Economic Growth in Developing Countries: The Role of Human Capital

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April 2013

Abstract

The focus on human capital as a driver of economic growth for developing countries has led to undue attention on school attainment. Developing countries have made considerable progress in closing the gap with developed countries in terms of school attainment, but recent research has underscored the importance of cognitive skills for economic growth. This result shifts attention to issues of school quality, and there developing countries have been much less successful in closing the gaps with developed countries. Without improving school quality, developing countries will find it difficult to improve their long run economic performance.

JEL Classification: I2, O4, H4

Highlights:

- Improvements in long run growth are closely related to the level of cognitive skills of the population.
- Development policy has inappropriately emphasized school attainment as opposed to educational achievement, or cognitive skills.
- Developing countries, while improving in school attainment, have not improved in quality terms.
- School policy in developing countries should consider enhancing both basic and advanced skills.

Keywords: economic development, economic impact, demand for schooling

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The role of improved schooling has been a central part of the development strategies of most countries and of international organizations, and the data show significant improvements in school attainment across the developing world in recent decades. The policy emphasis on schooling has mirrored the emphasis of research on the role of human capital in growth and development. Yet, this emphasis has also become controversial because expansion of school attainment has not guaranteed improved economic conditions.[1] Moreover, there has been concern about the research base as questions have been raised about the interpretation of empirical growth analyses. It appears that both the policy questions and the research questions are closely related to the measurement of human capital with school attainment.

Recent evidence on the role of cognitive skills in promoting economic growth provides an explanation for the uncertain influence of human capital on growth. The impact of human capital becomes strong when the focus turns to the role of school quality. Cognitive skills of the population – rather than mere school attainment – are powerfully related to individual earnings, to the distribution of income, and most importantly to economic growth.

A change in focus to school quality does not by itself answer key questions about educational policy. Other topics of considerable current interest enter into the debates: should

[1] See, for example, Easterly (2001) or Pritchett (2006).

policy focus on basic skills or the higher achievers? Also should developing countries work to expand their higher education sector? The currently available research indicates that both basic skills and advanced skills are important, particularly for developing countries. At the same time, once consideration is made of cognitive skills, the variations in the amount of tertiary education have no discernible impact on economic growth for either developed or developing countries.

This paper puts the situation of developing countries into the perspective of recent work on economic growth. When put in terms of cognitive skills, the data reveal much larger skill deficits in developing countries than generally derived from just school enrollment and attainment. The magnitude of change needed makes clear that closing the economic gap with developed countries will require major structural changes in schooling institutions.

The Measurement of Human Capital in Economic Growth

In the late 1980s and early 1990s, empirical macroeconomists turned to attempts to explain differences in growth rates around the world. Following the initial work of Barro (1991), hundreds of separate studies – typically cross-sectional regressions – pursued the question of what factors determined the very large observed differences. The widely different approaches tested a variety of economic and political explanations, although the modeling invariably incorporated some measure of human capital.

The typical development is that growth rates (g) are a direct function of human capital (H), a vector of other factors (X), and a stochastic element (ε) as in:

(1) $$g = rH + X\beta + \varepsilon$$

where r and β are unknown parameters to be estimated. The related empirical analysis employs cross-country data in order to estimate the impact of the different factors on growth.[2]

From a very early point, a number of reviews and critiques of empirical growth modeling went to the interpretation of these studies. The critiques have focused on a variety of aspects of this work, including importantly the sensitivity of the analysis to the particular specification (e.g., Levine and Renelt (1992)). They also emphasized basic identification issues and the endogeneity of many of the factors common to the modeling (e.g., Bils and Klenow (2000)).

In both the analysis and the critiques, much of the attention focused on the form of the growth model estimated – including importantly the range of factors included – and the possibility of omitted factors that would bias the results. Little attention was given to measurement issues surrounding human capital. This oversight in the analysis and modeling appears to be both explicable and unfortunate.

A short review of the history of human capital modeling and measurement helps to explain the development of empirical growth analysis. Consideration of the importance of skills of the workforce has a long history in economics, and the history helps to explain a number of the issues that are pertinent to today's analysis of economic growth. Sir William Petty (1676 [1899]) assessed the economics of war and of immigration in terms of skills (and wages) of individuals. Adam Smith ([1776]1979) incorporated the ideas in the *Wealth of Nations*, although ideas of specialization of labor dominated the ideas about human capital. Alfred Marshall (1898), however, thought the concept lacked empirical usefulness, in part because of the severe measurement issues involved.

[2] Detailed discussion of this growth model and of variants of it can be found in Hanushek and Woessmann (2008).

