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AUTHOR Summers, Anita A.; Wolfe, Barbara L.
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ABSTRACT

This paper discusses a statistical analysis of the impact on student learning of socioeconomic characteristics, certain aspects of the school environment, and the amount of educational resources expanded on students. It is felt that the analysis is quite similar to what economists do when they estimate production functions for films; but that there are several features unique to education, the most important being that the costs of the inputs to education (e.g., teacher salaries) do not vary with the value of the outputs of education (e.g., academic achievement). In an education production function, then, the value of the inputs must be directly estimated, without reference to price. The techniques appropriate to economic agents which maximize the value of outputs according to the cost of inputs are not applicable. The data base was provided by the Philadelphia school district. From pupil files, as of 1970-71 or 1971-72, detailed data were obtained for 627 sixth grade students in 103 elementary schools, for 533 eighth grade students in 42 junior high schools, and 716 twelfth grade students in five senior high schools. The results of the study are interpreted as suggesting that student achievement is increased when school resources are applied differentially to low income vs. high income students, black vs. non-black students, and, most clearly, to low-achieving vs. high-achieving students. (Author/JM)

EQUALITY OF EDUCATIONAL OPPORTUNITY QUANTIFIED: A PRODUCTION FUNCTION APPROACH

By

Anita A. Summers and Barbara L. Wolfe

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This paper describes an education production function study using Philadelphia School District data. Four points are covered: A discussion of the distinguishing characteristics of an education production function; a description of the sample and estimation procedures; a summary of some of the results; a consideration of the relevance of the study to issues of equity and efficiency.

IS AN EDUCATION PRODUCTION FUNCTION A PRODUCTION FUNCTION?

We are looking for an empirical description of the consequences for student learning of their socioeconomic characteristics, the school resources applied to them, and certain school characteristics. This is obviously a close parallel to what economists do when they estimate production functions for firms. Several features, however, distinguish an education production function from the standard one estimated by economists.

The Usual Production Function is Defined in Quantity Units. But education production functions are, in large part, defined in quality units. Output, in this study, is not measured by the quantity of students, but by the quality of their achievement growth--that is, by the valued added to their stock of achievement. Inputs, to the extent possible, are also of a qualitative sort--not just the number of pupils per teacher, but the experience (TEACH EXP), length of education (TEACH ED), teacher exam scores (TEACH SCORE), and rating of the undergraduate college the teacher attended (GOURMAN) are included, for example. With two exceptions--counseling and remedial education (REM EXP)-- inputs are not measured in dollar units. Rather,

they are measured in units closer to quality units--the number of library books per pupil (BKS/PUPIL), the number of pupils per science lab, the condition rating of the school plant, the amount of disruption (DISRUPT).

A common procedure by which economists estimate the parameters of production functions involves the exploitation of marginal productivity relationships. Factor prices are used in relating factor shares to marginal productivities and, hence, to the production function parameters. Why don't we follow this sort of strategy in our work? We don't, because we are describing a nonprofit maximizing sector, in which factor prices are the same for all observations. Teacher salary scales are the same for all schools in the Philadelphia School District, for example. Without variation in the price observations, of course, maximizing behavior would lead to no variations in input combinations under purely competitive conditions. The problem is not merely a technical statistical one--it is not merely that a moment matrix will blow up when inverted. The variability in the input combinations would never have arisen. In an education production function, then, the estimates of the input coefficients must be done directly, and without reference to price. The techniques appropriate to economic agents which optimize are not possible.

The results of our study suggest that student achievement is increased when school resources are applied differentially to low income vs. high income students, Black vs. non-Black students, and, most clearly, to low-achieving vs. high-achieving students. This raises the question whether educational output should be regarded as a multiproduct activity. Alternatively, perhaps the empirical work of this paper is best though of as an estimation of a number of separate production functions for these different

types of students which has been handled in one equation for reasons of statistical convenience and efficiency.

