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School policy: implications of recent research for human capital investments in South Asia and other developing countries

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Concentration on school attainment goals without close attention to school quality has hurt developing countries. Recent evidence shows that individual incomes, the distribution of income, and economic growth rates are all closely related to the cognitive skills of the population. While direct evidence from developing countries is thin, the evidence from developed countries points to the central importance of improving teacher quality in any reform strategies.

Keywords: economic growth; school quality; cognitive skills; teacher quality

Introduction

Improving schools is frequently high on the policy agenda of both developed and developing countries. The nature of the policy focus, however, differs across countries, with some emphasizing increasing school attainment and others focusing on quality concerns. The message here is that consideration of school quality and the development of cognitive skills should be the primary focus of development policy.

Until recently little evidence was very useful in helping decision-makers to formulate appropriate schooling policies. In the past decade, however, there has been a dramatic increase in useful information about the role of human capital in development and about the ways in which governments can promote human capital formation.

This paper reviews evidence on the economic impacts of human capital investment with an eye to where investment decisions might be made. While the evidence on actual impacts is quite clear, the evidence on how best to make the investments is less clear. Specifically, recent research underscores the prime importance of educational quality, as measured by cognitive achievement, and the much lower importance of pure school attainment. This research spans both developed and developing nations. On the other hand, on the key question of how cognitive achievement can be improved, the relevant evidence is less clear. There is substantial evidence that simple resource policies have not worked in either developed or developing countries. On the other hand, the leading candidate for high impact is teacher quality, but research on this is largely confined to the United States.

A key issue in this discussion is whether the evidence on economic impacts of human capital that has been largely gained from the study of developed countries, particularly the United States, also applies to developing countries. We give special

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emphasis to developing countries in the South Asian region, where the push to expand human capital has been a very significant thrust of development policy.

Is human capital important?

Governments around the world place considerable emphasis on investments in human capital through the provision of schooling. And this focus carries through to international agencies such as the World Bank, which also emphasizes the provision of schooling.

The underlying message is that human capital is important for individuals and for nations. At the same time, human capital – identified as the stock of productive skills of an individual – is an abstract concept. Both researchers and policy-makers must transform the concept into practical terms that can be studied and translated into policy.

The genius of early researchers, led by Mincer (1970, 1974), was to recognize that varying amounts of schooling signified different amounts of human capital, and thus could be a clear measure of the abstract idea of human capital. From a research standpoint, various census and survey databases routinely provide school attainment information that can be linked to incomes and other individual outcomes. From a policy viewpoint, school attainment is also a concrete notion – leading virtually all countries of the world to devote attention to rates of school completion and the promotion of access to further schooling.

The worldwide quest to improve schooling is highlighted in the developing world by the establishment of the Education for All movement (headed by UNESCO) and of the Millennium Development Goals of the United Nations. The Education for All initiative grew out of the world summit on education in 1990 and was given more specificity in the Dakar summit in 2000. The key elements of the Education for All initiative (all to be accomplished by 2015) are: expand early childhood care and education; provide free and compulsory primary education for all; promote learning and life skills for young people and adults; increase adult literacy by 50%; achieve gender parity by 2005, gender equality by 2015; and improve the quality of education. While each of the goals has received attention in annual monitoring reports (for example, UNESCO 2005), it appears clear that schooling attainment largely drives the movement. The Millennium Development Goals, developed in 2000, cover a range of broad issues including health, nutrition, and the environment, but the second goal is achieving universal primary education.[1] Again the focus is getting school attainment up at least to the primary schooling level everywhere.

This discussion begins with a brief review of the evidence on the value of added years of schooling.[2] Following that, however, the discussion turns to issues of educational quality. The perspective taken is that school attainment is just one possible proxy for human capital and that other plausible proxies may be superior, particularly in an international context. Specifically, using cognitive achievement tests in mathematics and science provides a superior measure of international differences in human capital. And, focusing on this measure leads to noticeable changes in the important policy issues.

School attainment

The importance of increasing school attainment is generally treated as needing little or no discussion in policy debates. It is, after all, well known to all that further

schooling has a large payoff. This fact was developed in the innovative analyses by Jacob Mincer (1970, 1974), who considered how investing in differing amounts of schooling affects individual earnings. Over the past 30 years, literally hundreds of such studies have been conducted around the world. In fact, these have been reviewed in a large number of interpretative articles including Psacharopoulos (1994), Card (1999), Harmon, Oosterbeek, and Walker (2003), Psacharopoulos and Patrinos (2004), and Heckman, Lochner, and Todd (2006).

By all accounts, the rate of return to additional years of schooling is large. In estimates of Mincer earnings functions for 98 countries, Psacharopoulos and Patrinos (2004) find that average returns for the world are above 17% and that they are systematically higher in developing countries (see Table 1).[3]

These findings have been reinforced in analyses of the relationship between schooling and economic growth. The standard method to estimate the effect of education on economic growth is to estimate cross-country growth regressions where countries' 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 to be important for economic growth. Following the seminal contributions by Barro (1991, 1997) and Mankiw, Romer, and Weil (1992), a vast early literature of cross-country growth regressions has tended to find a significant positive association between quantitative measures of schooling and economic growth.[4] To give an idea of the robustness of this association, in the recent extensive robustness analysis by Sala-i-Martin, Doppelhofer, and Miller (2004) of 67 explanatory variables in growth regressions on a sample of 88 countries, primary schooling turns out to be the most robust influence factor (after an East Asian dummy) on growth in GDP per capita during 1960–1996.

The problem of course is that cross-country comparisons of average years of schooling implicitly assume that a year of schooling delivers the same increase in knowledge and skills regardless of the education system. For example, an average year of schooling in Botswana is assumed to create the same increase in productive human capital as a year of schooling in Singapore. Additionally, this measure assumes that formal schooling is the primary (sole) source of education and, again, that variations in the quality of non-school factors have a negligible effect on education outcomes. This neglect of cross-country differences in the quality of education is probably the major drawback of such a quantitative measure of schooling, and we come back to this issue in great detail below.

Table 1. Private rates of return to investment in education by level (percentage increase in earnings).

	Primary	Secondary	Higher
Asia[a]	20.0	15.8	18.2
Europe/Middle East/North Africa[a]	13.8	13.6	18.8
Latin America/Caribbean	26.6	17.0	19.5
OECD	13.4	11.3	11.6
Sub-Saharan Africa	37.6	24.6	27.8
World	26.6	17.0	19.0

Note: [a]Non-OECD countries.
Source: Psacharopoulos and Patrinos (2004).

