EDUCATION QUALITY AND ECONOMIC GROWTH

THE WORLD BANK

Education Quality and Economic Growth

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Foreword

Access to education is one of the highest priorities on the development agenda. High-profile international commitment to progress—such as the second Millennium Development Goal of achieving universal primary education—has helped galvanize policy-makers into action. Significant results have already been achieved in school enrollment. Yet care must be taken that the need for simple, measurable goals does not lead to ignoring the fact that it ultimately is the degree to which schooling fosters cognitive skills and facilitates the acquisition of professional skills that matters for development.

As shown in this report, differences in learning achievements matter more in explaining cross-country differences in productivity growth than differences in the average number of years of schooling or in enrollment rates. A development-effective educational strategy should thus focus not only on sending more children to school, as the second Millennium Development Goal is often interpreted, but also on maintaining or enhancing the quality of schooling. The task at hand is imposing. As shown by the PISA survey, disparities in secondary education between developing countries and OECD countries are even larger when one considers not only access but also learning achievements. Things are not much better at the primary level. In recent surveys in Ghana and Zambia, it turned out that fewer than 60 percent of young women who complete six years of primary school could read a sentence in their own language.

Reducing disparities in access to, and in the quality of, education are two goals that must be pursued simultaneously for any education reform to be successful. Considerable progress has indeed been made recently in increasing enrollment, but a reversal could occur if parents were to realize that the quality of schooling is not guaranteeing a solid economic return for their children.

There are many reasons why school quality may be deficient. Countries should investigate what the precise causes are in their own context and should be encouraged to experiment in finding the best way to correct weaknesses. Tools such as effective teacher certification, public disclosure of the educational achievements of schools and teachers, local school control by parents associations, and, more generally, all measures contributing to the accountability of teachers and head teachers, can be useful starting points for reflection. Education reforms take time to mature and bear fruit. Engaging in such reflection and experimentation is therefore urgent for development.

The Bank will do its part in making learning outcomes part of the overall educational goal. It will contribute to ensuring that the measurement of learning achievements is undertaken in a more systematic way and is properly taken into account in the Bank's dialogue with partner countries. It will also invest in developing the appropriate evaluation tools to monitor this crucial part of educational development.

It is our hope that this report will be a first contribution to this agenda.

François Bourguignon
Senior Vice President and Chief Economist
The World Bank

About this book

This book aims to contribute to the World Bank's education agenda by communicating research findings on the impact of education quality on economic growth. Eric Hanushek and Ludger Wößmann show that indeed the quality of education, rather than mere access to education, is what impacts economic growth. These world-renowned researchers use data on economic growth and student cognitive skills to help shift the dialogue to the ever-pressing issue of education quality.

The authors have done a great service to the development community. This work will lead to further research on the issue of learning outcomes in developing countries and to sustained interest in the quality of education in World Bank education programs. Ruth Kagia, Harry Patrinos, Tazeen Fasih, and Verónica Grigera commented on the report. The production of this report was managed by the World Bank Office of the Publisher.

See the full report: Eric A. Hanushek and Ludger Wößmann. 2007. "The Role of Education Quality in Economic Growth." Policy Research Working Paper 4122, World Bank, Washington, D.C. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/01/29/000016406_20070129113447/Rendered/PDF/wps4122.pdf.

Schooling has not delivered fully on its promise as the driver of economic success. Expanding school attainment, at the center of most development strategies, has not guaranteed better economic conditions. What's been missing is attention to the quality of education—ensuring that students actually learn. There is strong evidence that the cognitive skills of the population, rather than mere school enrollment, are powerfully related to individual earnings, to the distribution of income, and to economic growth. And the magnitude of the challenge is clear—international comparisons reveal even larger deficits in cognitive skills than in school enrollment and attainment in developing countries.

Building on several decades of thought about human capital—and centuries of attention to education in the more advanced countries—it is natural to believe that a productive development strategy would be to raise the schooling levels of the population. Indeed, this is exactly the approach of the Education for All initiative and a central element of the Millennium Development Goals.

But there are four nagging uncertainties with these policies. First, developed and developing countries differ in myriad ways other than schooling levels. Second, a number of countries—both on their own and with the assistance of others—have expanded schooling opportunities without closing the gap in economic well-being. Third, poorly functioning countries may not be able to mount effective education programs. Fourth, even when schooling is a focus, many of the approaches do not seem very effective and do not produce the expected student outcomes.

Most people would acknowledge that a year of schooling does not produce the same cognitive skills everywhere. They would also agree that families and peers contribute to education. Health and nutrition further impact cognitive skills. Yet, research on the economic impact of schools—largely due to expedience—almost uniformly ignores these aspects.

Ignoring quality differences significantly distorts the picture of how educational and economic outcomes are related. The distortion misses important differences between education and skills and individual earnings. It misses an important underlying factor that determines the interpersonal distribution of incomes within societies. And it very significantly misses the important element of education in economic growth. There is credible evidence that educational quality has a strong causal impact on individual earnings and economic growth.

Although information on enrollment and attainment has been widely available in developing countries, information on quality has not. New data presented here on cognitive skills—our measure of educational quality—show that the education deficits in developing countries are larger than previously thought.

Policies aimed at increasing cognitive skills have themselves been disappointing. An emphasis on providing more resources while retaining the fundamental structure of schools has not had general success. On the other hand, one consistent finding emerging from research is that teacher quality strongly influences student outcomes. Just adding resources does not have much effect on teacher quality.

There is growing evidence that changing the incentives in schools has an impact. Accountability systems based upon tests of student cognitive achievement can change the incentives for both school personnel and for students. By focusing attention on

the true policy goal—instead of imperfect proxies based on inputs to schools—performance can be improved. These systems align rewards with outcomes. Moreover, increased local decisionmaking or local autonomy, coupled with accountability, can facilitate these improvements. There is also suggestive evidence that greater school choice promotes better performance.

In sum:

- Educational quality—measured by what people know—has powerful effects on individual earnings, on the distribution of income, and on economic growth.
- The educational quality in developing countries is much worse than educational quantity (school enrollment and attainment), a picture already quite bleak.
- Just providing more resources to schools is unlikely to be successful—improving the quality of education will take major changes in institutions.

Educational quality directly affects individual earnings

Most attention to the value of schooling focuses on the economic returns to different levels of school attainment for individuals. These studies have uniformly shown that more schooling is associated with higher individual earnings. The rate of return to schooling across countries is centered at about 10%, with returns higher for low-income countries, for lower levels of schooling, and frequently for women.[1]

The concentration on school attainment in the academic literature contrasts with much of the policy debates that, even in the poorest areas, involve elements of the "quality" of schooling. These debates, often phrased in terms of teacher salaries or class sizes, presume a high rate of return to schools in general and to quality in particular.

Researchers can now document that the earnings advantages to higher achievement on standardized tests are substantial. While these analyses emphasize different aspects of individual earnings, they typically find that measured achievement has a clear impact on earnings after allowing for differences in the quantity of schooling, the experience of workers, and other factors. In other words, higher quality, as measured by tests similar to those currently being used in accountability systems around the world, is closely related to individual productivity and earnings.

Three recent U.S. studies provide direct and consistent estimates of the impact of test performance on earnings.[2] They suggest that a one standard deviation increase in mathematics performance at the end of high school translates into 12% higher annual earnings. Part of the return to school quality comes from continuing school, perhaps a third to a half of the full return to higher achievement.[3]

Does the clear impact of quality in the United States generalize to developing countries? The literature on returns to cognitive skills is restricted: Ghana, Kenya, Morocco, Pakistan, South Africa, and Tanzania. But the evidence permits a tentative conclusion that the returns to quality may be even larger in developing countries than in developed countries. This would be consistent with the range of estimates for returns to quantity of schooling, which are frequently interpreted as indicating diminishing marginal returns to schooling.[4]

The overall summary is that the available estimates of the impact of cognitive skills on outcomes suggest strong economic returns within developing countries. The substantial magnitude of the typical estimates indicates that educational quality concerns are very real for developing countries and cannot be ignored.

Evidence also suggests that educational quality is directly related to school attainment. In Brazil, a country plagued by high rates of grade repetition and school dropouts, higher cognitive skills in primary school lead to lower repetition rates.[5] Lower quality schools, measured by lower value added to cognitive achievement, lead to higher dropout rates in Egyptian primary schools.[6] Thus, as for developed countries, the full economic impact of higher educational quality comes in part through greater school attainment.

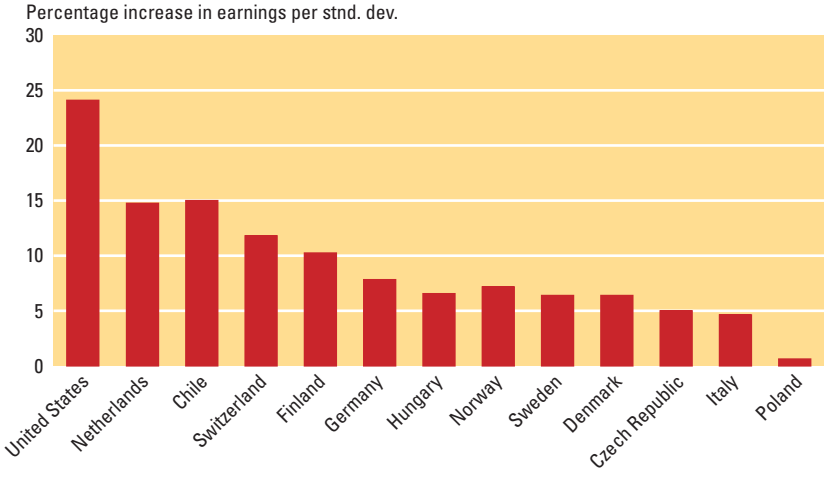
This complementarity of school quality and attainment also means that actions that improve quality of schools will boost attainment goals. Conversely, attempting to simply expand access and attainment—say through opening a large number of low

quality schools—will be self-defeating to the extent that there is a direct reaction to the low quality that affects actual attainment.