DESCRIPTION OF SAMPLE AND ESTIMATION PROCEDURES

We had access to an exceptionally rich data base. From pupil files, as of 1970-71 or 1971-72, we obtained detailed data for 627 sixth grade elementary school students in 103 elementary schools, for 553 eighth grade junior high school students in 42 junior high schools, and 716 twelfth grade senior high school students in five senior high schools. Though the elementary and junior high schools were a random selection from the Philadelphia school system, the senior high schools were not: they have higher proportions of low income and Black students than the average. The students themselves were randomly selected from their schools. Details of the profile of these samples with respect to income, race, and achievement, are given in Tables A-1, A-2, A-3, B, C-1, C-2, and C-3.

A two- or three-year school history was compiled for each student, which was then matched with data on school-wide resources of the school he or she attended, with his or her family income[1] (imputed through the use

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[1]We have developed a procedure, using 1970 Census data for Philadelphia, for estimating block income from block mean housing values, block mean contract rental values, tract distribution of block contract rental values, and tract distribution of income values.

This procedure involves (1) forming the cumulative distributions of data for each tract of owner-occupied housing values, contract rental values, and family income; (2) converting these cumulative distributions into relative distributions (percentiles); (3) determining for each block the percentile in the tract distribution of mean owner-occupied housing value and the percentile for mean contract rental value; (4) determining the corresponding normal deviate arguments; (5) adjusting these the by regression coefficient for the tract between housing and income data for a cross-classified 20 percent sample; (6) assigning percentiles to the adjusted arguments; (7) finding the income values for these percentiles; (8) adjusting for differences in the income distribution of renters and owners; (9) averaging the two income values for each block. (Continued on page 4.)

of Census block and tract income and housing data), and with data on his or her individual teachers. We were able, therefore, to (1) look at pupils longitudinally, (2) examine a great many variables in a pupil-specific way (the teacher variables are of particular interest), and (3) to beyond simple linear specifications because of the fairly large number of observations. The equations of "best fit" are described in Tables D-1, D-2, and D-3.

The dependent variable chosen was the change in a composite achievement score--achieving--over a two- or three-year period, depending upon the school level. Using the final score, which does not visibly control for initial achievement level, as the impact measure of various resources is less satisfactory. This use of a value-added measure is consistent with the usual choice in estimating aggregate production functions. Further, the change in formulation permits the prediction of the effect on pupil learning of educational input changes. This formulation, it might be and has been argued, is erroneous because the differences between initial and final score regress to the mean--that is, that because tests have random error, there will tend to be a negative correlation between initial score and change in achievement. The concern is, of course, that if initial achievement is omitted from the right-hand side, the estimates of all the coefficients of variables correlated with initial achievement will be biased. For the sixth grade sample, the coefficient for the initial score was found to be not significantly different from 0. For the eighth and twelfth grade samples, the coefficients for the initial scores were negative and

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(Continued from page 3.)

A working paper containing a detailed description of the method in cookbook form, a full statement of the computer program, and a presentation of the block data will be published by the Federal Reserve Bank of Philadelphia.

significant. However, when the regressions were run with and without the initial scores, with two exceptions (SS TEACH GOUR in Table E-2 and ENG TEACH SCORE in Table E-3) the variables which were significant did not lose significance, and the changes in the coefficients were, with the two exceptions, not large enough to alter any of the broad conclusions drawn from the study. (See Tables E-1, E-2, E-3.)

The independent variables were of three types: socioeconomic character of the pupil (for example, family income, race), school inputs (for example, class size, teacher qualities), and school climate (for example, number of disruptive incidents, proportion of Blacks).

The relationships were examined using single equation multiple regression. Dummy variables, piece-wise linear fitting, and other nonlinear specifications were employed. Interactions of income, race, and/or achievement with school input and school climate variables were explicitly taken into account.

Past attempts to estimate education production functions using single stage linear regressions have been criticized on the grounds that they have ignored important problems of simultaneity. Specifically, treating an endogenous variable as if it were exogenous leads to inconsistent and asymptotically biased estimates. The magnitude of the asymptotic bias will depend, of course, upon the extent to which the values of the variable, incorrectly assumed to be exognous, affects the equation's disturbance term. If the feedback is small, the error involved in not using a simultaneous equation technique will be minimal. The argument, in particular, is that achievement gains affect student attitudes, and student attitudes affect achievement gains.