Cognitive skills

The position taken here is that school attainment is simply one proxy for the relevant human capital skills of an individual. Another measure with considerable appeal is the cognitive achievement of individuals. This measure implicitly adds issues of school quality, but it also goes much further. As a wide range of research has demonstrated, achievement is a function of schooling plus families, peers, and other inputs.[5] This broader view is important methodologically but, more than that, also modifies the policy discussions to include other factors such as the role of health in cognitive development.

A variety of researchers are now able to document that the individual earnings advantages to higher achievement on standardized tests are quite substantial. These results are derived from different specific approaches, but the basic underlying analysis involves estimating a standard 'Mincer' earnings function and adding a measure of individual cognitive skills.[6]

Recent US studies by Mulligan (1999), by Murnane et al. (2000) and by Lazear (2003) obtain estimates of the value of cognitive skills from different nationally representative data-sets for the United States that follow students after they leave school and enter the labor force. They suggest that one standard deviation increase in mathematics performance at the end of high schools translates into 12% higher annual earnings.[7] A limited number of additional studies are available for other developed countries – McIntosh and Vignoles (2001) study wages in the United Kingdom, and Finnie and Meng (2002) and Green and Riddell (2003) in Canada also suggest that cognitive skills are important to earnings.

Further, in the developed countries, a portion of the return to cognitive skills comes through increased school attainment. In general, higher skills are strongly associated with continuation in school.[8]

The evidence for developing countries is a little difficult to summarize easily.[9] The literature on returns to cognitive skills in developing countries is restricted to a relatively limited number of countries: Ghana, Kenya, Morocco, Pakistan, South Africa, and Tanzania. Nonetheless, as Table 2 shows, the available estimates permit a tentative conclusion that the returns to quality may be even larger in developing countries than in developed countries. This of course would be consistent with the range of estimates for returns to quantity of schooling (for example, Psacharopoulos 1994; Psacharopoulos and Patrinos 2004), which are frequently interpreted as indicating diminishing marginal returns to schooling.

Evidence also suggests that educational quality is directly related to school attainment in developing countries. In Brazil, a country plagued by high rates of grade repetition and ultimate school dropouts, Harbison and Hanushek (1992) show that higher cognitive skills in primary school lead to lower repetition rates. Further, Hanushek, Lavy, and Hitomi (2008) find that lower-quality schools, measured by lower value-added to cognitive achievement, lead to higher dropout rates in Egyptian primary schools. Thus, as found 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 actually improve quality of schools will yield a bonus in terms of meeting goals for attainment. Conversely, simply attempting to expand access and attainment, say through starting 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 the actual attainment results.

Table 2. Summary of estimated returns to a standard deviation increase in cognitive skills.

Country	Study	Estimated effect[a]	Notes
Ghana	Glewwe (1996)	0.21**–0.3** (government), 0.14–0.17 (private)	Alternative estimation approaches yield some differences; mathematics effects shown generally more important than reading effects, and all hold even with Raven's test for ability.
Ghana	Jolliffe (1998)	0.05–0.07*	Household income related to average mathematics score with relatively small variation by estimation approach; effect is only observed with off-farm income, and on-farm income is not significantly related to cognitive skills.
Ghana	Vijverberg (1999)	?	Income estimates for mathematics and reading with non-farm self-employment; highly variable estimates (including both positive and negative effects) but effects not generally statistically significant.
Kenya	Boissiere, Knight, and Sabot (1985); Knight and Sabot (1990)	0.19**–0.22**	Total sample estimates: small variation by primary and secondary school-leavers.
Morocco	Angrist and Lavy (1997)	?	Cannot convert to standardized scores because use indexes of performance; French writing skills appear most important for earnings, but results depend on estimation approach.
Pakistan	Alderman et al. (1996)	0.12–0.28*	Variation by alternative approaches and by controls for ability and health; larger and more significant without ability and health controls.
Pakistan	Behrman, Ross, and Sabot (2008)	0.25	Estimates of structural model with combined scores for cognitive skill; significant effects of combined mathematics and reading scores that are instrumented by school inputs
South Africa	Moll (1998)	0.34**–0.48**	Depending on estimation method, varying impact of computation; comprehension (not shown) generally insignificant.
Tanzania	Boissiere, Knight, and Sabot (1985); Knight and Sabot (1990)	0.07–0.13*	Total sample estimates: smaller for primary than secondary school leavers.

Note: [a]Estimates indicate proportional increase in wages from a one standard deviation increase in measured test scores. *Significant at 0.05 level. **Significant at 0.01 level.

Finally, one data-set (the International Adult Literacy Survey) with consistent information on basic skills of literacy and numeracy for a representative sample of the population aged 15–65 years was collected for a sample of countries between 1994 and 1998. This data-set spans countries with different incomes. These data permit direct comparisons of the relative importance of quantity and quality of schooling across countries, although the bias toward developed economies remains. Hanushek and Zhang (forthcoming) estimate returns to school attainment and to literacy scores

(in both reading and mathematics) for the 13 countries where continuous measures of individual earnings are available. Their samples include full-time workers between 26 and 65 years of age. The dependent variable is the logarithm of annual earnings from employment, and control variables are gender, potential experience and its square, and an indicator for living in a rural area.

Figure 1 provides the relevant summary information on the returns to cognitive skills, estimated in a model that jointly includes school attainment and literacy scores. As in the prior analyses, both school attainment and cognitive skills enter into the determination of individual incomes. With the exception of Poland, literacy scores have a consistent positive impact on earnings. The (unweighted) average of the impact of literacy scores is 0.093, only slightly less than found previously for the US studies. (These estimates, as before, reflect the increase in log earnings associated with a one standard deviation increase in measured tests; for small changes in test scores, this estimate is approximately the proportionate increase in earnings.) The United States is noticeably higher than other countries and the previous US studies, perhaps reflecting that these earnings are obtained across the entire work life. The average excluding the United States is still 0.08.[10]

The estimates of the individual earnings functions show relative earnings within each country to be associated with both school attainment and with achievement. It does not, however, permit direct comparisons across countries in the value of skills. For this it is appropriate to return to differences in aggregate growth rates across countries – except here the focus is cognitive skills of individuals in different countries.