The foregoing analyses for both developed and developing countries rely largely on panel data that follow individuals from school into the labor market. The alternative approach is to test a sample of adults and then to relate the measures to labor market experiences, as in the International Adult Literacy Survey (IALS). Between 1994 and 1998, 23 countries participated in common testing of adults between age 16 and 65. For these representative samples, a number of countries also collected information on earnings and other attributes that permit estimating the effect on economic outcomes of combined scores in different kinds of "literacy" (prose, document, and quantitative).[7] An advantage is that it provides information across a broader range of age and labor market experience. As in prior analyses, both school attainment and cognitive skills determine individual incomes. Except in Poland, literacy scores have a consistent positive impact on earnings (figure 1). The (unweighted) average of the impact of literacy scores is 9.3%, only slightly less than in the U.S. studies. But after adjusting the returns for literacy scores, the estimated impact of school attainment across the 13 countries is just 4.9% (per added year of schooling). This low estimate partly reflects the joint consideration of literacy scores and school attainment. The estimated return to years of schooling without considering literacy scores is 6%, still below the more common estimates of 10%. The literacy tests in IALS are designed to measure basic skills only, and yet the differences are strongly associated with higher earnings. These results, from a broad age spectrum across a number of countries, reinforce the importance of quality.

One implication of the impact of cognitive skills on individual earnings is that the distribution of those skills in the economy will have a direct effect on the distribution of income. Very suggestive evidence comes from Nickell (2004), who considers how differences in the distribution of incomes across countries are affected by the distribution of skills and by such institutional factors as unionization and minimum wages. He concludes that most of the variation in the dispersion of earnings is explained by the dispersion of skills.[8]

Figure 1 The returns to cognitive skills (literacy) are generally strong across countries



Source: Hanushek and Zhang (2006).

Other studies have also concluded that skills have an increasing impact on the distribution of income.[9] They do not attempt to describe the causal structure, and it would be inappropriate to attribute the variance in earnings simply to differences in the quantity or quality of schooling. But to the extent that both contribute to variations in cognitive skills, it is fair to conclude that policies improving school quality (and educational outcomes) will improve the distribution of income.

Early analyses have emphasized the role of quantity of schooling for economic growth

For an economy, education can increase the human capital in the labor force, which increases labor productivity and thus leads to a higher equilibrium level of output.[10] It can also increase the innovative capacity of the economy—knowledge of new technologies, products, and processes promotes growth.[11] And it can facilitate the diffusion and transmission of knowledge needed to understand and process new information and to implement new technologies devised by others, again promoting growth.[12]

Just as in the literature on microeconomic returns to education, the majority of the macroeconomic literature on economic

returns to education employs the quantitative measure of years of schooling, now averaged across the labor force. Using average years of schooling as an education measure implicitly assumes that a year of schooling delivers the same increase in knowledge and skills regardless of the education system. This measure also assumes that formal schooling is the primary source of education and that variations in the quality of nonschool factors affecting learning have a negligible effect on education outcomes. This neglect of cross-country differences in the quality of education is the major drawback of such a quantitative measure.

The standard method of estimating the effect of education on economic growth is to estimate cross-country growth regressions where average annual growth in gross domestic product (GDP) per capita over several decades is expressed as a function of measures of schooling and a set of other variables deemed important for economic growth. A vast early literature of cross-country growth regressions tended to find a significant positive association between quantitative measures of schooling and economic growth.[13]

The research reported here suggests that each year of schooling boosts long-run growth by 0.58 percentage points (figure 2).

Figure 2 Each year of schooling is associated with a long-run growth increase of 0.58 percentage points

coef = .58144999, se = .09536607, t = 6.1

Source: Hanushek and Wößmann (2007).
Note: This is an added-variable plot of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960–2000 on average years of schooling in 1960 and the initial level of real GDP per capita in 1960.

There is a clear association between growth rates and school attainment.

Yet, questions persist about the interpretation of such relationships. A substantial controversy has emerged in the economics literature about whether it is the *level* of years of schooling (as would be predicted by several models of endogenous growth) or the *change* in years of schooling (as would be predicted by basic neoclassical models) that is the more important driver of economic growth. While recent research tends to find a positive effect of schooling quantity on economic growth, it seems beyond the scope of current data to draw strong conclusions about the relative importance of different mechanisms for schooling quantity to affect economic growth. Even so, several recent studies suggest that education is important in facilitating research and development and the diffusion of technologies, with initial phases of education more important for imitation, and higher education more important for innovation.[14] So, a focus on basic skills seems warranted for developing countries.

But reverse causation running from higher economic growth to additional education may be at least as important as the causal effect of education on growth in the cross-country association.[15] It is also important—for economic growth—to get other things right as well, particularly the institutional framework of the economy.[16]

The quality of education matters even more for economic growth

The most important caveat for the literature on education and growth is that it sticks to years of schooling as its measure of education—to the neglect of qualitative differences in knowledge. This misses the core of what education is all about. The problem seems even more severe in cross-country comparisons than in analyses within countries: Who would sensibly assume that the average student in Ghana or Peru would gain the same amount of knowledge in any year of schooling as the average student in Finland or Korea? Still, using the quantitative measure of years of schooling does exactly that.

Years of schooling has a second major shortcoming. It implicitly assumes that all skills and human capital come from formal schooling. Yet extensive evidence on knowledge development and cognitive skills indicates that a variety of factors outside of school—family, peers, and others—have a direct and powerful influence. Ignoring these nonschool factors introduces another element of measurement error into the growth analyses in the same way as it did in the analysis of individual earnings.

The leading role of cognitive skills

Since the mid-1960s, international agencies have conducted many international tests of student performance in cognitive skills such as mathematics and science. Every developing country that participated in one of the tests performed dramatically lower than any OECD (Organisation for Economic Co-operation and Development) country (figure 3). The variation in the quality of education that exists among OECD countries is already substantial. But the difference from developing countries in the average amount of learning acquired after a given amount of schooling dwarfs any within-OECD difference.

Over the past 10 years, growth research demonstrates that considering the quality of education, measured by the cognitive skills learned, dramatically alters the assessment of the role of education in economic development. Using the data from the international student achievement tests through 1991 to build a measure of educational quality, Hanushek and Kimko (2000) find a statistically and economically significant positive effect of the quality of education on economic growth in 1960–90 that is far larger than the association between the quantity of education and growth. So, ignoring quality differences very significantly misses the true importance of education for economic growth. Their estimates suggest that one country-level standard deviation (equivalent to 47 test-score points in PISA 2000 mathematics, the same scale used in figure 3) higher test performance would yield about one percentage point higher annual growth.

That estimate stems from a statistical model that relates annual growth rates of real GDP per capita to the measure of educational quality, years of schooling, the initial level of income, and several other control variables (including, in different specifications, the population growth rates, political measures, openness of the economies, and the like). Adding educational quality to a base specification including only initial income and educational quantity boosts the variance in GDP per capita among the 31 countries in Hanushek and Kimko's sample that can be explained by the model from 33% to 73%.[17] The effect of years of schooling is greatly reduced by including quality, leaving it mostly insignificant. At the same time, adding the other factors leaves the effects of quality basically unchanged. Several studies have since found very similar results.[18] In sum, the evidence suggests that the quality of education, measured by the knowledge that students gain as depicted in tests of cognitive skills, is substantially more important for economic growth than the mere quantity of education.

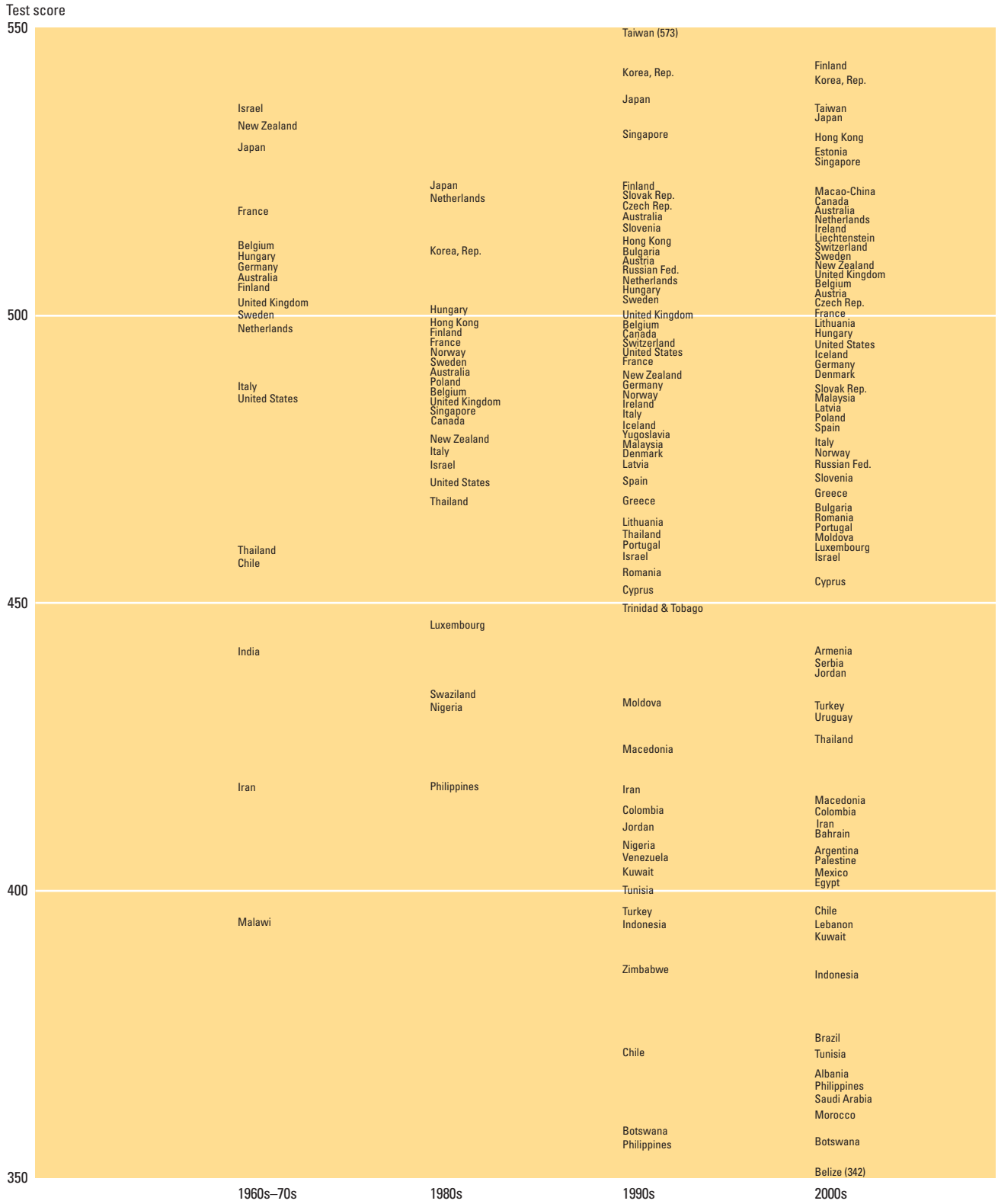
New evidence on the importance of educational quality for economic growth

New evidence adds international student achievement tests not previously available and uses the most recent data on economic growth to analyze an even longer period (1960–2000).[19] It extends the sample of countries with available test-score and growth information to 50 countries. These data are also used to analyze effects of the distribution of educational quality at the bottom and at the top on economic growth, as well as interactions between educational quality and the institutional infrastructure of an economy.

