

Incentives for Efficiency and Equity in the School System

*Eric A. Hanushek**

Hoover Institution of Stanford University, CESifo, and National Bureau of Economic Research

1. Introduction

Education around the world has gotten increased attention over the past few decades. It takes little to convince most policy makers, whether in developed or developing countries, that investments in education are worthwhile. As a result, education occupies a substantial portion of public budgets everywhere. Yet, even as this conviction about the value of schooling grows, dissatisfaction with one's own schools is growing alongside in a wide range of countries. Perhaps nowhere is this clearer than in Germany, where the PISA results provoked a broad reconsideration of many long-held beliefs about the success of German schools. But it also exists in many other countries. At the heart of the issue, countries want to ensure that their investments actually pay off as they expect. The theme of this article is that making this happen will require some substantial changes in approaches and policies. At the same time, it is important to be clear about the existing information and its implications for policy decisions.

2. The Economic Impact of Schooling and Cognitive Skills

An important starting point is understanding more fully just what everybody knows – that educational investments have a high return. The research on this issue, investments in “human capital,” has been extensive, touching virtually every country of the world and falling across a range of subdisciplines in economics including labor economics, public finance, macroeconomics, growth, and international economics. The research is so broad that it would be easy to fill a normal survey article with the work found in any of those subareas.

Yet, what we know may be misleading. Economists have devoted considerable attention to understanding how human capital affects a variety of

*Very helpful research assistance was provided by Trey Miller.

Eric A. Hanushek

economic outcomes. The underlying conceptual notion is now very familiar: individuals make investment decisions in themselves through schooling and other routes. The accumulated skills that are relevant for the labor market from these investments over time represent the human capital of an individual. The conceptual model is clear and elegant, but a central question has been how to measure human capital investments.

Much of the empirical work on human capital quite naturally has concentrated on the role of school attainment, that is, the quantity of schooling. This focus is natural. Policy, particularly in earlier stages of development, frequently focuses on access and attainment. The quantity of schooling is easily measured, and data on years attained, both over time and across individuals, are readily available. These arguments have been so pervasive that school attainment and human capital have virtually become synonyms, and no explanation of this measure is even required. As a result, much of what is commonly known about human capital investments flows directly from this work on how school attainment relates to individual and aggregate economic outcomes.

This focus stands in sharp contrast to policy concerns that revolve much more around issues of quality than issues of quantity, at least in developed countries. Moreover, the evidence suggests that, where quality is ignored, it is a mistake. Part of the neglect is simply due to past lack of measurement of anything but quantity and the commensurate lack of research. However, as Ludger Wößmann and I document, research is becoming more available, and it consistently points toward a redirection of attention to cognitive skills (Hanushek and Wößmann, 2006, 2007).

A key question is whether what we know from investigations of quantity of schooling about policy implications carries over to the consideration of quality, or cognitive skills. There are two primary places to consider in answering this question about the returns to education and human capital: individual earnings and aggregate effects on economic growth.¹ One of the challenges in understanding the impact of quality differences in human capital has been simply knowing how to measure quality. Much of the discussion of quality – in part related to new efforts to provide better accountability – has identified cognitive skills as the important dimension. And, while there is ongoing debate about the testing and measurement of these skills, most parents and policy makers alike accept the notion that cognitive skills are a key dimension of schooling outcomes.

The beginning point for this discussion is whether this proxy for school quality – students' performance on standardized tests – is correlated with individuals' performance in the labor market and the economy's ability to grow.

1. These topics neglect a variety of details for both macro- and microeconomic investigations, such as unemployment rates, diffusion of new technology, and income distribution at the aggregate level or health, individual employment rates, or firm demand for labor at the more micro level. Nonetheless, the two themes of individual earnings and economic growth capture the primary ideas that are important for policy.

Incentives for Efficiency and Equity in the School System

Until recently, little comprehensive data have been available to show any relationship between differences in cognitive skills and any related economic outcomes. Such data are now available.

2.1 Individual Productivity and Incomes

The extensive estimates of returns to years of schooling have been reviewed and critiqued frequently.² The basic approach, following the early developments by Jacob Mincer (1970, 1974), considers the impact of years of schooling on the log of earnings (holding constant experience and possibly other things). The schooling coefficient is frequently interpreted as the rate of return on schooling, although this requires a number of assumptions.³ These studies generally assume that quality differences among schools are unimportant, or at least that neglecting such differences does not bias the estimated returns to schooling.

The one exception is a long standing parallel line of research that is concerned with “ability bias” in the estimation of the returns to schooling.⁴ This fits into the work by economists on determining the average labor market returns to additional schooling. In this, a general concern has been that higher-ability students are more likely to continue in schooling. Therefore, part of the higher earnings observed for those with additional schooling may really reflect pay for added ability and not for the additional schooling. Economists have pursued a variety of analytical approaches for dealing with this, including adjusting for measured cognitive test scores, but this work generally focuses on ability as a predetermined factor, and the cognitive tests are taken simply as a readily available measure of this fixed factor.⁵ It almost completely ignores issues of variation in school quality, and seeing no obvious way around the problems of quality, most analyses tend simply to ignore the issue.⁶ But, this is obviously important for both interpretation and policy.

2. A variety of studies reviews and interprets the basic estimation of rates of return. See Psacharopoulos (1994), Card (1999), Harmon, Oosterbeek, and Walker (2003), Psacharopoulos and Patrinos (2004), and Heckman, Lochner, and Todd (2006).

3. See Heckman, Lochner, and Todd (2006).

4. See, for example, Griliches (1977).

5. The common tests of cognitive skills are sometimes labeled “ability” tests and other times “achievement” tests, in part to distinguish how sensitive they might be over time to various influences. Nonetheless, both typically vary significantly over time with schooling and family circumstances. At times, efforts have been made to isolate these effects in the estimation of returns to years of schooling (e.g., Griliches and Mason, 1972).

6. The approaches have included looking for circumstances where the amount of schooling is affected by things other than the student’s valuation of continuing and considering the income differences among twins (see Card, 1999). The various adjustments for ability differences typically make small differences on the estimates of the value of schooling, and Heckman and Vytalacil (2001) argue that it is not possible to separate the effects of ability and schooling. The only explicit consideration of school quality typically investigates expenditure and resource differences across schools, but these are known to be poor measures of school quality differences (Hanushek, 2002b).

Eric A. Hanushek

Before thinking about the interpretation, we start with the evidence. Direct investigations of cognitive achievement suggest generally large labor market returns to measured individual differences in cognitive skills. A variety of researchers document that the earnings advantages to higher achievement on standardized tests are quite substantial.⁷ These analyses typically find that measured achievement has a direct impact on earnings after allowing for differences in the quantity of schooling, the experiences of workers, and other factors that might also influence earnings. In other words, greater knowledge, as measured by tests similar to those currently being used in accountability systems in many countries, is closely related to individual productivity and earnings.