From the mid-1960s to today, international agencies have conducted many international tests of students' performance in cognitive skills such as mathematics and science. The different tests contain both 'academic' questions related to the school curricula as well as 'life skill' questions requiring practical applications to real-world phenomena. There have been 12 testing occasions that present results from a total of 36 separate test observations at different age levels and in different subjects.[11]

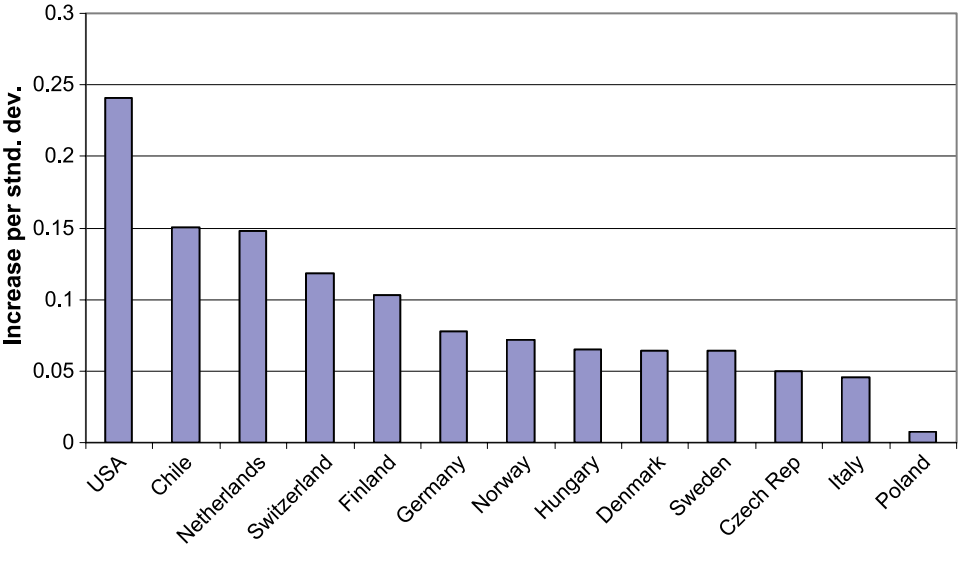

Figure 1. Returns to cognitive skills, International Adult Literacy Survey.
Source: Hanushek and Zhang (2008).

One immediate conclusion arising from putting these tests together is that the developing countries (that ever participated in one of the tests) perform dramatically lower than any country in the group of OECD countries. The variation in the quality of education that exists among OECD countries is already substantial, but the magnitude of the difference to developing countries in the average amount of learning that has taken place after a given number of years of schooling vastly exceeds any within-OECD difference.

Over the past 10 years, empirical growth research demonstrates that consideration of the quality of education, measured by the cognitive skills learned, alters the assessment of the role of education in the process of economic development dramatically. When 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 during 1960–1990 that dwarfs the association between quantity of education and growth. Thus, even more than in the case of education and individual earnings, ignoring quality differences very significantly misses the true importance of education for economic growth. The Hanushek and Kimko (2000) estimates suggest that one country-level standard deviation higher test performance would yield around one percentage point higher annual growth rates – an enormous impact by any standard.

This analysis has been extended to a larger group of countries and to economic performance through 2000 in Jamison, Jamison, and Hanushek (2007). The growth estimation relies upon the development of a consistent set of achievement estimates that rescale the various international tests to be comparable that is developed in Hanushek and Woessmann (forthcoming).[12]

Hanushek and Woessmann (2008) also use these data to extend the analysis of growth in a variety of ways. The Hanushek and Woessmann (2008) measure of the quality of education is a simple average of the mathematics and science scores over all the international tests between 1964 and 2003. They interpret this 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.[13]

The basic result is depicted graphically in Figure 2. After controlling for the initial level of GDP per capita and for years of schooling, the test-score measure features a statistically significant effect on the growth in real GDP per capita during 1960–2000. According to this basic specification, test scores that are larger by one standard deviation (measured at the student level across all OECD countries in Programme on International Student Assessment [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.[14]

Moreover, once cognitive skills are included in the cross-country growth regressions, school attainment appears to have little or no role in growth. This finding is extraordinarily important and is the subject of the policy discussion below. In other words, added years of schooling that do not increase achievement (cognitive skills) have no value for growth!

Three issues are particularly important for understanding the role of human capital on economic performance in developing countries, and the analysis is extended to address them. First, educational quality is surely not the only thing that is important in determining growth, and many have emphasized the role of economic institutions.

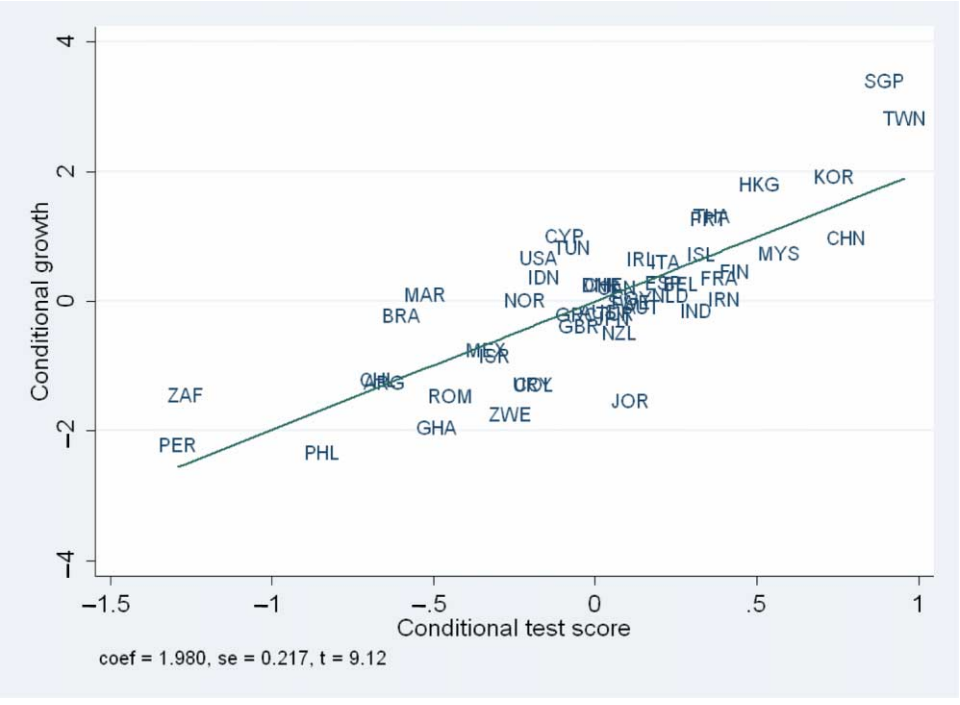

Figure 2. Added-variable plots of growth and educational quality.
Notes: Added-variable plots of a regression of the average annual rate of growth (%) of real GDP per capita during 1960–2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960.
Source: Hanushek and Woessmann (2008).

