Measuring the Value of Better Schools

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I
n 1993, spending on education represented 28 per-
cent of state and local government expenditures and
almost 14 percent of total government expenditures
in the United States.[1] The tremendous resources
devoted to education in this country underscore the need to
identify the tools and programs that yield the greatest return
on our investment. Policymakers have sought to improve
schools in a variety of ways, ranging from increasing per
pupil expenditures or teacher salaries to creating programs
that send inner-city students to suburban schools. How,
then, do we assess the cost-effectiveness of specific initiatives
and programs?

The first step is to measure the value of better
schools. The goal is to develop a sound method of quan-
tifying how investments in educational quality relate to
outcomes. Once we are able to put a dollar value on
improvements in school quality, we can compare policy
alternatives.

In this paper, I examine two methods of measuring
the value of better schools. One involves following individ-
uals over time to determine how the quality of their
schooling affects outcomes later in their lives; the other
involves calculating parental valuation of better schools
today. I review the benefits and limitations of the two
methods, then briefly consider how these methods might
be used in evaluating policies. At the end of the paper, I
note some uncertainties affecting research in the field and
outline directions for future research.

THE RELATIONSHIP BETWEEN INPUTS AND OUTPUTS

Determining the value of better schools is more difficult
than it seems. The effects of better schools are fully realized
only with the passage of time: the benefits of attending a
very good elementary school, for example, may stretch over a
lifetime. Nevertheless, assessing school value is easier if we
break the task down into two stages—first, determining
the relationship between inputs to a school and outputs,
and second, determining the dollar value of this increased
output (see figure on page 88).

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Inputs to a school can be characterized by a number of variables. Teacher salaries, per pupil expenditures, and expenditures to achieve a particular student-teacher ratio are forms of financial input, which is what is most commonly understood by the notion of inputs. Also important, however, are the nonfinancial forms of input—the mix of students in the school (an indicator of overall peer quality), parental time and resources, and the quality of the administration. All of these variables—financial and nonfinancial—can be used by researchers as indicators of school quality.

School outputs can also be measured in a number of ways. Improvements in test scores are an indicator of school success. So are financial gains, such as higher wages later in life. Intermediate to these is educational attainment: students who attend better schools may stay in school longer.

Once we establish a relationship between inputs and outputs, we need to put a dollar value on the increased output.[2] In some cases, the work is already done for us: wages earned later in life are one measure of output that needs no quantification.[3] But attaching a value to higher test scores or to longer stays in school is a more complicated undertaking. One way to do this is by calculating how much people are willing to pay for a home in a location that would allow their children to attend a better school—an approach that essentially measures the capitalization of better schools in house prices.

The next two sections examine in more detail how researchers use the concepts of input and output to develop techniques for measuring the value of better schools. The first technique focuses on the relationship between inputs to schools and children's outcomes later in life; the second looks at the links between inputs, outputs, and parental willingness to pay.
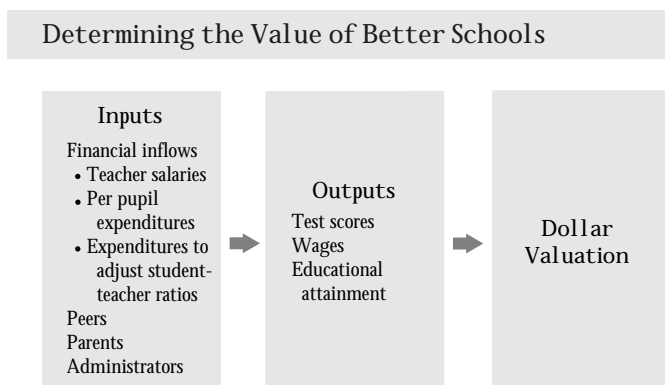
TRACKING INDIVIDUAL OUTCOMES

The advantage of following individuals over time is that you can look at a number of outcomes for each individual and assess the value of better schools in several different ways.[4] For example, you can see how better schools affect wages, educational attainment, and job choice. Under this approach, the optimal experiment would be to compare two individuals who are identical in all respects (family background, innate ability, and so forth) except for the schools they attended. Any differences in outcomes could then be attributed to differences in school quality.

