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The Mechanics of Progress in Education:

Evidence from Cross-Country Data

By

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Executive Summary

A staple feature of cross-country comparisons is that poor countries typically lag behind rich countries on almost any indicators of educational development. What in fact is the relation between country wealth and education? What underlying factors account for rich countries' advantage in education? How does the impact of these factors change in the course of economic growth? What scope is there for policy choice to improve education sector outcomes?

We explore these questions by first documenting the relation between per capita GNP and various indicators of educational development in a systematic fashion. We then exploit a simple accounting identity relating the availability of resources to the expenditure of those resources to clarify the sources of rich countries' advantage in education. Data for our sample of some 125 countries in 1993 confirm the expected favorable relation between per capita GNP and each of the following dimensions of educational development: (a) the sector context as characterized by the demographic burden on the education system, the government's overall fiscal capacity, and so on; (b) the production of education services, including such factors as public spending on education and the composition of spending; (c) education outcomes in terms of coverage and student learning; (d) efficiency of sector operations; and (e) equity in access and distribution of public spending on education.

An appealing explanation of why richer countries achieve better results is that they have more resources to run well-functioning and efficient education systems. Comparing pairs of countries at contiguous levels of per capita GNP between $200 and $10,000 (e.g. countries at $200 and $400 would form one pair, and those at $400 and $800, another pair), we found that indeed the richer country in each pair enjoys an advantage of almost 50 percent in the resources available per school-aged child. Yet a closer look reveals that bigger budget allocations to education make a relatively small contribution to the differences in resources. The commonly-cited role of lighter demographic burdens in the richer countries is also relatively modest, contributing between 17 and 32 percent of the advantage among the pairs of countries compared. By far the most important factor is the decline of teacher salaries relative to the per capita GNP, accounting for at least 50 percent of the advantage at all stages of economic development.

The extra resources per school-aged child that materializes in the process of income growth allow countries to expand enrollments and improve classroom conditions by reducing the pupil-teacher ratio. At the earliest phase of income growth—corresponding to a rise

in the per capita GNP from $200 to $400—countries allocate more of the extra resources to support expansion of coverage, but at all subsequent stages, the emphasis shifts in favor of reducing the pupil-teacher ratio. In both the 1970s and the 1990s the shift in emphasis away from expansion of coverage took place in contexts where access to primary education was still not yet universal. Moreover, it occurred at significantly lower enrollment rates—around 50 percent—in the 1990s than in the 1970s, signaling a stronger bias against expansion of coverage in the more recent period.

The revealed priorities in spending raise important policy questions. Is an emphasis on reduction of the pupil-teacher ratio at the cost of slower progress in expanding coverage an efficient strategy for the sector? Two considerations suggest an answer in the negative: the first is that over the range that the pupil-teacher ratio typically varies in developing countries, smaller pupil-teacher ratios have little or no impact on student learning; moreover, the slower progress in expanding coverage implies that tomorrow's adults will be less well-educated which in turn is likely to diminish student learning among tomorrow's children, given that adults' educational attainment is a strong predictor of children's school performance. Thus, as long as coverage is not yet universal a more efficient strategy for educational development is to emphasize continued expansion of coverage rather than a rapid reduction in the pupil-teacher ratio.

Aside from the systematic differences in education across rich and poor countries, the study also finds evidence of substantial diversity among countries at comparable levels of per capita GNP. Countries set different priorities in the allocation of public spending, pursue different policies that affect how education services are organized and delivered, and make different tradeoffs as to how resources are used to support expansion of coverage and reduction in the pupil-teacher ratio. In countries where education is poorly developed, policy choices that affect the market for teachers (and therefore their cost), as well as the balance between expansion of coverage and reduction in the pupil-teacher ratio have especially strong effects on the prospects for progress in education.

The Mechanics of Progress in Education:

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1. Introduction

In all countries education plays a key role in social and economic life, so it is not surprising that most governments seek, at least in rhetoric, to build education systems that offer the best possible services to as wide a segment of the population as possible. Despite the common goal, however, countries achieve very different results. On almost any measure of schooling outcome—whether related to coverage or student learning—low-income countries typically lag behind high-income countries. What are the sources of rich countries' advantage in education? What is the role of such factors as demographic conditions, government fiscal capacity, prices, and policy choice? Does the impact of these factors change as countries grow rich, and if so, how? What do the patterns reveal about the nature of policy choice in education?

Answers to these questions are explored in this paper. In the process we hope to discover patterns in the relation between country wealth and various aspects of educational development, and to clarify the mechanics of progress in education as a country grows rich.[1] At the same time, we also expect to improve our understanding of policy options to improve education. Given the breadth of these issues, our study represents a partial treatment, both because it focuses on system-wide features rather than on pedagogical processes at the classroom level, and because it relies solely on quantitative data.[2]

These limitations notwithstanding the findings reveal several key insights. The first is that systematic links exist between country wealth and most indicators of educational

[1] For a discussion of similar questions from the perspective of a production-demand framework based on data from 1960 to 1980 see Schultz, T.P. 1988 "Expansion of public school expenditures and enrollments: inter-country evidence on the effects of income, prices, and population growth," Economics of Education Review 7(2): 167-83.

[2] The bulk of the data pertains to 125 countries around 1993, the latest year for which data on the most of the indicators used in our study are currently available or can be constructed, supplemented by data for 1975 for a smaller set of indicators and countries. These data come from a larger time-series database prepared by the Institute de Recherche sur l'Economie de l'Education (IREDU), Université de Bourgogne, Dijon, France. The raw data come from various sources, including international organizations (e.g. UNESCO, the World Bank, ILO, and OECD), published and unpublished country and comparative studies, and doctoral dissertations. Data for all the indicators have been checked for consistency in their relation to each other, as well as across time. Where published data contain obvious inconsistencies they are replaced by data for a nearby year, or by simulations based on related data. Since the database was created, new data have become available, but rather than attempt to incorporate them we have decided simply to use what is already available in it.

development, including steady easing of demographic pressures on the education system as incomes rise, significant expansion, at the primary level of coverage accompanied by a gradual rise in per pupil spending, declines in the pupil-teacher ratio and teacher salaries relative to the per capita GNP. The relation between country wealth and most of the indicators was relatively loose, however, suggesting substantial scope for diversity in policy choice across countries. Exploiting an accounting identity to relate several indicators of expenditure to those on outcomes in primary education, we found that as a country grows rich, the resources for education that become available per school-aged child indeed increase significantly. Strikingly, the main source of the increase is not bigger budget allocations, nor a lighter demographic burden, but the sharp declines in teacher salaries relative to the per capita GNP. Countries use the extra resources to expand primary school coverage and reduce the pupil-teacher ratio, but they have tended to emphasize the latter option, a pattern that has become more obvious in the 1990s than in the 1970s. In light of the weak links between pupil-teacher ratios and student learning in the context of developing countries, the shift in emphasis raises serious questions about the underlying assumptions of recent policy choices in education, especially in poor countries.

The rest of this paper is organized as follows. Section 2 documents the relation between country wealth and educational development in order to identify systematic differences in education between rich and poor countries. Section 3 sets out a framework to clarify the sources of richer country's advantage in education, and to examine how countries allocate the resources that materialize in the process of economic growth to expand coverage and improve schooling conditions. Section 4 discusses the policy issues raised by the findings in the previous two sections, particularly with regard to quantity-quality tradeoffs in resource allocation, and the role of policy choice in shaping progress in the sector. Section 5 concludes the paper.

2. How Is Education Different In Rich And Poor Countries?

We make the comparisons along five dimensions of education that together paint a reasonably comprehensive picture of how the sector operates:[3]

[3]. For lack of space not only selected indicators of the five dimensions are included below. Supplementary graphs and tables are available upon request from the authors.

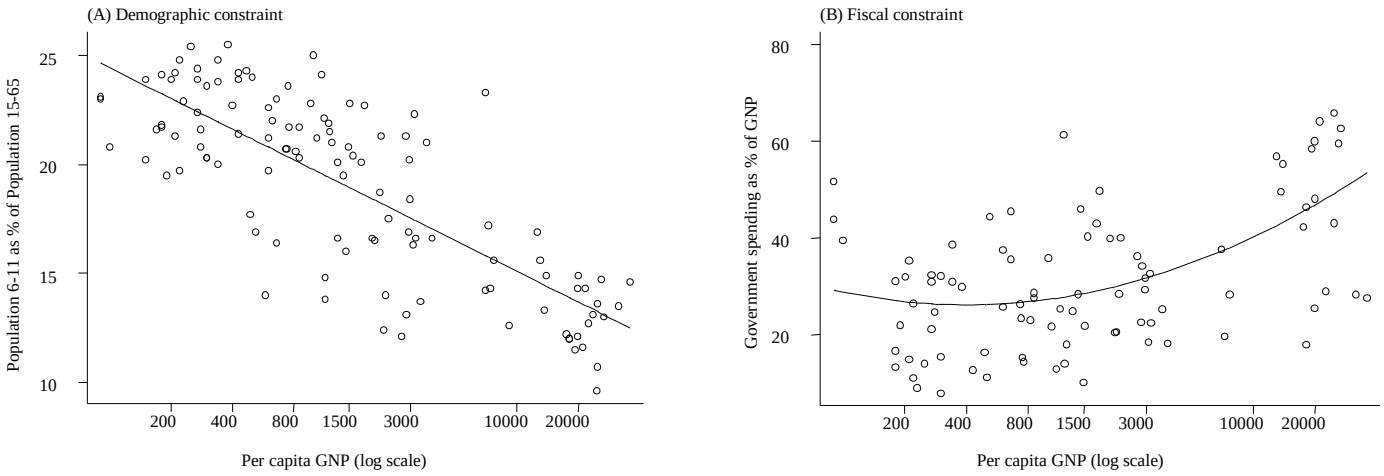
- Overall sector context, as described by demographic pressures on the education system, overall fiscal capacity of the government, the educational attainment of the adult population, the structure of employment by economic sector, and the share of education in the public budget;
- Production of education services as reflected in the public-private division of service provision, the composition of public spending on education by level and expenditure category, and average public spending per pupil;
- Education quantity and quality, as measured by various indicators of coverage, and by student achievement on international mathematics and science tests;
- Efficiency of the education system, as captured by the pattern of grade-to-grade student flow, and education outcomes relative to the amount of resources invested to achieve them; and
- Equity in education, as revealed by gender disparities in enrollments and by the distribution of public spending on education.

2.1 Overall sector context

The demographic composition of the population describes a key feature of the sector context because children and young people depend on adults to finance the system; thus, the more children there are relative to adults, the heavier is the fiscal burden that education places on each adult. The government's fiscal capacity—as reflected by total public spending relative to the GNP—also matters because a bigger overall budget is likely to improve the availability of resources for education, not least because in most countries the government provides most of the funds for education. A third aspect of the sector context is the educational attainment of adults, its relevance stemming from the fact that adults make decisions about children's schooling and they also shape the broader out-of-school learning environment to which children are exposed. Yet a fourth features is the distribution of employment by sector; it matters because it closely mirrors the economy's demand for educated labor, which in turn affects the opportunity cost of schooling and the employment prospects of school leavers. Finally, the intensity of the inter-sector competition for public funds, as reflected in the share of education in overall public spending, forms yet a fifth dimension of the overall context. Below we examine how the foregoing aspects of the sector context relate to country wealth, as proxied by the per capita GNP.

Demographic burden and overall fiscal capacity. As a measure of the demographic burden we express the population aged 6-11 (corresponding roughly to the primary school aged population) as a percentage of the total population.[4] Figure 1 (panel A) shows that this indicator (which we shall call the dependency ratio) declines steadily as per capita GNP rises, from an estimated average of 23 percent in countries at a per capita income of $200, down to only 14 percent, on average, among OECD countries. The difference is large, because it implies that, all other things being equal, achieving the same coverage in primary education implies twice as heavy a resource burden (relative to the GNP) in the poorest countries as in the richest countries.

Figure 1: Relation between demographic constraint and fiscal capacity, and per capita GNP, circa 1993



The line in the graph, estimated from regression analysis, describes the average relationship between the dependency ratio and per capita GNP (expressed in logarithmic units).[5] The R^2 statistic for the regression equation is relatively high, at 0.65, suggesting a fairly tight relationship between the two variables. Thus, although the scatter plot suggests variation across countries in the dependency ratio (ranging between 12 and 24 percent, for example, among countries at around $1,000 in per capita GNP), the broad pattern is that countries generally follow a predictable path of demographic transition as they grow rich.

[4] The pattern is similar when the numerator includes children in a broader age band (6-14) corresponding to basic education.

[5] We estimated the following equation: dependency ratio = $\alpha + \beta$. ln (per capita GNP) + μ , where α and β are the regression estimates, and μ is the error term. The value of β is the change in the dependency ratio associated with a percentage point change in the per capita GNP. In this formulation, a change in per capita GNP from, say, $200 to $400 (a 100 percent rise) would have the same impact as a change from, say, $1,000 to $2,000 (which is also a 100 percent rise).

Turning now to panel B in the figure, we note that the overall size of the government budget as a percentage of GDP tends to expand with country wealth—from an estimated average of 27 percent among the poorest countries, to 47 percent among the OECD countries. The pattern is consistent with the fact that as countries becomes richer and the economy more formalized, the tax base tends to broaden and tax administration generally becomes more efficient. The positive association is relatively weak, however, as the R^2 statistic of the regression equation is only 0.25 for the sample as a whole, and an even smaller 0.04 among countries with incomes no higher than $4,000 per person.[6] Thus, in this income group, the size of the public budget relative to the GNP varies almost independently of a country's level of economic development, suggesting that the variable is generally open to policy choice.

Adults' educational attainment and the economy's employment structure. To economize on space we examine only the adult literacy rate and the share of workers in agriculture as measures of these aspects of the sector context.[7] Data for our sample show that the literacy rate rises with the per capita GNP, from an estimated 50 percent in countries at $200 in per capita GNP in 1993, to nearly universal literacy by the time the per capita GNP exceeds $10,000. With regard to the structure of employment, the graph shows that the share of workers in agriculture drops precipitously as a country grows rich, from an estimated average of 71 percent at $200 in per capita GNP, to 35 percent at $1,500, and then to only about 5 percent at $20,000; correspondingly, employment in industry and services expands as country wealth rises. Both the literacy rate and the employment share of agriculture relate fairly tightly to the per capita GNP, with a R^2 statistic of 0.54 and 0.77 respectively; the result implies that countries face relatively similar constraints in these aspects of the context for educational development.