Second, the cross-country analysis is dominated by developed countries, and the impacts of educational quality may not be the same across all countries. Third, concentrating on just the average cognitive skills of a population may mask significant variations in quality within countries, particularly within developing countries.

While the evidence confirms an independent effect of educational quality on economic growth, this effect may differ depending on the economic institutions of a country. A variety of people have discussed rent-seeking behavior and how institutions might affect this (for example, Krueger 1974; North 1990; or Easterly 2001). If the available knowledge and skills are used in rent-seeking ways rather than productive ways, one may certainly expect the effect on economic growth to be substantially different, and perhaps even to turn negative. Similarly, Murphy, Shleifer, and Vishny (1991) show that the allocation of talent between rent-seeking and entrepreneurship matters for economic growth: countries with relatively more engineering college majors grow faster and countries with relatively more law concentrators grow more slowly. Easterly (2001) argues that education may not have much impact in less developed countries that lack other facilitating factors, such as functioning institutions for markets and legal systems. In a similar way, Pritchett (2001, 2006) suggests that deficiencies in the institutional environment might render the average effect of education on growth across all countries negligible.[15]

To address these issues, both Jamison, Jamison, and Hanushek (2007) and Hanushek and Woessmann (2008) incorporate measures of economic institutions in

their analyses. These measures include the openness of a country's economy over the latter half of the twentieth century and the strength of property rights in the country. Two findings emerge from these extensions. First, economic institutions are indeed important. But, second, the role of educational quality remains even in the face of different economic institutions. If anything, economic institutions and educational quality are complementary: better economic institutions leads to stronger impacts of educational quality.

An important issue is whether the role of cognitive skills in growth holds for developing countries. Of the countries in the analysis by Hanushek and Woessmann (2008), 23 are OECD countries and 27 are not, making it is possible to investigate whether there are differences in the growth relationships between OECD and non-OECD countries and between countries of different income levels. Perhaps surprisingly given the heterogeneity of the countries in the sample, the results remain very similar across OECD and non-OECD countries with a slightly larger impact of cognitive skills in non-OECD countries. Alternatively, it is possible to divide the sample into countries above and below the sample median of initial GDP per capita. Educational quality remains significant in both subsamples, but the effect of quality now is considerably larger in the low-income countries. Thus, if anything, the effect of educational quality is larger in developing countries than in developed countries – and this kind of human capital investment looks potentially very productive for developing countries.

The analyses of variations in economic growth across countries make it clear that educational quality is very important to a nation's economic health. Before discussing policy implications of this, however, it is important to understand the magnitude of these effects.

The implications of improved quality

The previous estimation provides information about the long-run economic implications of improvements in educational quality. These analyses provide a means for linking policy reforms directly to the pattern of economic outcomes.

Two aspects of any educational reform plan are important. First, what is the magnitude of the reform that is accomplished? Second, how fast does any reform achieve its results?

In attempting to frame the policy discussion, there is a trade-off between the urgency of the problem and the feasibility of change. Consider the scores on the PISA mathematics test for 2003.[16] On this, Brazil, Indonesia, and Tunisia posted average scores of approximately 360, while Thailand and Uruguay averaged close to 420. With an OECD mean of 500 and standard deviation of 100, the deficit in these countries is immediately obvious. In fact, the PISA scores are placed into various skill categories. Level 1 has a range of 358–420 points, which mirrors the developing country scores just given. The skill in this range is meant to denote that students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. Bringing Brazil, Indonesia, and Tunisia to the OECD average would involve moving the typical student 1.4 standard deviations; moving Thailand and Uruguay would imply increasing performance by 0.8 standard deviations. Common school interventions suggest much lower impacts, even under ideal situations. For example, evidence on class size reduction from the United States indicates at most a 0.25 standard deviation change associated with reducing class size by one-third.[17]

To illustrate the impact of improvements in cognitive skills, consider a schooling reform that yields a one-half standard deviation improvement in average achievement of school completers. This would not close the gap of developing countries with the average OECD student but, as will be seen, such an improvement would have a very significant effect on their economies.

The time to completion of the reform is also important. Two aspects of timing enter. First, student performance cannot be changed instantaneously, and improvements generally require adjustments in schools that will be phased in (say, through systematic replacement of teachers through retirements and subsequent new hiring). We have little experience to go on, but achieving the average change of a one-half standard deviation for an entire nation may realistically take 20–30 years. Second, if the reforms succeed, their impact on the economy will not be felt until the new graduates become a noticeable portion of the labor force.

Figure 3 simulates the impact on the economy of reform policies taking 20 or 30 years for a one-half standard deviation improvement in student outcomes at the end of upper secondary schooling – what is labeled as a 'moderately strong knowledge improvement.' For the calibration, policies are assumed to begin in 2010 – so that a 20-year reform would be complete in 2030.[18]

The figure indicates how much larger the level of GDP is projected to be at any point after the reform policy is begun as compared with that with no reform. In other words, the estimates suggest the increase in GDP expected (according to historical growth patterns) over and above any growth resulting from other factors.