In practice, of course, we cannot compare two identical individuals. In addition, educational quality is only one of many determinants of an individual's wage or educational attainment, and we have imperfect controls for the other determinants, such as family background. Therefore, any relationship we observe between outcomes and school quality may be tainted by "omitted variable bias" if we overlook, or cannot control for, differences in students' backgrounds or innate abilities. The danger is that we will overstate the effect of school quality on individual outcomes because we cannot adjust adequately for the effects of these other factors.

Because of the difficulty of measuring the relationship between school inputs and individual outcomes, the conclusions reached in the literature vary significantly with the outcome measure used. Problems such as short panels of wage data, state-level rather than local information about school quality, and incomplete characterizations of family backgrounds plague these studies.

To date, much of the literature has focused on the relationship between the financial inputs to schools and the wages earned by students later in life.[5] When following individuals over time, it makes sense to put a dollar value on better schools by calculating the influence of better schools on wages.[6] Using census data, Card and Krueger (1992a) estimate the relationship between the wage

Determining the Value of Better Schools

Inputs
Financial inflows
- Teacher salaries
- Per pupil expenditures
- Expenditures to adjust student-teacher ratios

Peers
Parents
Administrators

➔

Outputs
Test scores
Wages
Educational attainment

➔

Dollar Valuation

return to a year of school and the quality of that year of school, where the measures of quality—the student-teacher ratio, the term length in days, and the relative teacher wage in the students' state of birth—reflect the financial resources available to schools in that state.[7] The authors find a significant relationship, suggesting that financial inputs do matter. In a summary article (Card and Krueger 1996), they suggest that a 10 percent increase in school spending is associated with a 1 to 2 percent increase in earnings for students.

This result is contradicted in work by Betts (1995). Using the National Longitudinal Survey of Youth (NLSY) data set, Betts finds no significant relationship between the financial resources available to *individual* schools and students' earnings. However, when he substitutes state-level measures of school quality for measures at the individual-school level, he, like Card and Krueger, finds a significant relationship, suggesting that Card and Krueger are capturing state, rather than individual-school, effects. A criticism of Betts' work, however, is that the data contain information about wages early in life, and one might argue that the effects of school quality are not realized until later.

VALUATION AS CAPITALIZED IN HOUSING PRICES

Given the controversy surrounding the results of this approach, one is left looking for other methods of measuring the value of better schools. A second approach involves determining how much people are willing to pay for better schools. We can infer this value by examining how much more people pay for houses located in areas with better schools.[8] Although this methodology may seem indirect—it measures the value of better schools to parents, not the value to the child receiving the education—it has the advantage of putting a dollar value on current school quality, as opposed to school quality from many years earlier. Another advantage of the approach, as we will see below, is that it allows the analyst to minimize the potential for omitted variable bias.

Calculating the value of better schools this way calls for a two-step procedure: the analyst first evaluates the

relationship between inputs—most often, financial inputs to the school—and a measure of output—typically, the average test scores for that school. The analyst then derives the willingness to pay for higher test scores by examining how school test scores are capitalized in housing prices.[9] Parental willingness to pay serves as a measure in dollar terms of the benefit of higher student test scores;[10] this benefit can then be compared with the costs of different educational programs to determine each program's cost-effectiveness.

The literature examining the relationship between financial inputs to schools and test scores has generally followed the methodology used to assess the relationship between financial inputs and wages.[11] Hanushek (1986, 1996a, 1996b) finds little evidence to suggest that financial inputs to a school have any significant effect on student test scores. Even when evaluating the large number of existing studies on this topic—some of which claim to find a link between school financial resources and test scores—he still concludes that the relationship does not exist.