Inter-sector competition for public spending. The more intense the competition for resources, the smaller is likely to be the share of education in the public budget. Do rich countries tend to favor education over other sectors more than poorer countries? The evidence suggests no such tendency: rich countries allocate about the same share as poor countries,

[6] The regression equation is the same as that in the previous footnote, except that it contains an extra terms, the square of ln (per capita GNP). The new item is added to improve the fit of the regression to the data, which improves a higher R^2 value. Subsequent regressions use one of these functional forms, and the choice is decided based on the R^2 value of the regression.

[7] For details on other indicators see Mingat Alain and Jee-Peng Tan (1998) "Education in rich and poor countries: a systematic comparison" mimeo, Human Development Department, The World Bank.

ranging between 13 and 17 percent of the total public budget. However, as a share of the GNP, public spending on education rises more noticeably with per capita GNP, mainly because countries' overall fiscal capacity expands with country wealth. Both measures of the availability of resources for education show a fairly weak relation to the per capita GNP, with a R^2 statistic of 0.08 and 0.22 respectively. The results confirm the expectation that countries do have considerable leeway in deciding how much to spend on education.

2.2 Production of education services

Consider below the following aspects of the production of education services: the public-private provision in education; the distribution of public spending on education; and the level and pattern of public spending per pupil.

Public-private roles in service provision. The available data relate only to the share of enrollments in public and private schools at the primary and secondary levels. Because private schools often receive public subsidies and public schools sometimes charge fees, the public-private distinction does not correspond to a clear-cut separation in financing arrangements. The division is more reasonably interpreted as reflecting different arrangements for school management. Over the per capita income range in our data, private schools account for between 10 and 13 percent of all children at the primary level, and between 13 and 18 percent of those at the secondary level. At both levels, the share of private sector enrollments is unrelated to the per capita GNP, a pattern consistent with the findings in James (1993).[8] The role of private education thus reflects the influence of factors other than country wealth, including that of policy choices, that affect the incentives for private sector participation in education.

The distribution of public spending on education. Given the government's predominant role in education, we examine in more detail the allocation of spending by level and across pedagogical and non-pedagogical inputs. Table 1 shows simulations of the sub-sector shares of spending based on regression estimates of the relation between the shares and country wealth. In general, the share of primary education decline as countries grow rich, while those of

[8] James, Estelle. 1993. "Why do different countries choose a different public-private mix of educational services? "Journal of Human Resources. 28(3): 571-592. James found that religion and language exert a particularly strong influence on the share of private enrollments. In addition, the share is affected positively by the fact that the government subsidizes private education, and negatively by the magnitude of public spending on education.

secondary and higher education rise. The trends are relatively flat, however: the share of primary education, for example, falls only from 45 percent to 31 percent as per capita GNP rises a hundred-fold from $200 to $20,000. Moreover, there is wide variation across countries in the distribution of spending, as indicated by the small R^2 statistic for all the regressions (last two columns in the table). The result implies that countries have substantial leeway to set priorities for spending across levels of the education.

Table 1: Simulations of the sub-sector share of public spending on education at selected per capita GNP, circa 1993 (%) [a/]

Sub-sector	Per capita GNP, 1993 $							R^2	
	200	400	800	1,500	3,000	10,000	20,000	(1)	(2)
Primary	45.1	43.0	40.8	38.9	36.8	33.1	31.0	0.21	0.02
Secondary	25.8	26.8	27.8	28.7	29.7	31.5	32.5	0.06	0.03
Higher	17.1	17.7	18.4	19.0	19.6	20.7	21.4	0.05	0.05

a/ Excludes data for countries where primary and secondary are combined as basic education.
Note: The R^2 corresponds, in column (1), to a regression of the form noted in footnote 5, based on data for the whole sample; and in column (2), to the same regression based on data for countries with a per capita income below $4,000 in 1993.

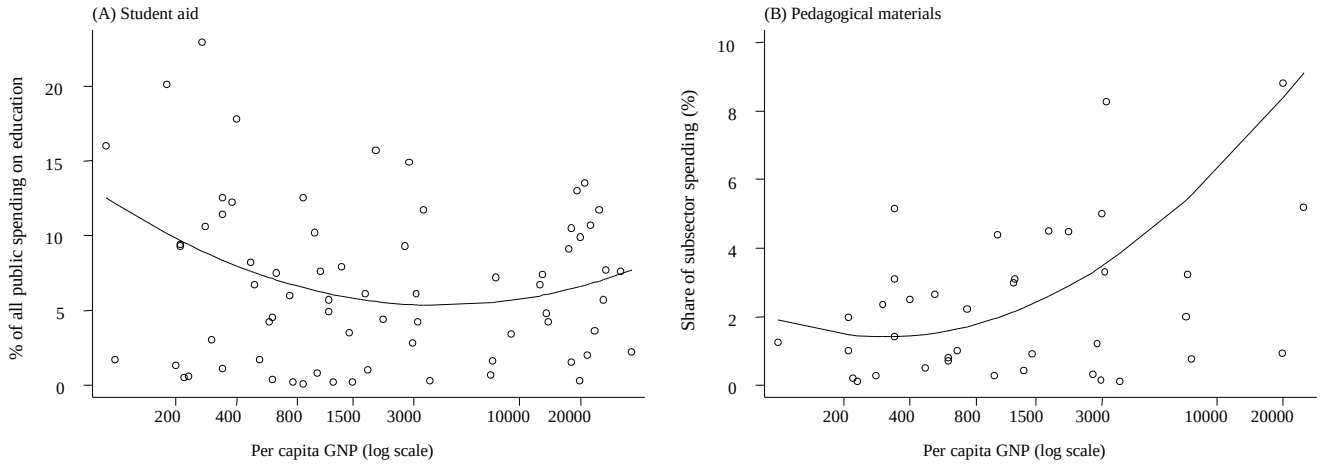
Consider now the allocation of spending by expenditure category. The available data pertain to spending on financial aid for students (in the form of grants, scholarships, bursaries and welfare services); and on pedagogical materials. Figure 2 (panel A) shows that the share of financial aid in total spending on education follows a U-shape, falling from about 10 percent in countries at $200 in per capita GNP, to about 5 percent among countries at $3,000, and then rising to about 8 percent among countries at $20,000. The U-shape is even more pronounced if we exclude the data for primary education where hardly any spending is used to provide student financial aid. The relation between the share claimed by student aid and the per capita GNP is relatively loose, however, with a R^2 statistic of only 0.06.[9] It means that country wealth have little influence on the pattern of allocation.

With regard to spending on textbooks and pedagogical materials, we focus on the pattern at the primary and secondary levels where these inputs are a key determinant of student achievement. The figure (panel B) shows that as countries grow richer this category claims an

[9] The R^2 statistic for separate regressions on secondary and higher education is, respectively, 0.23 and 0.38.

increasing share of public spending on primary and secondary education, rising from less than 2 percent among the poorest countries, to more 8 percent among the richest countries.[10] The relationship between spending share and per capita GNP is moderately loose, the R^2 statistic being 0.27 for the whole sample. It suggests that countries have some leeway in setting the level of spending on pedagogical materials, although poverty does constrain its range.

Figure 2: Relation between shares of public spending on student aid and pedagogical materials, and the per capita GNP, circa 1993



Per pupil public spending on education. We consider first the relation between country wealth and spending per pupil (expressed as a percentage of the per capita GNP), and then turn to examine its relation to two underlying components of unit spending—the pupil-teacher ratio and teacher salaries.[11]

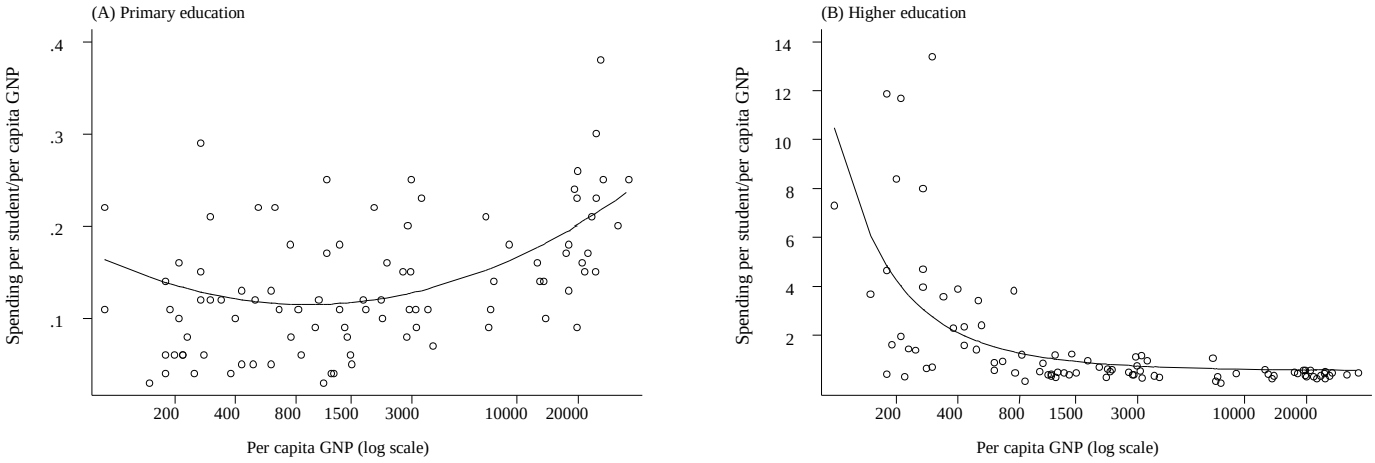
Figure 3 pertains to spending per student at the primary and tertiary levels; the pattern for secondary education, excluded to save space, is intermediate between that for the other two levels. In primary education, average spending per pupil among countries with incomes between $200 and $3,000 is more or less flat at around 0.12 to 0.14 times the per capita

[10] Because rich countries' total spending on primary and secondary education as a share of GNP also tends to be bigger, the gap in real spending on pedagogical materials between rich and poor countries is in fact wider than suggested by the difference in the shares of spending.

[11] The two indicators refer to averages for the sector as a whole. Thus, a low level of unit spending may reflect low aggregate spending or large shares of enrollment in unsubsidized private education. For the pupil-teacher ratio, both the numerator and denominator refer to totals in public and private schools. These definitions are appropriate mainly for comparisons of aggregate patterns across sub-sectors and countries.

GNP. It then rises as incomes increase beyond $3,000, reaching about 0.20 times the per capita GNP among the OECD countries.

Figure 3: Relation between per-pupil public spending on education and per capita GNP, circa 1993

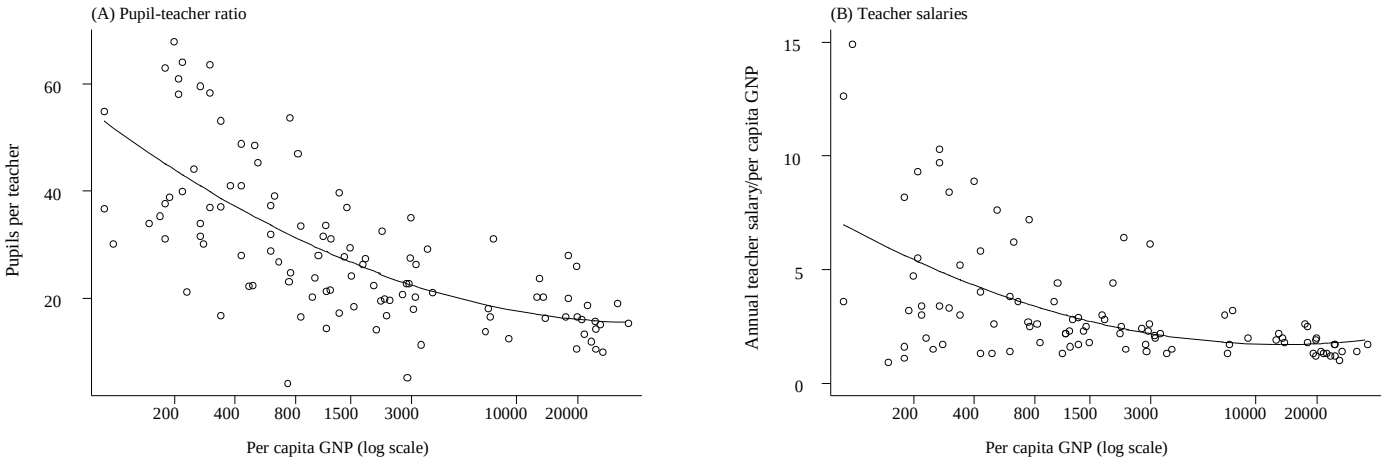


In higher education, the relation between the two variables follows the shape of a rectangular hyperbola: per student spending is highest among the poorest countries, averaging more than 4 times the per capita income for those at $200 in income, and flattening out at about 0.6 times the per capita income at $10,000 and beyond. In terms of the tightness of the relation between public spending per student and per capita GNP, the regression R^2 statistic ranges from 0.14 for primary education, to 0.38 for higher education, both values being smaller when the data are restricted to countries below $3,000 in per capita GNP. Thus, while there is a predictable pattern of per pupil spending and country wealth, the relation is loose, implying that countries do make quite different choices in education finance.

Per pupil spending can be decomposed into two underlying components: the pupil-teacher ratio and average teacher salaries. At the primary level where teachers typically account for the bulk of all spending, per pupil spending is approximately equal to average teacher salaries divided by the pupil-teacher ratio. Figure 4 shows how the two variables relate to the per capita GNP. The decline in pupil-teacher ratio as incomes rise is familiar from causal observation of schooling conditions in rich and poor countries, but the decline in teacher salaries is perhaps less familiar. The pattern stems directly from the fact that as countries develop, educated labor becomes more plentiful, and the earnings of teachers therefore generally rise less rapidly than the per capita

GNP. The behavior of the two variables taken together is consistent with the basic economic logic that when an input is costly, it tends to be used more sparingly than when it is less costly.