Obviously, for any magnitude of achievement improvement, a faster reform will have larger impacts on the economy. But, the figure shows that even a 20-year or 30-year reform plan has a powerful impact on GDP. For example, a 20-year plan would yield a GDP that was 5% greater in 2042 (compared with where the economy would be with no increase in educational quality). The figure also plots 3.5% of GDP, an

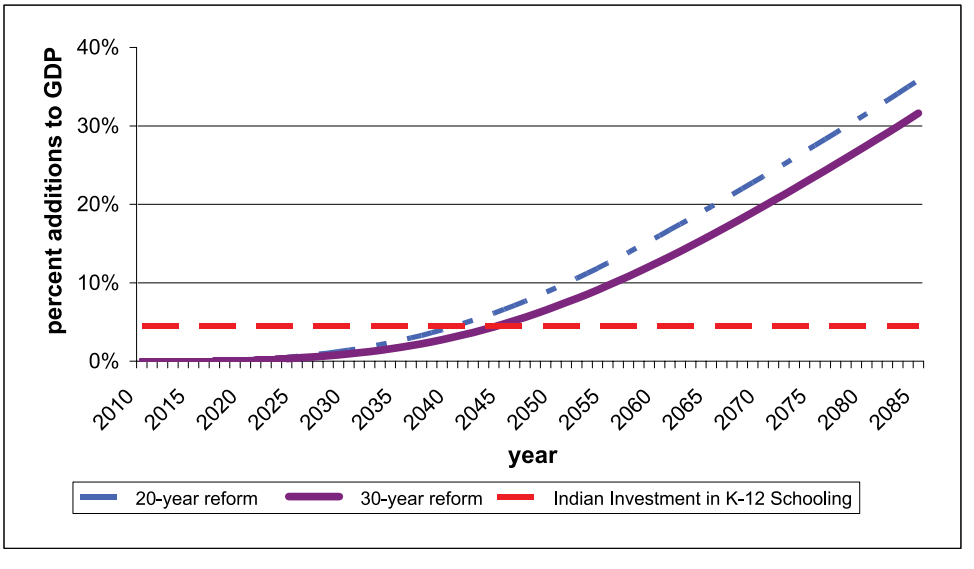

Figure 3. Improved GDP from reform that leads to one-half standard deviation improvement.

aggressive spending level for education in many developing countries of the world. Five percent of GDP is significantly greater than the typical country's total spending on primary and secondary schooling, so it is truly a significant change that would permit the growth dividend to more than cover *all* of primary and secondary school spending. But even a 30-year reform program (that would not be fully accomplished until 2040) would yield more than 5% higher real GDP by 2046. Over a 75-year horizon, a 20-year reform yields a real GDP that is 36% higher than would be with no change in educational quality.

Policy objectives

Governments generally have multiple objectives when they develop schooling policies. They generally are concerned about the economic well-being of citizens and the nation as a whole. But they are also concerned about the distribution of economic outcomes.

The previous analysis has suggested educational quality should be the primary focus of attention – because quality is the dominant factor affecting economic outcomes. However, the push to expand access clearly has deep roots in the distributional objective of governments by making sure that all citizens can obtain schooling. At a basic level the absence of schools means that government policy toward promoting human capital cannot be effective.

Two aspects of the distributional side of governmental schooling policy are important. First, the strong message of the existing empirical work reviewed above is that time in school has little payoff if it is not accompanied by learning. The student who attends eight years of school but comes away unable to read adequately is unlikely to reap many rewards from the schooling.

Second, the distribution of cognitive skills appears to be closely related to the distribution of earnings. Nickell (2004), employing the International Adult Literacy Survey data on international differences in literacy, finds a close association between skill variation and earnings variation. As seen in Figure 4, the spread of earnings mirrors the spread of cognitive skills. Clearly this does not establish causation, but it is highly suggestive of the role of educational quality.

All of this suggests that merely erecting schools without concern for quality is unlikely to meet the human capital objectives of governments. Indeed, as suggested previously, low-quality schools may also make it even more difficult to increase attainment, because students respond to lack of quality.

A second aspect of schooling is also important. Some developing countries have emphasized very high-quality schools for a small proportion of the population. This situation might characterize the typical approach of India, which has an elite higher education sector but a very low floor for the population as a whole. The alternative is providing a broad education for the entire population – and 'education for all' strategy with a quality component.

Hanushek and Woessmann (2008) further consider the roles of basic literacy and numeracy and of top-end performance in determining growth. Both turn out to be separately significantly related to economic growth. That is, both education for all and the share of absolutely top performers seem to exert separately identifiable effects on economic growth. In other words, specialization in just the top of the performance distribution does not seem entirely appropriate – since having a broad population with basic skills is also important.

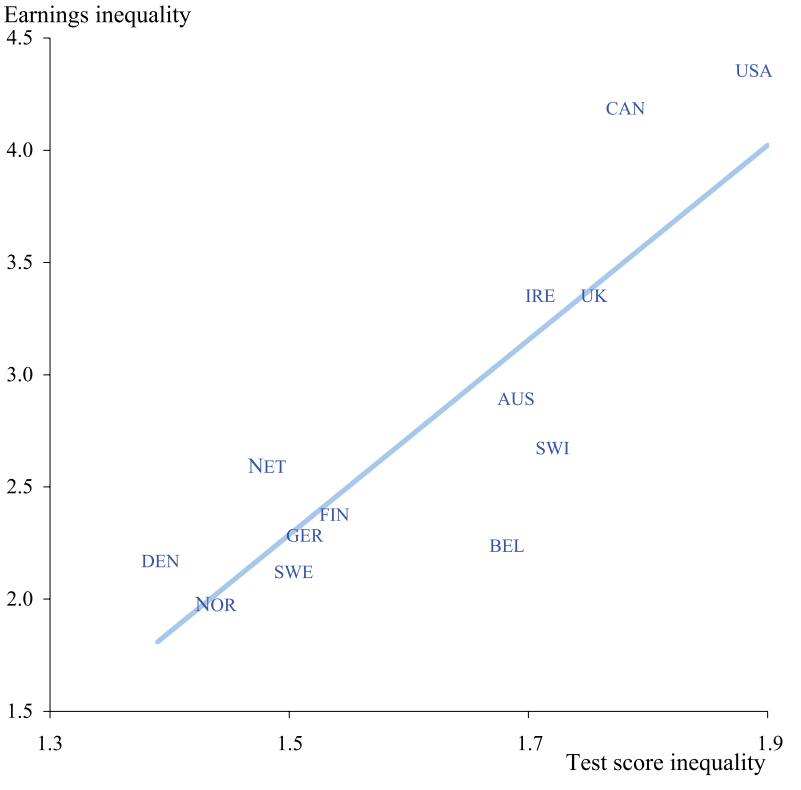

Figure 4. Inequality of educational quality and earnings.
Note: Measure of inequality is the ratio of ninth decile to first decile in both cases; test performance refers to prose literacy in the International Adult Literacy Survey.
Source: Hanushek and Woessmann (2008) as adapted from Nickell (2004).