Using the same studies as Hanushek, however, Hedges, Laine, and Greenwald (1994) come to quite a different conclusion. Applying a meta-analysis technique to evaluate the existing body of research, they find a significant relationship between financial inputs and achievement, such that a $500 increase in average per pupil expenditures (approximately a 10 percent increase) leads to a .7 standard deviation increase in student achievement.

Other researchers agree with Hanushek that the evidence of a relationship in existing studies is scant, but claim that data limitations are responsible. Ferguson (1991), for example, uses more detailed Texas data to show that better teachers lead to improved student performance. His conclusion is not inconsistent with Hanushek's position, however; Hanushek acknowledges that a relationship exists between the quality of schools and student achievement, but argues that this relationship cannot be explained by the measurable financial inputs to the schools.

Although the relationship between financial inputs and outputs is unclear, it is still important to have an understanding of the value of better schools. Educators and

policymakers have nonfinancial means of upgrading school quality. Given that improvements are possible, we can get a relatively clean estimate of parental willingness to pay for better schools by looking at the increase in house prices, or capitalization, that is associated with schools whose students, on average, score higher on tests.

When measuring the value of schools through the capitalization of test scores in house prices, we would like to compare two houses that are identical except that the children in one house attend a better school than the children in the other house. In that case, any difference in house prices can be attributed to differences in school quality. In practice, however, measurement is complicated by the difficulty of isolating school quality effects from better neighborhood effects. Since better schools tend to be located in better neighborhoods, ordinary hedonic housing price regressions of the form

$$\log(price_{ijk}) = \alpha + X_{ijk}\beta + Z_j\delta + S_k\theta + \varepsilon_{ijk},$$

where $price_{ijk}$ represents the selling price of house i in neighborhood j in school district k, X_{ijk} is a vector of house-level characteristics, Z_j is a vector of neighborhood characteristics, and S_k represents school quality characteristics, may lead to an overstated valuation of better schools if the available data do not provide a complete characterization of the neighborhood studied.

Early willingness-to-pay studies tended to look at large, heterogeneous areas in measuring the value of better schools.[12] Because these studies did not control adequately for neighborhood differences, they were very susceptible to omitted variable bias. To avoid such bias, more recent work has attempted to control for neighborhood differences by focusing on increasingly localized areas.

To understand how the literature has evolved, consider first a study by Jud and Watts (1981) that examined one school district—Charlotte, North Carolina. The authors found a significant and meaningful relationship between house prices and the average scores of the schools' third-grade students on the state test of reading skills. However, since the geographic area under study was quite large, the houses compared may have been in entirely different neighborhoods. Because the authors

controlled for only a limited number of neighborhood characteristics, their comparison may not have been valid.

Other work has attempted to correct for this problem by comparing houses in smaller geographic areas. Work by Hayes and Taylor (1996) and Clotfelter (1975), although not specifically focusing on the valuation of schools, looked at houses within the same school attendance district, where the attendance district is the geographical area that defines which school *within* a school district a child will attend.[13] Because the authors examined a smaller geographic area, the variation in neighborhoods across houses being compared should have been less.

Even with the focus narrowed to attendance districts, however, omitted neighborhood differences might still bias estimates of the value of higher student achievement. Two houses at opposite ends of an attendance district may be situated in very different neighborhoods. In a recent study (Black 1997), I address this problem by examining an even more localized area. Specifically, I compare the price of houses on opposite sides of elementary school attendance district boundaries in suburban Boston. Such a strategy, in its purest form, would restrict the area of the houses being compared to the point where there was no variation in neighborhoods. Imagine, for example, two houses on opposite sides of a street that forms the attendance district boundary. Children in the house on one side of the street attend a different school from the children in the house on the other side of the street, but the neighborhood is unquestionably the same. In such a case, any difference in prices would be attributable to differences in school quality.[14] Because attendance district boundaries are within school districts and within a city, variations in property tax rates would be eliminated.