Figure 4: Relation between the pupil-teacher ratio and teacher salaries at the primary level and per capita GNP, circa 1993



For both the pupil-teacher ratio and teacher salaries, the relation to the per capita GNP over the entire income range in our data is moderately tight, as indicated by R^2 values of 0.45 and 0.31 respectively; among lower income countries, however, the corresponding values are smaller, at 0.28 and 0.23. The results suggest that countries at the same level of economic development make appreciably different choices in how they organize teaching and learning. Given the scope for choice, the issue clearly is to discover options that produce the biggest impact on schooling outcomes.

At the secondary and tertiary levels, data for a sufficiently large number of countries exist only for the pupil-teacher ratio. The variable declines with per capita GNP in secondary education, from an estimated average of 24 pupils per teacher for countries at $200 in per capita income, to about 12-13 for countries at $10,000 and above. In higher education, however, the pattern is flat, at about 16-17 students per teacher across the entire income range represented in our data. Moreover, the R^2 statistic is modest, particularly among countries below $3,000 in per capita GNP, at 0.13 and 0.01, respectively, at the two levels of education. As before, we interpret the low values as reflecting the fact that countries do make very different choices in organizing the delivery of education services.

2.3 Education outcomes in quantity and quality

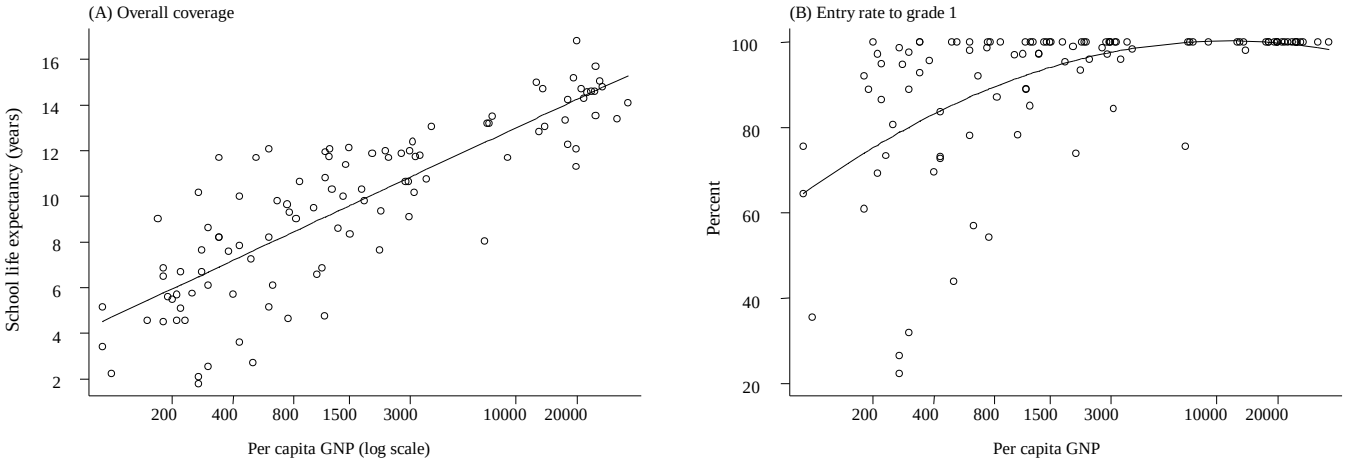
We focus here on school life expectancy and the intake rate in primary education as measures of quantity (i.e. coverage), and scores on international mathematics and science tests as a measure of quality (i.e. student learning).[12]

Coverage of the education system. The first indicator of coverage, the school life expectancy, is defined as the number of years of schooling the average child can expect to attain as he or she grows up, given the education system's current structure of enrollments. The indicator therefore succinctly captures the system's overall coverage. The other indicator, the intake rate to grade 1, is defined as the percentage of each age cohort that enter school.

Figure 5 shows the expected positive relation between the two indicators and the per capita GNP. Children in the poorest countries expect, on average, to be in school less than half as long as their counterparts in the richest countries; and the entry rate to first grade ranges from an estimated 75 percent in the former countries, to nearly universal entry in countries at or above $4,000 in per capita GNP. There is nonetheless substantial disparity across countries, especially in the intake rate. Among the poorer countries in the sample, the variable ranges from a low of less than 30 percent in Mali and Niger, for example, to nearly universal intake in Laos, and Kenya. The wide disparity is reflected in the moderately low value of the R^2 statistic for the regression between the intake rate and the per capita GNP—0.30 for the whole sample, and 0.24 for the restricted sample.

[12] Data are available on other indicators of coverage, but we exclude them here to save space. Gross enrollment ratios are a common measure of coverage. The data indicate that they relate positively to the per capita GNP at all three levels of education, with a reasonably close fit, as indicated by a R^2 statistic of 0.31 in primary education, 0.65 in secondary education, and 0.55 in higher education. Another variable of coverage is the transition rate between cycles of education; the available data relate to the transition between the primary and secondary cycles. The data again show that it relates positively to the per capita GNP: among the poorest countries, slightly more than half of primary school leavers enter secondary school, compared with nearly universal entry for countries with per capita GNP at or above $10,000. The relation is also moderately tight, with an R^2 statistic of 0.46 for the whole sample; the corresponding value for the restricted sample is much more modest at 0.15.

Figure 5: Relation between school life expectancy and grade 1 intake rate and the per capita GNP, circa 1993



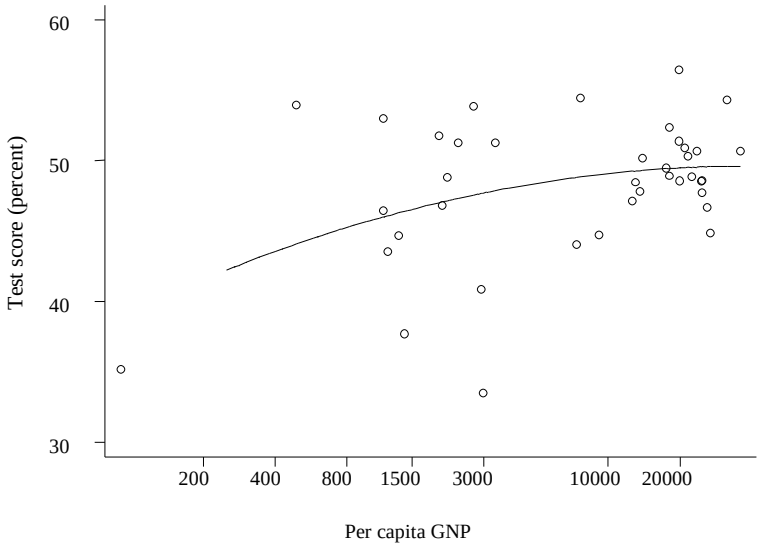
Student learning. The cognitive skills that school leavers bring to the labor force is the other important dimension of educational outcome.[13] For our purpose we amalgamate test scores from several rounds of international mathematics and science tests administered to 9-14 year old children in the 1990s.[14] The resulting indicator of achievement is calibrated to range between 0 and 100 percent, and is interpreted here as a summary measure of the achievement of children around the end of primary education and the beginning of lower secondary education.

Figure 6 shows the relation between the indicator and per capita GNP in 1993. Predictably, test scores are generally higher among children in richer than poorer countries. The relation is relatively weak, however, with a regression R^2 statistic of only 0.17, implying substantial variation among countries. It therefore appears that differences in student learning is not just a function of country wealth, but is probably also the result of differences in policy choices that ultimately affect the effectiveness of education processes within the classroom.

[13] For examples of studies on the relation between workers' cognitive skills and work productivity, see Murnane, Richard, J. John B. Willett, and Frank Levy (1994). "The growing importance of cognitive skills in wage determination," Harvard Graduate School of Education (mimeo); and Bishop, John (1991) "Achievement, test scores, and relative wages," in Marvin H. Kosters (ed.) Workers and Their Wages, Washington D.C.: The AEI Press.

[14] Pertaining to some 53 countries, the data come from the various international science and mathematics tests (e.g. the Third International Mathematics and Science Study) and are conveniently reported in Jong-Wha Lee and Robert J. Barro, 1997 "School quality in a cross-section of countries" National Bureau of Economic Research, Working Paper no. 6198, Cambridge, Mass. Not all countries participated in all the tests. We used regression estimates relating one test score to another to fill the gaps, and to produce a single test score incorporating all the available information. The procedure produced data on 44 observations.

Figure 6: Relation between international achievement score and per capita GNP, circa early 1990s



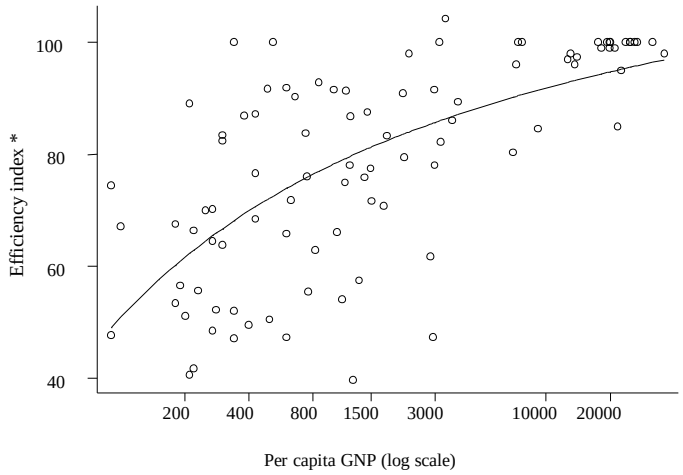
2.4 Efficiency of the education system

By efficiency we refer to two aspects of the education system's operation: student flow patterns, and output per unit of public spending on education.

Efficiency of student flow. The available data pertain to the first 8 grades of schooling. In primary education, high dropout rates imply inefficient systems because children who quit before completing the cycle, or who do so with less than four years of schooling, are unlikely to become permanently literate and numerate. Grade repetition also leads to wastage because repeaters use at least twice as much resources as other pupils to attain the same amount of education. To measure the combined influence of these problems we construct an index of student flow efficiency which is benchmarked against a system in which no child repeats or drops out.[15] An index of 100 means that all pupils complete primary school and that no one repeats; a smaller value, say 60, means that with a given amount of resources the system produces only 60 percent as many primary school completers as a system with no dropouts and no repeaters. The relation between the index and the per capita GNP appears in figure 7.

[15] For details on the construction of the summary index, see Mingat, Alain and Jee-Peng Tan (1998) "Analyzing problems in the structure of student flow," mimeo, Human Development Department, The World Bank.

Figure 7: The relation between efficiency of student flow in primary education and the per capita GNP, circa 1993



* Relative to system with no repeaters and no dropouts

As expected the overall efficiency of student flow in an education system improves as incomes rise; by the time incomes reaches $20,000 per person, dropping out and grade repetition are almost completely absent. The relation between the index and per capita GNP is relatively loose—as indicated by a R statistic of 0.44 for the whole sample, and 0.15 for countries below $4,000 in per capita income—which means that although poor countries generally have less efficient patterns of student flow, differences in policy choice and sector management probably makes an appreciable difference to how efficiently the system operates.

The separate behavior of dropping out and grade repetition relative to the per capita GNP is documented in table 2 (top two blocks), based on regression simulations. In the poorest countries, only about two-thirds of first graders complete the primary cycle, compared with universal completion in the richest countries. The difference implies that education systems in the former countries are only about three-quarters as efficient, if we take into account only the impact of dropping out. Differences in grade repetition add to the inefficiency, the rate being estimated at 17 percent in the poorest countries, compared with only 3 percent in the richest ones. Considering only the impact of this factor, the education systems of the poorest countries are only about four-fifths as efficient as those of the richest countries. The shortfall in efficiency associated with dropping out is greater than that associated with grade repetition, a pattern that holds across the entire income range represented in the data.

Table 2: Simulated indicators of student flow at selected per capita GNP, circa 1993

Indicator	Per capita GNP, 1993 $							R^2	
	200	400	800	1,500	3,000	10,000	20,000	(1)	(2)
Dropping out, primary cycle									
% grade 1 entrants reaching the end	62.4	68.1	73.8	79.0	84.7	94.6	100.3	0.45	0.16
Dropout-related efficiency index [a/]	74.4	80.3	84.9	88.3	91.5	95.9	97.9	0.38	0.11
Grade repetition, primary cycle									
% repeaters	17.2	13.7	10.9	8.8	6.9	4.2	3.0	0.31	0.11
Repetition-related efficiency index [b/]	82.7	86.3	89.1	91.2	93.2	95.8	97.1	0.31	0.11
Among pupils exiting before end of grade 8									
% leaving between prim. and sec. cycles	46.4	58.8	68.7	76.0	82.8	92.1	96.4	0.61	0.27

a/ Measured relative to a value of 100 which corresponds to a system in which no pupils drops out before completing the cycle.
b/ Measured relative to a value of 100 which corresponds to a system with no repeaters.

Note: The R^2 corresponds, in column (1), to a regression of the indicator concerned to the natural logarithm of the per capita GNP and its square, based on data for the whole sample; and in column (2), to the same regression based on data for countries with a per capita income below $4,000 in 1993.