Three recent U.S. studies provide direct and quite consistent estimates of the impact of test performance on earnings (Mulligan, 1999, Murnane, Willett, Duhaldeborde, and Tyler, 2000, Lazear, 2003). These studies employ different nationally representative data sets that follow students after they leave schooling and enter the labor force. When scores are standardized, they suggest that one standard deviation increase in mathematics performance at the end of high schools translates into 12 percent higher annual earnings over the work life.

Moreover, an additional part of the return to school quality comes through continuation in school. There is substantial U.S. evidence that students who do better in school, either through grades or scores on standardized achievement tests, tend to go farther in school.⁸ It is almost certainly even more important in countries with test-based sorting of students into different educational opportunities. Each of the available investigations highlights the independent role of achievement in affecting the schooling choices and investment decisions of individuals.

The role of schooling and human capital in altering the distribution of incomes in society has also received considerable separate attention. The idea of relating distributional outcomes to school quality is important in the social programs of many countries. It is hoped that through schooling family poverty

7. These results are derived from quite different approaches. The clearest analyses are found in the following references (which are analyzed in Hanushek, 2002b): Bishop (1989, 1991), O'Neill (1990), Grogger and Eide (1993), Blackburn and Neumark (1993, 1995), Murnane, Willett, and Levy (1995), Neal and Johnson (1996), Murnane, Willett, Duhaldeborde, and Tyler (2000), Altonji and Pierret (2001), Murnane, Willett, Braatz, and Duhaldeborde (2001).
8. See, for example, Dugan (1976), Manski and Wise (1983). 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. Bishop (1991) and Hanushek, Rivkin, and Taylor (1996), in considering the factors that influence school attainment, find that individual achievement scores are highly correlated with continued school attendance. Behrman, Kletzer, McPherson, and Schapiro (1998) find strong achievement effects on both continuation into college and quality of college; moreover, the effects are larger when proper account is taken of the various determinants of achievement. Hanushek and Pace (1995) find that college completion is significantly related to higher test scores at the end of high school.

Incentives for Efficiency and Equity in the School System

would not be transferred to the next generation – specifically, that high-quality school investments could overcome deficits originating in the home. Researchers have focused on skill differences as being important in, for example, explaining the patterns of racial earnings differences in the U.S. or the expansion of earnings differences among people with the same levels of schooling.⁹ A number of analyses have further emphasized the growing rewards to skills and have developed the implications of this for wage inequality. Owing to lack of sufficient data over time, they have mostly not looked directly at measured cognitive skills.¹⁰ Nonetheless, building on the findings about individual earnings, it is reasonable to conclude that variations in cognitive skills have a direct impact on variations in the distribution of incomes. Additionally, variations in the skills of those with similar amounts of schooling – say, completing four years of college – may actually be growing over time and may reinforce income differences that come from increased rewards to skills. Nickell (2004) provides direct evidence on the relationship of variations in achievement and variations in incomes across countries.

The simple summary is that cognitive skills are highly related to earnings. The remaining issue, discussed below, is then what determines cognitive skills and how malleable they are.

2.2 Economic Growth

The relationship between measured labor force quality and economic growth is perhaps even more important than the impact of human capital and school quality on individual productivity and incomes. Economic growth determines how much improvement will occur in the overall standard of living of society. Moreover, the education of each individual has the possibility of making others better off (in addition to the individual benefits just discussed). Specifically, a more educated society may lead to higher rates of invention; may make everybody more productive through the ability of firms to introduce new and better production methods; and may lead to more rapid introduction of new technologies. These externalities – influences on others of individual education outcomes – provide extra reason for being concerned about the quality of schooling. Because this is so important and because it has received little attention, this feature of the economy receives the most attention here.

While a variety of models and ideas have been developed to explain differences in growth rates across countries, they invariably include (but are not

9. See, for example, O'Neill (1990), Juhn, Murphy, and Pierce (1991, 1993), Murphy and Welch (1992), Pierce and Welch (1996).

10. Identifying the changing impact of measured ability on the distribution of outcomes over time is also a very difficult problem, particularly given the structure of available data (see Cawley, Heckman, Lochner, and Vytlačil, 2000, Heckman and Vytlačil, 2001).

limited to) the importance of human capital.¹¹ The empirical work supporting growth analyses has emphasized school attainment differences across countries. Again, this is natural because, while compiling comparable data on many things for different countries is difficult, assessing quantity of schooling is more straightforward.

The typical study finds that quantity of schooling is highly related to economic growth rates. But, again, quantity of schooling is a very crude measure of the knowledge and cognitive skills of people. Few people would be willing to assume the amount learned during the sixth grade in a rural hut in a developing country equals that learned in a German sixth grade. Yet that is what is implicitly assumed when empirical analyses focus exclusively on differences in average years of schooling across countries.

Recent work, beginning with efforts by Dennis Kimko and me and extended by others, delves into cognitive skills and the quality of education (as measured by cognitive achievement scores).¹² These analyses incorporate information about international differences in mathematics and science knowledge that has been developed through testing over the past four decades. They find a remarkable impact of differences in school quality on economic growth.

While there are different variants, the analysis by Hanushek and Kimko (2000) is very straightforward, and it provides the essential features and results. We combine all of the available earlier test scores (through 1990) into a single composite measure of quality and consider statistical models that explain differences in growth rates across nations during the period 1960 to 1990. The basic statistical models, which include the initial level of income, the quantity of schooling, and population growth rates, explain a substantial portion of the variation in economic growth across countries. Adding the measure of cognitive skills to the basic equation more than doubles the amount of explained variance in growth rates, with the R^2 going from 0.33 to 0.73.

Most important, the quality of the labor force as measured by math and science scores is extremely important in a quantitative sense. One standard deviation difference on test performance across countries is related to a 1 percent difference in annual growth rates of gross domestic product (GDP) per capita. Moreover, adding other factors potentially related to growth, including aspects of international trade, private and public investment, and political

11. Barro and Sala-i-Martin (2004) review recent analyses. Some have questioned the precise role of schooling in growth. Easterly (2001), for example, notes that education without other facilitating factors such as functioning institutions for markets and legal systems may not have much impact. He argues that World Bank investments in schooling for less developed countries that do not ensure that the other attributes of modern economies are in place have been quite unproductive. As discussed below, schooling clearly interacts with other factors, and these other factors have been important in supporting U.S. growth.
12. The analysis in Hanushek and Kimko (2000) has been extended in a variety of important ways, as discussed in Hanushek and Wößmann (2006). Some notable studies in this line include Lee and Lee (1995), Barro (2001), Wößmann (2002, 2003), Bosworth and Collins (2003), Coulombe and Tremblay (2006), and Jamison, Jamison, and Hanushek (2007).

Incentives for Efficiency and Equity in the School System

instability, leaves the effects of labor force quality measured by the international tests unchanged.

One common concern in analyses such as this is of course that schooling might not be the actual cause of growth but, in fact, may just reflect other attributes of the economy that are beneficial to growth. For example, the East Asian countries consistently score very highly on the international tests, and they also had extraordinarily high growth over the 1960–1990 period. It may be that other aspects of these East Asian economies have driven their growth and that the statistical analysis of labor force quality simply is picking out these countries. But in fact, even if the East Asian countries are excluded from the analysis, a strong – albeit slightly smaller – relationship is still observed with test performance.