In this study, however, very few "psychological" variables are used. Only two of our variables might, conceivably, be regarded as problems.

The first is the variable(s) measuring the student's attendance record, which is intended to reflect the student's motivation. A simultaneous equation does not seem warranted, however, for two reasons: (A) When the equations were estimated in the reduced form version, without the attendance variables (Tables F-1, F-2, F-3), the coefficients were not changed in a way which altered any conclusions that reasonably flowed from coefficients which were the product of an extensive search for the "best" specification. (B) Causality flowing from achievement (as measured by tests) to motivation seems to be a tenuous one: Children are frequently unaware of their achievement test scores, grades and teacher attitudes are probably far more important in attitude reinforcement than Iowa scores, and there is considerable evidence that grades are poorly correlated with standard test scores.

The second candidate for problems is the earliest test score we have for each sample of students--first grade IQ scores (IQ) for the sixth grade sample, third grade Iowa scores (3G SCORE) for the eighth grade sample, and seventh grade Iowa scores (7G SCORE) for the twelfth grade sample. These earliest scores are a proxy for previously determined ability and might be viewed as endogenous. In addition to reflecting initial knowledge, they, presumably, reflect family income and race. The main concern here is that this might bias downward the estimates of the coefficients of the socioeconomic variables. When the "best fit" equations were estimated without the earliest scores, the coefficients related to income and race changed very little. (see Table E-1, E-2, E-3)

SUMMARY OF FINDINGS

The coefficients, t-statistics, $\bar{X}$'s and σ's for the equation of "best fit" for the sixth grade sample is presented in Table D-1, for the eighth grade in Table D-2, and for the twelfth grade in Table D-3. A key describing the variables and the significance tests for the interaction terms follow each table.

A. Socioeconomic Inputs

1. Income and Race (Y and RACE)

An important and repeated finding of many studies searching for the determinants of student achievement has been that the pupil's background--family income and race, among other things--is the dominant determinant. This has left schools in the position of being regarded as a relatively ineffective tool in changing the achievement growth of students. Schools would emerge as far more potent tools, however, if it were true that when school inputs were applied differentially--if, for example, small classes were used for low achievers, and larger classes for all others--the rate of achievement improved.

It may be, then, that the reason educational studies have failed to find that the things schools do are effective, is that there are few things which are consistently effective for all students. Many of these studies have been hampered by the limited amount of data which are specifically tied to the pupil. Thus, in many studies, the only data available bearing on the influence of teacher experience in helping students to achieve more

was the average experience level in a school, rather than the experience level of the specific teacher confronting a particular pupil. Perhaps, therefore, the reason so many nihilistic results emerged on the effectiveness of school resources was that their averages disguised the true impact. If many years of experience helps some students achieve and hinders other students, then the result, if only averages are looked at, will be that no beneficial effect shows through.

We have looked carefully for interactions between school input and type of pupil. And a great deal of interaction was revealed. We find that, for many school resources, the effect on some types of students is very different--and, frequently, in the opposite direction from the effect on other types of students. Not only does this explain why many studies have been so negative in findings, but the results point out how achievement growth can be increased. In fact, when the interactions between income and/or race and school inputs were revealed, no residual impact of race and income remained (except for RACE in the twelfth grade sample). These equations are described in Tables G-1, G-2, and G-3.

2. Sex (SEX)

The sex of the student affects achievement at all school levels: Males do worse than females in elementary

school, but in junior high school only low-ability males do worse than low-ability females; however, in senior high school, males do better than females, except for high-ability students.

3. Starting Scores (IQ, 3G SCORE, 7G SCORE)

The initial abilities of the pupil have a strong effect on the student's growth in achievement at every level of schooling--if a student has a higher ability at the beginning, he or she will learn more. But, at each level, it is also true that if a high-achieving Black student and a high-achieving non-Black student start out with equal test scores, the non-Black student will move further ahead. Headstart participants typically scored higher at the third grade. A separate regression (Table H) shows this.