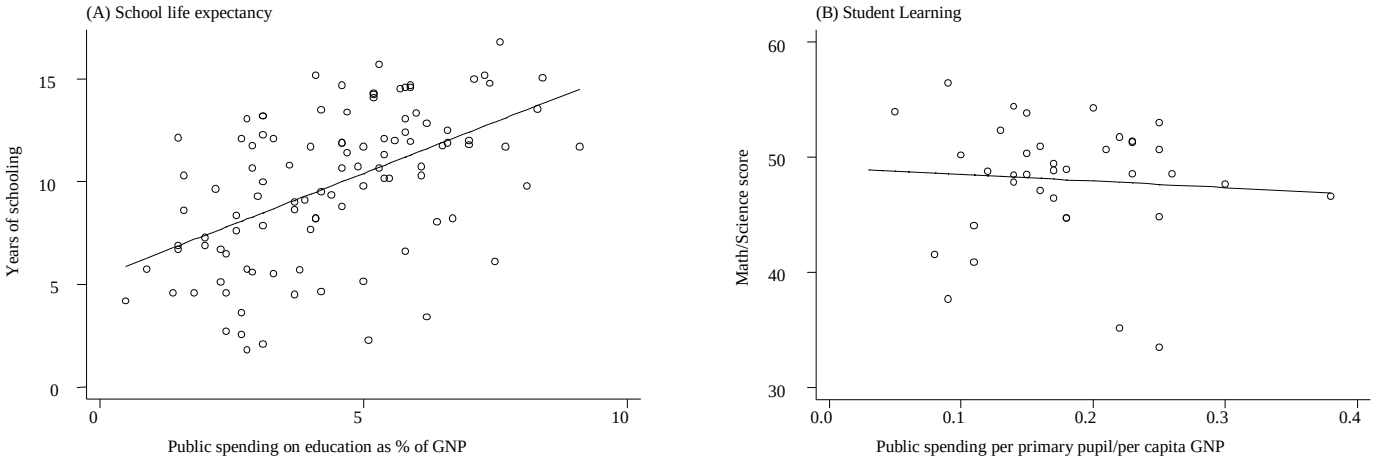
The last line in the table pertains to the efficiency of student flow from grade 1 to grade 8, using as an indicator the percentage of school leavers who exit from the system in the interval *between* the primary and lower secondary cycles rather than *within* either cycle. The larger the percentage, the more children complete their studies rather than abandon them halfway, and the more efficient the pattern of student flow. An index of 100 means that all selection takes place between the two cycles.[16] As countries grow richer, the efficiency of inter-cycle student selection improves: the share of pupils leaving between cycles is only 46.4 for countries at $200 in per capita, compared with 96.4 for countries at $20,000. The R^2 statistic is 0.61 for the whole sample, suggesting the efficiency of student selection rises in a predictable fashion as incomes increase. Among countries with per capita income below $4,000, however, the R^2 statistic drops to only 0.27, indicating much greater diversity in the efficiency of student selection, as well as greater scope for countries to influence the outcome through policy choice.

Efficiency of resource use in education. To assess cross-country differences in this regard, we first relate education outcomes to the input of public resources in the sector, defining outcomes in two ways: (a) years of school life expectancy; and (b) scores on

[16] Because dropping out within the secondary cycle tends to occur less frequently than at the primary level, a small index may usually be interpreted as signifying significant dropping out within primary education.

international achievement tests.[17] Figure 8 shows while the former indicator tends to rise with the level of aggregate spending, the latter is flat against spending per pupil. There is, moreover, substantial cross-country variation even among those with similar levels of spending.

Figure 8: Relation between schooling outcomes and input of public resources, circa 1993



Deviations from the regression line in the figure provide one measure of efficiency in resource use: positive deviations signal better than average efficiency because more is produced for the same level of spending, and negative deviations signal the opposite. For both outcome indicators, the deviations relate positively to per capita GNP, implying that the education systems of richer countries tend to be more efficient than those of poorer countries. As before, however, the general tendency masks large variations across countries: the R^2 statistic for the relevant regressions range between 0.10 and 0.50, suggesting that country wealth is not the only, or even the most important, factor in determining how efficiently an education system operates.

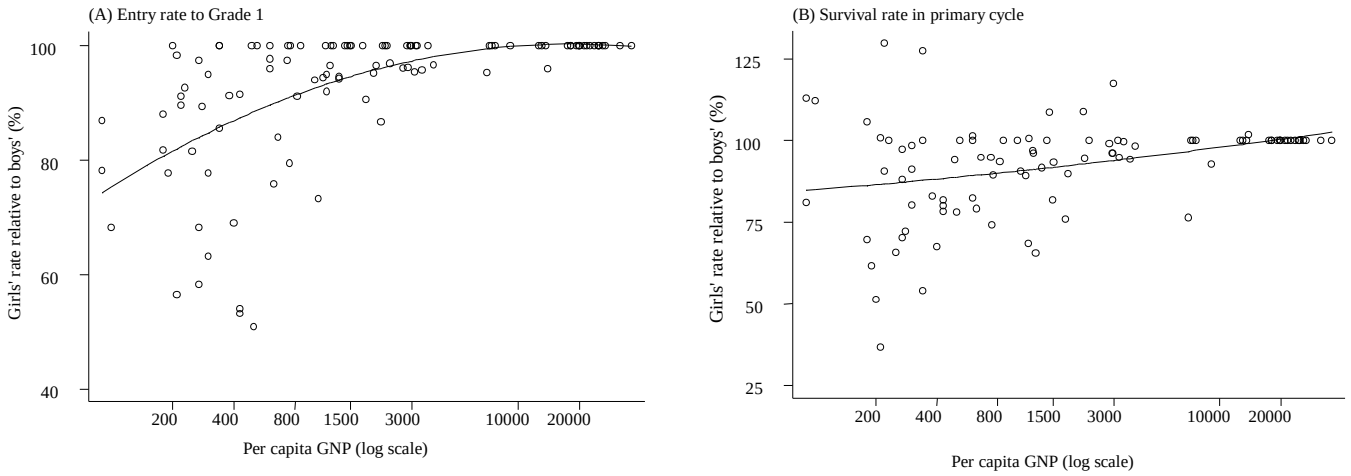
2.5 Equity in access and resource allocation

We examine here two aspects of equity in education: gender disparities and the distribution of public spending on education.

[17] Because private financing of education differs across countries and are probably influenced by policies toward private education (including the level of public spending itself) the indicator actually refers to the efficiency of public spending on education working directly through government provision of services, as well as through its catalytic effect in leveraging private resources for education.

Gender disparities. Girls in low-income countries generally have fewer chances for schooling than boys. For example, a girl's school life expectancy in a country at a per capita GNP of $200 is, on average, only three-quarters as long as that of a boy's. Girls catch up with boys as incomes grow, and are on par with them by the time incomes reach about $3,000 per capita. Low entry rates to first grade, as well as low survival rates within primary education are the main reasons why girls have shorter school life expectancies. Figure 9 shows that girls' schooling generally improve with country wealth, but the path of improvement is diverse across countries. Among countries at a per capita income of $400, for example, girls in some countries enter first grade at the same rate as boys while in other countries they are only half as likely to do so as boys. Similarly, among countries at this income level, girls' survival rates range from only half as high as boys; to 1.3 times as high.

Figure 9: Relation between gender disparity in education and per capita GNP, circa 1993



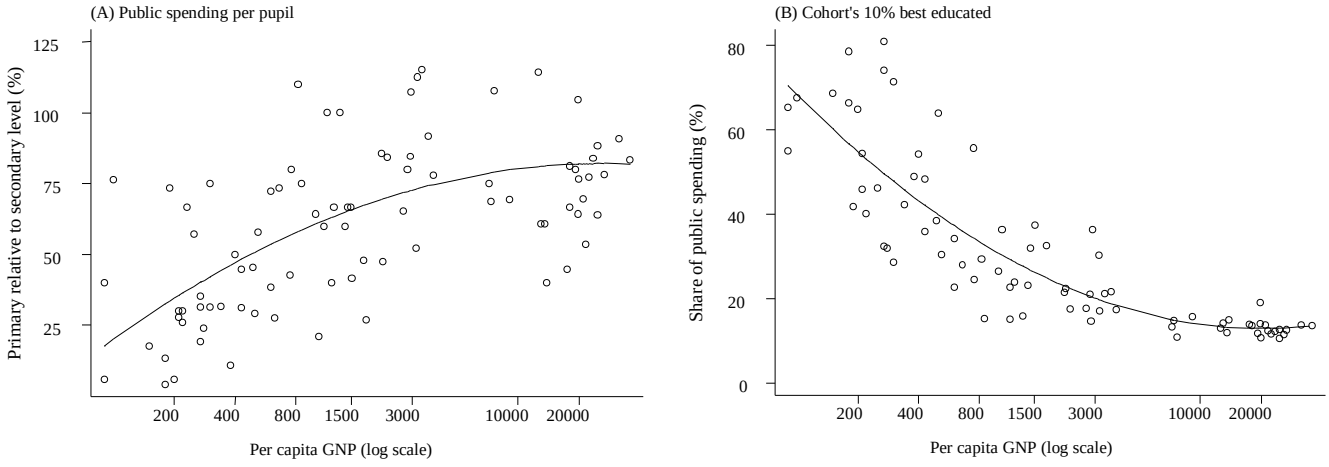
Distribution of public spending on education. Among many possible indicators we use two relatively simple ones for which data are available for most countries: (a) public spending per primary pupil as a percentage of spending per secondary pupil; and (b) the share of public spending on education benefiting the 10 percent best educated in a cohort. The latter is constructed from data on the structures of enrollments and public spending per student by level of education.[18] It therefore is a succinct measure of inequities in the pattern of spending on

[18] The construction of the indicator is explained in detail in Mingat and Tan 1986.

education that arise both from the structure of enrollment and that of spending per pupil across levels of education. The steeper is the rise in public spending per pupil as the level of education rises, and the fewer are the opportunities for people to proceed up the educational ladder, the bigger the share of public spending received by the best education in a cohort, and the more inequitable is the distribution of public spending on education.

Figure 10 describes the relation between both indicators of equity and the per capita GNP. It reveals a consistent picture of increasing equity as countries grow rich. The ratio in per pupil spending between primary and secondary education in a country at $200 in per capita income is, on average, only about 0.40 times as high as the corresponding ratio in countries above $10,000 in income. The ratio shows only a moderately tight relation to the per capita GNP, with a R^2 statistic of around 0.37 for the regressions based on both the whole sample and the restricted sample of countries below $4,000 in per capita GNP.

Figure 10: Relation between selected indicators of equity in public spending on education and the per capita GNP, circa 1993



Equity measured in terms of the distribution of the public spending by educational attainment also show dramatic differences between rich and poor countries. Among countries at the low end of the income scale, the best educated 10 percent in a cohort receives, on average, 55 percent of the total public spending on that cohort's education, compared with an average of about 13 percent—only slightly more than their population share—for countries at the top end of the income scale. The regression equation linking the two variables yields a R^2 statistic of 0.74

for the whole sample, but only 0.54 for the restricted sample of poorer countries. As with the first indicator, the results suggest that although equity in education follows a predictable relation to the per capita GNP, differences in policy probably also account for part of the observed diversity across countries.

2.6 Summary of the relation between country wealth and education

In the foregoing discussion we have considered how selected features of the education system relate to country wealth, in terms of both the structure and the closeness of the fit between each indicator and the per capita GNP. With regard to structure, the patterns fall into four categories: (a) rising consistently against per capita GNP; (b) falling consistently against it; (c) flat against it; or (d) rising against it over some income range and falling over other ranges (or vice versa). With regard to the closeness of the fit, we discern on the basis of the R^2 statistic associated with the regression equations, that some relationships show a tight fit, while others reveal a moderate to loose fit, and yet others, hardly any fit at all. The data indicate that the relationships are almost always less tight among lower income countries (i.e. those below $4,000 in 1993) which imply generally greater diversity among them.

Of the indicators pertaining to the sector context, three strong patterns emerge: a continuous easing of the demographic pressures on education as countries grow rich; a steady rise in the educational attainment of the adult population, which flattens out as incomes continue to rise beyond $10,000; and a sharp shift in employment out of agriculture. All three variables follow a highly predictable path as incomes rise.[19] The other variables describing the sector context show the following behavior: the government's fiscal capacity is flat against the per capita GNP up to around $1,500, after which it shows a gradual but steady rise, while the share of education in the public budget rises then falls as incomes grow. Neither variable shows a close fit to the per capita GNP.

On the production of education services, significant shifts occur as countries grow rich, as indicated by the following trends: shifts in the allocation of spending away from primary education to the other two levels; a generally rising per pupil-spending (expressed as a percentage of the per capita GNP) at the primary level, accompanied by sharp drops in the pupil-teacher ratio and average teacher salaries (again expressed as a percentage of the per capita GNP); and a sharply declining per pupil spending in higher education at low incomes which then flattens out as incomes continue rise beyond $3,000. The shares of spending on pedagogical

[19] The relation between the demographic burden and the per capita GNP is less tight among countries with for income below $4,000, and reflects their diverse history of demographic transition experienced.

materials is flat up to about $3,000 in per capita GNP, after which it rises appreciably, but the share of spending on student aid show first a negative then positive trend against income. Finally, the private sector share of enrollments is flat across the income range in our data. For all the indicators, the relation to the per capita GNP is only moderately tight.

Education outcomes in terms of coverage show large improvements as countries grow rich: the school life expectancy ratio nearly doubles as the per capita GNP rises from $200 to $3,000, and entry rates into first grade becomes universal. In contrast, improvements in scores on international tests improve much more gradually. The relation between the various indicators of coverage and the per capita GNP is moderately tight, but that between student learning and the per capita GNP is looser. The result suggests that countries at comparable income levels can and do make policy choices that differ in the impact on sector outcomes.

With regard to efficiency, all the indicators relate positively to the per capita GNP. As incomes rise above $10,000 per person, problems such as dropping out and grade repetition at the primary level all but disappear, and most school leavers exit the system between cycles of study rather than within a cycle. As incomes rise, countries also produce more coverage or student learning per unit of public spending. None of the indicators show a very close fit to the per capita GNP, however, so that country income explains only part of the differences. Even among poor countries choices can and do make a difference to how efficiently the education system operates.

Finally, we also considered the relation between equity in education and the per capita GNP. The trends are again striking: girls' entry rate to grade 1 rise to match boys' by the time the per capita GNP exceeds $3,000, and their survival rate in primary cycle reach the same level as boys' as the per capita income passes the $10,000 mark. The gap in per pupil spending between primary and secondary education closes as incomes rise, and the share of public spending garnered by the 10 percent best educated in a cohort falls continuously over the income range in our sample—both trends indicating increasing equity in the course of economic development. In general the indicators of equity show only a moderately close fit to the per capita GNP.

3. What Are The Sources Of Rich Countries' Advantage In Education?

Having describe the key patterns in the relation between the per capita GNP and the various indicators of educational development we are now in a position to examine the sources of rich countries advantage in education. We know, for example, that demographic burdens ease, that spending on education rise, and that teachers become less expensive, as the per capita GNP increase, but how important are each of these factors and what is their joint impact on the availability of resources for education? How do countries make the tradeoff between expanding coverage and raising per pupil-spending with the extra resources that become available in the course of economic development? What implicit priorities in education do the trends reveal about the path of educational development as country incomes rise?