After languishing for over a half century, the concept of human capital was resurrected by the systematic and influential work of Theodore Schultz (1961), Gary Becker (1964), and Jacob Mincer (1970, (1974), among others. Their work spawned a rapid growth in both the theoretical and empirical application of human capital to a wide range of issues.

The contributions of Mincer were especially important in setting the course of empirical work. A central idea in the critique of early human capital ideas was that human capital was inherently an elusive concept that lacked any satisfactory measurement. Arguing that differences in earnings, for example, were caused by skill or human capital differences suggested that measurement of human capital could come from observed wage differences – an entirely tautological statement. Mincer argued that a primary motivation for schooling was developing the general skills of individuals and, therefore, that it made sense to measure human capital by the amount of schooling completed by individuals. Importantly, school attainment was something that was frequently measured and reported. Mincer followed this with analysis of how wage differentials could be significantly explained by school attainment and, in a more nuanced form, by on-the-job training investments(Mincer (1974)). This insight was widely accepted and has dictated the empirical approach of a vast majority of empirical analyses in labor economics through today. For example, the Mincer earnings function has become the generic model of wage determination and has been replicated in over 100 separate countries (Psacharopoulos and Patrinos (2004)).

Owing in part to the power of the analysis of Mincer, schooling became virtually synonymous with the measurement of human capital. Thus, when growth modeling looked for a measure of human capital, it was natural to think of measures of school attainment.

The early international modeling efforts, nonetheless, confronted severe data issues. Comparable measures of school attainment across countries did not exist during the initial modeling efforts, although readily available measures of enrollment rates in schools across countries were a natural bridge to changes in school attainment over time. The early data construction by Barro and Lee (1993), however, provided the necessary data on school attainment, and the international growth work could proceed to look at the implications of human capital.[3]

In this initial growth work, human capital was simply measured by school attainment, or S. Thus, Equation (1) could be estimated by substituting S for human capital and estimating the growth relationship directly.[4]

Fundamentally, however, using school attainment as a measure of human capital In an international setting presents huge difficulties. In comparing human capital across countries, it is necessary to assume that the schools across diverse countries are imparting the same amount of learning per year in all countries. In other words, a year of school in Japan has the same value in terms of skills as a year of school in South Africa. In general, this is implausible.

A second problem with this measurement of human capital is that it presumes schooling is the only source of human capital and skills. Yet, a variety of policies promoted by the World Bank and other development agencies emphasize improving health and nutrition as a way of

[3] There were some concerns about accuracy of the data series, leading to alternative developments (Cohen and Soto (2007)) and to further refinements by Barro and Lee (2010).

[4] A variety of different issues have consumed much of the empirical growth analysis. At the top of the list is whether Equation (1) should be modeled in the form of growth rates of income as the dependent variable, or whether it should model the level of income. The former is generally identified as endogenous growth models (e.g., Romer (1990)), while the latter is typically thought of as a neoclassical growth model (e.g., Mankiw, Romer, and Weil (1992)). The distinction has received a substantial amount of theoretical attention, although little empirical work has attempted to provide evidence on the specific form (see Hanushek and Woessmann (2008)).

developing human capital. These efforts reflect a variety of analyses into various health issues relative to learning including micro-nutrients (Bloom, Canning, and Jamison (2004)), worms in school children (Miguel and Kremer (2004)), malaria, and other issues. Others have shown a direct connection of health and learning (Gomes-Neto, Hanushek, Leite, and Frota-Bezzera (1997), Bundy (2005)).

This issue is in reality part of a larger issue. In a different branch of research, a vast amount of research has delved into "educational production functions." This work has considered the determinants of skills, typically measured by achievement tests.[5] Thus, this line of research has focused on how achievement, A, is related to school inputs (R), families (F), other factors such as neighborhoods, peers, or general institutional structure (Z), and a stochastic element (η):

$$A = f(R, F, Z, \eta) \tag{2}$$

Much of the empirical analysis of production functions has been developed within individual countries and estimated with cross-sectional data or panel data for individuals. This work has concentrated on how school resources and other factors influence student outcomes (Hanushek (2003)). However, as reviewed in Hanushek and Woessmann (2011a), a substantial body of work has recently developed in an international context, where differences in schools in other factors are related to cross-country differences in achievement.