4. Motivation (UNEXCUSED, LATE, DAYS PRES)

As expected, the motivation of students affects learning. For all students, at each level of schooling, more unexcused absences (taken to reflect poorer motivation) go along with less learning growth, and being in school more days goes along with more learning growth. But, high-income students are the biggest losers. Perhaps, this is because when an advantaged student misses school it signifies a far more serious negative attitude toward schooling then when a disadvantaged student does the same thing.

5. Residential Moves (MOVES)

Junior high school students seem particularly sensitive to some other socioeconomic characteristics. Unlike elementary and senior high students, coming from a family that moves more frequently has an adverse effect.

C. Native Born (SECOND GENERATION)

Not being a second-generation American--that is, not being born in one of the 50 states and having parents who were born in one of them, has an adverse effect for early teen-agers.

To summarize, the socioeconomic background of the pupil clearly plays an important role in what the student achieves through the school years. A student's sex can be a handicap, as can race, income and abilities. But, these handicaps should not be regarded as immutable, if they can be shown to be overcome--at least in part--through things the schools can do.

B. School Inputs That Make a Difference

Finding out which inputs are helpful to learning, and which are not, is what we are most interested in. These are the things that the school administration and the teachers union can do something about. And, if the spirit is willing, these are the things which can be changed.

1. Class Size (CLASS)

We find that in elementary school, students who are below grade level should be in classes with less

than 28 students, but the rest of the students, can, without any negative effect on achievement, be in classes of 33. For all elementary school students, being in classes of 34 or more has a negative effect, and increasingly so. Perhaps, this is related to the target class size in the current teacher contract.[2] In junior high school, classes of 32 or more reduce achievement growth, with low-income students being affected most adversely. Low achievers in senior high English classes do better in smaller classes; high achievers do better in larger classes.

2. Size of School (SCHOOL SIZE)

Smaller schools are effective in increasing learning in elementary and senior high schools. Black elementary school students particularly benefit from being in smaller schools, and low achievers particularly benefit in senior high schools. At the junior high levels, the school size does not seem to matter, but it seems to be much more beneficial to be in an eighth grade that is part of an elementary school than one that is not.

3. Teacher Experience (TEACH EXP)

Many studies have indicated that teacher experience is not a very important factor, but that where it is

[2]The September 1, 1972 to August 31, 1976 Agreement between the Board of Education of the School District of Philadelphia and the Philadelphia Federation of Teachers calls for a maximum class size throughout all levels of schooling of 33 by September 1, 1975, and a longer term goal of 30 in elementary school, and 25 in secondary schools.

helpful is in the more than and less than seven to ten year experience span. The interaction between student abilities and teacher experience has not been examined in these studies, however, though it seems clearly unreasonable to expect equal effectiveness of teacher experience for all types of students.

In elementary school, length of experience has a very different impact on high- and low-achieving pupils. High-achieving pupils do best with more experienced teachers, but these teachers lower the learning growth of low achievers--these students do best with new, relatively inexperienced teachers, who, perhaps, have an undampened enthusiasm for teaching those who find it hard to learn. In junior high school, a very experienced English teacher is particularly effective with high ability students, but experience of ten or more years helps all students. The pattern of effectiveness for math teachers is somewhat different: Math teachers with three to nine years of experience are particularly effective, but math teachers with more than ten years of experience actually have a negative effect on learning math. This latter effect arises, most likely, because these teachers received pre-Sputnik training. They are teaching the New Math, though they were not originally trained to teach it.

4. Rating[3] of the Colleges From Which Teachers Received a B. A. (GOURMAN)

Does it make a difference to students' learning? Certainly, the current salary scale assumes that it does not, since no rewards are given for being trained at a "better" school.

It seems clear that, in some segments of the school system, teachers from colleges with higher ratings are more effective teachers. Elementary school teachers from schools rated 525 or higher do a distinctly better job in increasing student achievement. This training helps all students, and is particularly helpful to the low income pupil. In junior high school, being trained at these "better" schools does not seem to play much of a role in teaching English or Math, but it is clearly helpful in the teaching of social science--particularly so for the high ability student.