3.1 A framework for the analysis

We develop here a simple accounting framework to disaggregate both the sources and use of the increased resource available for education as countries grow richer. We begin with the following identity:

$$\frac{G_e}{GNP} = \frac{G_e}{P_{sa}} \cdot \frac{P_{sa}}{P_t} \cdot \frac{P_t}{GNP} \qquad (1)$$

where G_e refers to total public spending on education; GNP is the gross national product; P_{sa} is the school-aged population; and P_t is the total population. Ignoring spending on pedagogical materials to simplify the presentation, the first component on the right-hand-side can be expressed as follows:

$$\frac{G_e}{P_{sa}} = \frac{G_e}{P_e} \cdot \frac{P_e}{P_{sa}} = \frac{TS \cdot T}{P_e} \cdot \frac{P_e}{P_{sa}} \qquad (2)$$

where TS is average teacher pay, T is the number of teachers, and P_e is the enrolled population. Thus, equation (1) can be expressed as:

$$\frac{G_e}{GNP} = \frac{TS \cdot T}{P_e} \cdot \frac{P_e}{P_{sa}} \cdot \frac{P_{sa}}{P_t} \cdot \frac{P_t}{GNP} \qquad (1')$$

Rearranging, we can rewrite it as follows:

$$\frac{G_e}{GNP} \cdot \frac{1}{P_{sa}/P_t} \cdot \frac{1}{TS/(GNP/P_t)} = \frac{P_e}{P_{sa}} \cdot \frac{1}{P_e/T} \qquad (1'')$$

In this expression, the right-hand-side contains two terms: P_e/P_{sa} is the share of the school-aged population that is enrolled; and P_e/T is the pupil-teacher ratio. The former is a measure of the coverage of the education system, while the latter is one measure of the quality of the schooling environment.[20]

The left-hand-side contains various terms relating to resource availability: G_e/GNP is public spending on education as a share of the GNP; P_{sa}/P_t is the demographic burden on the education system; and $TS/(GNP/P_t)$ is average teacher pay relative to the per capita GNP, the latter being simply the GNP divided by the total population (P_t). The first term, G_e/GNP, can be written as the product of G_t/GNP and G_e/G_t, which are respectively the ratio of total government spending (G_t) to GNP, and public spending on education as a share of total government spending:

$$\frac{G_e}{GNP} = \frac{G_t}{GNP} \cdot \frac{G_e}{G_t} \qquad (2)$$

Substituting equation (2) into (1"), we obtain the following expression:

$$\frac{G_t}{GNP} \cdot \frac{G_e}{G_t} \cdot \frac{1}{P_{sa}/P_t} \cdot \frac{1}{TS/(GNP/P_t)} = \frac{P_e}{P_{sa}} \cdot \frac{1}{P_e/T} \qquad (1''')$$

Equation (1''') provides a basis for comparing educational development across any two countries or types of countries (or even the same country at two points in time).[21] To make the comparison, we would simply compute the ratio of the data for the two countries for each of the items in the equation. Taking country A as the reference, for example, the ratios on the right-hand-side would indicate country B's relative advantage (or lack thereof) over A in terms resources available for education. The ratios on the right-hand-side would indicate how country B uses the extra resources to expand coverage and reduce the pupil-teacher ratio.

[20] The pupil-teacher ratio is admittedly an imperfect indicator of educational quality. We nonetheless use it here as it relates directly to the resource intensity of the learning environment to which students are exposed.

[21] As will become apparent below, it does require some modification to accommodate the nature of the available data. Used as a conceptual framework, however, it helps to organize analysis of the sources of educational growth

3.2 Rich countries' advantage in overall educational development

For our purpose we define two generic countries, a poor one with a per capita GNP of $200 (country A), and a richer one with a per capita GNP of $3,000 (country B).[22] We simulate for both countries the values of the various components in equation (1'") based on regression estimates of the relation between per capita GNP and each of the corresponding indicators.[23] Below we consider the two sides of the equation in turn.

Advantage in resources available for education. The left hand-side of the equation pertains to resource availability for the education. Table 3 shows the simulated values of the various components for the two countries. The share of total government spending in GNP (G_t/GNP) is estimated at 26.8 percent for country A, and 31.7 percent for country B. Similarly, the share of education in total government spending is estimated at 13.4 percent and 16.7 percent respectively. Note that the table lists an item not explicitly incorporated in equation (1'"): the share of spending on education allocated to student financial aid. We include it here because it is relatively sizable, at an estimated 9.8 percent for country A, and 5.4 percent for country B.

Focussing first on these three items in the table, we note that more resources are available for education in country B because overall government spending relative to the GNP is bigger (by 18 percent) and the share of education in overall spending is also bigger (by 25 percent). As a percentage of GNP, public spending on education in country B amounts to 5.3 percent (=31.7 x 16.7 / 100), compared with 3.6 percent in country A; thus, country B's overall spending on education is 1.47 times (=5.3/3.6) that in country A. Adjusting the spending for allocations to student aid, the resources available for school operations amount to 3.2 percent of GNP (=3.6 x (1-0.098)) in country A, and 5.0 percent (=5.3 x (1-0.054) in country B. Thus, the relative advantage of B in terms of budget allocations for school operations rises to 1.55 times (=5.0/3.2), reflecting the combined influence of all three factors. By implication, the gain in resource availability due to the smaller share of student aid is about 5 percent (=1.55/1.47).

[22] All monetary values are denominated in 1993 constant dollars.

[23] Recall that the regression estimates are based on the data for all the countries in our sample, as described in section 2 above.

Table 3: Sources of rich country advantage in resource availability for education

Indicator	Item in equation (1''')	Country and per capita GNP		Country B's advantage over A [d/]	% contribution to country B's advantage
		A: $200	B: $3,000		
Budget allocations					
Overall govt. budget as % of GNP[/]	G_t/GNP	26.8	31.7	1.18	12.1
Education as % of overall govt. budget	G_e/G_t	13.4	16.7	1.25	16.3
Student aid as % of education budget	-	9.8	5.4	1.05	1.8
Education budget as % of GNP	-	3.2	5.0	1.55	30.2
Demographic burden [a/]	P_{sa}/P_t	23.0	17.5	1.31	18.9
Teacher pay b[/]	$TS/(GNP/P_t)$	6.3	3.0	2.08	50.9
Spending per school-aged population [c/]	-	-	-	4.23	100

Source: columns 3 and 4 are simulated from regression estimates of the relation between the corresponding indicator and per capita GNP, based on the data for some 125 countries in 1993; the last two columns are authors' computation, following procedures explained in the text.
a/ Population aged 6-11 as percent of total population.
b/ As ratio of the per capita GNP.
c/ This item is equal to the product of the components on the left-hand-side of equation (1'''), i.e. the product of the first two items in column 2, and the inverse of the third and fourth items in the column.
d/ In the framework of equation (1'''), country B's advantage is computed, for the first two items listed, as the ratio of its indicator to that of A; and for the last two items, as the inverse of its indicator to that of A. For the third item, the calculation is explained in the text.

We turn next to consider the other sources of country B's advantage in resource availability for education. A lighter demographic burden is an important source of advantage because it means more can be spent per school-age child.[24] Table 3 shows that whereas the share of the school-age children in the population is 23 percent in country A, it is only 17.5 percent in country B. With a smaller school-age population country B can allocate more resources for education per child. If A and B have the same aggregate budget for education as well as the same population size, the resources available per child of school-age would in fact be 31 percent (= (23.0/17.5) x 100) greater in country B.

Finally, because teachers are a key input in the production of education services, differences in the relative cost of teachers also influence the resources that are effectively available for education. As countries grow richer in the course of economic development the prices of most goods and services tend to rise in absolute terms, as does teachers' pay. Our simulations show that teachers earn, on average, $9,084 a year in country B compared with

[24] For our purpose we measure demographic burden as the ratio of the population aged 6-11 to the total population. Because our focus here is on overall educational development, it would have been better to include in the numerator the population over a wider age range, say 6-23, so as to encompass students at al three levels of schooling. However, population structures are relatively stable, and as the accounting exercise involves comparing relative rather than absolute demographic burdens, we simply used the population data that are most readily available, i.e. those for the population aged 6-11, to compute the demographic burden.

$1,262 in country A, for a pay ratio of 7.12.[25] When teachers' pay are expressed in terms of each country's per capita GNP, however, teacher pay in country B is actually lower, at 3.0 times the per capita GNP, compared with 6.3 times in country A. If teacher pay in country B had risen at the same rate as the rise in per capita GNP from $200 to $3,000, its absolute level would have been $18,900, instead of the simulated $9,084. The implication is that the same amount of aggregate resources for education can purchase 2.08 times (=6.3/3.0) as much teacher time in country B as in country A.

Taking into account all six components listed in the table—overall government budget, education's share in that budget, allocation to student aid, demographic burden, and teacher pay—the net resources for education available in country B is 4.22 times (=1.18 x 1.25 x 1.05 x 1.31 x 2.08) that in country A. The last column in the table shows the percentage contribution of the various factors to country's B advantage in resource availability for education.[26] More than half the advantage can be traced to the decline in teacher pay relative to the per capita GNP, making it the single most important factor in accounting for differences in resource availability between rich and poor countries. Significantly, easing of demographic burden contributes only about a fifth of the advantage, while the increased spending by governments contributes the remaining 30 percent.

Gains in coverage and quality We turn now to the right-hand-side of equation (1'''). Recall that it breaks down spending on education into two components: (a) coverage as reflected in the share of the school-age population that is enrolled; and (b) the quality of the learning environment as proxied by the pupil-teacher ratio. For coverage, we use school life expectancy as a convenient summary measure of enrollment ratios at the three levels of schooling. For the pupil-teacher ratio use the average of the ratios at each of the three levels of education, weighted by the corresponding enrollment ratio. As before, the data for the two generic countries we are comparing—one at a per capita GNP of $200, and the other at $3,000—are simulated from regression estimates of the relation between each of the indicators and the per capita GNP.

[25] The pay refers to the average across all three levels of education, weighted by the corresponding enrollment ratios. Data were sufficiently plentiful for regression analysis only for the pay of primary school teachers; for the other two levels, however, the data are much scarcer. We assume that the pay of teachers at the secondary and higher levels are 1.5 and 2.5 times as high as that at the primary level, based on the ratios for secondary education for selected countries reported in Tan and Mingat (1992) and SPESSA, and on our informed judgement for higher education.

[26] Because the aggregate advantage is computed as a product of the various ratios between the two countries' data, the percentage contribution of each factors is computed simply by dividing the logarithm of the corresponding ratio by the logarithm of the product; for example, the contribution of the greater size of overall public spending in country B is estimated to contribute 12.1 percent (=[ln(1.18)/ln(4.22)] x 100) to B's overall advantage over A in resource availability.

The results appear in table 4. School life expectancy in country B is estimated to be 1.8 times that in country A—10.8 years compared with 6.0 years. The pupil-teacher ratio, on the other hand is lower, 19.8 pupils per teacher, compared with 38.5 in country A, implying that other things being the same, per pupil spending in country B is 1.95 times (=38.5/19.8) as high as in country A. The product of these two ratios reflect the aggregate resources expended per school-aged child in country B as a ratio of the resources expended per child in country A. The ratios imply that 46.9 percent of the extra resources in country B are deployed to expand coverage, while the remaining 53.1 percent are invested to improve the learning environment via a reduction in the pupil-teacher ratio.[27]

Table 4: Expansion of coverage and decline in the pupil-teacher ratio as countries grow rich

Indicator	Item in equation (1''')	Country and per capita GNP		Country B's advantage over A [c/]	% contribution to country B's advantage
		A: $200	B: $3,000		
Overall coverage [a/]	P_e/P_{sa}	6.0	10.8	1.80	46.9
Pupil-teacher ratio	P_e/T	38.5	19.8	1.95	53.1
Spending per school-aged child [a/]	--	--	--	3.51	100

Source: columns 3 and 4 are simulated from regression estimates of the relation between the corresponding indicator and per capita GNP, based on the data for some 125 countries in 1993; the last two columns are authors' computation, following procedures explained in the text.
a/ Proxied by the school life expectancy which is defined as the expected number of years of schooling given the current structure of enrollment rates across the three levels of schooling.
b/ This is the product of the components on the right-hand-side of equation (1'''), i.e. the product of the first item in the next column and the inverse of the second item.
c/ In the framework of equation (1'''), B's advantage is computed, for the first item listed, as the ratio of its indicator to that of country A; and for the second item, as the inverse of its ratio to that of A.

Because equation (1''') is an identity, we expect the product of the components of both sides of it to have the same value. Yet based on the data in table 4., the product on the right-hand-side is 3.51 (=1.80 x 1.95), which is only about 83 percent of 4.22, the corresponding figure on the left-hand-side shown in the previous table. Data flaws and incompleteness are a possible source of the discrepancy, but the aggregation of data for the three levels of education—on coverage, teacher pay and pupil-teacher ratio—into a single synthetic indicator representing the system as a whole, may also have contributed to it. To avoid this problem, we repeat the disaggregation exercise below, focussing on only one level of education, the primary level, for which the available data are more complete.

[27] These percentages are calculated in the same way as those completed earlier showing the sources of contribution to the rise in resource availability. For example, the estimated share of resources used to expand coverage, 46.9 percent, is evaluated as ln(1.8)/(ln(1.95 x 1.80)) x 100.

3.3 Rich countries' advantage in primary education

Before proceeding we expand the left-hand-side of equation (1''') by an extra term, the share of primary education in total public spending on education. The equation for the disaggregation exercises is as follows:

$$\frac{G_t}{GNP} \cdot \frac{G_e}{G_t} \cdot \frac{G_p}{G_e} \cdot \frac{1}{P_{sa}/P_t} \cdot \frac{1}{TS/(GNP/P_t)} = \frac{P_e}{P_{sa}} \cdot \frac{1}{P_e/T} \qquad (3)$$

We ignore spending on student financial aid, as it is negligible at this level of education. We also exclude spending on pedagogical materials on the grounds that the percentages involved are small, ranging from 1.5 percent of total public spending on primary education, in the poorest countries to about 6 to 8 percent among OECD countries.[28]

Data on the items in equation (3) for countries at selected per capita GNP in 1993 appear in table 5, the unshaded block containing items on the left-hand-side of the equation, and the shaded block, items on the right-hand-side. As before, each item is simulated from regression estimates of the relation between it and the per capita GNP. The simulations reveal a similar pattern as incomes rise: generally expanding total government spending, growing allocation to education, easing of the demographic burden, falling relative teacher salaries, expanding coverage and declining pupil-teacher ratios. Note, however, that as incomes grow, the share of primary education in total public spending on education falls, from 45 percent in countries at $200 in per capita GNP, to 33 percent in those at $10,000. Below we use the simulations to the compare the differences in education between pairs of countries at contiguous levels of per capita GNP.