The analysis of cross-country skill differences has been made possible by the development of international assessments of math and science (see the description in Hanushek and Woessmann (2011a)). These assessments provide a common metric for measuring skill

[5] See, for example, the general discussion in Hanushek (2002).

differences across countries, and they provide a method for testing directly the approaches to modeling growth, as found in Equation (1). [6]

The fundamental idea is that skills as measured by achievement, A, can be used as a direct indicator of the human capital of a country in Equation (1). And, as described in Equation (2), schooling is just one component of the skills of individuals in different countries. Thus, unless the other influences on skills outside of school are orthogonal to the level of schooling, S, the growth model that relies on only S as a measure of human capital will not provide consistent estimates of how human capital enters into growth.

The impact of alternative measures of human capital can be seen in the long run growth models displayed in Table 1. The table presents simple models of long run growth (g) over the period 1960-2000 for the set of 50 countries with required data on growth, school attainment, and achievement (see Hanushek and Woessmann (2012a)). The first column relates growth to initial levels of GDP and to human capital as measured by school attainment.[7] This basic model shows a significant relationship between school attainment and growth and explains one-quarter of the international variation in growth rates. The second column substitutes the direct measure of skills derived from international math and science tests for school attainment. Not only is there a significant relationship with growth but also this simple model now explains three-quarters of the variance in growth rates. The final column includes both measures of human

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[6] This approach to modeling growth as a function of international assessments of skill differences was introduced in Hanushek and Kimko (2000). It was extended in Hanushek and Woessmann (2008) and a variety of other analyses identified there.

[7] The inclusion of initial income levels for countries is quite standard in this literature. The typical interpretation is that this permits "catch-up" growth, reflecting the fact that countries starting behind can grow rapidly simply by copying the existing technologies in other countries while more advanced countries must develop new technologies. Estimating models in this form permits some assessment of the differences between the endogenous and neoclassical growth models discussed previously (see Hanushek and Woessmann (2011b)).

capital. Importantly, once direct assessments of skills are included, school attainment is not significantly related to growth, and the coefficient on school attainment is very close to zero.

These models do not say that schooling is worthless. They do say, however, that only the portion of schooling that is directly related to skills has any impact on cross-country differences in growth. The importance of skills and conversely the unimportance of schooling that does not produce higher levels of skills has a direct bearing on human capital policies for developing countries.

Finally, the estimated impacts of cognitive skills on growth are very large. The cognitive skills measure is scaled standard deviations of achievement. Thus, one standard deviation difference in performance equates to two percent per year in average annual growth of GDP per capita. The importance of human capital indicated by these estimates combined with the deficits of developing countries (below) identifies the policy challenges.

Improvement in School Attainment of Developing Countries

With this background on human capital and growth, it is possible to assess the position of developing countries and their prospects for the future. To provide perspective, this discussion begins with the traditional measure of human capital, school attainment.

International development agencies have pursued the expansion of schooling as a primary component of development. Growing out of a 1990 international conference in Jomtien, Thailand, UNESCO and the World Bank began a movement to achieve "Education for All

(EFA)"[8] While this conference developed some fairly general goals, a follow-on conference became much more specific. A central element of the goals for Education for All is achieving compulsory and universal primary education in all countries. The 2000 conference included a commitment to achieving the specific goals by 2015.

The United Nations in 2000 established the Millennium Development Goals (MDG).[9] The second MDG goal was universal primary education, to be achieved by 2015 and consistent with Education for All. To be sure, both the MDG's and the EFA goals recognize that quality is an issue, and both suggest that quality should be monitored. But, the ease of measurement of school completion and the ability to assess progress toward the specific goals imply that qualitative issues of schooling receive considerably less attention.

The data on school attainment show dramatic growth and improvement of developing countries. Table 2 charts the progress since 1991 in school attainment across the developed and developing world.

The developed world has maintained high levels of net enrollment at about 95 percent. Transitional economies have slightly improved over these two decades. But developing countries have closed half of the gap of their enrollment rates compared to those in developed countries.

The similar picture holds for school expectancy. All countries have on average increased school expectancy over the period 1991-2008. And, again, the largest gains are in developing counties that on average added two years to their average school completion, reaching 10.4 years

[8] See the history and framework at: http://en.wikipedia.org/wiki/Education_For_All [accessed February 10, 2012].
[9] See the history and framework at: http://en.wikipedia.org/wiki/Millennium_Development_Goals [accessed February 10, 2012].

in 2008. Developed countries also made significant gains, moving to 15.9 years by 2008, so the closing of schooling gaps has been relatively slow. But, there is no doubt that there have been steady gains in developing countries.

These are the data typically used to judge the progress and the challenges facing the developing world. But the previous discussion of the measurement of human capital suggests that the data on school attainment – the focus of international monitoring – may be misleading without consideration of how much students are learning.