How can it be achieved? Developed country evidence

The difficulty with this policy prescription is that increasing student achievement has often proved to be a difficult challenge. Policy-makers around the world have taken up the pursuit of improved school quality. Sometimes it is based on concerns about the observed performance on assessments – ones like PISA that provide direct information on relative performance. Sometimes it is based simply on their instincts or on the political popularity of discussing school quality issues.

One important feature, however, pervades much of the existing reform discussion. Historic reform policies have generally been expensive, but they have not led to widespread improvements in student performance. The existing evidence suggests that common improvement strategies center on such things as increasing teacher qualifications or reducing class size do not have a powerful effect on student outcomes (see discussion in Hanushek 1995, 2003). Although clearly controversial, the past analyses of resource policies do not indicate that continuation of these as a very hopeful way to achieve student performance increases.

One possible explanation for past failure, supported by research into the determination of achievement, is that insufficient attention has been given to teacher quality. By many accounts from different studies in the United States, the quality of teachers

is the key to student performance. But the research evidence suggests that many of the policies that have been pursued have not been very productive. Specifically, while the policies may have led to changes in measured aspects of teachers, they have not improved the quality of teachers when identified by student performance.[19]

The strong conclusion from current research is that evaluations of teacher quality must be based on student outcomes for the simple reason that the typical proxies for teacher quality have proven to be very limited in value.[20] Output-based measures of teacher quality are rather new, and they are non-existent for research outside the United States.[21] Thus, this part of the analysis is based entirely on the US teacher market and the quality distribution found there.

In order to improve student achievement, teacher quality would have to improve on average from the current level. This is necessarily a time-consuming plan, because it involves replacing typical teachers of today with teachers that are of higher quality.[22] This necessity of phasing in a policy in fact leads to the length of time previously considered for reform in Figure 3.

The estimates of the importance of teacher quality in fact suggest that teacher policies could potentially yield a one-half standard deviation improvement in student performance such as discussed previously. The specific policy exercise considered is replacing the most ineffective current teachers with higher-quality teachers. The exact mechanism to obtain this change is unclear, but it is useful to see what can be accomplished by such a replacement policy. Estimates based on the variation of teacher performance in the United States suggest that replacing the bottom 6–10% of teachers with an average teacher could yield average student gains of one-half standard deviation (Hanushek 2009). Of course, this is often viewed as a difficult if not impossible policy, from a political point of view. Partly because of this difficulty and partly because replacement of teachers may be a long-term policy, other performance-related incentive programs may also be considered and may be politically more feasible to improve teachers' performance.[23]

Of course, to avoid being circular, there must be some way to identify teacher quality. The studies that have been made of teacher quality differences indicate that student performance information could possibly be used to select teachers. By obtaining estimates of the value-added of individual teachers, it is possible to observe teachers at the bottom of the distribution.[24] Additionally, within the United States, a variety of studies suggest that supervisors can identify differences in teacher quality, at least at the extremes of the distribution.[25] Having the information about quality is clearly the first step in being able to improve quality. It is of course not the complete story, because it is necessary to have a system for using that information to adjust the stock of teachers. Nonetheless, if we assume that adjustments can be made, we can see what kinds of effects are possible.

The implications of the differences in quality that are observed are dramatic. Let us consider the impact of low-quality, or ineffective, teachers on student achievement, as estimated by Rivkin, Hanushek, and Kain (2005).[26] If the average learning growth each academic year is one grade level equivalent, the bottom 5% of teachers obtain gains that are at best two-thirds of a grade level equivalent. Some are much worse that this. The bottom 1% of teachers get no more that one-half of a grade level equivalent in annual gains.[27]

An external validation of these estimates comes from Hanushek (1992). The calculations of the low end of the distribution developed here are similar to the effects calculated in Hanushek (1992), but suggest that the most conservative estimates may

be too optimistic. That analysis of the range in performance of schools in Gary, Indiana suggests that the bottom 5% are no better than one-half grade level equivalent years in growth per academic year. These direct estimates of teacher differences are actually close to the higher estimates of variations of teacher quality used in the simulations (0.30 standard deviations of student achievement).

Clearly, students in class with ineffective teachers are damaged. They can probably recover from a single year of having a bottom 5% teacher, but a few years might lead to lasting problems – ones that follow the student for a lifetime.

Let us look at the aggregate impact of the bottom teachers. As an example, consider what would happen to average student performance if we could eliminate the bottom 5% of teachers from the distribution. The previous estimates of the impact of teachers on student achievement indicate that students would on average gain 0.28–0.42 standard deviations of performance over their schooling.[28]

Based on this idea of eliminating the bottom portion of the distribution, eliminating the worst 6–10% of teachers in terms of effectiveness would bring student achievement up by one-half standard deviation. In other words, achieving the significant changes in achievement for a population could be achieved by strong but achievable kinds of improvements in the distribution of teachers.

Is the evidence relevant for South Asia and other developing countries?

The question of course is what portion of this evidence is relevant for South Asian or other developing countries. We know, for example, that the developing world is noticeably behind the rest of the world in terms of simple school enrollment rates. Table 3 provides recent information on net enrollment rates in primary school, gross enrollment rates for tertiary schooling, and expected schooling for the world and for South Asian countries. Developing countries as a whole are significantly behind others at primary school, and, not surprisingly, this gap expands by tertiary schooling.

Table 3. Enrollment rates by development status: world and South Asia, 2006.

	Net enrollment rate (primary school)	Gross enrollment rate (tertiary school)	School life expectancy
World	86	25	11
Countries in transition	90	57	13
Developed countries	95	67	16
Developing countries	85	17	10
South Asia	86	11	9
Bangladesh	89	6	8
Bhutan	79	6	10
India	89	12	10
Iran	94	27	13
Maldives	97	–	12
Nepal	79	6	–
Pakistan	66	5	7
Sri Lanka	97	–	–

Source: UNESCO (2008).

While some South Asian countries have moved forward with school enrollment – notably Maldives, Sri Lanka, and Iran – the other countries of the region lag behind. India now beats the developing world in primary school enrollment (an estimated 89%[29] versus 85%) but actually does worse in terms of tertiary school enrollment (12% versus 17% in the rest of the developing world) (see UNESCO 2008). Enrollment and elementary school completion are far from universal in most other South Asian countries as well. The low school life expectancy, particularly in Pakistan, stands out even among developing countries.