[28] That the omission is unlikely to affect our calculations is suggested by the results reported in table 2.1 relating to student aid. Spending on student aid as a percentage of total spending on education changed from 9.8 percent in one country to 5.4 percent in the other, but the change contributed only 1.8 percent to the total increase in resources available for school operations. By implication, incorporating spending for pedagogical materials, will make an even smaller contribution. Thus, to keep the computations simple we choose to ignore this component of spending.

Table 5: Simulations of education indicators by level of per capita GNP, 1993

Indicator [a/]	Item in equation (3)	Per capita GNP, 1993					
		$200	$400	$800	$1,500	$3,000	$10,000
Total govt. budget as % of GNP	G_t / GNP	26.2	26.2	26.8	28.6	31.7	40.2
Education share of total govt. budget (%)	G_e / G_t	13.4	15.1	16.2	16.7	16.7	15.5
Primary ed. as share of total ed. budget (%)	G_p / G_e	45.1	43.0	40.8	38.9	36.8	33.1
School-aged children's share of population	P_{sa} / P_t	23.0	21.6	20.2	18.9	17.5	15.1
Teacher pay relative to per capita GNP	TS / (GNP/P_t)	5.4	4.3	3.4	2.7	2.2	1.7
Enrollment rate at end of primary cycle [a/]	P_e / P_{sa}	47.0	56.7	66.1	74.3	82.7	94.8
Pupil-teacher ratio	P_e / T	44.0	37.2	31.3	26.7	22.6	17.7

Source: simulated from regression estimates of the relation between each indicator and the per capita GNP, based on data for a sample of some 125 countries in 1993.
a/ The enrollment rates is defined as the proportion of each age cohort that is enrolled at the end of the primary cycle; we chose this indicator rather than the more common gross or net enrollment ratios because it offers a more accurate picture of coverage.

Comparing countries with per capita GNP of $200 and $400. For simplicity, we shall refer to these countries as A and B, respectively. Table 6 shows the advantage of B over A in terms of resources available for primary education, as well as in the deployment of those resources to expand coverage and reduce the pupil-teacher ratio. As before, the unshaded rows in the table correspond to the left-hand-side of the accounting equation (i.e. equation (3)), while the shaded rows correspond to the right hand-hand-side.

The results in the table show that there is no difference between the two countries in overall government budget; but in the share of education in the overall government budget in country B is 1.13 times that in country A. However, because primary education's share of the education budget in country B is smaller than in country A, the resources available for primary education relative to the GNP are in fact only 1.07 times (=1.13 x 0.95) as high as in country A. The other two sources of country B's resource advantage are a lighter demographic burden and lower teacher salaries relative to the per capita GNP. The share of its school-age population in the total population is 21.6 percent, compared with 23.0 percent in country A, implying an advantage for country B of 6.0 percent (=(23.0/21.6 – 1) x 100); and average teacher pay is 4.3 times the per capita GNP in country B, compared with 5.4 times in country A, implying an advantage of 26 percent (=(5.4/4.3 – 1) x 100) for country B.

Table 6: Comparing resource availability and education outcomes in countries at $400 and $200 in per capita GNP, 1993

Indicator [a/]	Richer country's advantage [b/]	Percentage contribution to richer country's advantage
Budget allocations		
Overall government budget as % of GNP	1.00	0.0
Public spending on education as % of government budget	1.13	33.0
Primary education as % of public spending on education	0.95	-13.2
Primary education spending as % of GNP	1.07	19.8
School-aged children's share of population	1.06	17.3
Teacher pay relative to per capita GNP	1.26	62.9
Public spending per primary school-aged child	1.43	100.0
Enrollment rate	1.21	52.7
Pupil-teacher ratio	1.18	47.3
Public spending per primary school-age child	1.43	100.0

Source: authors' calculation based on data in previous table.
a/ The variables that are not italicized are defined in the previous table. The first two italicized variables refer to the net impact of the preceding three variables; while the last italicized variable refers to the net impact of the preceding two variables.
b/ Following equation (3), the richer country's advantage for the indicators in rows 1,2,3 and 8 are computed as the ratio between its data and that of the poorer country; its advantage in the indicators in rows 5,6, and 9 are computed as the inverse of the ratio between its data and that of the poorer country. For rows 4 and 7, the data are the products of the data in the preceding 3 rows; and for row 10, the figure is the product of the data in the preceding two rows.

Taking all the factors into account, the resources available per school-aged child in country B is 1.43 times (=1.0 x 1.13 x 0.95 x1.06 x 1.26) as high as in country A. The relative contribution of the various sources to country B's resource advantage appears in the last column. It shows that nearly two thirds of its advantage stem from the fact that teacher salaries in country B fell relative to the per capita GNP. Had teachers salaries maintained the same relation to the per capita GNP as in country A, the availability of resources for primary education in country B would have been only 1.14 times (=1.0 x 1.13 x 0.95 x 1.06 x 1.0) as high as that in country A.

Turning now to the resource deployment side of the equation, we note from the data in the shaded part of the table that country B uses its extra resources to expand primary school coverage by a factor of 1.21 relative to coverage in country A, and to increase spending

per pupil by a factor of 1.18 via a reduction in the pupil-teacher ratio.[29] The ratios imply that about 52.7 percent of the extra resources available in country B are used to increase education quantity, and the remaining 47.3 percent to improve quality.

Comparing countries with per capita GNP from $200 to $10,000. Following the same procedure as above, we can compare pairs of countries spanning the full range of per capita GNP, from $200 to $10,000. The results relating to differences in resource availability appear in table 7.[30] Looking down column three, we note that in all the five pairs of countries, resource availability for primary education in the richer country exceeds that in the poorer country by a factor of between 1.32 and 1.46. In other words, at every stage of per capita income growth across the entire range from $200 to $10,000, substantial resources do become available for primary education.

Table 7: Comparing resource availability for primary education in pairs of countries at selected levels of per capita GNP, 1993

Per capita GNP ($)		Resource availability in B relative to A	Percentage contribution to country B's advantage over country A						
			Increase in public spending				Easing of demo-graphic burden	Decline in relative teacher salaries	All sources
Country A	Country B		Overall govt. budget in GNP	Share of education in govt. budget	Share of primary in education budget	Primary education budget in GNP			
200	400	1.43	0.0	33.0	-13.2	19.8	17.3	62.9	100 %
400	800	1.39	6.6	20.5	-15.3	11.8	19.6	68.6	100 %
800	1,500	1.32	18.9	8.8	-13.8	13.8	19.3	66.9	100 %
1,500	3,000	1.32	31.3	0.0	-16.9	14.4	23.4	62.2	100 %
3,000	10,000	1.46	51.4	-16.1	-22.9	12.3	31.9	55.8	100 %

Source: authors' calculation based on data in table 5.

Increased government spending on primary education contributes between 12 and 20 percent of the increase (see column 7), reflecting the expansion of overall government budgets and increased allocation to education as a whole. The former factor becomes

[29] Note that the product of these ratios, 1.43 (=1.21 x 1.18) is the same as the product of the ratios on the left hand side of the equation.

[30] The first row relates to the data for the two countries at the bottom of the per capita income scale––$200 and $400 respectively––that were already examined in detail above; they are included here for completeness.

increasingly important as per capita income rises, while the role of the latter declines. For example, when the per capita income doubles from $400 to $800, expansion of overall government spending contributes 6.6 percent to the increased availability of resources for primary education, while growth in education's share in the government budget contributes 20.5 percent. But when the per capita GNP doubles from $1,500 to $3,000, the corresponding percentage contribution from these factors are, respectively 31.3 percent and zero percent (the later implying no change in the budget share of education). As incomes rise from $3,000 to $10,000, the budget share of education even goes into decline, compared with continued sizable expansion of overall government spending. At all income levels, the share of primary education in public spending on education declines as income rises, by between 13 and 22 percent. However, the declining share is more than compensated for by the trends in overall government spending and allocations to education, resulting in net increases in public spending on primary education relative to the GNP at all income levels.

With regard to the other two factors contributing to increased resources for primary education, the easing of demographic pressures account for between 17 and 32 percent of the richer country's advantage, the contribution being smaller at the lower end of the income scale. Finally, with regard to declines in teacher salaries relative to the per capita GNP, the table shows that at all stages of economic development, it is the single most important source of increase in resources for primary education, contributing between half and two-thirds of the richer country's advantage. At the lower end of the income scale, its contribution is especially large, reflecting the typical pattern of precipitous decline in teacher pay relative to per capita GNP as country incomes rise from low levels.

How do countries deploy the extra resources that become available for primary education in the process of economic development? Table 8 shows how they are allocated to expand coverage and reduce pupil-teacher ratios in the same pairs of rich and poor countries as above. In only the lowest income group does quantitative expansion receive more emphasis than quality improvement in education as countries' per capita GNP levels rise. When incomes rise from $200 per capita to $400, 53 percent of the increase in public resources for education is used to expand coverage, raising primary school enrollment rates from 47 percent to 57 percent. At all subsequent stages of economic development, however, a declining share of the extra resources is used in this way, even though coverage remains far from universal. By the time the enrollment rate reaches about 75 percent, nearly two-thirds of the gain in resources that become available for primary education in the course of economic development are directed toward lowering pupil-teacher ratios.

Table 8: Comparing the deployment of increased resources for primary education in pairs of countries at selected levels of per capita GNP, 1993

Per capita GNP ($)		Primary schooling in Country A		Resource availability in B relative to that in A [a/]	Percentage allocation of country B's extra resources for primary education		
Country A	Country B	Enrollment rate (%)	Pupil-teacher ratio		Expansion of coverage	Reduction in pupil-teacher ratio	Total
200	400	47.0	44.0	1.43	52.7	47.3	100 %
400	800	56.7	37.2	1.39	47.0	53.0	100 %
800	1,500	66.1	31.3	1.32	42.4	57.6	100 %
1,500	3,000	74.3	26.7	1.32	39.2	60.8	100 %
3,000	10,000	82.7	22.6	1.46	35.9	64.1	100 %

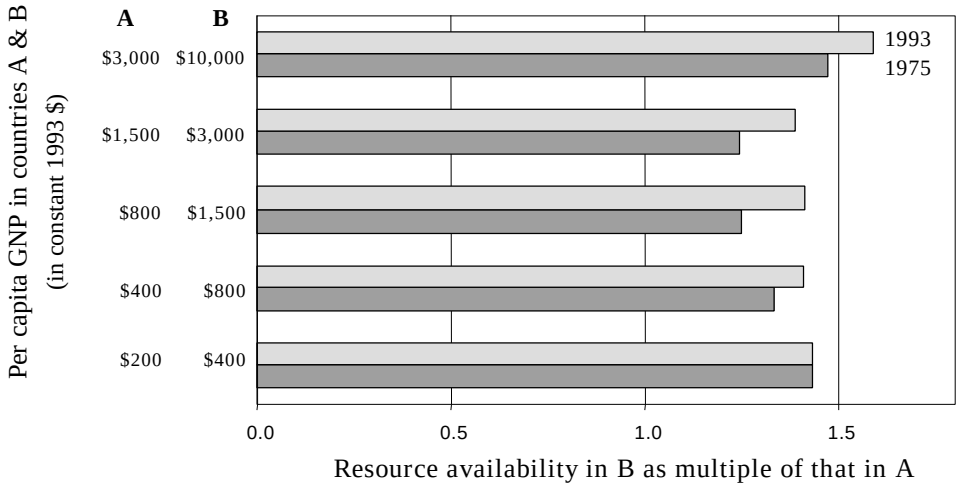
Source: authors' calculation based on data in table 5.
a/ This column corresponds to the right-hand-side of equation (3) and is the product of country B's advantage over A in coverage and in the pupil-teacher ratio. Note that the data are close to the figures in column 3 of table 2.5, which correspond to the left-hand-side of equation (3).

Comparing resource availability and deployment in 1993 and 1975. Do the same patterns in resource availability and deployment characterize richer and poorer countries in an early period? To find out, we compared the same pairs of countries presented above, using data for 1975. We chose this year because it is sufficiently far back to offer a long-term perspective and because data are still available for a sufficiently large number of countries on the key indicators.

The results pertaining to resource availability appear in figure 11, which also includes the data for 1993 as a reference.[31] The pattern in 1975 is comparable to that in the later year in that the resources for primary education are always more plentiful in the richer country in each pair. For all income pairs except the first ($200 and $400), the advantage in 1993 slightly exceeds that in 1975.

[31] Another way to view the differences between 1995 and 1993 is to compare countries at the same level of per capita GNP in the two years; the results appear in appendix A and confirm the patterns discussed here.

Figure 11: Advantage in resource availability for primary education in a richer country (B) relative to that in a poorer country (A), 1975 and 1993

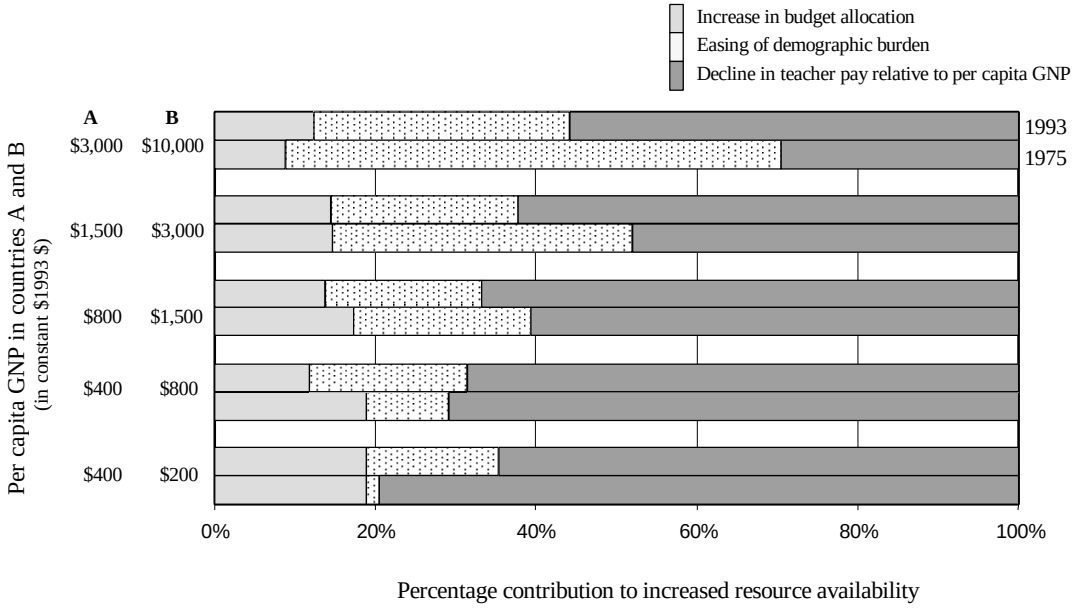


Note: top bar in each pair refers to 1993; bottom bar, to 1975.