Better Measures of the Human Capital Deficit in Developing Countries

International data on skills are most readily available for developed countries, but in recent years their availability in developing countries has expanded dramatically. There are two current sources of assessments: the International Association for the Evaluation of Educational Achievement (IEA) which has produced the TIMSS assessments and related tests[10]; and the Organisation for Economic Cooperation and Development (OECD which has produced the PISA assessments.[11] These assessments, which were used in the skill measures that went into Table 2, have somewhat different test developments, age coverage, and country sampling. Nevertheless, they provide a clear indication of the skill differentials across countries that were absent from the prior discussion of school attainment.

[10] The IEA tests were the first such assessments, begun with the First International Math Study (FIMS) in 1964 and continuing through the most recent Trends in Mathematics and science Study (TIMSS) in 2007.

[11] The Programme of International Student Assessment (PISA) started in 2000 and has continued at three year intervals through 2009. It has expanded country coverage significantly over time.

Table 3 provides basic measures of math competencies for a sample of developing countries that have participated in the 2009 PISA assessment of mathematics. The PISA assessments of performance of 15-year-olds categorize students in Levels 1-6. Level 1, which includes scores 0.8 standard deviations or more below the OECD mean, relates to the most rudimentary knowledge. The performance levels are described in Organisation for Economic Co-operation and Development (2010): "Students proficient at Level 1 can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform obvious actions that follow immediately from the given stimuli." At this level of knowledge, students will have a difficult time participating in a modern workforce that includes new technologies, and they will have trouble adjusting to changes in these technologies. Such students are likely to have serious difficulties using mathematics to benefit from further education and learning opportunities throughout life.

Across OECD countries, an average of 14 percent of students perform at Level 1, and 8 percent perform below Level 1. But, Table 3 illustrates the plight of a number of countries where over 40 percent of the students (who are still in school at age 15) are performing at Level 1 or below in 2009.[12] Restricting the assessments to those who are still in school at 15 is also an important caveat, since many still drop out before grade 9. If the less able students tend to be

[12] Note that these are not all of the developing countries. These are the countries that both participated in PISA 2009 and had such substantial numbers performing at the bottom levels. The vast majority of developing countries have never participated in the PISA examinations. Although a somewhat larger number of developing countries has participated in the TIMSS assessments, their performance relative to developed countries is not noticeably better.

the earliest drop outs, the data on achievement of 15-year-olds will overstate the performance of children in these countries.

The deficit of developing countries can be better illustrated by considering the full distribution of outcomes for countries, i.e., by merging the typical school attainment data with the achievement data from the international assessments. A graph that highlights the alternative perspectives of the traditional focus on attainment and the achievement focus can be found in Figure 1. In the separate panels, the pattern of school attainment – taken from recent household surveys – is combined for a subset of countries with the minimal skill achievement from PISA.[13] PISA tests achievement for a representative sample of 15-year-olds in each country and thus can be taken as a measure of the competencies of the subset of students in each country that completes grade 9.

Take Peru as an example.[14] Sixty percent of students make it at least through grade 9. Assuming that the students with the highest achievement levels complete the most schooling and applying an even looser definition of “modern literacy” – scoring within one standard deviation of the OECD average – shows that only 20 percent of ninth grade completers and only 12 percent of the population is fully literate.[15] Comparable calculations for full literacy yield 21 percent in the Philippines and just seven percent in South Africa. Thus, the performance in terms of school attainment may show some success and promise, but this stands in contrast to the

[13] See the description in Hanushek and Woessmann (2008). These figures rely on household surveys generally done around 2000; the achievement data use the closest international assessment data.

[14] Peru is actually illustrative of a much larger problem in Latin America where achievement has lagged significantly behind the expansion of school attainment. This lag in fact can fully explain why growth rates in Latin American countries have been disappointingly small (Hanushek and Woessmann (2012b)).

[15] One standard deviation away from the OECD average on PISA tests is 400 points. The top of the Level 1 range illustrated previously was 420 points in mathematics in 2009.

performance in terms of internationally competitive skills. The general narrowing of the human capital deficit shown in Table 2 is far less evident in Table 3 and Figure 1.

International agencies have not completely ignored the possibility that there are school quality differences across countries. Indeed both Education for All and the Millennium Development Goals include mention of quality in their goals. But when they have developed measures of quality to parallel the attainment data, they have employed school input measures. Thus, for example, the quality measures in UNESCO (2006) include: pupil/teacher ratio, % female teachers, % trained teachers, public current expenditure on primary education as a percent of GDP, and public current expenditure per pupil on primary education. Unfortunately, the large volume of studies that have looked at educational production functions in both developed and developing countries has shown little relationship between any of these measures and student achievement.[16] As a result, the focus of much of the international attention to human capital development appears less successful than commonly available reports might suggest.