Another concern might be that other factors that affect growth, such as efficient market organizations, are also associated with efficient and productive schools – so that, again, the test measures are really a proxy for other attributes of the country. In order to investigate this, Hanushek and Kimko concentrate on immigrants to the United States who received their education in their home countries. The analysis shows that immigrants who were schooled in countries that have higher scores on the international math and science examinations earn more in the United States, but earnings of immigrants schooled in the U.S. are unrelated to the cognitive skills of their home country. This analysis makes allowance for any differences in school attainment, labor market experience, or being native English-language speakers. In other words, skill differences as measured by the international tests are clearly rewarded in the United States labor market, reinforcing the validity of the tests as a measure of individual skills and productivity.

Finally, the observed relationships could simply reflect reverse causality, that is, that countries that are growing rapidly create the resources necessary to improve their schools and that better student performance is the result of growth, not the cause of growth.¹³ As a simple test of this, Hanushek and Kimko investigated whether the international math and science test scores were systematically related to the resources devoted to the schools in the years prior to the tests. They were not. If anything, we found relatively better performance in those countries spending less on their schools.

These results, including the sensitivity analyses, have been extended to 2000 by Hanushek and Wößmann (2006). This extension both allows for possible influence of the international instability of the 1990s and permits an expansion of the country database (because of additional international testing). The estimated impact of cognitive skills on growth is remarkably stable.

Importantly, when cognitive skills are added to the basic growth model, the effect of quantity of schooling falls dramatically and becomes statistically

13. This reverse causation is most clearly argued by Bils and Klenow (2000) in analyses of growth and school attainment.

insignificant. In other words, once knowledge is included, just measuring how long people attend formal schooling is no longer a useful predictor.

In sum, the relationship between math and science skills on the one hand and productivity and growth on the other hand comes through clearly when investigated in a systematic manner across countries. The importance of cognitive skills reinforces the attention that nations today are giving to school quality.

3. Changing Cognitive Outcomes

As noted, early analyses of “ability bias” in earnings assumed that cognitive skills were essentially fixed. Analyses of achievement outcomes for students show, however, that this is clearly not the case. Yet, a key question remaining is whether these skills are amenable to government policies that might improve them.

Turning to what countries can do if they want to change cognitive skills, the challenge becomes immediately obvious. Even though a wide range of factors are known to influence student achievement – including family, peers, and schools – policy attention generally concentrates on the role of schools and school quality. This focus is quite natural because governments typically are reluctant to be too actively involved in the family but do have significant control over the schools.¹⁴

The research over the past four decades has returned a somewhat surprising set of results about the influence of schools. Specifically, hundreds of estimates of the impact of school resources on performance suggest that basic resources have no consistent effect on student performance.

Research has not shown any clear causal relationship between the amount that schools spend and student achievement.¹⁵ Although there has been considerable debate on aspects of the research, it is now generally recognized that within broad ranges *how* money is spent is much more important than *how much* is spent. This finding is particularly important in considering aggregate governmental actions including those related to the financing of schools. Is it possible to control effectively how any new monies are spent so that added funds would consistently lead to improved student outcomes?

Specifically, a vast literature has looked at class size, teacher experience, and teacher education effects on achievement. The results are very clear on each. With pupil – teacher ratios, almost three-quarters of all studies find no significant relationship with achievement, and the statistically significant estimates

14. Virtually all research into student achievement finds that families are very important. The evidence on the role of peers is considerably less clear. See Hanushek (2002b).

15. Hanushek (1986, 2003, 2006). This line of research was begun by the Coleman Report (Coleman et al., 1966), which early suggested that school resources were not a very important determinant of student achievement and has grown into a vast set of statistical studies.

Incentives for Efficiency and Equity in the School System

are evenly divided between those showing the expected negative impact of a higher pupil-teacher ratio and those showing a positive impact on achievement.¹⁶ With teacher education, less than 10 percent of estimates indicate a statistically significant positive impact of more education on student achievement. Again, there is no support for any consistent relationship between teacher education and student achievement. In overall terms, teacher experience has historically shown a stronger relationship with performance, but recent studies have consistently shown that the impact of experience is concentrated in the first year or two of teaching with little impact of any additional experience.¹⁷

Not surprisingly, since the primary components of teacher salary determination – experience and education levels – do not have any consistent link with achievement, teacher salary differences themselves also show little consistent relationship with achievement. A good teacher is as likely to have a low salary as a high salary.¹⁸ Further, since salaries and pupil-teacher ratios are the largest determinants of variations in instructional expenditures, the level of spending also has little consistent relationship with achievement.¹⁹

The studies on student achievement vary in a variety of ways including, importantly, quality of the study. Yet, after adjusting for quality of the study in a variety of ways, the lack of systematic relationship of resources and achievement becomes even more evident (Hanushek, 2003, 2006).

The most intense discussions of resource effects come in terms of class-size effects. Although the vast majority of econometric studies show little impact of class-size reduction on achievement, the now-famous STAR study from Tennessee found positive impacts in a random assignment experimental study during the 1980s.²⁰ These debates have generally focused on the simple issue of whether there is a small effect of lower class sizes versus no effect. At the same time, because class size reduction is so expensive, there is much less debate on whether class size reduction is a good policy or not, because the expense

16. The results of prior studies can be found in Hanushek (2003, 2006) and Hanushek and Rivkin (2006). Note that some studies use teacher-pupil ratios while others use actual class sizes. The results for studies of actual class sizes if anything show a weaker relationship of class size and achievement than those for studies involving pupil-teacher ratios.

17. For further discussion of teacher experience, see Hanushek and Rivkin (2007) and Murnane and Steele (2007). The analysis of experience is also complicated because more senior teachers often have more chances to move among schools. At least in the U.S., teachers tend to seek out schools with higher achieving students, thus entering questions about the direction of causation; see Greenberg and McCall (1974), Murnane (1981), and Hanushek, Kain, and Rivkin (2004).

18. See Hanushek and Rivkin (2006).

19. In all cases, some studies have found statistically significant positive effects of school spending, and people who wish to advocate for more spending tend to cite just these. Nonetheless, particularly with the spending studies, the ones finding a positive relationship with achievement prove to be the lowest-quality studies (Hanushek, 2003).

20. The debates on the subject can be found in Word et al. (1990), Hanushek (1999a, b, 2002a) and Krueger (2002). For discussion of the international evidence, see Wößmann (2007a).

Eric A. Hanushek

swamps the small achievement impacts that might be expected even under optimistic interpretations of the estimates in the achievement literature.

A simplistic view of this general argument about resources – conveniently raised as a straw man to be beaten down – is that “money never matters.”²¹ The research, of course, does not say that. Nor does it say that “money cannot matter.” It simply underscores the fact that historically a set of decisions and incentives existing in schools have blunted any impacts of added funds, leading to inconsistent outcomes. That is, more spending on schools has not led reliably to substantially better results by students on achievement tests.

