teachers also signals a decline in the quality of instruction (World Bank, 1986).

Table 6 summarizes how this relative price of teachers has changed per year over the period the panel is observed. The relative price of teachers has increased slowly in high income countries, but has declined in low income countries. The rate of decline has been greatest in Africa, but the levels remain highest in this region, as for example, Niger where this relative price has fallen from 23 in 1965 to 14 in 1975. Because this measure of the price of teachers does not take into account the experience of the teacher, rapid growth in the school system augments the proportion of teachers with less experience,

Table 6

Recent Annual Rates of Change in the Relative Price of Primary and Secondary School Teachers, by Region

Region	Primary		Secondary	
	Sample Size	Annual Change	Sample Size	Annual Change
Africa	19	-3.1%	14	-5.8%
Latin America	14	-1.4%	8	.5%
East Asia	6	-3.9%	6	-2.6%
South and West Asia	5	-3.6%	5	-5.5%
High Income Countries	16	.5%	15	1.6%
Total Sample	60	-1.9%	48	-2.0%

Source: For the composition of the sample of countries examined here and dates, see Appendix Table A-1.

lowering the average cost of a teacher. This is confirmed in the auxiliary instrumental variable prediction equations for teacher compensation (see Appendix Table A-3). Also a larger secondary school enrollment reduces the cost of a teacher, as anticipated, and it is hardly unexpected that if a greater proportion of those secondary school graduates are women, given the limited professional occupations open to women, that this variable also contributes to reducing the relative price of teachers ten years later.

Although far from a complete model of the demand and supply of educated labor that is needed to fully describe the composition of educational expenditures, this paper has indicated several of the important parts to such a model. The task remains to make more complete use of data on the development process to explain the determinants of the private and social returns to schooling and the relative price of teachers to the public sector. Clearly, these two variables are inversely and closely associated. Understanding better the reasons for a divergence between these distinct measures of the scarcity of educated workers in an economy may provide a deeper understanding of the origins of large unexplained differences in educational expenditures among nations.

Notes

[1]/The gap in expected education and expected life at birth between the lowest income countries (excluding India and China in the World Bank categories) and the high income industrial market economies decreased markedly in the last two decades. Life expectation stood at about 43 and 71 years in 1960, and had increased to roughly 51 and 75 years by 1982 in these two groups of countries, respectively. Expected years of schooling, on the other hand, increased for these two groups of countries from almost 3 and 11.5 years in 1960, to almost 6 and 13.3 years in 1982, or from one-to-four to one-to-two. These achievements were recorded despite the fact that income (GNP) per capita in constant prices grew in the same period three times faster in the high income countries than it did in this lowest income group of countries. These illustrative figures are drawn from the World Bank (1984, Tables 1, 23, and 25). See also Preston's (1980) comparisons of life expectation across more uniform and reliable data from a smaller number of countries. There are differences between and limitations of such synthetic summary measures of health and education. The schooling in high and low income countries (as suggested in Table 1) may be of increasingly disparate quality, so the gap in equality adjusted years may not be decreasing though the gap in years is. Analogously, the gap between the quality of life (however that is measured) in high and low income countries may be widening, undermining consideration of the expectation of life as an overall indicator of health and vitality. There is also the bounded nature of both life expectation and years of education which may imply a narrowing gap as many countries approach that upper limit.

[2]/See explanatory footnotes to Table 1 in T.P. Schultz, 1987.

[3]/ The most comprehensive comparison of rate of return studies is that by Psacharopoulos (1973, 1981, 1985). Differences in methodology across these summarized country studies limits the precise comparability of the return calculations.

4/ The political process may not assign everyone's vote an equal weight, however. For example, urban populations in many low income countries appear to exercise greater influence on public sector decisions than do dispersed rural populations. The opposite condition seems to prevail in industrially advanced countries where farmers have disproportionate standing in political process. Without data on the distribution of income, public services, or taxes across subgroups within countries, it is not fruitful to speculate further here on the distributional implications of how this political process works.