Do these numbers not indeed show that the access and grade attainment problems should be paramount?

The answer again is that low-quality schooling appears to confer few benefits. And the quality issue is real. For a selection of developing countries, Hanushek and Woessmann (2008) calculate the proportion of recent students who both finish Grade Nine *and* are minimally literate by OECD standards on the PISA tests. These calculations suggest that less than 10% of 15–19 year olds achieve that level in Ghana or in South Africa or in Brazil. Less than 15% meet that standard in Peru, even though almost one-half of the population does complete Grade Nine. Thus, by all accounts, efforts to expand school attainment – which have been significant in recent years – may do little to meet the human capital goals of many developing countries. On this message it appears clear that the research pertains directly to developing countries.

India has not participated in any of the international tests since the early 1970s, and other South Asian countries have not participated in them at all. Thus, it is difficult to benchmark student performance in South Asian countries in terms of developed or developing countries of the world. Two innovative studies, by Wu (2009) and Das and Zajonc (2008), however, give a useful comparison. By testing 6000 Indian students using the publicly available mathematics test items from Trends in International Mathematics and Science Study (TIMSS) and applying item response theory to these, they can place India within the world distribution of performance. In terms of average performance, Das and Zajonc (2008) show that the tested Indian states of Orissa and Rajasthan are placed near the bottom of the 51 countries participating in TIMSS.[30] These findings are consistent with an earlier study of rural Indian students that found 'close to 35% of children in the 7–14 age group could not read a simple paragraph (grade 1 level difficulty) and almost 60% of children could not read a simple story (grade 2 level difficulty).'[31]

Table 4 provides information about literacy rates of adults and of youth (age 15–24 years) in South Asian countries. First, the variations across South Asia are striking – varying from roughly one-half of adults in Bangladesh being illiterate to almost full literacy in the Republic of Maldives. Second, and more problematic, is the literacy shortcomings in several countries for youth, indicating that the problem of illiteracy will not disappear with current policies and schooling availability. Third, the inconsistency of the literacy data and the simple test results in Pratham (2005) suggests that these data actually understate the problem of achievement and cognitive skills that exists in the region.

The larger issue is whether policy implications revolving around teacher quality hold for developing countries. The evidence on the magnitude of teacher quality differences comes directly from the United States. While it has been essentially duplicated across US analyses, little is available for the developing world.

We do know that the lack of relationships between student achievement and common measures of teacher quality is quite consistent across developed and developing

Table 4. Literacy rates: world and South Asia, 2000–2006.

	Adult literacy rate (age 15+ years)	Youth literacy rate (age 15–24 years)
World	84	89
Countries in transition	99	100
Developed countries	99	99
Developing countries	79	87
South Asia	64	79
Bangladesh	52	71
Bhutan	54	76
India	65	81
Iran	84	98
Maldives	97	98
Nepal	55	78
Pakistan	54	69
Sri Lanka	91	97

Source: UNESCO (2008).

countries (Hanushek 1995, 2003). But that does not establish the impact of variations in teacher quality or the appropriate policies that might be followed. Harbison and Hanushek (1992) do show that, at least for poor areas of Brazil, common teacher measures – such as school attainment of the teachers – bear little relationship to student outcomes even when observed at very low levels. They also indicate that there are huge variations in performance across individual teachers and classrooms, although a portion of this could reflect the composition of students in the classroom.[32]

Some specific research on South Asia supports these general conclusions. Kingdon (2006) shows that little gain can be expected simply from improving teacher characteristics such as training and qualifications. Similarly, a study by Pandey, Goyal, and Sundararaman (2008) across three Indian states finds that, although teacher attendance and effort generally affect student achievement (with some heterogeneity across states), there is little relationship between observable teacher characteristics and teacher effort. Thus, the research (and policy) challenge is establishing what drives performance in developing countries such as India and what can be done to alter the current state.

There is simply much less evidence on the variation of teacher quality in developing countries. There is, however, a variety of estimates of how different incentives might yield important results, even if teacher quality variations are not well understood. For example, Muralidharan and Sundararaman (2008) suggest from experimental evidence in India that two years of performance incentives to teachers could yield close to 0.3 standard deviation improvements in student scores.

Conclusions

Virtually every government is concerned about investments in human capital. These objectives must be put within context, because schooling is different from many publicly provided goods. First, schooling has direct implications for individual outcomes, for national aggregate outcomes, and for the distribution of outcomes

across society. Thus, there is a direct economic relationship between government spending and the returns on investments. Second, schooling is not a homogeneous commodity but varies considerably in quality. The simple message of existing research is that the quality dimension is overwhelmingly important. Third, policy toward schools is heavily laden with politics that emanate both from students and parents and from teachers and school personnel, making the explicit policies quite contentious at times. It is ultimately very important that countries pursue policies that are successful, even if they may be less popular in the short run.

Even though we have considerable reason to believe that high-quality teachers are absolutely essential – both in developed and in developing countries – we have much less knowledge about how to institute policies that will improve the teaching force. In order to dramatize the issue of teacher quality, the existing evidence was used to provide estimates of what would happen to student achievement if we could simply cut off the bottom of the quality distribution. Of course, this is not a policy in itself. Moreover, the optimal policy is almost certainly one that operates on incentives in schools – such as improved accountability for student results and pay that was linked to teacher and school performance – and not one that relies on wholesale firing of teachers or the like. Nonetheless, the current dearth of information on the best way to provide incentives calls for much broader policy experimentation.[33]

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Notes

1. The Millennium Declaration has eight objectives, initially set by a UN resolution in 2000 and adopted by 189 world leaders during the world summit in 2005: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability; and develop a global partnership for development.
2. Details of the underlying statistical analyses plus an extended set of references can be found in Hanushek and Woessmann (2008).
3. The Mincer earnings function relates the logarithm of earnings to years of schooling, potential labor market experience, and other factors specific to individual studies (Mincer 1974). The coefficient on years of schooling in this regression can, under specific circumstances, be interpreted as the rate of return to schooling. (See, however, Heckman, Lochner, and Todd [2006], who offer a critique and interpretation of these analyses.)
4. For extensive reviews of the literature, see for example Topel (1999), Temple (2001), Krueger and Lindahl (2001), and Sianesi and Van Reenen (2003). Early studies used adult literacy rates (for example, Azariadis and Drazen 1990; Romer 1990) or school enrollment ratios (for example, Barro 1991; Mankiw, Romer, and Weil 1992; Levine and Renelt 1992) as proxies for the human capital of an economy. An important innovation by Barro and Lee (1993, 2001) was the development of internationally comparable data on average years of schooling for a large sample of countries and years, based on a combination of census or survey data on educational attainment wherever possible and using literacy and enrollment data to fill gaps in the census data.
5. See the general conceptual model in Hanushek (1979) and the review in Hanushek (1986).
6. The clearest analyses are found in several references for the United States (analyzed in Hanushek 2002). See Bishop 1989, 1991; O'Neill 1990; Grogger and Eide 1993;

Blackburn and Neumark 1993, 1995; Murnane, Willett, and Levy 1995; Neal and Johnson 1996; Mulligan 1999; Murnane et al. 2000, 2001; Altonji and Pierret 2001; Lazear 2003).