In terms of the growth analysis, one standard deviation in achievement is related to two percentage point higher long run growth. While one standard deviation is a large skill difference, the a significant number of developing countries participating in the PISA 2009 assessments were more than this far behind the OECD average: Argentina, Jordan, Brazil, Colombia, Albania, Tunisia, Indonesia, Qatar, Peru, Panama, and Kyrgyzstan.

Varying Human Capital Approaches for Developing Countries

[16] The evidence for developed countries is summarized in Hanushek (2003). For developing countries, similar evidence is found in Hanushek (1995) and Glewwe, Hanushek, Humpage, and Ravina (2013). The direct cross-country studies are analyzed in Hanushek and Woessmann (2011a).

It is useful to look deeper into the relationship between human capital (as measured by achievement) and growth. To begin with, simply because of the different technologies that are being employed, the overall relationship between skills and growth may be more important to OECD countries than in developing countries. Moreover, given the more basic and less technologically advanced technologies in developing countries, there may a stronger demand for basic skills and a weaker demand for high level skills in developing countries.

To assess these, Table 4 expands on the modeling of long run growth contained in Table 2. The first column provides a direct test about whether cognitive skills are more important in developed as opposed to developing countries. The point estimate on the interaction of cognitive skills and OECD countries is slightly negative – indicating that skills are *more* important in developing countries. Nonetheless, the differences are not statistically significant.

The previous growth models have uniformly considered just country-average skills. But, particularly in developing countries there is often a large variance in performance with some very high performers and many very low performers (see Hanushek and Woessmann (2008). In fact, given resource constraints, many developing countries frequently feel it is necessary to make decisions about whether to spread resources broadly across their population to provide as great of coverage as possible for its schools or to concentrate resources on those students identified as the best.

To judge the efficacy of these alternative strategies, it is possible to measure the proportion of high performers and the proportion with basic literacy as assessed by the cognitive skills tests.[17] Column (2) of Table 4 provides an estimate of the impact on long run growth of

[17] Basic literacy for this purpose is a score one standard deviation below the OECD mean. Top-performing is a score one standard deviation above the OECD mean.

having a broad basic education versus having more high achievers. Importantly, both broad basic skills ("education for all" in terms of achievement) and high achievers have a separate and statistically significant impact on long term growth. Interestingly, column (3), which allows for different impacts in the OECD and nonOECD countries, indicates that high performers are more important for growth in developing countries than in the OECD countries. This somewhat surprising result suggests the importance of high skills for adapting more advanced technologies to developing countries, particularly when the overall proportion of high performers is small.

These estimates of the varied impact of basic literacy and of top-performers, while suggestive, do not answer the overall policy question about where to invest resources. To address that question, it is necessary to know more about the relative costs of producing more basic and more high-performers. In fact, no analysis is available to describe the costs of producing varying amounts of skills.

An additional issue about the level of investment in developing countries revolves around the development of tertiary education. A variety of developing countries have contemplated expanding their systems of higher education, both in terms of broad access institutions (generally two-year colleges) and higher level institutions. Column (4) provides estimates of the separate impact of tertiary education on long run growth. Consistent with the prior analysis, once the level of cognitive skills is considered, years of tertiary schooling – like years of earlier schooling – in the population has no independent effect on growth. This result also holds for just developing countries or for just OECD countries (not shown). [18]

[18] This result, particularly for developed countries, is somewhat surprising. A variety of models such as those of Vandenbussche, Aghion, and Meghir (2006) or Aghion and Howitt (2009) suggest that tertiary education is particularly important for countries near the technological frontier where growth requires new inventions and innovations.

Finally, the form of education institutions is an issue that has not been adequately addressed, particularly for developing countries. A common issue is how much of education should be general in nature and how much should be vocational. Vocational education is designed to provide students with the specific job-related skills that will allow them to move easily into employment. This type of education appears very attractive when there are large youth unemployment problems as is the case in many developing countries. But, there may well be a trade-off with vocational education. If students have a limited set of skills, even if very appropriate for today's jobs, they might find that they are less adaptable to new technologies that are introduced.[19] Such an issue is particularly important for developing countries that frequently experience very rapid growth and significant changes in production technologies.

Some evidence in developing countries suggests that the tradeoff of easy labor market entry versus potential disadvantages later in the life cycle because of less adaptability can be significant (Hanushek, Link, and Woessmann (forthcoming)). Unfortunately, this evidence comes just from developed countries. No similar analysis exists for developing countries, and it is unclear whether the tradeoff holds across different development levels.