5/ Equation (7) may be rewritten in logarithms:

$$\ln(E/P) = \ln(S/P) + \ln(T/S) + \ln(C/T) + \ln(E/C)$$

and regressions would be calculated of the following form at each level of schooling:

$$\ln(E/P) = \beta_{11} + \beta_{12}\ln Y + \beta_{13}\ln W + \beta_{14}Z$$
$$\ln(S/P) = \beta_{21} + \beta_{22}\ln Y + \beta_{23}\ln W + \beta_{24}Z$$
$$\ln(T/S) = \beta_{31} + \beta_{32}\ln Y + \beta_{33}\ln W + \beta_{34}Z$$
$$\ln(C/T) = \beta_{41} + \beta_{42}\ln Y + \beta_{43}\ln W + \beta_{44}Z$$
$$\ln(E/C) = \beta_{51} + \beta_{52}\ln Y + \beta_{53}\ln W + \beta_{54}Z$$

The adding up of component effects implies that

$$\beta_{1i} = \sum_{j=2}^{5} \beta_{ji} \qquad \text{for } i = 1,\ldots,4.$$

6/ It may be argued that the use of foreign exchange (FX) rates in 1969-71 to translate GNP from local currencies into the common unit of dollars gives insufficient weight to nontraded commodities. Substantive conclusions were not particularly sensitive to the use of other procedures for translating GNP across countries into common welfare units, based on purchasing power parities (T. P. Schultz, 1987).

7/ It was expected that the lagged secondary enrollment rate would depress the teacher price, the female share of teachers would do likewise since women tend to be paid less than men, whereas income and urbanization would increase the teacher price. The countries where the number of teachers have grown rapidly would have teachers who are on an average younger and less highly paid.

[8]/ Appendix Table A-3 reports the actual instrumental variable auxiliary equation for teacher relative prices based on the cross section (between) and time series (within) sample variation. The two most important variables are the lagged secondary school enrollment rate (proxy for teacher supply) and the rate of growth of teachers (proxy for the age/experience composition of the staff of teachers). For example, according to the within country estimates for the price of secondary school teachers, a ten percent higher secondary school enrollment rate a decade ago reduces the current wage by 18 percent; 10 percent more females in that past enrollment reduces the wage 12 percent; a ten percent faster growth in teachers reduces the wage another 3 percent. The total effect of these three changes is about a third reduction in teacher prices and an increase in enrollment of a third.

[9]/From equation (6) the coefficient on the relative price or teacher wage variable in the expenditure function is $b_2 = \alpha(\eta + 1)$, and thus the estimated price elasticity, $\eta = (b_2/\alpha) - 1$. The sample mean of α is .85.

[10]/Economies of scale in producing school services might be distinguished at three levels: (1) with the size of the national educational system, (2) with the size of the school measured in terms of its number of full time teachers, and (3) with the size of the teacher's span of control or student-teacher ratio. The importance of (1) in primary and secondary school systems was assumed at the outset to be negligible in adopting the production function specification (1). The number of primary schools is reported in the 1984 UNESCO Yearbook. If the system's average school size (i.e. log of teachers per school) is added to equation (6), one might expect this added scale variable to diminish the coefficient on urbanization, if larger urban schools realized economies that reduced unit costs. In a sample of 60 countries for which these data are recently available, school size is associated with <u>greater</u> expenditures per child due to higher teacher-student ratios and higher current outlays per teacher. The between country coefficients on urbanization are not reduced in magnitude by the addition of school size. Consolidation economies, however, could remain important at the secondary level, but no data were found to test this conjecture.

A plausible interpretation of the pattern found here is that there are economies in using teachers in the larger scale urban schools and perhaps compensating amenities in urban areas that teachers value, such as attractive employment opportunities for teachers when schools are not in session. In fact, urban teachers are probably better trained than rural ones in most countries, so qualitatively one would expect to therefore see higher teacher costs in urban school systems.

11/Standardized test comparisons confirm that spending less per student in low income countries is associated with lower standardized test scores on average (Heyneman and Loxley, 1983). There appears to be little evidence on the marginal gains from additional expenditures on raising school quality for currently enrolled students or extending more years of schooling for those students or others not previously enrolled. The economic gains would not be valued by test scores but by market wage rate differences in the specific national labor market. An interesting study of Brazil considers this question (Behrman and Birdsall, 1983).