As before the richer country in each pair derives its advantage in resource availability from three sources: increased budget allocations, easing of the demographic burden, and decline in teacher pay relative to the per capita GNP. How does the relative contribution from these sources differ between 1993 and 1975? Figure 12 reveals similarities as well as differences. The most apparent similarity is the relatively stable and modest share contributed by increased budgetary allocations for primary education in both years, accounting for no more than 20 percent at any income level. Another similarity is that in both years, the decline in teacher pay relative to per capita GNP made the largest contribution—except in the highest income pair for 1975—accounting for between half and three-quarters of the increased resource availability for primary education in the richer country.

What is different between 1975 and 1993 relates to the pairs of countries at the two ends of the income scale. In the low income pair—countries at $200 and $400 in per capita GNP—easing of the demographic burden contributes only 1.7 percent to the richer country's resource advantage in 1975, compared with 16.2 percent in 1993. The result reflects the fact that in the earlier year, the share of the school-aged children in the population was nearly the same at both levels of per capita GNP, around 25 percent. In the later year, however, it was 23.0 percent in the poorer country compared with 21.6 percent in the richer country. In both countries, the decline in teacher pay relative to the per capita GNP contributed 79 percent in 1975 and 63 percent in 1993 to the richer country's advantage in resource availability.

Figure 12: Contribution of various factors to the resource advantage enjoyed by richer countries (B) relative to poorer ones (A) in 1975 and 1993



Note: top bar in each block refers to 1993;bottom bar, to 1975.

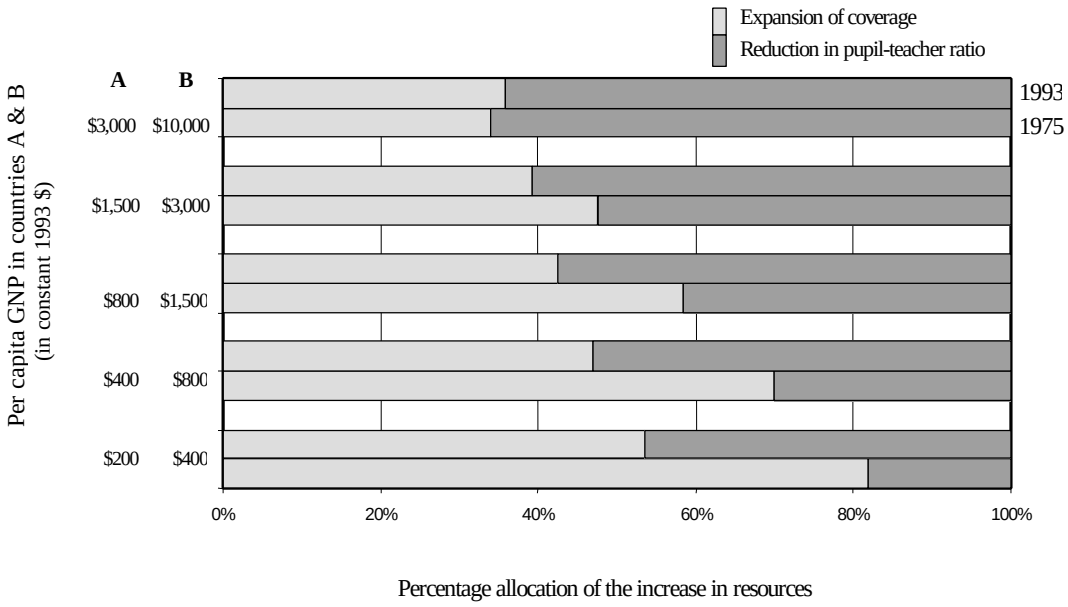
At the high end of the income range, the two countries being compared—with a per capita GNP of $3,000 and $10,000 respectively—also show striking differences in the impact of the easing of the demographic burden on the richer country's advantage. In 1975, this factor accounted for 62 percent of the richer country's resource advantage, compared with 32 percent in 1993. The pattern in 1975 is the only instance where the easing of the demographic burden contributes more to a richer country's resource advantage than the decline in teacher pay relative to the per capita GNP.

The contrast between the patterns in the sets of countries at the extreme ends of the income spectrum in 1975 and 1993 illustrates the impact of demographic transition over the past few decades. In the earlier year, the demographic transition occurred at higher levels of per capita GNP, but by 1993, the phenomenon had spread to even the lowest income countries. Correspondingly, in 1993 the easing of demographic pressures began making a significant contribution to the richer country's advantage in resource availability for primary education at all stages of economic development, whereas in 1975 did so only at the more advanced stages.

We turn now to compare patterns in the allocation of the resource advantage enjoyed by the richer country in each income pair. As before, our accounting framework allows

us to examine the issue in terms of the relative share of the resources directed to expanding coverage or reducing the pupil-teacher ratio. Figure 13 suggests the following broad difference between 1975 and 1993: countries generally placed greater emphasis on expanding coverage in the earlier year. In the lowest income pair, for example, 81.0 percent of the resource advantage enjoyed by the richer country (i.e. the one at $400 in per capita GNP) was used to expand enrollments in 1975, compared with only 52.7 percent in 1993. In both years, however, the common feature is that countries begin to shift the emphasis toward reducing the pupil-teacher ratio at all subsequent stages of income growth. In each pair of countries, its share of the richer country's resource advantage exceeds 50 percent as incomes rise beyond $400 in 1993, and beyond $1,500 in 1975.

Figure 13: Resource allocation to expand coverage and reduce pupil-teacher ratios in richer countries (B) relative to poorer ones (A) in 1975 and 1993

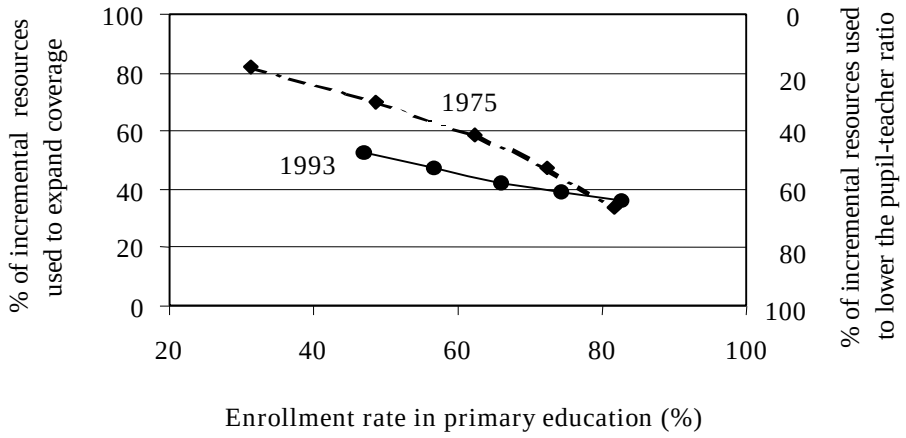


Note: top bar in each block refers to 1993; bottom bar, to 1975.

Given that the enrollment rate has an upper bound of 100 percent, it is not surprising that as countries grow rich and coverage expands, they allocate a declining share of the incremental resources for the sector to expand coverage. Yet when we plot the share allocated to expand coverage against the enrollment rate of the poorer country in each pair, the shift in emphasis away from the expansion of coverage occurs well before universal coverage is achieved, as figure 14 shows (for completeness, the figure shows on the right axis, the

complementary percentage used to reduce the pupil-teacher ratio). In 1993, for example, at an initial enrollment rate of 60 percent in primary education, only about 40 percent of any extra resources that materialize in the process of economic development are used to expand coverage. What is especially interesting is that the shift away from coverage occurs at much lower levels of initial coverage in the later year. At an enrollment rate of 50 percent, for example, about 75 percent of the extra resources is used to expand coverage in 1975, compared with only 50 percent in 1993.

Figure 14: Relative emphasis on expansion of coverage and reduction of pupil-teacher ratio at various levels of initial enrollment ratios, 1975 and 1993



3.4 Summary of structural differences in education between rich and poor countries

In the foregoing discussion we have decomposed the differences in education between rich and poor countries, using an accounting identity involving terms pertaining to the availability of resources for education on one hand, and the deployment of those resources on the other.

When pairs of countries at contiguous income levels are compared, the richer country in each pair invariably enjoys a substantial resource advantage; a country at $3,000 in per capita GNP, for example, has more than 4 times the resources per school-aged child of a country at $200. The advantage arises from three sources: bigger budget allocations, lighter demographic burdens; and smaller teacher salaries relative to the per capita GNP. The resource advantage of richer countries allows them to expand coverage and lower teacher-pupil ratios.

Looking more closely at primary education, we found that at all stages of economic growth, differences in budget allocations generally make only a modest contribution to richer countries' resource advantage, while the decline in teacher pay relative to the per capita GNP makes the biggest contribution, accounting for between 56 and 68 percent of the advantage. The contribution of the easing of the demographic burden shows dramatic changes over time, ranging between 17 and 32 percent in 1993 across the income spectrum represented in our exercise (from $200 to $10,000), and between 1.7 and 62 percent in 1975. The much wider range in 1975 is consistent with the fact that the transition to lower fertility rates occurred at higher income levels in 1975 than in 1993.

With their resource advantage, richer countries have the option of emphasizing an expansion of coverage or a reduction in the pupil-teacher ratio. They have emphasized the former only at the earliest stages of economic growth, when incomes rise from $200 to $400 in 1993 and from $200 to about $1,500 in 1975. At all subsequent levels of income growth, the emphasis shifted to lowering the pupil-teacher ratio. Noteworthy is that the shift occurred in contexts where coverage in primary education is still not yet universal.

4. What are the policy issues?

Two kinds of policy issues arise from the foregoing analysis. The first relates to the long-term shift in favor of lowering pupil-teacher ratios that we have documented: to what extent does it represent an efficient path for the development of primary education in developing countries, particularly in the poorest countries where a significant share of children still have no access to primary education? The second issue relates to the fact that the patterns refer to the *average* for countries at each stage of economic development: how much scope is there for deviation from the average pattern, and what difference in educational outcomes does it make?

4.1 Expansion of coverage versus lowering pupil-teacher ratios

In all countries improving access and student learning are key objectives of educational policies. The accelerated decline in pupil-teacher ratios over the past two decades suggests that policy makers have succumbed to the hope that lowering this indicator would translate into gains in student learning. Yet there is persistent and widespread evidence that simply lowering pupil-teacher ratios does not generally produce the desired gains in learning.[32] While recent evidence from a randomized experiment in the United States do suggest a

[32] See, for example, Hanushek, E. A.(1995) "Interpreting recent research on schooling in developing countries." World Bank Research Observer 10(2): 227-46.

connection between smaller classes and achievement[33], the finding has limited relevance in developing countries for several reasons. Most importantly, the experiment involves reducing class size from a much smaller initial level than is typical in the average low-income country. Gains in student learning also depends on changes in teaching and learning practices—from passive learning by students listening to a teacher talking in front of the class, to hands-on learning—that may be difficult to implement in systems without adequate support and resources for teacher training and classroom experimentation.

Evidence from the cross-country data used in the present study support the claim that lowering the pupil-teacher ratios has few payoffs (if any) in student learning in the typical context of developing countries. In table 9 we regressed achievement scores on international mathematics and science tests among 9-14 year-old children against selected regressors.[34] The results strongly suggest that variation in pupil-teacher ratios in the sample range has no impact on student achievement; in all three regression models, the coefficient on the indicator is statistically not different from zero. Instead, the educational attainment of adults in the country and the adult literacy rate show strong and positive impact. The estimates indicate that a one-year rise in adults' average school attainment raises a country's performance on international mathematics and science tests by 0.84 points (or 0.17 of a standard deviation from the sample mean), and that a one percentage point advantage in the adult literacy rate raises test scores by 0.30 points (or 0.06 of a standard deviation from the sample mean).

Table 9: Regression estimates of the correlates of scores on international mathematics and science tests, 1990s

	(I)	(II)	(III)
Ln (per capita GNP, 1993)	1.11 (1.5)	--	--
Adults' average years of school attainment [a/]	--	0.84** (2.2)	--
Adult literacy rate (%)	--	--	0.30*** (3.3)
Pupil-teacher ratio in primary education	-0.11 (0.1)	-0.11 (1.0)	0.10 (0.7)
Constant Number of countries R^2	40.6 35 0.19	43.7 33 0.30	17.7 34 0.38

Source: the estimates are based on country data on achievement from Lee and Barro 1997 (op. cit.); and on the other variables from the IREDU database.

[33] See Krueger, Alan B. (1997) "Experimental estimates of education production functions," National Bureau of Economic Research Working Paper # 6051, Cambridge, Mass.

[34] See section 2.3 above for a description of the data used in this analysis.

That adults' educational capital affect children's learning achievement should hardly be surprising. The link arises not just because educated parents provide more effective support for a child's education, but also because in more literate societies, children are exposed to many learning opportunities in daily living—through newspapers and other printed materials—that reinforce what is taught in the classroom. The finding argues not so much for massive investment in adult literacy programs, as for a dedicated and sustained effort to expand coverage so that each child has the opportunity to enter school and complete at least primary schooling. Especially in countries where substantial numbers of children still do not enroll and where too many of those who enroll drop out before finishing the cycle, a re-orientation toward expanding coverage and away from reducing the pupil-teacher ratio, requires serious consideration by policy makers.

Where budgets for education are limited, these choices present a stark tradeoff that is probably more efficient to resolve in favor of expanding coverage. This does not mean there is no place for policies to rationalize the distribution of teachers within the system; such policies are clearly relevant where wide disparities in pupil-teacher ratios exist (e.g. across urban and rural areas and across rich and poor neighborhoods). However, the appropriate way to address them is to redistribute resources across schools, rather than to reduce the overall pupil-teacher ratio at the expense of expanding coverage in the system as a whole.