Issues of Causation

An analytical concern is that the growth relationships discussed do not measure causal influences but instead reflect reverse causation, omitted variables, cultural differences, and the like. This concern has been central to the interpretation of much of the prior work in empirical growth analysis.

[19] In a series of macro models of employer adoption of new technologies, Krueger and Kumar (2004a, (2004b) suggest that relying on more vocational training may explain the lower growth in Europe as opposed to the U.S.

An obvious issue is that countries that grow faster have the resources to invest in schools so that growth could cause higher scores. However, the lack of relationship across countries in the amount spent on schools and the observed test scores that has been generally found provides evidence against this (Hanushek and Woessmann (2011a)). Moreover, a variety of sensitivity analyses show the stability of these results when the estimated models come from varying country and time samples, varying specific measures of cognitive skills, and alternative other factors that might affect growth (Hanushek and Woessmann (2012a)). Finally, other work has considered a series of analyses aimed at eliminating many of the other natural concerns about the identification of the causal impacts of cognitive skills (Hanushek and Woessmann (2012a)).[20]

Each of the analyses points to the plausibility of a causal interpretation of the basic models. Nonetheless, with our limited international variations, it is difficult to demonstrate identification conclusively. But, even if the true causal impact of cognitive skills is less than suggested in Table 1, the overall finding of the importance of such skills is unlikely to be overturned.

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[20] To rule out simple reverse causation, Hanushek and Woessmann (2012a) separate the timing of the analysis by estimating the effect of scores on tests conducted until the early 1980s on economic growth in 1980-2000, finding an even larger effect. Three further direct tests of causality were also devised to rule out certain alternative explanations based on unobserved country-specific cultures and institutions confirm the results. The first one considers the earnings of immigrants to the U.S. and finds that the international test scores for their home country significantly explain U.S. earnings but only for those educated in their home country and not for those educated in the U.S. A second analysis takes out level considerations and shows that changes in test scores over time are systematically related to changes in growth rates over time. A third causality analysis uses institutional features of school systems as instrumental variables for test performance, thereby employing only that part of the variation in test outcomes emanating from such country differences as use of central exams, decentralized decision making, and the share of privately operated schools. These results support a causal interpretation and also suggest that schooling can be a policy instrument contributing to economic outcomes.

Some Conclusions

Much of the motivation for human capital policies in developing countries is the possibility of providing economic growth that will raise the levels of incomes in these countries. The focus on alleviating poverty in developing countries relates directly to economic growth because of the realization that simply redistributing incomes and resources will not lead to long run solutions to poverty.

The direct analysis of growth in developing countries adds a much more specific focus than has existed in much of the current policy discussions. Differences in economic growth across countries are closely related to cognitive skills as measured by achievement on international assessments of mathematics and science. In fact, once cognitive skills are incorporated into empirical growth models, school attainment has no independent impact on growth.

The general focus on universal school attainment underlying the campaigns of Education for All and Millennium Development Goals, while seemingly reasonable and important, have not put the developing countries in a good position for growth. Specifically, while emphasizing school attainment – a readily available quantitative measure – they have not ensured that the quality of schools has had a commensurate improvement. The data on improvements in school attainment has been impressive, but the very large gaps in achievement lead to a different interpretation of progress.

In terms of cognitive skills, little closing of the gaps between developed and developing countries has occurred.[21] A surprisingly large proportion of students completing nine years of schooling is uncompetitive in terms of international skill levels.

A focus on quality does, however, complicate decision making. It appears to be generally easier to understand how to expand access than to improve quality. Simple approaches to improving quality have not proved very effective. Past research has indicated that simply providing more resources to schools is generally ineffective.[22] Political problems may also accompany an emphasis on quality. For any given amount of funds, if resources are focused on a smaller set of schools in order to improve quality, it implies that less access to schooling can be provided.

Certainly, in order to provide quality schooling, there must be both infrastructure and access. However, the evidence from the growth analysis indicates that providing schools that fail to teach basic skills does no good. Therefore, slowing the pace of the provision of schools to a rate that also permits the development of quality schools appears to be a good solution.

One other element enters into the calculations. The rapid expansion of new digital technologies – both as blended learning with teachers and technology and as standalone approaches – suggests that many of the past decisions both on access and on quality might rapidly change.[23] The potential in developing countries appears especially large.