Research into student achievement has also not ended at this point of “no effects.” In particular, this is mounting evidence that teacher quality is extraordinarily important. Specifically, analysis of student performance shows that achievement gains in the classes of some teachers consistently outstrip the gains of other teachers.²² But this research at the same time reinforces the prior analyses of resources. The best teachers are not the ones with the most education or experience. In fact, there is no consistent relationship between teacher quality – measured by student achievement growth – and the characteristics of teachers (except, again, for the effect of the first year of teaching experience).

This research as a whole begins to fill in the details of what has been seen about resources and achievement overall. The strategy of pumping more resources into the current system has not led to any overall improvements in student outcomes. To be sure, sometimes schools use resources effectively to enhance student performance. But as often as not, other schools do not use resources effectively.

This situation with respect to the impact of resources on achievement is partly surprising and partly not. The unsurprising part is that a government-run program with virtual local monopolies does not appear to be particularly efficient. Our normal presumption in market situations is that we can use measures of resources to provide an index of quality, but this clearly does not hold in the case of schools. The surprising part is that a number of analyses indicate that it is more than just inefficiency. At various times, it appears that more resources are actually associated with lower outcomes. It is not just a matter of inefficiency, or failing to get as much as possible from added resources, but of resources possibly lowering outcomes.

The idea of negative resource effects is of course difficult to believe, suggesting that it might simply reflect analytical problems. For example, if extra

21. At least outside of courtrooms in school finance court cases (see below), most discussion of the “money never matters” debate, a controversy of a decade ago, has subsided. For the historical framing of the question, see the following exchange: Hedges, Laine, and Greenwald (1994) and Hanushek (1994).
22. A variety of studies have pursued this general approach over the past four decades; see, Hanushek (1971, 1992), Armor et al. (1976), Murnane (1975); Murnane and Phillips (1981), Aaronson, Barrow, and Sander (2007), Rockoff (2004), Rivkin, Hanushek, and Kain (2005), and Hanushek, Kain, O’Brien, and Rivkin (2005).

Incentives for Efficiency and Equity in the School System

resources are typically supplied in a compensatory manner when performance is low, higher resources would appear to be related to lower performance. Nonetheless, the general nature of the findings holds for the best studies. More particularly, a variety of analytical strategies have been devised to obtain causal impacts of resources, and these have failed to show consistent positive impacts of resources (Hanushek, 2006).

In response, one common policy approach has been regulatory in nature. Starting with the findings that teacher quality is important, the idea has been to define more precisely what qualifications a teacher should have. These qualifications, part of the requirements for certification, have, however, been generally ineffective, because the research has been unable to pinpoint particular characteristics of teachers that are important (Hanushek and Rivkin, 2006). Similar results hold for other regulatory approaches to school policy, such as dictating lower class sizes or instituting other specific broad-scale programs. Even if these policies are truly effective in some environments, they generally fail to improve outcomes when implanted into very heterogeneous school settings. Thus, we are back to looking for other approaches to improve schools and to raise student achievement.

4. Institutions and Incentives

The desire to improve student outcomes, combined with the dismal results of the regulatory approach, has led to a variety of calls for an alternative – changing the incentives that are operating across schools. The fundamental concern is that the incentives currently operating do not point systematically toward higher student achievement.

4.1 Supply Side Incentives

A variety of policy prescriptions have been proposed. The most frequently discussed include introducing standards and accountability, greater school autonomy, direct pay for performance, and expanded school choice. Standards and accountability begin with a comprehensive specification of what content knowledge students should have in each subject and at each grade level; this clear statement of objectives forms the basis for assessment that are both made public and form the basis for rewards and punishments to schools. School autonomy, which can be defined along various dimensions including fiscal autonomy, curricular autonomy, and local hiring authority, posits that performance of schools can be improved if local officials have greater latitude in making school decisions. Finally, expanded choice holds that allowing students to choose what school they attend will set up incentives for schools to design programs that attract students, and that this will in turn lead to better outcomes.

Eric A. Hanushek

Some evidence suggests that each of these has positive impacts on student outcomes. Each is difficult at times to evaluate because the policies tend to be introduced on a broad scale – either across a nation or across a state or province. As a result, it is difficult to develop a suitable control situation to the use of these major institutions/incentives. Furthermore, these innovations have generally been introduced on a limited scale, and frequently only in recent years where the opportunity for evaluation has been limited. Nonetheless, the available evidence fairly consistently indicates that these incentives have desirable effects on outcomes.²³

These various alternative incentives lay a strong groundwork for a different perspective on policy – and surely not one that would surprise economists. The primary focus of these incentive approaches has been on the operations of schools – namely, supply side incentives.²⁴ And, the conceptual properties of these incentives are well known, even if some uncertainty exists about the empirical evidence on effects.

My interpretation of these supply side incentives is that they operate through affecting the quality of teachers in the classroom. Each in one way or another rewards schools that contribute more to student achievement, and the most reliable way to increase achievement is through improving the quality of teachers.

4.2 Demand Side Incentives

The more novel approach comes from “demand-side” incentives. These are sets of incentives designed to work primarily through students and their families, as opposed to their impact on the schools themselves. These are interesting because of their potential impacts. But, perhaps more important, they are also a timely reminder about being clear on the objectives and measurement of success.

Demand side incentives are more commonly, but not exclusively, used in developing countries. In more developed countries it is often believed that the high rates of return to educational investments identified previously are sufficient to motivate students and their parents. On the other hand, because lack of information, competing pressures, credit constraints and the like may be more important, such general market incentives may be muted in developing countries.

23. See Hanushek and Wößmann (2006) for a review and evaluation of the available U.S. and international evidence. High-quality studies of voucher choice programs are available for Columbia (Angrist et al., 2002, Angrist, Bettinger, and Kremer, 2006) and Chile (Spaelli and Vial, 2002); see also the review in Wößmann (2007b). Quality estimates of the effects of decentralization in developing countries are found in Jimenez and Sawada (1999), Galiani and Schargrodsy (2002) and Di Gropella and Marshall (2002). Interesting investigations of teacher incentives include Glewwe, Ilas, and Kremer (2003) and Duflo and Hanna (2005); see also Hanushek and Rivkin (2006) and Podgursky and Springer (2007) for U.S. evidence.

24. Expanded choice might be thought of as combining supply-side and demand-side incentives, although the reform portion clearly comes from ideas of impacts on schools through their desire to attract students.

Incentives for Efficiency and Equity in the School System

Table 1 High-Quality Studies of Fee Reduction in Developing Countries

Study	Country	Background	Estimation Method	Result
Sparrow (2007)	Indonesia	Evaluates scholarship for primary-secondary schooling in Indonesia targeted at poor.	IV exploiting decentralized targeting design of program	10% increase in enrollment for primary school; lower but substantial for secondary. Substantial decrease in child labor.
Spohr (2003)	Taiwan	Evaluates Taiwan's extension of tuition-free education from 6–9 years.	Regression discontinuity type IV for labor market models	Average impact of .4 yr increase in schooling for males and .25 yrs for females; larger effect for females in labor market.
Schady and Filmer (2006)	Cambodia	Evaluates scholarship program aimed at keeping girls in school	OLS, Matching, and Regression Discontinuity	Program increase probability of school attendance by 33–43% for females. Impact largest for those with low SES at baseline.
Kremer, Miguel, and Thornton (2004)	Kenya	Randomized evaluation of a merit scholarship program for adolescent girls in Kenya. Random selection of schools eligible; females scoring highest on exam got scholarship	Randomization	Increased exam scores .12–.19 sd for eligible females. Evidence of externalities for boys and females unlikely to win the scholarships.