My study gets very close to this ideal comparison. Although data limitations prevent me from looking at houses on opposite sides of the same street, I am able to limit my sample to houses located within a relatively short distance of the boundary. I then narrow the sample to houses located closer and closer to the attendance district boundaries in order to minimize the likelihood that omitted neighborhood characteristics are driving the

results of the estimation. The final comparison I draw is of houses within .15 miles of an attendance district boundary.

The estimated equation is:

$$\log(price_{iab}) = \alpha + X_{iab}\beta + K_b\Phi + \gamma\, test_a + \varepsilon_{iab},$$

where $price_{iab}$ is the selling price of house i in attendance district a near boundary b, X_{iab} is a vector of house characteristics, K_b is a vector of boundary dummies, and $test_a$ is the measure of school quality assessed at the individual school level.

Using this boundary fixed-effects technique, I find that substantial omitted variable bias exists when one relies on the standard controls for neighborhood characteristics. Significantly, my estimate of the value of better schools is only about half of the normal hedonic housing price estimate. Controlling for neighborhoods and school financial inputs, I find that a 5 percent increase in elementary school test scores (a change of approximately one standard deviation in the observed data) leads to an increase in house prices of approximately 2.1 percent, or $4,000 at the mean house price of the sample. From another perspective, a movement from the twenty-fifth-percentile school in the sample as ranked by test scores to the seventy-fifth-percentile school results in a 2.9 percent increase in house prices, or $5,500 at the mean house price.[15]

How can we be sure that this procedure actually estimates the value of better schools? The study includes a number of specification checks, including checks to determine whether the attendance district boundaries chosen represent neighborhood divisions. For example, I eliminate any boundaries that could be major roads, and I control for measurable neighborhood characteristics (evaluated at the level of the census block group). A particularly compelling check involves comparing the results for one- and two-bedroom houses with the results for houses containing three or more bedrooms. One would expect individuals who live in houses with three or more bedrooms to be willing to pay more for better schools than people in smaller houses because they are more likely to have children. The study very clearly confirms this expectation.

This type of estimation provides a measure of the value of higher test scores that is remarkably free from omitted variable bias. The analyst who follows students over time to determine how the quality of their schooling relates to their wages later in life cannot easily control for influences and events that affect students outside of school. In contrast, the analyst who looks within neighborhoods at the relationship between school quality and house prices can significantly reduce the number of omitted variables.

This estimation technique does, however, have some limitations. Studies employing the technique must focus on small localities—in the case of my study, suburban Boston—and, consequently, generalizing results to a wider area requires strong assumptions. In addition, in order to look at attendance district boundaries, such studies must look within school districts, which is the level at which school inputs such as spending are determined. As a result, the variation in school spending is significantly reduced, and calculations are based on differences in test scores that are attributable for the most part to the nonfinancial inputs to a school. Therefore, the variable of interest reflects differences in teacher quality, administrator quality, parental involvement, and school composition (peer effects). That is not to say that the value of high test scores will change when financial inputs vary; we do not currently have enough information to determine how differences in expenditures would affect the results.

CONCLUSION

At present, there is no perfect way to measure the value of better schools. For those charged with evaluating school policy, the best approach would be to combine the information acquired using both techniques explored in this paper and to draw inferences using all available evidence.

Current school quality evidence indicates that increased spending will not automatically improve student outcomes; this finding suggests that we should look at other ways to improve schools. Evidence from Black (1997) confirms the value of raising test scores, particularly through parental and administrative involvement and the influence of school peers.

How can we use these research findings when evaluating government policies? One way to apply my estimate of the value of higher test scores is in the analysis of policies involving student integration. Consider, for example, reforms such as the METCO program in Boston, which sends a few students from poorer urban neighborhoods to wealthier suburban schools. Suppose that a student is transferred from an inner-city Boston elementary school where test scores average 21.27 to an elementary school in the wealthier suburb of Belmont where test scores average 30.67. We can measure the benefit of this test score improvement by calculating the percentage difference in house prices for two equivalent houses in the same neighborhood but in different attendance districts. Using the estimate obtained in Black (1997), we find that a house would appreciate 14 percent in value if the family residing there acquired the right to send their child to the elementary school in Belmont instead of the one in Boston. When evaluated at the mean housing price in my sample, this number in dollar terms is approximately $25,660.[16] We can then compare this benefit with the costs of implementing the program and thereby evaluate the program's cost-effectiveness.