The measure of the quality of education is a simple average of the mathematics and science scores over international tests, interpreted as a proxy for the average educational performance of the whole labor force. This measure encompasses overall cognitive skills, not just those developed in schools. Thus, whether skills are developed at home, in schools, or elsewhere, they are included in the growth analyses.

After controlling for the initial level of GDP per capita and for years of schooling,

Figure 3 Performance on international student achievement tests tracks educational quality over time



Source: Based on Hanushek and Wößmann (forthcoming).

the test-score measure features a statistically significant effect on the growth of real GDP per capita in 1960–2000 (figure 4). According to this simple specification, test scores that are larger by one standard deviation (measured at the student level across all OECD countries in PISA) are associated with an average annual growth rate in GDP per capita that is two percentage points higher over the whole 40-year period.

Adding educational quality (to a model that just includes initial income and years of schooling) increases the share of variation in economic growth explained from 25% to 73%. The quantity of schooling is statistically significantly related to economic growth in a specification that neglects educational quality, but the association between years of schooling and growth turns insignificant and is reduced to close to zero once the quality of education is included in the model (see the bottom of figure 4).[20] The same pattern of results is preserved when any variation between five world regions is ignored. So even when considering the variation just within each region, educational quality is significantly related to economic growth.

Recent literature on the determinants of economic growth emphasizes the importance of the institutional framework of the economy. The most common and powerful measures of the institutional framework used in empirical work are the openness of the economy to international trade and the security of property rights. These two institutional variables are jointly highly significant when added to the model. But the positive effect of educational quality on economic growth is very robust to the inclusion of these controls, albeit reduced in magnitude to 1.26.

Other possible determinants of economic growth often discussed in the literature are fertility and geography. But when the total fertility rate and common geographical proxies, such as latitude or the fraction of the land area located within the geographic tropics, are added to the model, neither is statistically significantly associated with economic growth.

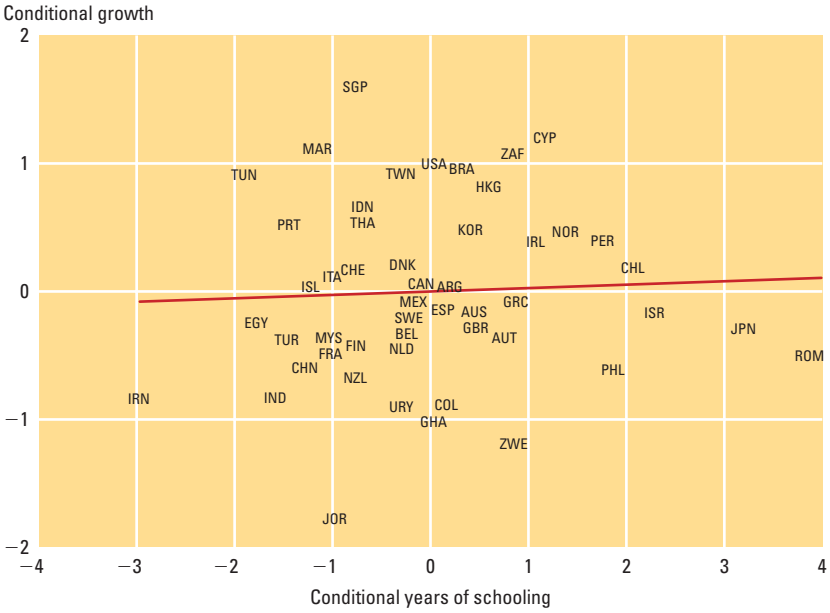
An important issue is whether the role of educational quality in economic development differs between developing and developed countries. But results are remarkably similar when comparing the sample

Figure 4 Test scores, as opposed to years of schooling, have a powerful impact on growth

a. Impact of test scores on economic growth

coef = 1.9804387, se = .21707105, t = 9.12

b. Impact of years of schooling on economic growth



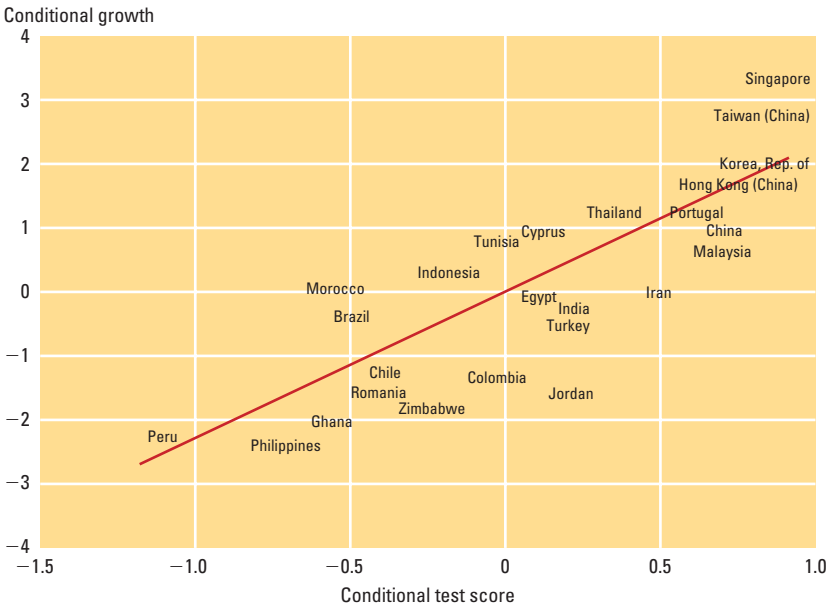
coef = .0264058, se = .07839797, t = .34

Source: Hanushek and Wößmann (2007).
Note: These are added-variable plots of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960–2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960.
ARG = Argentina, AUS = Australia, AUT = Austria, BEL = Belgium, BRA = Brazil, CAN = Canada, CHE = Switzerland, CHL = Chile, CHN = China, COL = Colombia, CYP = Cyprus, DNK = Denmark, EGY = Arab Rep. of Egypt, ESP = Spain, FIN = Finland, FRA = France, GBR = United Kingdom, GHA = Ghana, GRC = Greece, HKG = Hong Kong (China), IDN = Indonesia, IND = India, IRL = Ireland, IRN = Islamic Rep. of Iran, ISL = Iceland, ISR = Israel, ITA = Italy, JOR = Jordan, JPN = Japan, KOR = Rep. of Korea, MAR = Morocco, MEX = Mexico, MYS = Malaysia, NLD = Netherlands, NOR = Norway, NZL = New Zealand, PER = Peru, PHL = Philippines, PRT = Portugal, ROM = Romania, SGP = Singapore, SWE = Sweden, THA = Thailand, TUN = Tunisia, TUR = Turkey, TWN = Taiwan, URY = Uruguay, USA = United States, ZAF = South Africa, and ZWE = Zimbabwe.

of OECD countries to the sample of non-OECD countries, with the point estimate of the effect of educational quality slightly larger in non-OECD countries. (The difference in the effect of educational quality on economic growth between the two groups of countries is not statistically significant, however). The results remain qualitatively the same when openness and quality of institutions are again added as control variables. When the sample is separated based on whether a country was below or above the median of GDP per capita in 1960, the effect of educational quality is larger in low-income countries than in high-income countries (figure 5).

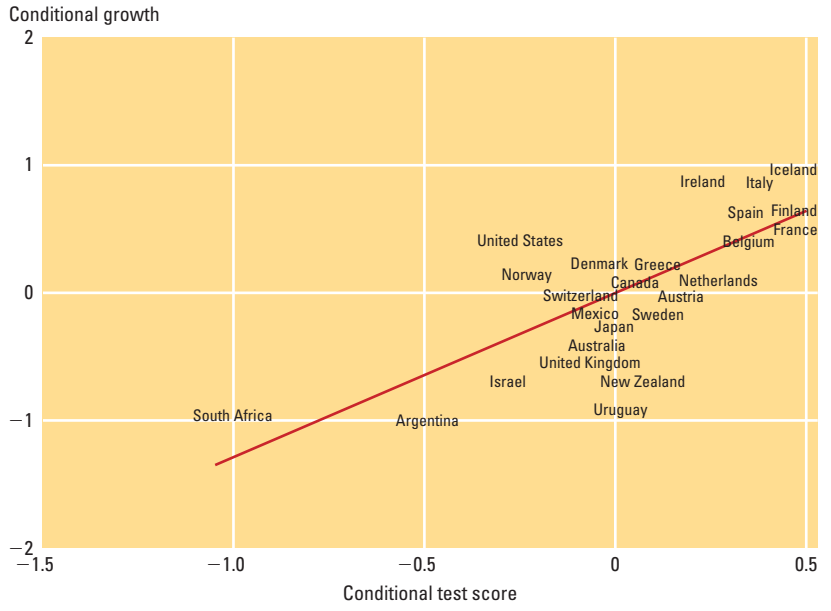
Figure 5 Test scores influence growth in both low- and high-income countries

a. Countries with initial income below mean



coef = 2.2860685, se = .32735727, t = 6.98

b. Countries with initial income above mean



coef = 1.2869403, se = .23947381, t = 5.37

Source: Hanushek and Wößmann (2007).
Note: These are added-variable plots of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960–2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960. Division into low- and high-income countries based on whether a country's GDP per capital in 1960 was below or above the sample median.

Among the developing countries, the returns to increased years of schooling increase with the quality of the education. Once there is a high-quality school system, it pays to keep children in school longer—but it does not pay if the school system does not produce skills.