Source: Own collection.

Before moving to developing countries, however, it is useful to note the clearest exception with demand side incentives being found exclusively in developed countries. This exception is the role of centralized examination systems. Many countries link various educational decisions, particularly those involving continuation to various tertiary schooling, to performance on a common examination. Consequential central examinations, by providing incentives to students to perform well that are different from the incentives of classroom- or school-based exams, encourage students both to work together and to perform

better. And this appears to be borne out in international evidence.²⁵ This work is especially interesting. Students are obviously a key part of learning, but they are most often essentially ignored from a policy viewpoint. These analyses show a generally positive impact of exams on cognitive achievement and thus look like a potentially useful institutional policy tool.

The more specific demand side incentives that have received considerable attention in developing countries involve monetary incentives (fee reduction and conditional cash transfers) and food and nutrition programs that go with school attendance. These programs are interesting in their focus. Moreover, they have been subjected to especially reliable analyses. Because these treatments are generally clearly defined and can be structured so that there are clear control groups, they lend themselves to a variety of approaches that get at causality of the programs.

The first set of programs considered here involves reductions in school fees. In general, the idea is that the fees charged to students could constrain attendance, particularly among children from poor families. Table 1 summarizes the results from a series of high-quality evaluations in a range of countries – Indonesia, Taiwan, Cambodia, and Kenya. Two results are evident in this summary. First, each of these demand-side programs leads to strong responses from those involved. These effects, estimated through regression discontinuity designs and explicit randomization (by school), suggest a strong impact. Second, however, with the exception of the Kenyan merit scholarship program, the entire emphasis focuses on school attendance and school attainment.

It seems natural that developing countries pay attention to attainment. They begin with low levels of attendance and school completion. And, this focus fits into the Millennium Development Goals and the Education for All Initiative – two high profile international efforts to improve the human capital investments in developing countries. Moreover, children cannot effectively learn if they are not attending schools.

These access programs are viewed as a central component of improving the equity of the educational system. They reflect an attempt to reverse the highly distorted attendance patterns by socio-economic status that have typically prevailed in developing countries where large segments of the population have not participated much if at all in the schooling system.

On the other hand, the previous evidence emphasized the role of cognitive skills over the role of school attainment. Indeed, the evidence also shows that many countries, where attainment is relatively high, develop abysmally low levels of cognitive skills.²⁶ There clearly is a delicate trade-off between

25. See Bishop (1997, 2006), Bishop, Mane, Bishop, and Moriarty (2001), Wößmann (2005).

26. For example, 5 percent of the youth in Ghana both complete grade nine and can perform at basic skill levels according to the PISA tests (i.e., within one standard deviation of the OECD mean). This is less than 15 percent of the students who complete grade 9 (Hanushek and Wößmann, 2006).

Incentives for Efficiency and Equity in the School System

Table 2 High Quality Studies of Conditional Cash Transfers in Developing Countries

Study	Country	Background	Estimation Method	Result
Todd and Wolpin (2006)	Mexico	Evaluates Mexican Progresa Program and uses results to validate a behavioral model of schooling and fertility.	Randomization and structural Model	Experimental dif-in-dif estimates: increase 12-15 girl attendance by 10% and 12-15 boys attendance by 3%.
Schultz (2004)	Mexico	Evaluates Progresa	Randomization	Found large positive impacts on school attendance, especially in "transition years." Decreased child labor and found no impact on fertility.
Attanasio et al. (2006)	Colombia	Evaluates Colombian Fiamilias in Accion program (Similar to Progresa)	Non-Random assignment at village level – Difference in differences with well constructed control groups.	5-7% increase school participation for 14-17 yr old – 2.5% for younger children. Decreased domestic work by 10-12% for young children
Maluccio and Flores (2005)	Nicaragua	Evaluates Nicaraguan Red de Proteccion Social (Similar to Progresa)	Randomized village-level implementation	Strong and favorable impacts on household expenditure, schooling, child labor and child health.
Cardoso and Souza (2004)	Brazil	Evaluates Brazil's "Bolsa Escola" Program (similar to Progresa).	Non-random and poor at implementation requires post implementation matching method.	No significant impact on child labor but positive and highly significant effect on school attendance.

Source: Own collection.

getting students into schools and getting them to learn something. Seat time does not translate clearly into the cognitive skills with payoffs. And expanding the numbers of students in schools may even make it more difficult to mount effective programs. The one exception in the fee programs is the Kenyan

Table 3 High-Quality Studies of Food and Nutritional Supplements in Developing Countries

Study	Country	Background	Estimation Method	Result
Meng and Ryan (2003)	Bangladesh	Evaluates Bangladeshi Food for Education Program	Propensity Score Matching – selection only on observables.	Program estimated to increase school participation rates by 20–30% and educational attainment by .5–2.0 yrs.
Bobonis, Miguel, and Puri-Sharma (2006)	India	Evaluates randomized intervention delivering iron supplements and deworming drugs to children in slums of Delhi, India.	Randomization	69% anemic and 30% underweight at baseline. Program increased weight and preschool participation rates increased by 5.8%. Absenteeism decreased 20%.
Miguel and Kremer (2004)	Kenya	Evaluates school-based deworming program in Kenya.	Randomization	Reduced absenteeism by 25% – effect produced externalities in neighboring schools. No evidence of improvement in test scores.
Vermeersch and Kremer (2005)	Kenya	Evaluates randomized intervention providing school meals to pre-schools in Kenya.	Randomization	School participation increased by 30% and higher scores on exams, but only when students had experienced teachers. Caused school to increase fees and pupil-teacher ratios.

Source: Own collection.

activity that explicitly linked the student subsidy program to student learning and knowledge, and there it worked to increase student achievement.

Table 2 provides similar information for high-quality studies of conditional case transfers. The general idea is that families of students who regularly attend school receive an income transfer based on family income and grade level. The best-known of these programs is the Progresa program in Mexico, but similar

Incentives for Efficiency and Equity in the School System

programs have been developed in Brazil, Columbia, and Nicaragua. Again, these programs with high-quality evaluations based largely on randomization find that there are typically strong impacts on attendance (and decreased involvement in child labor). Thus, similar to the fee reduction programs there are important responses to incentives, but again the policies and outcomes are focused most directly on school attainment and not cognitive skills.

The food and nutrition programs summarized in Table 3 follows the same pattern. There are direct impacts on attendance, school participation, and health, but no observable impacts on learning. In other words, the encouragement of school attendance through incentives to students works to bring them in, even if the educational programs when they get there are not particularly effective.