In the end, it is important to think about what we can and cannot say. We can say that parents are willing to pay more for better test scores, although we do not have a clear understanding of the relationship between spending on inputs and test scores. We can say that evidence suggests a relationship between school inputs and the wages earned by students later in life, but we would be hard pressed to assign an actual dollar value to the school inputs. Our uncertainty suggests a need for communication with educators and other policymakers. Their knowledge and experience can help researchers to identify the best ways to improve student performance—through hiring better teachers, boosting parental and administrative involvement, creating the optimal mix of students in a classroom, or increasing the efficiency with which schools use financial resources. Finally, we must continue to improve our methods of evaluation by collecting relevant data and seeking an experimental design that eliminates biases in our estimates.

ENDNOTES

1. See U.S. Department of Commerce, Bureau of the Census (1996).

2. In this paper, I focus on the private, rather than the social, valuation of better schools. Those who believe that education is a public good would argue that the private valuation understates the true value of education. Two studies exploring these issues are Kane and Rouse (1995) and Rauch (1993).

3. Note that while student wage increases are one obvious way of putting a dollar value on better schools, this valuation does not incorporate other, nonmonetary benefits such as a more pleasant work environment, a more interesting job, and the like.

4. See Burtless (1996) for a review of the studies that take this approach.

5. Because the literature is vast, this paper can only highlight a few of the more representative studies.

6. A primary source of evidence supporting the positive relationship between school quality and earnings is work that relates relative changes in school quality for one group to changes in relative wages for that group. For example, a large literature focuses on changes in school quality for blacks and the subsequent shift in black-white earnings differentials. Card and Krueger (1992b) find that between 1960 and 1980, improvements in the relative quality of black schools explain 20 percent of the narrowing of the black-white earnings gap.

7. Essentially, Card and Krueger estimate individual-level wage equations and allow for state-specific intercepts and education slopes. They then take these state-specific education coefficients and regress them on state school quality averages and other state-level data.

8. Another way to calculate people's valuation of a good is to ask them directly how much they value the particular good. This contingent valuation approach is widely used in the environmental literature (see Cummings, Brookshire, and Schulze [1986]). However, because the quality of the answers obtained through this method is often doubtful, most economists prefer to use a market-determined estimate of valuation.

9. Early work by Rosen and Fullerton (1977) shows that test scores perform better than per pupil expenditures as a measure of school quality in property value equations. More recently, work by Hayes and Taylor (1996) suggests that parents actually do focus on the value added of a school and not, as one might expect, the inputs to the school.

10. Although parental willingness to pay is equated with the value of higher test scores, it may in fact also be picking up the value of other things that are correlated with higher test scores.

11. Again, see Burtless (1996) for a review.

12. See work by Kain and Quigley (1975) for an example of this literature.

13. Hayes and Taylor focus more specifically on whether parents use test scores or inputs to the school as measures of school quality. The authors find that property values reflect student test scores but not school expenditures, and they conclude that the relationship between test scores and property values arises from an underlying relationship between property values and the marginal effects of schools. Clotfelter uses attendance districts to look at the effect of school desegregation on housing prices.

14. In the construction of the data set, boundaries that represented clear neighborhood divisions such as railroad tracks or parks were excluded from the sample.

15. These estimates are also robust to a number of specification tests.

16. The calculation would be (30.67-21.27)*.015 = 9.4*.015 = .14, where .015 is the coefficient on the elementary school test score in the hedonic housing price regression estimated in Black (1997). Note that this policy application requires strong out-of-sample assumptions.

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