The results are very robust to alternative specifications of the growth relationships. First, the impact of cognitive skills remains qualitatively the same when measured just by the tests performed at the level of lower secondary education, excluding any test in primary schooling or in the final year of secondary education. Given differing school completion rates, the test for the final year of secondary schooling may imply cross-country samples with differential selectivity of test takers. Yet neither the primary-school tests nor the tests in the final secondary year are crucial for the results.

Furthermore, results are qualitatively the same when using only scores on tests performed since 1995. These recent tests have not been used in the previous analyses and are generally viewed as having the highest standard of sampling and quality control. At the same time, because test performance measured since 1995 is related to the economic data for 1960–2000, a test score measure that disregards all tests since the late 1990s was also used. The results are robust, with a point estimate on the test score variable that is significantly higher when the tests are restricted to only those conducted until 1995 (sample reduced to 34 countries) and until 1984 (22 countries). In sum, the results are not driven by either early or late test scores alone.

The results are also robust to performing the analyses in two sub-periods, 1960–80 and 1980–2000. The most recent period includes the Asian currency crisis and other major economic disruptions which could affect the apparent impact of educational

quality on growth—but they do not. Test scores exert a positive effect on growth in both sub-periods, while years of schooling remain insignificant in both.

Are East Asian countries driving the association between educational quality and economic growth? As is obvious from figure 4, several East Asian countries feature both high educational quality and high economic growth—these countries dominate the top right corner of the figure. Still, the association between educational quality and growth is not solely due to a difference between the East Asian countries and the rest, or between any other world regions. Furthermore, when all 10 East Asian countries are dropped from the sample, the estimate on educational quality remains statistically highly significant at a point estimate of 1.3. The significant effect in the sample without East Asian countries is also evident in the two separate sub-periods, with the point estimates larger in the separate regressions.

Education for all or rocket scientists—or both?

It is important to know whether different parts of the distribution of education affect growth differently. Loosely speaking, is it a few "rocket scientists" at the very top who spur economic growth, or is it "education for all" that lays a broad base at the lower parts of the distribution? Does educational performance at different points in the distribution have separate effects on economic growth?

Such effects are estimated by measuring the share of students in each country that reaches a certain threshold of basic literacy at the international scale, as well as the share of students that surpasses an international threshold of top performance. The 400 and 600 test-score points are used as the two thresholds on the transformed international scale.

The threshold of 400 points is meant to capture basic literacy. On the PISA 2003 math test, for example, this would correspond to the middle of the level 1 range, denoting that students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. While the PISA 2003 science test does not define a full set of proficiency levels, the threshold of 400 points is used as the lowest bound for a basic level of science literacy.[21] A level of 400 points means performance at one standard deviation below the OECD mean. The share of students achieving this level ranges from 18% in Peru to 97% in the Netherlands and Japan, with an international median of 86% in the sample. The threshold of 600 points captures the very high performers, those performing at more than one standard deviation above the OECD mean. The share of students achieving this level ranges from below 0.1% in Colombia and Morocco to 18% in Singapore and the Republic of Korea and 22% in Taiwan (China) with an international median of 5% in the sample.

When the share of students above the two thresholds is entered in the growth model, both turn out to be separately significantly related to economic growth. That is, both education for all and the share of top performers seem to exert separately identifiable effects on economic growth. These initial results should be viewed as suggestive rather than definite, not least because of the high correlation between the two measures of quality (0.73 at the country level). Importantly, the relative size of the effects of performance at the bottom and at the top of the distribution depends on the specification, and further research is needed to yield more detailed predictions. Even so, the evidence strongly suggests that both dimensions of educational performance count for the growth potential of an economy.[22] Additional specifications using different points of the distribution of test scores support this general view.

The combined test-score measure can also be divided into one using only the math tests and one using only the science tests. Both subject-specific test scores are significantly associated with growth when entered separately or jointly. There is some tendency for math performance to dominate science performance in different robustness specifications, but math and science performance carry separate weights for economic growth.

In sum, different dimensions of the quality of education seem to have independent positive effects on economic growth. This is true both for basic and top dimensions of educational performance and for the math

and science dimensions. Because of the thin country samples, however, one should trust the pattern of results more than the specific estimates.

The interaction of educational quality with economic institutions

The role of economic institutions as the fundamental cause of differences in economic development, emphasized in recent literature,[23] raises the possibility that the effect of educational quality on economic growth may differ depending on the economic institutions of a country. The institutional framework affects the relative profitability of piracy and productive activity. If the available knowledge and skills are used in the former activity rather than the latter, the effect on economic growth may be very different, perhaps even turning negative.[24] The allocation of talent between rent-seeking and entrepreneurship matters for growth: countries with more engineering students grow faster and countries with more law students grow more slowly.[25] Education may not have much impact in less developed countries that lack other facilitating factors such as functioning institutions for markets and legal systems.[26] And due to deficiencies in the institutional environment, cognitive skills might have been applied to socially unproductive activities in many developing countries, rendering the average effect of education on growth across all countries negligible.[27] Social returns to education may be low in countries with perverse institutional environments—a point certainly worth pursuing.

Adding the interaction of educational quality and one institutional measure—openness to international trade—to the growth specification suggests that both have significant individual effects on economic growth and a significant positive interaction. The effect of educational quality on economic growth is indeed significantly higher in countries that have been fully open to international trade than in countries that have been fully closed. The effect of educational quality on economic growth is significantly positive, albeit relatively low at 0.9, in closed economies—but it increases to 2.5 in open economies. The reported result is robust to including the measure of protection against expropriation. When using protection against expropriation rather than openness to trade as the measure of institutional quality, there is similarly a positive interaction term with educational quality, although it lacks statistical significance.

In sum, both the quality of the institutional environment and the quality of education seem important for economic development. Furthermore, the effect of educational quality on growth seems significantly larger in countries with a productive institutional framework, so that good institutional quality and good educational quality can reinforce each other. Thus, the macroeconomic effect of education depends on other complementary growth-enhancing policies and institutions. But cognitive skills have a significant positive growth effect even in countries with a poor institutional environment.

The implications of educational reform for faster growth

It is important to understand the implications of policies designed to improve educational outcomes. The previous estimates provide information about the long run economic implications of improvements in educational quality. To better understand the impact of improved achievement, it is useful to relate policy reforms directly to the pattern of economic outcomes consistent with feasible improvements.

Two aspects of any educational reform plan are important: First, what is the size of the reform accomplished? Second, how fast does the reform achieve results? As a benchmark, consider a reform that yields a 0.5 standard deviation improvement in average achievement of school completers. This metric is hard to understand intuitively, in part because most people have experiences within a single country. It is possible, however, to put this in the context of the previous estimates. Consider, for example, a developing country with average performance at roughly 400 test-score points, approximately minimal literacy. On the PISA

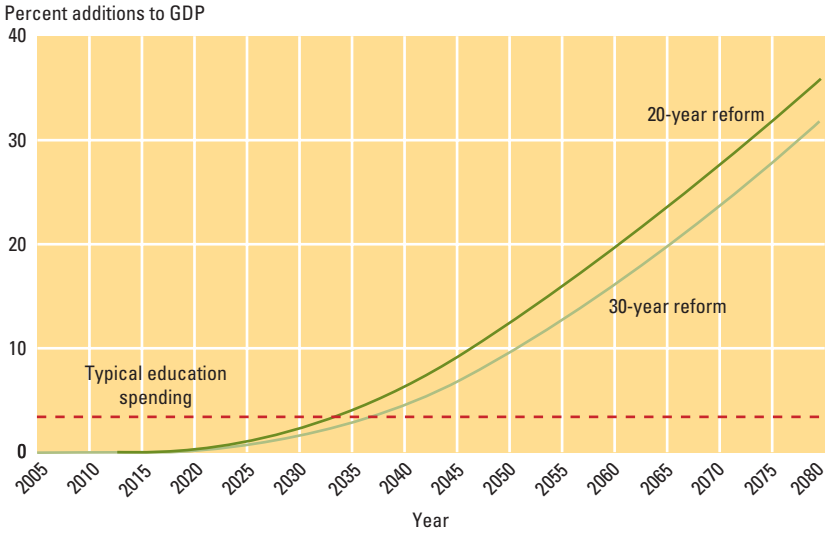
2003 examinations, average achievement in Brazil, Indonesia, Mexico, and Thailand fell close to this level. An aggressive reform plan would be to close half the gap with the average OECD student, an improvement of half a standard deviation.

As an alternative policy change, consider what it would mean if a country currently performing near the mean of OECD countries in PISA at 500 test-score points (for example, Norway or the United States in PISA 2000 or Germany in PISA 2003) managed to increase its educational quality to the level of top performers in PISA at roughly 540 test-score points (for example, Finland or Korea on either PISA test). Such an increase amounts to 0.4 standard deviations.

The timing of the reform is also important in two ways. First, such movement of student performance cannot be achieved instantaneously but requires changes in schools that will be accomplished over time (say, through systematic replacement of teachers through retirement and subsequent hiring). The timeframe of any reform is difficult to specify, but achieving the change of 0.5 standard deviations described above for an entire nation may take 20 to 30 years. Second, if the reforms succeed, their impact on the economy will not be immediate—initially the new graduates will be a small part of the labor force. It will be some time after the reform of the schools before the impact on the economy is realized. In other words, the prior estimates are best thought of as the long-run, or equilibrium, outcomes of a labor force with a given educational quality.

Faster reforms will have larger impacts on the economy, simply because the better workers become a dominant part of the workforce sooner (figure 6). But even a 20- or 30-year reform plan has a powerful impact. For example, a 20-year plan would yield a GDP 5% greater in 2037 (compared with the same economy with no increase in educational quality). The figure also plots 3.5% of GDP, an aggressive spending level for education in many countries of the world. Significantly greater than the typical country's spending on all primary and secondary schooling, 5% of GDP is a truly significant change that would permit the growth dividend to more than cover *all* primary and secondary school spending. But even a 30-year reform program (not fully accomplished until 2035) would yield more than 5% higher real GDP by 2041.

Figure 6 GDP increases significantly with moderately strong knowledge improvement (0.5 standard deviations)



Source: Hanushek and Wößmann (2007).
Note: The figure simulates the impact on the economy of reform policies taking 20 or 30 years for a 0.5 standard deviation improvement in student outcomes at the end of upper secondary schooling—labeled as a "moderately strong knowledge improvement." For the calibration, policies are assumed to begin in 2005—so that a 20-year reform would be complete in 2025. The actual reform policy is presumed to operate linearly such that, for example, a 20-year reform that ultimately yielded ½ standard deviation higher achievement would increase the performance of graduates by 0.025 standard deviations each year. It is also necessary to characterize the impact on the economy, which is assumed to be proportional to the average achievement levels of prime age workers. Finally, for this exercise the growth impact is projected according to the basic achievement model that also includes the independent impact of economic institutions, where the coefficient estimate on test scores is 1.265. The figure indicates how much larger the level of GDP is at any point after the reform policy is begun as compared to that with no reform. In other words, the estimates suggest the increase in GDP expected over and above any growth from other factors.