Furthermore, access to low-quality schools hardly seems equitable. There is an obvious need to balance expanded school attendance with school quality. Further, while beyond the scope of his article, there is evidence that good quality frequently does not cost more than poor quality (Hanushek, 2003).

5. Conclusions

The review of human capital research produces a very simple result – attention has to be given to the knowledge and skills that students acquire. By the historical development of research, prior analytical attention concentrated on school attainment as the measure of human capital. Yet, this measure of human capital neglects learning that comes from outside of schools, and it neglects qualitative differences in schools and other inputs. More recent research shows simply that direct measures of cognitive skills are far superior measures of the human capital of individuals and of nations. Moreover, once quality is considered, the economic impact of attainment drops noticeably and even disappears in the case of economic growth.

This finding is important, because it focuses any policy concerns on the achievement of students. That has advantages and disadvantages. The advantages are that it reinforces efforts to improve the quality of schools and to establish accountability based on measured skills of students. The disadvantages reflect largely the fact that changing quality has proved difficult (while changing attainment looks noticeably easier from a governmental policy viewpoint). The ineffectiveness of general resource policies toward schools – increasing funding, emphasizing teacher degrees or experience, or reducing pupil–teacher ratios – has highlighted the difficulties. Such policies are relatively easy to put in place through governmental intervention, but they cannot be counted on to lead to improvements in student achievement.

The ineffectiveness of common “input” strategies motivates a number of recent attempts to alter the incentives faced by schools and students. In particular, desirable behavior by schools and teachers is rewarded in a variety of ways through governmental programs, and these attempts generally show

Eric A. Hanushek

positive impacts. Supply incentives (those operating on school personnel) include a range of pay for performance schemes, accountability with rewards and punishments attached to outcomes, expanded choice of schools for students, and increased decision-making authority in schools, and these have generally had positive effects on student achievement. The limited application of these programs does leave a variety of remaining questions about the magnitude of any impacts.

Other incentive programs operate on the demand side, altering the rewards to students for successful attendance at schools. These programs, found importantly in developing countries, have received less general attention, but they provide some additional insights.

Two general conclusions come out of these demand-side programs. To begin with, contrary to what many assert, students and their families do respond strongly to the incentives that they face. This presents a positive finding for the direction of future program development, in developing as well as developed countries.

But, equally important, more attention needs to be given to what behaviors are rewarded. Perhaps because much of the discussion of policy in developing countries revolves around access and getting children to attend schools, most of the demand-side programs have emphasized school attainment. Yet, the evidence that is accumulating suggests that simply recording attendance and attainment may give very little information about the effective human capital of these students. Thus, the objective of incentives needs more attention, because the effective incentives may not be providing as much in the way of true improvements in outcomes as many believe when they do not emphasize cognitive skills directly.

References

- Aaronson, D., L. Barrow and W. Sander (2007), Teachers and Student Achievement in the Chicago Public High Schools, *Journal of Labor Economics* 25, 95–135.
- Altonji, J.G. and C.R. Pierret (2001), Employer Learning and Statistical Discrimination, *Quarterly Journal of Economics* 116, 313–350.
- Angrist, J., E. Bettinger, E. Bloom, E. King and M. Kremer (2002), Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment, *American Economic Review* 95, 1535–1558.
- Angrist, J., E. Bettinger and M. Kremer (2006), Long-Term Educational Consequences of Secondary School Vouchers: Evidence from Administrative Records in Colombia, *American Economic Review* 96, 847–862.
- Armor, D.J., P. Conry-Oseguera, M. Cox, N. King, L. McDonnell, A. Pascal, E. Pauly and G. Zellman (1976), *Analysis of the School Preferred Reading Program in Selected Los Angeles Minority Schools*. Rand Corp., Santa Monica.
- Attanasio, O., E. Fitzsimons, A. Gomez, D. Lopez, C. Meghir and A. Mesnard (2006), Child Education and Work Choices in the Presence of a Conditional Cash Transfer Programme in Rural Colombia, Institute for Fiscal Studies, Working Paper No. 06/01.
- Barro, R.J. (2001), Human Capital and Growth, *American Economic Review* 91, 12–17.

Incentives for Efficiency and Equity in the School System

- Barro, R.J. and X. Sala-i-Martin (2004), *Economic Growth*. 2nd ed., MIT Press, Cambridge.
- Behrman, J.R., L.G. Kletzer, M.S. McPherson and M.O. Schapiro (1998), The Microeconomics of College Choice, Careers, and Wages: Measuring the Impact of Higher Education, *Annals of the American Academy of Political and Social Science* 559, 12–23.
- Bils, M. and P.J. Klenow (2000), Does Schooling Cause Growth?, *American Economic Review* 90, 1160–1183.
- Bishop, J.H. (1989), Is the Test Score Decline Responsible for the Productivity Growth Decline?, *American Economic Review* 79, 178–197.
- Bishop, J.H. (1991), Achievement, Test Scores, and Relative Wages, in: M.H. Koster (ed.), *Workers and their Wages*. AEI Press, Washington, D.C., 146–186.
- Bishop, J.H. (1997), The Effect of National Standards and Curriculum-Based Examinations on Achievement, *American Economic Review* 87, 260–264.
- Bishop, J.H. (2006), Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn – Externalities, Information Problems, and Peer Pressure, in: E.A. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*. North Holland, Amsterdam, 909–944.
- Bishop, J.H., F. Mane, M. Bishop and J. Moriarty (2001), The Role of End-of-Course Exams and Minimal Competency Exams in Standards-Based Reforms, in: D. Ravitch (ed.), *Brookings Papers on Education Policy 2001*. Brookings, Washington, D.C., 267–345.
- Blackburn, M.L. and D. Neumark (1993), Omitted-Ability Bias and the Increase in the Return to Schooling, *Journal of Labor Economics* 11, 521–544.
- Blackburn, M.L. and D. Neumark (1995), Are OLS Estimates of the Return to Schooling Biased Downward? Another Look, *Review of Economics and Statistics* 77, 217–230.
- Bobonis, G., E. Miguel and C. Puri-Sharma (2006), Anemia and School Participation, *Journal of Human Resources* 41, 692–721.
- Bosworth, B.P. and S.M. Collins, (2003), The Empirics of Growth: An Update, *Brookings Papers on Economic Activity* 2003, 113–206.
- Card, D. (1999), Causal Effect of Education on Earnings, in: O. Ashenfelter and D. Card (eds.), *Handbook of Labor Economics*. North-Holland, Amsterdam, 1801–1863.
- Cardoso, E. and A. Souza (2004), The Impact of Cash Transfers on Child Labor and School Attendance in Brazil, Vanderbilt University, Department of Economics, Working Paper No. 0407.
- Cawley, J., J.J. Heckman, L. Lochner and E. Vytlačil (2000), Understanding the Role of Cognitive Ability in Accounting for the Recent Rise in the Economic Return to Education, in: K. Arrow, S. Bowles and S. Durlauf (eds.), *Meritocracy and Economic Inequality*. Princeton University Press, Princeton, 230–265.
- Coleman, J.S., E.Q. Campbell, C.J. Hobson, J. McPartland, A.M. Mood, F.D. Weinfeld and R.L. York (1966), *Equality of Educational Opportunity*. U.S. Government Printing Office, Washington, D.C.
- Coulombe, S. and J.-F. Tremblay (2006), Literacy and Growth, *Topics in Macroeconomics* 6, Article 4.
- Di Gropella, E. and J. Marshall (2002), Teacher Effort and Schooling Outcomes in Rural Honduras, in: E. Vegas (ed.), *Incentives to Improve Teaching: Lessons from Latin America*. World Bank, 307–358.
- Duflo, E. and R. Hanna (2005), Monitoring Works: Getting Teachers to Come to School, NBER, Working Paper 11880.
- Dugan, D.J. (1976), Scholastic Achievement: Its Determinants and Effects in the Education Industry, in: J.T. Froomkin, D.T. Jamison and R. Radner (eds.), *Education as an*