See Tables I-1, I-2, and I-3 for evidence that introducing the teacher quality variables, which did not prove significant, left these findings in tact.

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[3]The Gourman rating, published in The Gourman Report (Phoenix, Arizona: The Continuing Education Institute, 1967) was used. It is a rating based on the undergraduate programs of nearly all colleges and universities in the United States, with information drawn from professional societies, commercial publications, foundations, etc., as well as the institutions themselves. The areas rated include (1) individual departments, (2) administration, (3) faculty (including student/staff ratio and research), (4) student services including financial and honor programs, and (5) general areas such as facilities and alumni support. The Gourman rating is a simple average of all of these.

C. School Inputs That Don't Make a Difference

As important as learning which school inputs improve learning is sifting out which inputs are not productive. We find a number of things, for which we pay, which do not achieve the goal of increasing learning. Clearly, this does not mean that reducing these expenditures to zero is the logical policy recommendation. Without some minimum level, there might be some negative effect, and with much more than we now put in, there might be some positive effect. Further, and a point not to be ignored, the objective of many school inputs is not limited to the one used here--growth in achievement scores. Other objectives--attitudes toward other races, sense of participation in the democratic process--may be part of the desired outcome.

But, in terms of the achievement objective, and within the range of expenditures budgeted by the School District, these school inputs do not appear to improve learning. The list of all the variables tested in this study, including those not in the "best fit" equations is included with the Tables in Table J.

Whether a child did or did not participate in the Headstart program, does not, by the latter half of elementary school, affect his or her achievement growth. But participation in the Headstart program does contribute to the child arriving in the third grade at an improved level of achievement.

The general physical facilities of schools does not make much difference, one way or another, to students' learning. Whether the pupil had more or less playground space, more or less crowded science labs, a new or old school building, or a building rated higher or lower in general physical condition, does not seem to matter much when it comes to achievement test scores.[4] However, there may well be benefits from better facilities which are not reflected in these data. Some facilities may be far more important in imparting specialized knowledge than they are in imparting the knowledge tested on the general achievement scores we looked at. Further, good facilities may be important in attracting good teachers, and improving teachers' motivations.

The measurable characteristics of school principals do not appear to be particularly effective in increasing student achievement. There is a wide range among Philadelphia public school principals in experience, extra degrees, and extra educational credits--and, yet, no particular beneficial achievement result emerges in that range. Most of these characteristics, it should be noted, are rewarded by salary increments. In terms of achievement results, at least, this reward does not seem to be for productivity. Most likely, the things principals can do to be effective,

[4]This finding is confirmed by most of the large studies done by social scientists, including James S. Coleman. Little investigation of this has been done by educators.

like display a sense of leadership, are things which are not picked up by these measures.[5]

Whether teachers have more or less education beyond the B. A. or teachers do better or worse on the National Teachers' Examination (Common), does not seem to make him or her more effective as a teacher. Neither of these appear to result in increased productivity. This is consistent with many education studies, yet salary increments do reward teachers for more education. The absence of impact on achievement of extra training is consistent with many education studies and with the large-scale studies done by social scientists--yet salary increments are given as rewards to teachers who take extra educational courses beyond the B. A. The discriminatory powers of the National Teacher Examination were evaluated, in 1972, by the Philadelphia School District. They concluded that they should not be used as the only measure of potentiality as a teacher--our findings suggest that they should not be used as any measure.

Within the range of expenditures on counseling, and on remedial education, no particular benefit in terms of increased learning is discernible. Both of these are designed to be compensatory--that is, students who are having more difficulty are getting more remedial work and guidance time. But, apparently, the amount spent and/or

[5]A well-known education study confirms this. See Neal Gross and Robert E. Herriott, Staff Leadership in Public Schools: A Sociological Inquiry (New York: John Wiley and Sons, 1965).

the techniques used, are not adequate for the jobs. Low-income, low-achieving students are not doing better with remedial resources.