Projecting these net gains from school quality further past the reform period shows vividly the long-run impacts of reform. Over a 75-year horizon, a 20-year reform yields a real GDP 36% higher than without a change in educational quality.

It must nonetheless be clear that these effects represent the result from *actual gains* in educational outcomes. There have been many attempts around the world to improve student outcomes, and many of these have failed to yield gains in student performance. Bad reforms—those without impacts on students—will not have these growth effects.

This simulation shows that the previous estimates of the effects of educational quality on growth have large impacts on national economies. At the same time, while the rewards are large, they also imply that

policies must be considered across long periods, requiring patience—patience not always clear in national policymaking. These reforms must also be put in a broader perspective because other kinds of institutional changes and investments will also take time. Changing basic economic institutions, for example, seldom happens overnight, and the economy needs time to adjust.

Where does the developing world stand today?

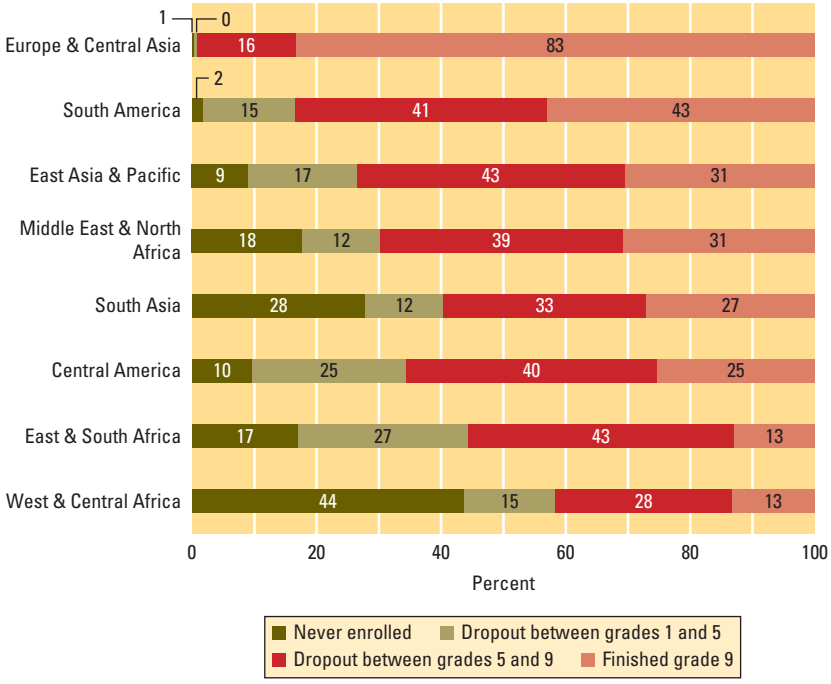
Given the importance of cognitive skills for economic development, it is telling to document how developing countries fare in the quantity of schooling and the quality of education.

Low quantity of schooling

The disadvantages of less developed countries in educational enrollment and attainment have been well documented. While almost all OECD countries have universal school attainment to grade 9, all developing regions are far from that (figure 7). In the average African country in the data, only 13% of each cohort finishes grade 9, and less than 30% in Central America and South and East Asia do so. Even in South America, only 43% finish, although only 17% of a cohort do not complete grade 5 (which often serves as an initial indication of basic literacy and numeracy rates). In West and Central Africa, 59% of each cohort do not even complete grade 5, and 44% never enroll in school in the first place.

Focusing on this dimension of schooling quantity, many policy initiatives of national governments and international development agencies have tried to increase educational attainment. The data in figure 7 show that there is a long way to go. But even this dire picture may understate the challenge.

Figure 7 Low educational attainment is clear in developing countries



Note: Based on Pritchett (2004).

Low quality of education

The description of school completion ignores the level of cognitive skills acquired. Completing 5 or even 9 years of schooling in the average developing country does not mean that the students have become functionally literate in basic cognitive skills. As a recent report by the World Bank Independent Evaluation Group (2006) documents, high priority was accorded to increasing primary school enrollment in developing countries over the past 15 years. Whether children were learning garnered much less attention. The low performance of students in nearly all the developing countries participating in the international student achievement tests has already been documented (figure 3). But mean performance can hide dispersion within countries, and the prior analyses of growth show that there is separate information at different percentiles of the test-score data.

Figure 8 depicts the share of students in selected countries that surpasses the thresholds of 400 and 600 test-score points on the transformed scale of the combined international tests—the same measure and thresholds used in the prior growth analyses.

When considering the basic educational achievement of students, the share of students surpassing the threshold of 400 test-score points is a rough threshold of basic literacy in mathematics and science. As is evident from the figure, this share varies immensely across countries. In Japan, the Netherlands, Korea, Taiwan, and Finland,

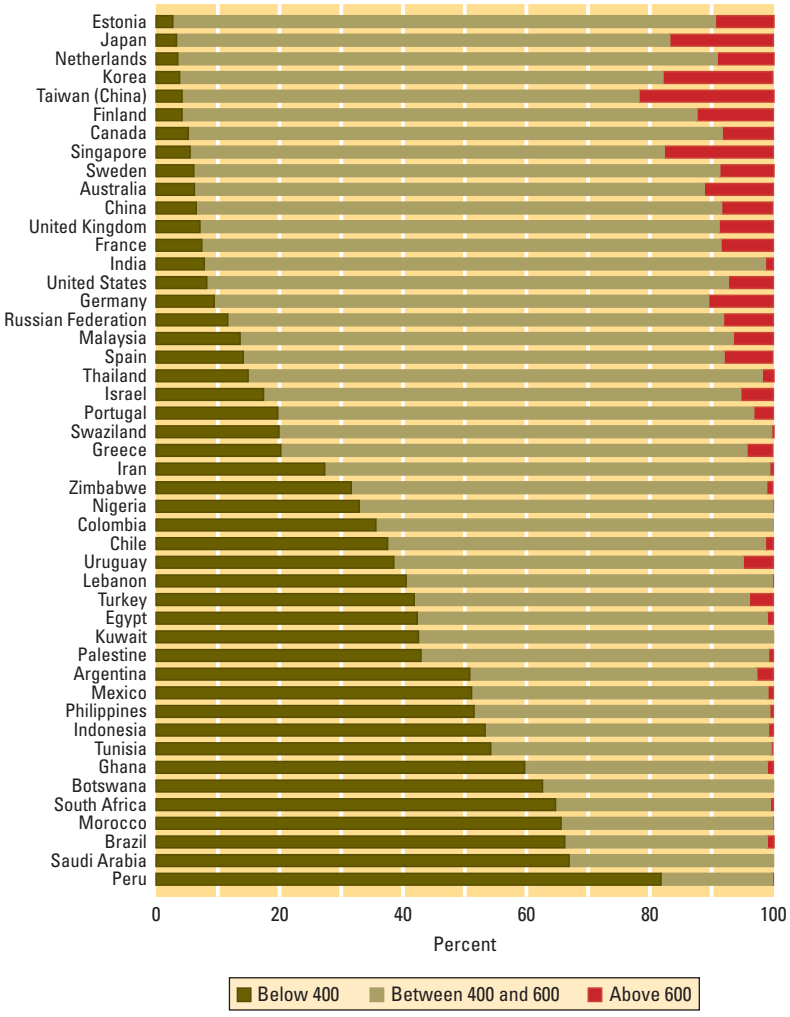
less than 5% of tested students fall below this literacy threshold. By contrast, more than half the tested students in many developing countries do not reach this threshold. The countries with the largest shares of students who are functionally illiterate are Peru (82%), Saudi Arabia (67%), Brazil (66%), Morocco (66%), South Africa (65%), Botswana (63%), and Ghana (60%). In these countries, more than 60% of those in school do not reach basic literacy in cognitive skills. Note that the group of developing countries participating in the international tests is probably already a select sample from all developing countries and that the children enrolled in school at the different testing grades are probably a select group of the children of a certain age.

The size of the task: educational quantity and quality

It is useful to combine the two separate views of the educational challenges for developing countries—the quantity and quality of education. For countries with both reliable attainment data from the household surveys and data from international student achievement tests, educational attainment of 15–19-year-olds from the latest available year is combined with test scores at the end of lower secondary education (eighth grade or 15-year-olds) from an adjacent year close by. This allows calculation of rough shares of recent cohorts of school-leaving age: how many were never enrolled in school, how many dropped out of school by grade 5 and by grade 9, how many finished grade 9 with a test-score performance below 400 (signaling functional illiteracy), and how many finished grade 9 with a test-score performance above 400. Only the last group can be viewed as having basic literacy in cognitive skills.[28]

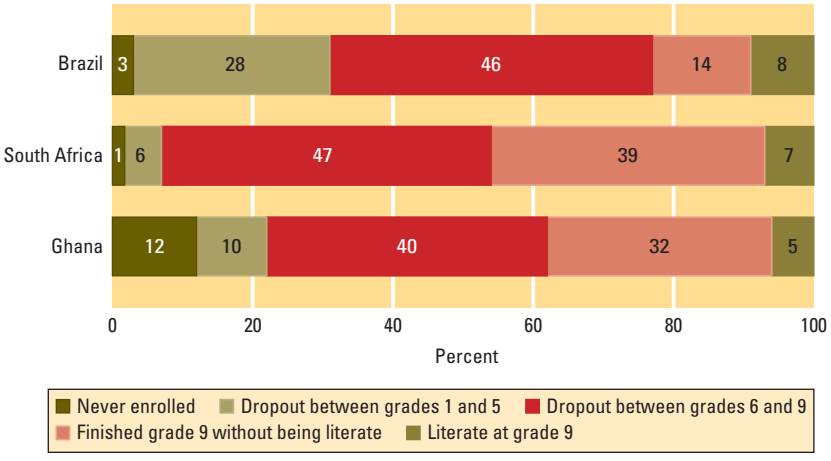
In 11 of the 14 countries for which the data are available—Albania, Brazil, Colombia, Egypt, Ghana, Indonesia, Morocco, Peru, the Philippines, South Africa, and Turkey—the share of fully literate students in recent cohorts is less than a third. In Ghana, South Africa, and Brazil, only 5–8% of each cohort reaches literacy (figure 9). The remainder, more than 90% of the population, are illiterate—because they never enrolled in

Figure 8 The share of students below 400 ("illiterate"), between 400 and 600, and above 600 varies noticeably across selected countries



Source: Hanushek and Wößmann (in process), based on several international tests.