Eric A. Hanushek

- Industry*. Ballinger, Cambridge, 53–83.
- Easterly, W. (2001), *The Elusive Quest for Growth: An Economists' Adventures and Misadventures in the Tropics*. MIT Press, Cambridge.
- Galiani, S. and E. Schargrodsy (2002), Evaluating the Impact of School Decentralization on Educational Quality, *Economia* 2, 275–302.
- Glewwe, P., N. Ilas and M. Kremer (2003), Teacher Incentives, NBER, Working Paper No. 9671.
- Greenberg, D. and J. McCall (1974), Teacher Mobility and Allocation, *Journal of Human Resources* 9, 480–502.
- Griliches, Z. (1977), Estimating the Returns to Schooling: Some Econometric Problems, *Econometrica* 45, 1–22.
- Griliches, Z. and W. Mason (1972), Education, Income and Ability, *Journal of Political Economy* 80, 74–103.
- Grogger, J.T. and E. Eide (1993), Changes in College Skills and the Rise in the College Wage Premium, *Journal of Human Resources* 30, 280–310.
- Hanushek, E.A. (1971), Teacher Characteristics and Gains in Student Achievement: Estimation Using Micro Data, *American Economic Review* 60, 280–288.
- Hanushek, E.A. (1986), The Economics of Schooling: Production and Efficiency in Public Schools, *Journal of Economic Literature* 24, 141–177.
- Hanushek, E.A. (1992), The Trade-Off between Child Quantity and Quality, *Journal of Political Economy* 100, 84–117.
- Hanushek, E.A. (1994), Money Might Matter Somewhere: A Response to Hedges, Laine, and Greenwald, *Educational Researcher* 23, 5–8.
- Hanushek, E.A. (1999a), The Evidence on Class Size, in: S.E. Mayer and P.E. Peterson (eds.), *Earning and Learning: How Schools Matter*. Brookings Institution, Washington, D.C., 131–168.
- Hanushek, E.A. (1999b), Some Findings from an Independent Investigation of the Tennessee STAR Experiment and from Other Investigations of Class Size Effects, *Educational Evaluation and Policy Analysis* 21, 143–163.
- Hanushek, E.A. (2002a), Evidence, Politics, and the Class Size Debate, in: L. Mishel and R. Rothstein (eds.), *The Class Size Debate*. Economic Policy Institute, Washington, D.C., 37–65.
- Hanushek, E.A. (2002b), Publicly Provided Education, in: A.J. Auerbach and M. Feldstein *Handbook of Public Economics*. Elsevier, Amsterdam, 2045–2141.
- Hanushek, E.A. (2003), The Failure of Input-Based Schooling Policies, *Economic Journal* 113, 64–98.
- Hanushek, E.A. (2006), School Resources, in: E.A. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*. North Holland, Amsterdam, 865–908.
- Hanushek, E.A., J.F. Kain, D.M. O'Brien and S.G. Rivkin (2005), The Market for Teacher Quality, National Bureau of Economic Research, Working Paper No. 11154.
- Hanushek, E.A., J.F. Kain and S.G. Rivkin (2004), Why Public Schools Lose Teachers, *Journal of Human Resources* 39, 326–354.
- Hanushek, E.A. and D.D. Kimko (2000), Schooling, Labor Force Quality, and the Growth of Nations, *American Economic Review* 90, 1184–1208.
- Hanushek, E.A. and R.R. Pace (1995), Who Chooses to Teach (and Why)?, *Economics of Education Review* 14, 101–117.
- Hanushek, E.A. and S.G. Rivkin (2006), Teacher Quality, in: E.A. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*. North Holland, Amsterdam, 1051–1078.

Incentives for Efficiency and Equity in the School System

- Hanushek, E.A. and S.G. Rivkin (2007), Pay, Working Conditions, and Teacher Quality, *Future of Children* 17, 69–86.
- Hanushek, E.A., S.G. Rivkin and L.L. Taylor (1996), Aggregation and the Estimated Effects of School Resources, *Review of Economics and Statistics* 78, 611–627.
- Hanushek, E.A. and L. Wößmann (2006), The Role of School Improvement in Economic Development, National Bureau of Economic Research Working Paper No. 12832.
- Hanushek, E.A. and L. Wößmann (2007), *Education Quality and Economic Growth*. World Bank, Washington, D.C.
- Harmon, C., H. Oosterbeek and I. Walker (2003), The Returns to Education: Microeconomics, *Journal of Economic Surveys* 17, 115–155.
- Heckman, J.J., L.J. Lochner and P.E. Todd (2006), Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond, in: E.A. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*. North Holland, Amsterdam, 307–458.
- Heckman, J.J. and E. Vytlacil (2001), Identifying the Role of Cognitive Ability in Explaining the Level of and Change in the Return to Schooling, *Review of Economics and Statistics* 83, 1–12.
- Hedges, L.V., R.D. Laine and R. Greenwald (1994), Does Money Matter? A Meta-Analysis of Studies of the Effects of Differential School Inputs on Student Outcomes, *Educational Researcher* 23, 5–14.
- Jamison, E.A., D.T. Jamison and E.A. Hanushek (2007), The Effects of Education Quality on Mortality Decline and Income Growth, *Economics of Education Review* 26, 772–789.
- Jimenez, E. and Y. Sawada (1999), Do Community-Managed Schools Work? An Evaluation of El Salvador's EDUCO Program, *World Bank Economic Review* 13, 415–441.
- Juhn, C., K.M. Murphy and B. Pierce (1991), Accounting for the Slowdown in Black-White Wage Convergence, in: M.H. Koster (ed.), *Workers and their Wages*. AEI Press, Washington, D.C., 107–143.
- Juhn, C., K.M. Murphy and B. Pierce (1993), Wage Inequality and the Rise in Returns to Skill, *Journal of Political Economy* 101, 410–442.
- Kremer, M., E. Miguel and R. Thornton (2004), Incentives to Learn, NBER Working Paper No. 10971.
- Krueger, A.B. (2002), Understanding the Magnitude and Effect of Class Size on Student Achievement, in: L. Mishel and R. Rothstein (eds.), *The class Size Debate*. Economic Policy Institute, Washington, D.C., 7–35.
- Lazear, E.P. (2003), Teacher Incentives, *Swedish Economic Policy Review* 10, 179–214.
- Lee, D.W. and T.H. Lee (1995), Human Capital and Economic Growth: Tests Based on the International Evaluation of Educational Achievement, *Economics Letters* 47, 219–225.
- Maluccio, J. and R. Flores (2005), Impact Evaluation of a Conditional Cash Transfer Program: The Nicaraguan Red de Protección Social, International Food Policy Research Institute Working Paper No. 141.
- Manski, C.F. and D.A. Wise (1983), *College Choice in America*. Harvard University Press, Cambridge.
- Meng, X. and J. Ryan (2003), Evaluating the Food for Education Program in Bangladesh, Australia South Asia Research Centre, Australian National University.
- Miguel, E. and M. Kremer (2004), Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities, *Econometrica* 72, 59–217.