Appendix Table A-1

Panel Sample of Countries Reporting Education Data

Region/Country	Primary		Secondary	
	Dates	Number of Observations	Dates	Number of Observations
Africa				
Ethiopia	1970-1980	2	-	-
Madagascar	1970-1980	2	-	-
Malawi	1965-1980	4	1965-1980	4
Mauritius	1960-1980	5	1960-1975	4
Rwanda	1965-1980	4	1965-1980	4
Tanzania	1965-1975	3	1965-1975	3
Zambia	1970-1980	3	1970-1980	3
Central African Rep.	1970-1980	3	1970-1980	3
Congo Republic	1970-1975	2	1970-1975	2
Algeria	1965-1980	3	1970-1980	2
Morocco	1965-1980	4	1965-1980	4
Tunisia	1975-1980	2	1975-1980	2
Ghana	1965-1980	4	1965-1980	4
Ivory Coast	1970-1975	2	-	-
Liberia	1970-1975	2	-	-
Niger	1970-1980	3	1970-1980	3
Senegal	1970-1980	2	1970-1980	2
Togo	1970-1980	3	-	-
Burkina Faso	1975-1980	2	1975-1980	2
		55		42
Latin America				
Dominican Republic	1970-1975	2	-	
Haiti	1970-1975	2	-	
Trinidad/Tobago	1965-1980	4	1965-1980	4
El Salvador	1965-1975	3	-	
Guatemala	1965-1980	4	1965-1980	4
Honduras	1965-1980	4	1965-1980	4
Mexico	1965-1975	3	1965-1975	3
Panama	1960-1980	4	1960-1980	4
Uruguay	1965-1980	4	-	
Bolivia	1965-1975	3	-	
Colombia	1965-1980	4	1965-1980	4
Paraguay	1960-1970	3	1960-1970	3
Peru	1970-1980	2	-	
Venezuela	1965-1980	4	1965-1980	4
		46		30

East Asia				
Hong Kong	1970-1980	3	1970-1980	3
South Korea	1960-1965	2	1960-1965	2
Malaysia	1975-1980	2	1975-1980	2
Philippines	1970-1980	3	1970-1980	3
Singapore	1970-1980	3	1970-1980	3
Thailand	1960-1980	5	1960-1975	4
		18		17
South and West Asia				
Afghanistan	1970-1980	3	1970-1980	3
Iran	1970-1975	2	1970-1975	2
Iraq	1965-1970	2	1965-1970	2
Kuwait	1975-1980	2	1975-1980	2
Syria	1970-1980	3	1970-1980	3
		12		12
High Income Industrial Countries				
Japan	1965-1975	3	1965-1975	3
Israel	1965-1980	4	1965-1980	4
Finland	1960-1975	4	1960-1975	4
Ireland	1960-1980	5	1960-1980	5
Norway	1960-1980	5	1960-1970	3
Sweden	1965-1980	4	1975-1980	2
United Kingdom	1970-1980	3	1970-1980	3
Greece	1970-1975	2	1970-1975	2
Italy	1960-1980	5	1960-1980	5
Portugal	1975-1980	2	1975-1980	2
Spain	1965-1975	3	1965-1975	3
Yugoslovia	1960-1970	3	1960-1970	3
Austria	1960-1980	3		
France	1965-1980	4	1970-1980	3
West Germany	1960-1980	5	1960-1980	5
Netherlands	1960-1980	5	1960-1965	2
		60		49
	TOTAL	191		150

Table A-2

Mundlak Specification Test for Rejecting the Null Hypothesis of the Random-Effects Model

Dependent Variable	Primary F(5, 185)	Secondary F(5,144)
Expenditures per child	116.	223.
Enrollment rate	56.5	171.
Teacher-student ratio	94.8	13.0
Current expenditures per teacher	31.9	53.2
Capital intensity	31.6	290.
Teacher relative price (endogenous)	7.22	12.2

$F(5,185) > 3.79 \quad p < 1\%$

Table A-3

Instrumental Variable Auxiliary Regressions for Endogenous Teacher Relative Prices

School Level and Estimator:	Income Per Adult (Log) t-10	Urban Share t-10	Secondary Enrollment Rate t-10	Female Share of Secondary Enrollment t-10	Growth in Teachers in Preceding Decade	Intercept	R^2	Sample Size
Primary School System								
Between	.0860 (.63)	-.415 (.98)	-.263 (2.63)	-.329 (1.25)	-.602 (2.41)	-.470 (.46)	.410	59
Within	.0648 (.49)	.0285 (.03)	-.186 (3.05)	.103 (.72)	-.183 (1.75)	-	.095	191
Secondary School System								
Between	.138 (.61)	-.110 (.17)	-.645 (3.99)	-.591 (1.24)	-.615 (1.52)	-1.51 (.88)	.606	47
Within	.364 (1.92)	-1.31 (.97)	-.315 (3.70)	-.475 (2.40)	-.347 (4.05)	-	.272	150

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