Figure 9 Ghana, South Africa, and Brazil show varying sources for the lack of education of 15–19-year-olds



Note: Hanushek and Wößmann calculations based on Filmer (2006) and micro data from different international student achievement tests.

school, because they dropped out of school at the primary or early secondary level, or because even after completing lower secondary education their grasp of basic cognitive skills was too low to be viewed as literate. In contrast, 42% of a cohort in Thailand, 55% in Armenia, and 63% in Moldova can be viewed as literate at the end of lower secondary schooling.

An example of a basic test question from one of the international achievement tests illustrates the scope of the problem in developing countries. One question asked to eighth-graders in TIMSS 2003 was: "Alice ran a race in 49.86 seconds. Betty ran the same race in 52.30 seconds. How much longer did it take Betty to run the race than Alice? (a) 2.44 seconds (b) 2.54 seconds (c) 3.56 seconds (d) 3.76 seconds." While 88% of eighth-grade students in Singapore, 80% in Hungary, and 74% in the United States got the correct answer (a), only 19% in Saudi Arabia, 29% in South Africa, and 32% in Ghana got the correct answer. Random guessing would have yielded a 25% average.

Combining the data on quantitative educational attainment and qualitative achievement of cognitive skills makes clear the truly staggering task facing most developing countries. In many developing countries, the share of any cohort that completes lower secondary education and passes at least a low benchmark of basic literacy in cognitive skills is *below 1 person in 10*. Thus, the education deficits in developing countries seem even larger than generally appreciated. Several additional references for examples of extremely low educational performance of children even after years of schooling from different developing countries are provided in Pritchett (2004). With this dismal state of the quantity and quality of education in most developing countries, the obvious remaining question is, what can be done?

Improving educational quality requires a focus on institutions and efficient education spending, not just additional resources

The question remains, "What can be done to improve the schools in developing countries?" It has bedeviled policymakers in each of the developing countries of the world and in international development organizations. Much of policy over recent decades has been predicated on the view that the primary obstacle to improving schools is the lack of resources—a seemingly self-evident approach given the lack of facilities and shortages of trained personnel that developing countries face.

The role of resources and teachers

Unfortunately, both simple and sophisticated analyses produce the same answer: Pure resource policies that adopt the existing structure of school operations are unlikely to lead to the necessary improvements in learning. Box 1 provides simple evidence on this point—there is no relationship between spending and student performance across the sample of middle- and higher-income countries with available data. Investigations within a wide range of countries, including a variety of developing countries, further support this picture.[29]

The research on schools in developing countries has been less extensive than that in developed countries. Moreover, the evidence is frequently weaker because of data or analytical problems with the underlying studies. Nonetheless, as Pritchett (2004) convincingly argues on the basis of ample evidence, just increasing spending within current education systems in developing countries is unlikely to improve students' performance substantially.[30] Overwhelming evidence shows that expansions on the input side, such as simple physical expansion of the educational facilities and increased spending per student, generally do not seem to lead to substantial increases in children's competencies and learning achievement. The lack of substantial resource effects in general, and class-size effects in particular, has been found across the developing world, including countries in Africa, Latin America, and Asia.[31]

Again, it is necessary to understand the character of the results. In particular, the evidence refers most specifically to overall infusions of resources. They do not deny that some investments are productive. A number of studies provide convincing evidence that some minimal levels of key resources are

BOX 1. *Simply increasing educational spending does not ensure improved student outcomes*

The disappointing past results generally reflect pursuing policies with little empirical support. But past outcomes should not be generalized to all policies. Many policies involve substantial flows of resources—direct spending, changes in teacher salaries, reductions in class size, and the like—made within the context of current school organization. The empirical evidence documents the difficulties with such policies. Simply providing more resources gives little assurance that student performance will improve significantly.

The box figure presents the international association between spending levels and math performance in the latest international test, the 2003 cycle of PISA conducted by the OECD. The solid line is the regression line for PISA scores on cumulative expenditure (age 6–15). Taken literally, this line indicates that $60,000 per student in additional expenditure (a quadrupling of spending in the low spending countries) is associated with about a half standard deviation improvement in scores. But, this relationship is almost entirely due to the two spending and performance outliers—Mexico and Greece. It is impossible to believe that the only difference between these two countries and the remainder is their spending on schools. For example, there are four countries spending less than Greece but performing better. Omitting Mexico and Greece, there is no relationship between expenditure and performance (the dashed regression line).

On average, the countries with high educational expenditure perform at the same level as countries with low educational expenditure. While the sampled countries in the figure are middle- and higher-income countries, as the text points out, other evidence from developing countries is consistent. This picture is only the most recent demonstration that spending alone is not associated with student performance. The same picture can be found with previous international student tests like TIMSS. Hanushek and Kimko (2000) take into account other factors, including parental education, in their investigation of earlier test score differences but find no relationship with expenditure per pupil, expenditure as a fraction of GDP, or pupil-teacher ratios. Similarly, even when numerous family background and school features are considered in cross-country student-level microeconometric regressions, these results hold.

Nor does the picture change when changes in expenditure over time within individual countries are examined. A detailed study of changes over time in educational expenditure and student performance has shown that educational expenditure per student increased substantially in real terms in all considered OECD countries between the early 1970s and the mid-1990s. Yet, comparing scores in 1970 and 1994/95 suggests that no substantial performance improvements for students occurred in these countries.[a]

This evidence, while covering a wide range of countries, is again lightly represented in developing countries, because developing countries have not participated very frequently in the various international tests. This nonparticipation is itself an important policy issue. It is difficult to know what improvements are needed or whether any policy changes are having an impact without accurately measuring student performance.

The general story that emerges from work in developing countries remains very similar to that for developed countries. Simply providing generally increased resources, or resources along the lines commonly suggested, such as reducing class sizes or across-the-board increases in teacher salaries, is unlikely to lead to substantial changes in student performance. As in developed countries, it appears extraordinarily important to get the incentives and institutional structure right.

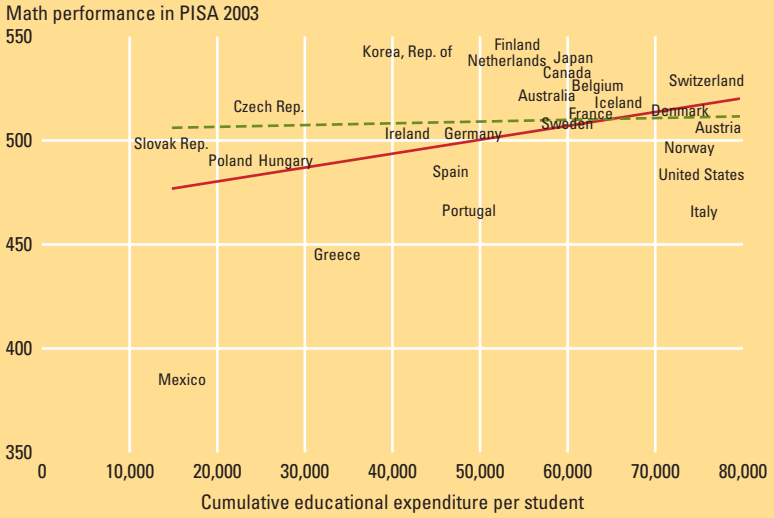
The general lack of any systematic relationship between student achievement and resources raises the question of whether there is some minimum required level of resources even if impacts are not evident at higher levels. This almost certainly is the case. It is consistent with the few "resource findings" about the availability of textbooks, the importance of basic facilities, the impact of having teachers actually show up for class, and similar minimal aspects of a school.[b]

At the same time, there is little evidence for any serious notion of resource needs. One might suspect that resource effects would appear to be nonlinearly related to achievement such that, below some level, there is a strong relationship between added resources and student outcomes. There is little evidence supporting this kind of relationship.

Part of the difficulty arises from the inference that teacher quality is the most important school element but that teacher quality is unrelated to common measures of salary, education, experience, certification, and the like.[c] This implies that resources, at least as currently spent, are not effective in improving teacher quality. Rather than a necessary condition, this is merely an observation about how the current institutions translate resources into results.

Expenditure per student does not drive student performance differences across countries

Association between average math performance in PISA 2003 and cumulative expenditure on educational institutions per student between ages 6–15, in US dollars, converted by purchasing power parities



Source: OECD (2004, pp. 102 and 358); Wößmann (forthcoming-a).

a. Gundlach, Wößmann, and Gmelin (2001); Wößmann (2002, section 3.3).
b. Hanushek (1995, 2003).
c. Hanushek and Rivkin (2006).

frequently valuable in promoting student learning. Nonetheless, while there are suggestive findings of positive resource effects scattered across the literature,[32] the main message is still not one of broad, resource-based policy initiatives. The impact of these policies and programs, even if we presume that they could be replicated elsewhere, is limited.

The most consistent finding across a wide range of investigations is that the quality of the teacher in the classroom is one of the most important attributes of schools.[33] Good teachers, defined in terms of student learning, are able to move the achievement of their students far ahead of those of poor teachers. Yet the identification of good teachers has been complicated by the fact that the simple measures commonly used—such as teacher experience, teacher education, or even meeting the required standards for certification—are not closely correlated with actual ability in the classroom. Much of this evidence comes from research in developed countries, but there is strongly consistent work from a number of developing countries.[34] Thus, it is difficult if not impossible to identify aspects of teachers that could form the basis for policies and regulations encouraging good teachers in the classroom.

This difficulty of regulating the employment of high-quality teachers (or high-quality administrators) suggests that the institutional structure of the school system must be designed to provide strong incentives for improving student achievement.

It's the incentives

The analogy with economic institutions is useful. National economies are dependent on the quality of their economic institutions. It is hard to have a strongly growing economy without complementary institutions in the labor and product markets, without openness to trade and investments from the outside, and without effective systems of laws and property rights. Similarly, it is difficult to have a well-functioning education system without a supportive institutional structure. On this matter, however, there are more different opinions and perhaps wider divergence in outcomes. Part of the reason for the different opinions is simply a lack of experience, analysis, and evidence.