Eric A. Hanushek

- Mincer, J. (1970), The Distribution of Labor Incomes: A Survey with Special Reference to the Human Capital Approach, *Journal of Economic Literature* 8, 1–26.
- Mincer, J. (1974), *Schooling Experience and Earnings*. NBER, New York.
- Mulligan, C.B. (1999), Galton versus the Human Capital Approach to Inheritance, *Journal of Political Economy* 107, 184–224.
- Murnane, R.J. (1975), *Impact of School Resources on the Learning of Inner City Children*. Ballinger, Cambridge.
- Murnane, R.J. (1981), Teacher Mobility Revisited, *Journal of Human Resources* 16, 3–19.
- Murnane, R.J. and B. Phillips (1981), What Do Effective Teachers of Inner-City Children Have in Common? *Social Science Research* 10, 83–100.
- Murnane, R.J. and J.L. Steele (2007), What Is the Problem? The Challenge of Providing Effective Teachers for All Children, *Future of Children* 17, 15–43.
- Murnane, R.J., J.B. Willett, M.J. Braatz and Y. Duhaldeborde (2001), Do Different Dimensions of Male High School Students' Skills Predict Labor Market Success a Decade Later? Evidence from the NLSY, *Economics of Education Review* 20, 311–320.
- Murnane, R.J., J.B. Willett, Y. Duhaldeborde and J.H. Tyler (2000), How Important Are the Cognitive Skills of Teenagers in Predicting Subsequent Earnings? *Journal of Policy Analysis and Management* 19, 547–568.
- Murnane, R.J., J.B. Willett and F. Levy (1995), The Growing Importance of Cognitive Skills in Wage Determination, *Review of Economics and Statistics* 77, 251–266.
- Murphy, K.M. and F. Welch (1992), The Structure of Wages, *Quarterly Journal of Economics* 107, 285–326.
- Neal, D.A. and W.R. Johnson (1996), The Role of Pre-Market Factors in Black-White Differences, *Journal of Political Economy* 104, 869–895.
- Nickell, S. (2004), Poverty and Worklessness in Britain, *Economic Journal* 114, 1–25.
- O'Neill, J. (1990), The Role of Human Capital in Earnings Differences between Black and White Men, *Journal of Economic Perspectives* 4, 25–46.
- Pierce, B. and F. Welch (1996), Changes in the Structure of Wages, in: E.A. Hanushek and D.W. Jorgenson (eds.), *Improving America's Schools: The Role of Incentives*. National Academy Press, Washington, D.C., 53–73.
- Podgursky, M.J. and M.G. Springer (2007), Teacher Performance Pay: A Review, *Journal of Policy Analysis and Management* 26, 909–949.
- Psacharopoulos, G. (1994), Returns to Investment in Education: A Global Update, *World Development* 22, 1325–1344.
- Psacharopoulos, G. and H.A. Patrinos (2004), Returns to Investment in Education: A Further Update, *Education Economics* 12, 111–134.
- Rivkin, S.G. (1995), Black/White Differences in Schooling and Employment, *Journal of Human Resources* 30, 826–852.
- Rivkin, S.G., E.A. Hanushek and J.F. Kain (2005), Teachers, Schools, and Academic Achievement, *Econometrica* 73, 417–458.
- Rockoff, J.E. (2004), The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data, *American Economic Review* 94, 247–252.
- Schady, N. and D. Filmer (2006), Getting Girls into School: Evidence from a Scholarship Program in Cambodia, World Bank Working Paper No. 3910.
- Schultz, P. (2004), School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program, *Journal of Development Economics* 74, 199–250.
- Spaelli, C. and B. Vial (2002), The Performance of Private and Public Schools in the Chilean Voucher System, *Cuadernos de Economia* 39, 423–454.

Incentives for Efficiency and Equity in the School System

- Sparrow, R. (2007), Protecting Education for the Poor in Times of Crisis: An Evaluation of a Scholarship Programme in Indonesia, *Oxford Bulletin of Economics and Statistics* 69, 99–122.
- Spohr, C. (2003), Formal Schooling and Workforce Participation in a Rapidly Developing Economy: Evidence from “Compulsory” Junior High School in Taiwan, *Journal of Development Economics* 70, 291–327.
- Todd, P. and K. Wolpin (2006), Assessing the Impact of a School Subsidy Program in Mexico: Using a Social Experiment to Validate a Dynamic Behavioral Model of Child Schooling and Fertility, *American Economic Review* 96, 1384–1417.
- Vermeersch, C. and M. Kremer (2005), School Meals, Educational Achievement, and School Competition: Evidence from a Randomized Evaluation, World Bank Working Paper No. 3523.
- Word, E., J. Johnston, H.P. Bain, B.D. Fulton, J.B. Zaharies, M.N. Lintz, C.M. Achilles, J. Folger and C. Breda (1990), *Student/Teacher Achievement Ratio (STAR), Tennessee’s K-3 Class Size Study: Final Summary Report, 1985–1990*. Tennessee State Department of Education, Nashville.
- Wößmann, L. (2002), *Schooling and the Quality of Human Capital*, Springer, Berlin.
- Wößmann, L. (2003), Specifying Human Capital, *Journal of Economic Surveys* 17, 239–270.
- Wößmann, L. (2005), The Effect of Heterogeneity of Central Exams: Evidence from TIMSS, TIMSS-Repeat and PISA, *Education Economics* 13, 143–169.
- Wößmann, L. (2007a), International Evidence on Expenditure and Class Size: A Review, in *Brookings Papers on Education Policy*. Brookings Institution, Washington, D.C., 245–272.
- Wößmann, L. (2007b), International Evidence on School Competition, Autonomy and Accountability: A Review, *Peabody Journal of Education* 82, 473–497.

Abstract: *Recently available evidence emphasizes the role of cognitive skills in determining not only individual earnings but also national growth rates. While prior studies concentrated on just school attainment as a measure of human capital, the availability of more refined quality measures using student achievement assessments demonstrates the inadequacies of these pure quantity measures of schooling. Improving cognitive skills, such as those measured by PISA, has, however, proved difficult. The only viable approach appears to be improving the incentives for higher performance. But particularly the reactions to demand-side incentives indicate a requirement to focus incentives carefully on achievement.*