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[21] While some developing countries have made significant gains in achievement – e.g., Latvia, Chile, and Brazil – there is little overall tendency for developing countries to gain more than developed countries on international assessments (Hanushek, Peterson, and Woessmann (2012)).
[22] Hanushek (1995), Hanushek and Woessmann (2011a), Glewwe, Hanushek, Humpage, and Ravina (2013).
[23] Christensen, Horn, and Johnson (2008).

Acknowledgements: This analysis is closely related to work on international growth an development done jointly with Ludger Woessmann. Helpful comments were received from Bruce Chapman and the participants at the ANU-DPU International Conference on the Economics of Education Policy.

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Table 1. Alternative Estimates of Long Run Growth Models
Dependent variable: average annual growth in GDP per capita, 1960-2000

	(1)	(2)	(3)
Cognitive skills (A)		2.015	1.980
		(10.68)	*(9.12)*
Years of schooling 1960 (S)	0.369		0.026
	(3.23)		*(0.34)*
GDP per capita 1960	-0.379	-0.287	-0.302
	(4.24)	*(9.15)*	*(5.54)*
No. of countries	50	50	50
R^2 (adj.)	0.252	0.733	0.728

Notes: Dependent variable: average annual growth rate in GDP per capita, 1960-2000. Regressions include a constant. *t*-statistics in parentheses.

Source: Hanushek and Woessmann (2012a)

Table 2. Expansion of Primary Education

	1991	1999	2008
Net Enrollment in primary school			
Developed	96.2	96.6	95
Countries in transition	89.0	85.4 (89)[a]	91
Developing	79.5	83.2 (80)[a]	87
School Expectancy			
Developed	14.2	15.7	15.9
Countries in transition	12.2	11.9	13.5
Developing	8.4	9.1	10.4

Note: a. Alternative estimate from UNESCO (2011) as opposed to UNESCO (2006).

Source: UNESCO (2006), UNESCO (2011)

Table 3. Performance at or below Level 1 on the PISA Mathematics Assessment, 2009: Selected countries (percent)

	below level 1	Level 1	Level 1 or less
Kyrgyzstan	64.8	21.8	86.6
Panama	51.5	27.3	78.8
Indonesia	43.5	33.1	76.7
Qatar	51.1	22.7	73.8
Tunisia	43.4	30.2	73.6
Peru	47.6	25.9	73.5
Colombia	38.8	31.6	70.4
Brazil	38.1	31.0	69.1
Albania	40.5	27.2	67.7
Jordan	35.4	29.9	65.3
Argentina	37.2	26.4	63.6
Kazakhstan	29.6	29.6	59.1
Montenegro	29.6	28.8	58.4
Trinidad and Tobago	30.1	23.1	53.2
Thailand	22.1	30.4	52.5
Uruguay	22.9	24.6	47.6
Bulgaria	24.5	22.7	47.1
Romania	19.5	27.5	47.0
Azerbaijan	11.5	33.8	45.3
Serbia	17.6	22.9	40.6

Source: Organisation for Economic Co-operation and Development (2010)

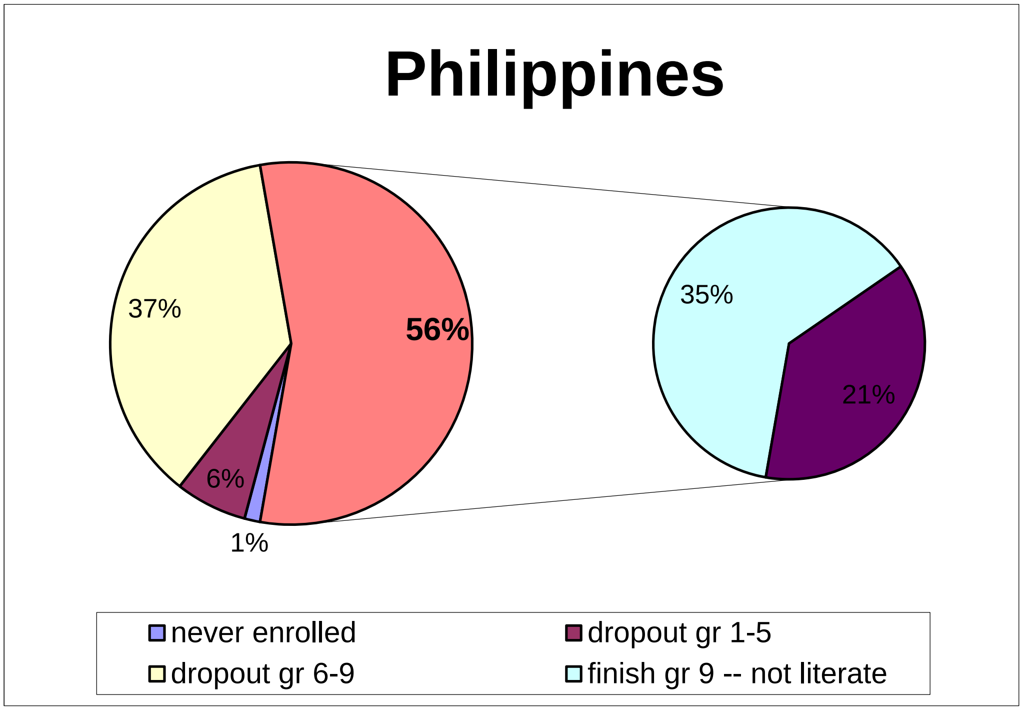
Table 4. Extensions of Basic Models for Developing Countries