This said, some clear general policies are important. Foremost among them, the performance of a system is affected by the incentives that actors face. If the actors in the education process are rewarded (extrinsically or intrinsically) for producing better student performance, and if they are penalized for not producing high performance, this will improve performance. The incentives to produce high-quality education, in turn, are created by the institutions of the education system—all the rules and regulations that (explicitly or implicitly) set rewards and penalties for the people involved. A significant aspect of such incentives involves either getting better performance out of existing teachers or improving the selection and retention of high-quality teachers. So, one might expect that institutional features impact student learning.

Evidence suggests that three institutional features may be part of a successful system for providing students with cognitive skills:

- Choice and competition.
- Decentralization and autonomy of schools.
- Accountability for outcomes.

Deeper analyses, particularly of issues of design and implementation in specific contexts, have to be left for more encompassing surveys and collections.[35]

Choice and competition in developing countries

Choice and competition in schools were proposed a half century ago.[36] The simple idea: parents, interested in the schooling outcomes of their children, will seek productive schools. This demand side pressure will create incentives for each school to produce. These incentives will also pressure schools to ensure high-quality staff and a good curriculum.

In developed countries, a number of privately managed schools (particularly in Europe) provide alternatives for students. Unfortunately, little thorough evaluation has been done of the choice possibilities, in large part because there is no obvious comparison group (choice is instituted for an entire country and there is no example of the no-choice alternative). In a cross-country comparison, students in countries with a larger share of privately managed schools tend to perform better.[37]

In the United States, there are limited examples of private school choice, ranging from the publicly funded school vouchers in Milwaukee, Cleveland, and Washington, D.C., to privately financed voucher alternatives. The choice schools do at least as well as the regular public schools, if not better.[38]

In England, there are similar positive effects of school competition on the performance of schools.[39] In Sweden, competition from privately operated schools has significant positive effects on the performance of public schools.[40] In the Czech Republic, the introduction of a voucher-type system led to the creation of private schools in areas where public schools are doing badly, and the public schools facing private competition improved their performance in obtaining university admission for their graduates.[41]

The evidence from evaluations in developing countries is also generally consistent with the evidence from developed countries. For example, Colombia ran a program that provided vouchers for attending private schools. The benefits of this program clearly exceed its cost, similar to providing a place in public schools.[42] While evidence on the extensive voucher system in Chile is less uniform, the most elaborate studies suggest that it had positive effects on student performance.[43] In Chile, private fee-paying schools are the most technically efficient, followed by private subsidized and public schools.[44] Similarly, private-school students perform better in both Colombia and Tanzania.[45] And privately managed schools in Indonesia are more efficient and effective than public schools.[46]

But experience is still limited. The teachers unions and administrator groups dislike competition—because it puts pressure on them. So, not many examples of operational, large-scale attempts at competition have been evaluated. Nonetheless, the benefits of competition are so well documented in other spheres of activity that it is inconceivable that more competition would not be beneficial.

Choice and competition are very broad terms that can encompass many different programs. The specific design of any choice program will be important, particularly in distributional outcomes, because programs might segregate the school population in various ways that might not be desirable.[47] There is a need for greater experimentation and experience, given the current levels of uncertainty.

School autonomy

Several institutional features of a school system can be grouped under autonomy or decentralization, including local decisionmaking, fiscal decentralization, and parental involvement. Almost any system to improve incentives for schools depends on school personnel being heavily involved in decisionmaking. It is difficult to compile evidence on the impact of autonomy because the degree of local decisionmaking is most generally a decision for a country (or state) as a whole, leaving no comparison group within countries. Across countries, students tend to perform better in schools that have autonomy in personnel and day-to-day decisions, particularly when there is accountability.[48]

There is evidence from a few developing countries that shows the positive effects of decentralization, school autonomy, and community involvement. In the Philippines, local financial contributions increased the productivity of public schools relative to central financing.[49] Enhanced community and local involvement improved student learning in El Salvador.[50] Decentralization in the Argentine secondary school system improved test performance.[51] Teacher autonomy positively affects student outcomes in Chile when decisionmaking authority is decentralized.[52] Decentralization of decisionmaking to the local level in Mexico positively affects student outcomes, with accountability very important in enhancing local decisionmaking.[53] Also in Mexico, the combination of increased school resources and local school management can produce small but statistically significant improvements in learning.[54]

Nonetheless, given the available evidence, support for autonomy also rests on a simple idea: it is hard to imagine a system with strong incentives that does not capitalize on local decisionmaking.

School accountability

Many countries have been moving toward increased accountability of schools for student performance. The United Kingdom

has developed an elaborate system of "league tables" designed to give parents full information about performance. The United States has a federal law that all states develop an accountability system that meets certain guidelines. It also establishes series of actions required when a school fails to bring sufficient numbers of students to proficiency in core subjects.

Evidence on the impacts of these systems has begun to accumulate. While there is some uncertainty given the newness of the overall accountability system (introduced in 2002), the best U.S. evidence indicates that strong accountability systems lead to better student performance.[55]

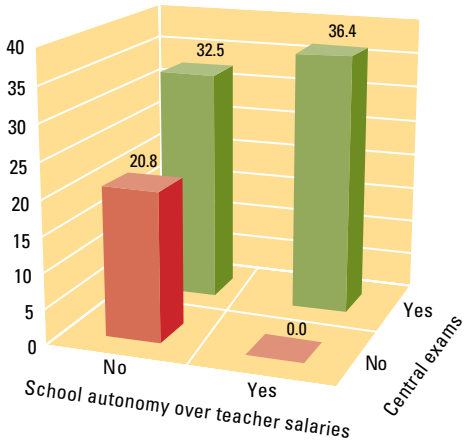
One institutional setup that combines accountability with parental choice is a system that gives students in schools that repeatedly do badly on the accountability test a voucher to attend private schools.[56] In Florida, the threat of subjecting schools to private-school choice if they fail the test has increased performance, particularly for disadvantaged students.[57]

Curriculum-based external exit exams are another means of accountability. They provide performance information that can hold both students and schools accountable. Students in countries with external exit exam systems tend to systematically outperform students in countries without such systems.[58] In the two national education systems where the existence of external exams varies within the country, Canada and Germany (some regions have them and others do not), students perform better in regions with external exams.[59]

Little evidence is currently available about accountability systems in developing countries. This reflects the generally weak accountability in these countries and a general lack of systematic measurement and reporting of student achievement. However, there is a strong impact of accountability and local decisionmaking in Mexico, and this remains even considering the relative impact of teachers unions.[60]

It is difficult to imagine choice or autonomy working well without a good system of student testing and accountability. Thus, the ideas about institutional structure are closely linked.[61] The international evidence clearly suggests that school autonomy, in particular local autonomy over teacher salaries and course content, is only effective in school systems with external exams.[62] One example of this evidence is depicted in figure 10, which plots relative student performance under the four conditions resulting from the presence and absence of central exams and school autonomy over teacher salaries, after controlling for dozens of student, family, and school background factors. School autonomy regarding teacher salaries is negatively associated with student performance in systems without central exams. In systems with central exams, student performance is generally higher than in systems without central exams, reflecting the increased accountability. In addition, the effect of school autonomy is reversed in systems with central exams: Salary autonomy of schools has positive effects on student performance in central-exam systems. This pattern has been found in TIMSS, TIMSS-Repeat, and PISA. Similar cases where external exams turn a negative autonomy effect around into a positive effect have been found for other decision-making areas, such as school autonomy in determining course content and teacher influence on funding.

Figure 10 Accountability and autonomy interact to affect student performance across countries



Source: Wößmann (2005a).
Note: Performance differences estimated after controlling for student, family, and school factors.

Given the importance of high teacher quality, aiming incentives directly at teachers is promising. While convincing evidence on the effects of performance-related teacher pay is scarce, the more rigorous studies in empirical identification find a positive relationship between financial teacher incentives and student outcomes.[63] Monetary incentives for teachers based on their students' performance have improved student learning in Israel immensely.[64] Similarly, the introduction of performance-related pay had a substantial positive impact on student achievement in England.[65]

Summarizing the evidence on how policies can produce better outcomes, a simple picture emerges. First, the evidence shows that "pure resource policies"—policies that simply provide more resources within the current incentive structure of schools—are unlikely to produce substantial systematic gains in student outcomes (box 1). There are caveats, of course. Some schools will use added resources effectively. And some systems that fail to provide minimal resources such as basic textbooks could improve if resources were applied to the key shortage areas. Yet both developed and developing countries demonstrate an improbable—but tangible—disconnect between simple resource solutions and student achievement.

Second, the evidence about what counts in schools is limited. The best candidate is teacher quality. Unfortunately, the characteristics of good teachers are not well understood, making regulatory solutions difficult and supporting rewards for high-quality teaching. But most countries—both developed and developing—have implicit policies built into teacher salaries and contracts that resist significant change and that are not aligned with teacher quality.

Third, the key to improvement appears to lie in better incentives—incentives that will lead to management keyed to student performance and that will promote strong schools with high-quality teachers. Here, three interrelated policies come to the forefront: promoting more competition, so that parental demand will create strong incentives to individual schools; autonomy in local decisionmaking, so that individual schools and their leaders will take actions to promote student achievement; and an accountability system that identifies good school performance and leads to rewards based on this.

The three separate parts of improved incentives form a package. Local autonomy without strong accountability may be worse than doing nothing. Accountability without choice is likely to be watered down and made impotent by schools that would prefer no accountability. Choice without good information about performance has uncertain outcomes attached to it. In other words, these should not be thought of as isolated policies that can be independently introduced while retaining their advantages.

The need to alter institutions fundamentally is inescapable

A simple but powerful picture emerges. First, what people know matters. Second, developing countries are much worse off than commonly perceived from common data about enrollments and school attainment. Third, the road to improvement will involve major structural changes and will not follow from simple additions to resources.

Much of the discussion of development policy today simplifies and distorts these messages. It recognizes that education matters but focuses most attention on ensuring that everybody is in school—regardless of the learning that goes on. Relatedly, it assumes that the prime constraint is resources—those needed to provide broad access to basic schooling. Because of these distortions, the results in terms of measurable economic circumstances have been disappointing.