As a final observation it is of interest to take note of the choices that Korea (whose education system is recognized as among the best in the world today) made with regard to the pupil-teacher ratio as the country developed economically.[35] Between 1950 and 1970, as the per capita GNP rose from $500 to $1,000, this indicator was maintained at the astonishingly high level of nearly 60 pupils per teacher; at the same time, primary education expanded to reach universal coverage in the 1960s. It was only at subsequent stages of income growth that the ratio was allowed to decline, reaching 30 only after the per capita GNP had risen to $8,000 (in the early 1990s). Although we have no information on student learning in Korea in the 1950s and 1960s we do know that in the 1980s and 1990s, the average Korean pupil achieved among the highest scores on international science and mathematics tests, despite the country's generally higher pupil-teacher ratio relative to other countries. Korea's experience suggests that a strategy of emphasizing expansion of coverage over lowering of the pupil-teacher does not necessarily harm student learning in the long run; on the contrary, by broadening the base of human capital development, it may have contributed to the outstanding achievement of its young people today.

[35] See Alain Mingat (1988), "The strategy used by high-performing Asian economies in education: some lessons for developing countries," World Development 26(4): 695-715.

4.2 The scope for and consequences of policy choice within countries

We turn now to examine deviations from the average patterns in the structure of progress in education, focussing on the diversity across countries in terms of budget allocations for education, demographic pressures and labor market conditions for teachers, as well as education outcomes as reflected in coverage and pupil-teacher ratios. We use examples from selected low-income countries where the scope for policy intervention appears to be particularly clear.

Consider Laos and Niger which had a similar per capita GNP in 1993—$280 and $270, respectively. The resources available per school-aged child for primary education in Laos were 4.3 times as high as that in Niger, however. What is the source of this enormous gap? The latter country admittedly faced a heavier demographic burden, with the school-age population representing 24 percent of the total population rather than only 21 percent. But this factor by itself would have implied an advantage for Laos of only 1.17 times. Indeed the advantage should have been completely reversed by the fact that in Laos public spending on primary education was only 0.64 times as high as in Niger. Instead the advantage enjoyed by Laos widens to a startling 4.3 times. The reason is that the cost of teachers is much smaller in Laos, with salaries averaging 1.7 times the per capita GNP, compared with 9.7 times in Niger. Because of its resource advantage, Laos achieved more than twice Niger's coverage in primary education, enrolling 53 of the primary school age population. instead of only 20 percent. In both countries, pupil-teacher ratios were comparable at about 31-34 pupils per teacher.

Niger allocated more public spending for primary education than Laos, but achieved less in coverage, because teacher salaries were so high. High teacher salaries are indeed a common feature of the education sector in Francophone African countries. In countries where budget allocations for primary education are not as favorable as in Niger, the result has been lower coverage as well as severe pressures on classroom conditions in the form of very high pupil-teacher ratios. Compare, for example, Chad and Nepal—countries with per capita GNP of around $200 in 1993. Public spending on primary education in Chad was only 80 percent as high as than in Nepal in 1993, and teacher salaries were 1.72 times as high. Both factors put Chad at a resource disadvantage, which translated into smaller coverage and higher pupil-teacher ratios: Chad enrolled only 25 percent of its primary school-age children, compared with 54 percent in Nepal; and its education system had an average of 61 pupils per teacher, compared with 39 in Nepal.

The contrast between Chad and Nepal, and between Laos and Niger highlights the fact that poverty is not the only factor that hampers educational development. Demographic pressures tend to be more burdensome in poor countries, increasing the difficulty of expanding coverage and improving the quality of the learning environment. Yet among poor countries, policies that affect budget allocations to education and especially policies that influence teacher salaries do vary and account for widely different paths of educational development.

Cross country comparisons as well as within country evidence point to possible directions for policy development. In Niger, the scope for further increases in budget allocations for primary education is probably more limited than in Chad, given that current spending levels are already relatively high. In both countries, as in the majority of Francophone African countries, substantial headway depends on the future evolution of teacher salaries. In many of these countries, teacher salaries have declined in real terms (i.e. relative to the per capita GNP) between 1980 and 1993, reflecting the impact of general price inflation and structural adjustment policies[36]. But several observations among countries in the region indicate that much deeper declines are probably feasible:

(a) Salaries in private schools are much lower than in public schools, by as much as 40 percent or more;

(b) Excess demand for public sector teaching jobs, even when the jobs are offered at much lower salaries than those received by incumbents. In Burkina Faso, the government created a new category of lesser-qualified teachers—"instituteur adjoints" which require only a lower secondary school certificate. It received 18,000 applications for the 800 positions, many from people with much more education than was required. Similarly in Senegal, the government hired "volontaires" at one third the salary of incumbent teachers, and even so received 28 applications for each available job in this category.

(c) Expansion of community schools where teachers are hired directly by the local community. Teachers typically receive a fraction of the pay of public school teachers and none of the non-pecuniary benefits of public sector employment. Examples include the "écoles de base" in Mali and the "écoles spontanées" in Chad.

[36] See Mingat, Alain (forthcoming 1999) "Assessing priorities for education policy in the Sahel from a comparative perspective," Comparative Education.

Hiring lesser qualified teachers and encouraging cheaper types of schools are obviously feasible in many of the countries where public sector teacher pay is relatively high. A direct consequence would be to allow coverage to expand; at the same time the policy does not necessarily compromise student learning. A recent evaluation suggests that students in Mali's "écoles de base" in fact outperform their counterparts in regular public schools; and that students taught by the "volontaires" in Senegal outperform pupils taught by the more qualified teachers.[37]

Thus, although gains in coverage and improvement in classroom conditions generally materialize as part of the process of economic development, countries achieve better or worse results than other countries at comparable levels of economic development according to the policies they adopt, particularly with respect to budget priorities, teacher salaries, and the relative emphasis on expansion of coverage and decreases in pupil-teacher ratios.

5. Conclusion

In this study we have used aggregate data to explore the relation between country wealth and various aspects of educational development; examine the underlying sources of differences in education among rich and poor countries; and raise questions about promising directions for policy development in the sector, particularly in the context of lower income countries. As countries become richer, they generally spend more per pupil, expand coverage of the school-aged population, lower the pupil teacher ratio, achieve improvements in student learning, enhance the efficiency of student flow patterns and sector operations, and improve equity in access to schooling and the distribution of public spending on education. On some dimensions, such as coverage, access and per pupil spending, the improvement follows a relatively steep rise with per capita GNP, whereas on other indicators, such as student learning, the rise is less steep, and on yet other indicators, such as the share of enrollments in private schools, there is hardly any relationship to the per capita GNP.

An appealing explanation for the generally superior outcomes in richer countries is that they have more resources to support well-functioning and effective systems of education. Indeed richer countries have more resources for education per school-aged child. But bigger budget allocations account for a modest share of the advantage, since public spending on education relative to the GNP rises only modestly as incomes grow. Focussing on primary

[37] Fomba, M. (1996) "L'enseignment primaire au Mali: mode de financement et acquisition des élèves," PhD dissertation, Uinversité de Bourgogne, Dijon, France.

education for which more detailed analysis was feasible, we found that this factor contributed no more than 20 percent of a richer countries' resource advantage as incomes rise from $200 to $400 (in 1993 prices), and no more than 14 percent of the advantage at all subsequent stages of income growth up to $10,000. Easing of the demographic burden makes a bigger difference, its contribution ranging between 17 and 32 percent of richer countries' advantage as incomes rise from $200 to $10,000. At all stages of economic development, by far the most important source of increased public spending available per school-aged child in the richer countries is the dramatic decline in teacher salaries relative to the per capita GNP as countries grow rich, accounting for as much as two-thirds of the resource advantage in the richer country at some stages of income growth. As the resources available per school-aged child materializes with income growth, countries are able to expand coverage and improve schooling conditions via a reduction in the pupil-teacher ratio. They initially allocate more of the resources to expand coverage, but the emphasis quickly shifts in favor of lowering the pupil-teacher ratio even though a substantial share of the primary school-aged population remains out of school. This trend toward lower pupil-teacher ratios was stronger in the 1990s than in the 1970s.

Is the shift toward smaller pupil-teacher ratios an efficient way to use the extra resources that become available for education in the course of economic growth? According to the cross-country evidence in the present study as well as findings reported in the broader literature the answer is probably in the negative, particularly in the context of the poorer countries. One reason is that over the typical range of the pupil-teacher ratio in developing country contexts, a reduction in the variable has little impact on student learning. Another is that reducing the pupil-teacher ratio implies slower progress in expanding educational coverage. The long run result is lower levels of educational attainment among tomorrow's adults, which in turn is likely to diminish learning achievement among tomorrow's children.

Besides the systematic differences in education associated with country wealth, substantial diversity is also evident among countries at comparable levels of economic development. In all low income countries, for example, high teacher salaries relative to the per capita GNP reduce the scope for expanding educational coverage, but the salaries are much higher in African countries than in comparable countries in other regions, leading to wide gaps in coverage and well as in pupil-teacher ratios. Where a country deviates substantially from the income-related structural patterns, a likely reason is that it has made different policy choices than other countries. The scope for choice is indeed wide, ranging from the overall pattern of resource allocation in education, to how education services are organized and delivered. Setting aside the impact of country wealth, policy choices, particularly with regard to teacher salaries

and the tradeoff between coverage and reductions in pupil-teacher ratios, can and do have significant influence on the path of educational development in developing countries.

Appendix A
Comparing Education in Rich and Poor Countries in 1975 and 1993

In section 3.3 in the text we compared richer countries' advantage in education in 1975 and 1993 by looking at pairs of countries at contiguous income levels in each year. Another way to examine the data is to compare pairs of countries--one from each year--at the same level of per capita GNP (in constant dollar terms). The patterns that emerge (summarized in the three graphs below) are consistent with those discussed in the text. At each stage of economic development, more public resources are available for primary education in the later than earlier year. Larger budget allocations account for little of the advantage in the later year, but differences in demographic burdens and teacher pay relative to the per capita GNP make significant contributions. A country at $800 in per capita GNP in 1993, for example, derives nearly 40 percent of its resource advantage relative to its 1975 counterpart from the fact that its school aged population was only 20.2 percent of the total population compared with 24.1 percent in the earlier year. Declines in relative teacher pay make the largest contribution, however, accounting for between 80 and 60 percent of the resource advantage in the latter year. With regard to how the resource advantage is used, the pattern confirms what we have already seen above: in the poorest countries, the overriding emphasis has been on expansion of coverage, but this focus quickly switches in favor of reducing the pupil-teacher ratios once the per capita incomes exceeds $800.

Figure A.1: Resource availability for primary education in 1993 and 1975

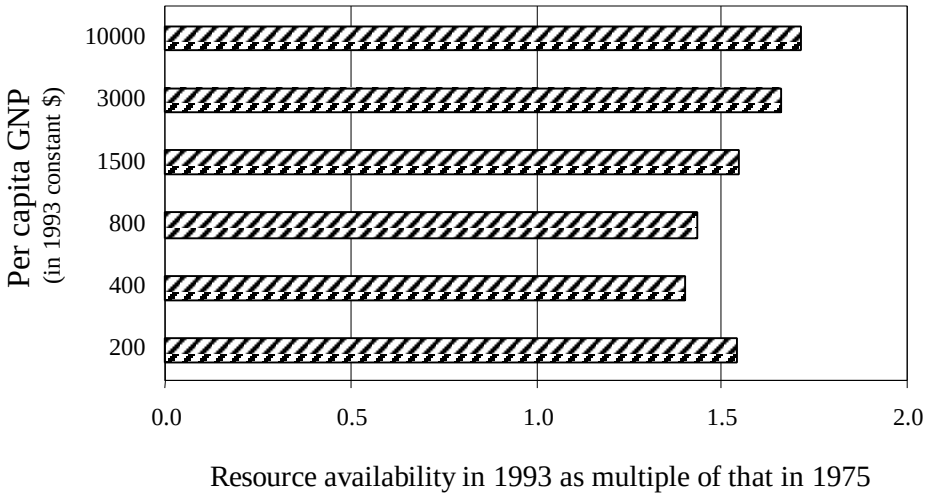


Figure A.2: Sources of the resource advantage for primary education in 1993 relative to that in 1975

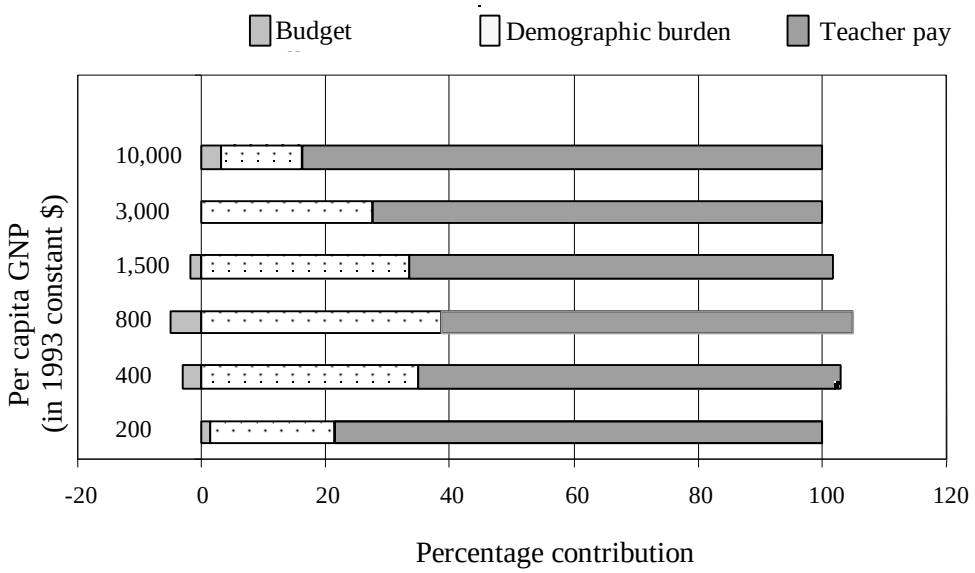


Figure A.3: Deployment of the resource advantage for primary education in 1993 relative to that in 1975