7. Scores are standardized to mean zero and standard deviation one for comparative purposes. A one-half standard deviation change would move somebody from the middle of the distribution (the 50th percentile) to the 69th percentile; a one standard deviation change would move this person to the 84th percentile. Because tests tend to follow a normal distribution, the percentile movements are largest at the center of the distribution.
8. See, for example, Dugan (1976) and Manski and Wise (1983)) for early analyses. Murnane et al. (2000) separate the direct returns to measured skill from the indirect returns of more schooling and suggest that perhaps one-third to one-half of the full return to higher achievement comes from further schooling. Similarly, Rivkin (1995) finds that variations in test scores capture a considerable proportion of the systematic variation in high school completion and in college continuation, so that test score differences can fully explain black-white differences in schooling. See further discussion and references in Hanushek (2006)
9. See Glewwe (1996), Jolliffe (1998), Boissiere, Knight, and Sabot (1985), Knight and Sabot (1990), Angrist and Lavy (1997), Alderman et al. (1996), Behrman, Ross, and Sabot (2008) and Moll (1998).
10. At the same time, the estimates of the return to years of schooling from models that incorporate families and ability to allow for other inputs to cognitive skills show noticeably lower Mincer returns to school attainment – consistent with the general model of student achievement.
11. As discussed below and in Hanushek and Woessmann (2008), there are some difficult issues in putting these results on a common scale.
12. The rescaling uses performance of US students over time (as measured by the National Assessment of Educational Quality, or NAEP) to calibrate the US scores on different international tests. Then, by setting the variance of each test according to an OECD standardization group, each country and test can be equated. See the further description along with a listing of the separate tests in Hanushek and Woessmann (2008).
13. Details of the data and analysis are found in Hanushek and Woessmann (2008). The source of the income data is version 6.1 of the Penn World Tables (cf. Heston, Summers, and Aten 2002), and the data on years of schooling is an extended version of the Cohen and Soto (2001) data described in Jamison, Jamison, and Hanushek (2007).
14. These results are very close to the estimates by Hanushek and Kimko (2000), which reported estimates in terms of the country level standard deviation that is approximately one-half as large as the individual level standard deviation; see Hanushek and Woessmann (2008).
15. Note that it is possible to have high rates of return for secondary and tertiary attainment without getting the gains through economic growth. With low quality, the growth effects can be small, even though the people with more school attainment get significantly higher incomes than those with low attainment. In the case of South Asia, see the returns in Riboud, Savchenko, and Tan (2007).
16. PISA is conducted by the OECD. It involves testing a representative group of 15 year olds in each participating country. The tests themselves are designed to measure practical skills rather than deeper conceptual skills. These scores from PISA also enter into the construction of aggregate country measures of cognitive skills used in Hanushek and Woessmann (2008).
17. See Krueger (1999) and Hanushek (1999) on the estimated impacts both from experimental manipulation and from econometric analyses.
18. The actual reform policy is presumed to operate linearly such that, for example, a 20-year reform that ultimately yielded one-half standard deviation higher achievement would see the performance of graduates increasing by 0.025 standard deviations each year over the period. It also assumes that the impact is proportional to the average achievement levels of prime age workers, based on workers in the first 35 years of their work life.
19. For a review of existing literature, albeit largely for developed countries, see Hanushek and Rivkin (2004). This paper describes various attempts to estimate the impact of teacher quality on student achievement.
20. The conventional measures of teacher experience and the level of teacher schooling are not closely related to student outcomes except for the first year or two of experience. Neither is teacher certification itself closely related. Hanushek (2003).
21. See, for example, Rivkin, Hanushek, and Kain (2005), Aaronson, Barrow, and Sander (2007), Boyd et al. (2006), and Gordon, Kane, and Staiger (2006) for added examples.

Reviews of the US teacher quality research and of the policy implications can be found in Hanushek and Rivkin (2004, 2006).

22. The discussion presumes that quality improvements require changing the stock of teachers. It is possible that this could be done through professional development and training of existing teachers, but currently available evidence does not suggest that such an approach would be very effective.
23. A recent study on India suggests that performance pay could work to improve teachers' performance in particular country settings; see Muralidharan and Sundararaman (2008)
24. There are of course many reasons for caution. The most important is that estimates of individual teacher value-added contains substantial measurement error. For an analysis of how this can be integrated into policy, see Gordon, Kane, and Staiger (2006)
25. See Murnane (1975), Armor et al. (1976), and Jacob and Lefgren (2006).
26. These basic estimates are described in detail in Hanushek (2009).
27. These calculations assume that one standard deviation of teacher quality – moving from the center of the distribution to the 84th percentile – is 0.20 standard deviations of student achievement; using a calculation of 0.30 makes these conclusions even more grim.
28. These estimates apply the information on the distribution of teacher effectiveness for each year to a cumulative impact if teachers are improved in all grades. To obtain these steady-state results, it would be necessary for a student to have a higher average teacher throughout school to Grade 12.
29. UNESCO data may not be the most up to date. According to the most recent household survey data, the primary net enrollment rate may have now reached 95% in India.
30. India also has almost the largest variance in performance, placing it behind just South Africa. Because it is so populace, India then produces a very large number of students at the top of the distribution (even though the proportions of Indian students there is small).
31. Similar concerns exist for mathematics; see Pratham (2005).
32. For other related works on teacher quality, see Hanushek and Rivkin (2007).
33. The innovative experimentation described in Muralidharan and Sundararaman (2008) amply demonstrates both the feasibility and utility of such experimentation. See also Kremer (2003).

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