The accumulated evidence from analyses of economic outcomes is that the quality of education—measured on an outcome basis of cognitive skills—has powerful effects. Individual earnings are systematically related to cognitive skills. The distribution of skills in society appears closely related to the distribution of income. And, perhaps most importantly, economic growth is strongly affected by the skills of workers.

Other factors also enter into growth and may well have stronger effects. For

example, having well-functioning economic institutions—such as established property rights, open labor and product markets, and participation in international markets—have clear importance for economic development and may also magnify the benefits of quality education. Nonetheless, existing evidence suggests that quality of education independently affects economic outcomes, even after allowing for these other factors.

Moreover, the existing research provides strong reasons to believe that quality of education is causally related to economic outcomes. To be sure, quality may come from formal schools, from parents, or from other influences on students. It may result from policies that maintain and enhance health and nutrition, allowing students to learn effectively. But a more skilled population—almost certainly including both a broadly educated population and a cadre of top performers—results in stronger economic performance for nations.

Available measures of school attainment uniformly indicate that developing countries lag dramatically behind developed countries. This fact has driven a variety of efforts to expand schooling in developing countries, including the Education for All initiative. Yet much of the discussion and much of the policymaking has tended to downplay the issues of quality.

International testing indicates that, even among those attaining lower secondary schooling, literacy rates (by international standards) are very low in many developing countries. By reasonable calculations, many countries have fewer than 10% of their youth currently reaching minimal literacy and numeracy levels, even when school attainment data look considerably better.

Because of the previous findings—that knowledge rather than just time in school is what counts, policies must pay more attention to quality of schools.

For developing countries, the sporadic or nonexistent assessment of student knowledge is an especially important issue—correcting this shortcoming should have the highest priority. It is impossible to develop effective policies without having a good understanding of which work and which do not. Currently available measures of program "quality" frequently rely upon various input measures that unfortunately are not systematically related to student learning. Moreover, the existing international tests—such as the PISA tests of the OECD—may not be best suited to provide accurate assessments of student performance in developing countries. The evolving capacity for adaptive testing that can adjust test content to the student's ability level seems particularly important, offering the possibility of meaningful within-country variation in scores, along with the ability to link overall performance with global standards.

Even though attempts to improve quality have frustrated many policymakers around the world, extensive research now reaches some clear conclusions. Research has delved deeply into the impact of adding resources within the current institutional structure (of both developed and developing countries). The overall finding is that simple resource policies—reducing class sizes, increasing teacher salaries, spending more on schools, and so forth—have little consistent impact on student performance when the institutional structure is not changed.

This does not say that spending never has an impact. In fact, there is reason to believe that some basic resources in the least developed schools, such as textbooks for all students, have a reliable impact. But these situations have been documented just in the poorest schools and, even there, just in limited areas. There is also evidence that some schools use added resources better than others, although research does not characterize these different situations well enough to build them into overall resource policies.

There is mounting evidence that the quality of teachers is the key ingredient to student performance. But the characteristics of good teachers are not described well, making it impossible to legislate or regulate good teachers.

Nor does evidence say that resources can never have an impact. In fact, the kinds of institutional changes identified here are designed precisely to ensure that added resources are effective.

The largest problem in current school policy is the lack of incentives for improved student performance. Neither students nor

school personnel in most countries of the world are significantly rewarded for high performance. Without such incentives, it is no surprise to find that added resources do not consistently go toward improvement of student outcomes.

Three sets of policies head the list for improving the overall incentives in schools: strong accountability systems that accurately measure student performance; local autonomy that allows schools to make appropriate educational choices; and choice and competition in schools so that parents can enter into determining the incentives that schools face.

Many if not most developing countries currently lack performance measurement that would allow them to know which policies were working and which were not or where performance was most in need of change. Lack of measurement of student outcomes clearly makes any system of direct rewards for success difficult if not impossible. An early step in any reform program should be instituting reliable school accountability systems.

If schools are held responsible for results, they must have the ability to make decisions that will lead to better outcomes. Highly centralized regulatory systems simply cannot work effectively without broad knowledge of what programs are effective in different situations. Such knowledge is currently lacking, leading to centralized decisionmaking that does not produce strong results. (The lack of results from centralized decision making can be readily seen in the data provided, particularly for developing countries.)

Finally, in terms of overall changes, more choice and competition among schools leads parents to be directly involved in evaluating the performance of schools. While experiments in various choice plans have been limited, the existing evidence suggests that they do tend to lead to better student outcomes. The best way to introduce choice in rural systems within resource-constrained developing countries is not fully known now, but it appears clear that the existing system is not working.

Uncertainty about the best design of incentive programs for schools is most acute in developing countries, largely due to lack of relevant experience. For this reason, it is especially important to implement a program of experimentation and evaluation—a key missing aspect of policymaking in most developing countries. Education policy must be viewed as evolutionary, where ongoing evaluation permits discarding policies that are ineffective while expanding those that are productive.

How can education policies in developing countries create the competencies and learning achievements required for their citizens to prosper in the future? The binding constraint seems to be institutional reform—not resource expansions within the current institutional systems. For educational investments to translate into student learning, all people involved in the education process have to face the right incentives that make them act in ways that advance student performance.

Notes

1. Mincer (1974); Psacharopoulos and Patrinos (2004); Card (1999); Heckman, Lochner, and Todd (2006).
2. Mulligan (1999); Murnane, Willett, Duhaldeborde, and Tyler (2000); Lazear (2003).
3. Murnane, Willett, Duhaldeborde, and Tyler (2000) separate the direct returns to measured skill from the indirect returns of more schooling.
4. For example, Psacharopoulos (1994) and Psacharopoulos and Patrinos (2004).
5. Harbison and Hanushek (1992).
6. Hanushek, Lavy, and Hitomi (2006).
7. Hanushek and Zhang (2006) show that the measure of quantitative literarcy in IALS is highly correlated with scores on the Third International Mathematics and Science Study (TIMSS).
8. De Gregorio and Lee (2002) find a (somewhat weaker) positive association between inequality in years of schooling and income inequality.
9. Juhn, Murphy, and Pierce (1993).
10. Mankiw, Romer, and Weil (1992).
11. Lucas (1988); Romer 1990; Aghion and Howitt (1998).
12. Nelson and Phelps 1966; Benhabib and Spiegel (2005).
13. For extensive reviews of the literature, see Topel (1999); Temple (2001); Krueger and Lindahl (2001); Sianesi and van Reenen (2003).

14. Vandenbussche, Aghion, and Meghir (2006).
15. Bils and Klenow (2000).
16. Pritchett (2001, 2006).
17. Hanushek and Kimko (2000).
18. Barro (2001); Wößmann (2002, 2003b); Bosworth and Collins (2003); Coulombe, Tremblay, and Marchand (2004); Coulombe and Tremblay (2006); Jamison, Jamison and Hanushek (forthcoming).
19. Hanushek and Wößmann (2007).
20. In either specification, there is evidence for conditional convergence in the sense that countries with higher initial income tend to grow more slowly over the subsequent period (Hanushek and Wößmann 2007).
21. OECD (2004).
22. See Hanushek and Wößmann (2007) for greater detail.
23. Acemoglu, Johnson, and Robinson (2001, 2002, 2005).
24. North (1990).
25. Murphy, Shleifer, and Vishny (1991).
26. Easterly (2002).
27. Pritchett (2001, 2006).
28. Pritchett (2004); Wößmann (2004).
29. Hanushek (1995, 2003), Hanushek and Luque (2003), Wößmann and West (2006).
30. See Hanushek (1995), Glewwe (2002), Pritchett (2004), and Glewwe and Kremer (2006) for reviews of research on the determinants of educational quality in developing countries.
31. For evidence from African countries, see, for example, Kremer (2003) and Michaelowa (2001); for Latin American countries, see, for example, Mizala and Romaguera (2002) and Wößmann and Fuchs (2005); for East Asian countries, see, for example, Gundlach and Wößmann (2001) and Wößmann (2005c).
32. See, for example, Lockheed and Hanushek (1988).
33. Hanushek and Rivkin (2006).
34. Harbison and Hanushek (1992); Hanushek (1995); Hanushek and Luque (2003); Hanushek and Rivkin (2006).
35. Hanushek (1994); Peterson and West (2003); Betts and Loveless (2005); and, for developing-country contexts, World Bank (2004), chapter 7; Vegas (2005).
36. Friedman (1962).
37. Wößmann (2005b, forthcoming-b).
38. Rouse (1998); Howell and Peterson (2002).
39. Bradley and Taylor (2002); Levačić (2004).
40. Sandström and Bergström (2005); Björklund, Edin, Frerikson, and Krueger (2004).
41. Filer and Münich (2003).
42. Angrist et al. (2002); King, Orazem, and Wohlgemuth (1999).
43. Mizala and Romaguera (2000); Sapelli and Vial (2002); Vegas (1999); Hsieh and Urquiola (2006). A less positive interpretation of vouchers in Chile is found in McEwan and Carnoy (2000) and of vouchers in general in McEwan (2000).
44. Mizala, Romaguera, and Farren (2002).
45. Cox and Jimenez (1991).
46. James, King, and Suryadi (1996); Bedi and Garg (2000).
47. McEwan (2000).
48. Wößmann (2003a, forthcoming-b).
49. Jimenez and Paqueo (1996).
50. Jimenez and Sawada (2001).
51. Galiani and Schargrodsky (2002).
52. Vegas (1999).
53. Gertler, Rubio-Codina, and Patrinos (2006); Álvarez, Moreno, and Patrinos (2006).
54. Skoufias and Shapiro (2006).
55. Carnoy and Loeb (2002); Hanushek and Raymond (2005); Jacob (2005).
56. The legality of this system has been challenged in the Florida courts, so the future of the program is in doubt.
57. West and Peterson (2006); Figlio and Rouse (2006).
58. Bishop (1997); Bishop (2006); Wößmann (2001, 2003a, forthcoming-b).
59. Bishop (1997); Jürges, Schneider, and Büchel (2005).
60. Álvarez, Moreno, and Patrinos (2006).
61. World Bank (2004).
62. Wößmann (2005a, forthcoming-b); Fuchs and Wößmann (forthcoming).
63. See the survey in Atkinson et al. (2004) along with the discussions in Vegas (2005) and Vegas and Umansky (2005).
64. Lavy (2002, 2004).
65. Atkinson et al. (2004).

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