	(1)	(2)	(3)	(4)
Cognitive skills	1.978			1.923
	(7.98)			*(9.12)*
Share of students reaching basic literacy		2.644	2.146	
		(3.51)	*(2.58)*	
Share of top-performing students		12.602	16.536	
		(4.35)	*(4.90)*	
OECD	0.859		-0.659	
	(0.32)		*(0.44)*	
OECD x Cognitive skills	-0.203			
	(0.36)			
OECD x basic literacy			2.074	
			(0.94)	
OECD x top-performing			-13.422	
			(2.08)	
Years of non-tertiary schooling				0.076
				(0.94)
Years of tertiary schooling				0.198
				(0.16)
Initial years of schooling	0.080	0.066	0.070	
	(1.07)	*(0.87)*	*(0.94)*	
Initial GDP per capita	-0.313	-0.305	-0.317	-0.325
	(5.61)	*(6.43)*	*(5.63)*	*(6.81)*
No. of countries	50	50	50	50
F (OECD and interaction)	0.10		1.62	
R^2 (adj.)	0.723	0.724	0.734	0.728

Notes: Dependent variable: average annual growth rate in GDP per capita, 1960-2000. Regressions include a constant. *t*-statistics in parentheses. Basic literacy is a score of 400 or above on the PISA scale, which is one standard deviation below the OECD mean. To-performing is a score of 600 or above on the PISA scale, which is one standard deviation above the OECD mean.

Source: Hanushek and Woessmann (2011b)

Figure 1. Combined Completion and Achievement Outcomes, Selected Countries



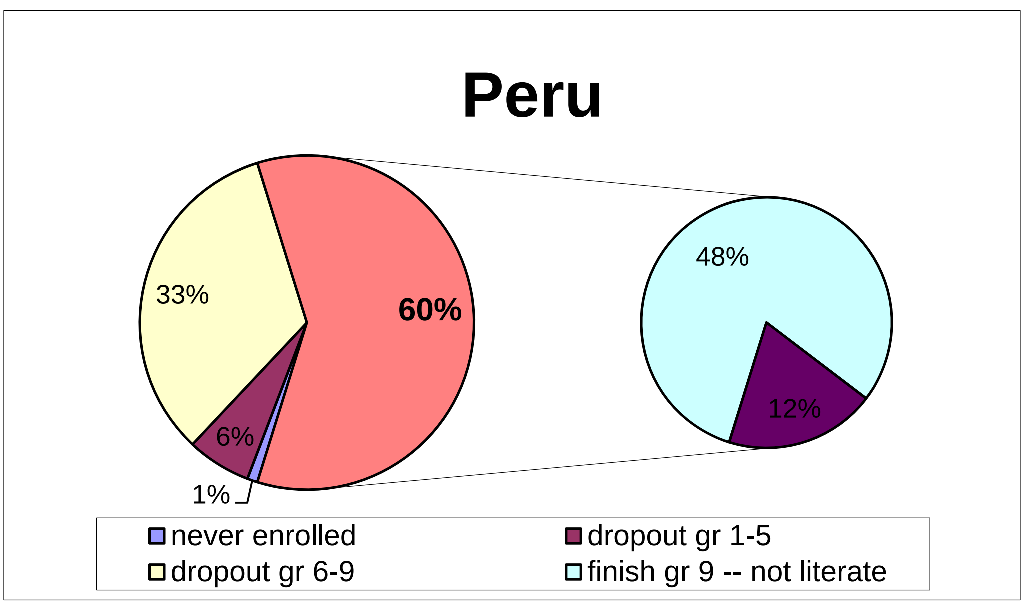


Figure 1(cont.). Combined Completion and Achievement Outcomes, Selected Countries