D. School Climate Inputs

School integration is customarily discussed in terms of racial mixing but, in the broader sense, it can apply to homogenizing on the basis of income and abilities as well. It is a common misconception that the percentage of Black students, the percentage of low-income students, and the percentage of low achieving students are perfectly coincident. They do, indeed, overlap--but they are far from identical. If a student is in a school with more Black pupils, higher average family incomes, more low-achieving students[6], more high-achieving students,[7] does it affect his or her learning? Along with this, one might ask if going to a school where there are more disruptive incidents (like assault, fire bombs, drug possession, robberies, and use of weapons) affects learning. All of these, with the exception of the average family income of the school population, turn out to have an important influence on learning.

1. Racial Mixture (PERCENT BLACK)

In 1954 the U. S. Supreme Court, as part of the famous Brown v. Board of Education decision declaring

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[6]Low achievers are those who test below the 16th percentile in relation to a national norm.

[7]High achievers are those who test above the 84th percentile in relation to a national norm.

de jure school segregation unconstitutional, said:

> Segregation of white and colored children in public schools has a detrimental effect upon the colored children. The impact is greater when it has the sanction of the law; . . . Segregation with the sanction of law, therefore, has a tendency to retard the educational and mental development of Negro children and to deprive them of some of the benefits they would receive in a racially integrated school system. . . . [Emphasis ours.]

Is it true that segregation affects achievement? It cannot be emphasized strongly enough that objectives other than achievement gains may dominate the decision to desegregate schools. But it is clearly relevant, and of vital importance, to know what the impact of any desegregation target is.

Segregation, in the sense of a heavily concentrated racial mixture, does exist in the Philadelphia schools. In the year in which the sample was taken, 23 percent of the elementary schools, 26 percent of the junior high schools, and 18 percent of the senior high schools had less than 10 percent Black students. 40 percent of the elementary schools, 28 percent of the junior high schools, and 27 percent of the high schools had more than 90 percent Black students.

In elementary school, Black and non-Black students benefit--have the largest growth in achievement--when they are in schools with a 40 to 60 percent Black student body, rather than in schools that are more racially segregated. The stimulative effect is true

for both Black and non-Black pupils. When they are in schools with less than 40 to 60 percent Blacks, the learning rate is less; and when they are in schools with more than 60 percent Black, the learning rate is less. In short, all elementary school students would benefit in terms of achievement if their schools could be desegregated to somewhere in the 40 to 60 percent range.[8]

In junior high school, the impact of the racial balance on Black and non-Blacks varies. In general, the junior high students seem to be more sensitive to a number of factors in their surroundings which don't influence elementary and senior high students. They respond, in terms of learning, to whether they have moved about more or less frequently and whether they and their parents are native born, for example. Perhaps, the different sensitivity of Black and non-Black students to the proportion of Blacks in the school, is part of the general psychological makeup of early teen-agers.

We find that for Black and non-Black students there is a very slight positive effect in being in

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[8]Most of the studies on this subject have concentrated on the impact on Black students of being in a segregated vs. a desegregated school. Many studies have shown no difference in terms of achievement levels. Coleman's study, and a reworking of his data, show some benefit to Black students of being in classes with more non-Black students. Our results confirm these latter findings and, even further, indicate that non-Black students do better. This finding probably emerges, because it is the change in achievement we are focusing on, rather than just the level.

schools ranging up to 50 percent Black students. After 50 percent, however, Blacks experience significant learning growth as the proportion of Blacks in the school increases, but non-Blacks experience significant learning declines.

Our sample of senior high school students came only from five schools. In this sample, 88 percent of the students were Black, and the proportion of Blacks in the schools had the limited range of 55 to 99 percent. Some positive effect on achievement was found, but the range of what was examined was so narrow, that no policy conclusion can, legitimately, be drawn.

2. Ability Mixture (PERCENT HIGH, PERCENT LOW)

What are the effects of being in a student body with more or less very high achievers and more or less very low achievers? A very large percentage of elementary and junior high schools have a very low percentage of high-achieving students--70 to 75 percent have less than 10 percent. And a very high proportion of schools--52 percent of the elementary schools and 43 percent of the junior high schools have more than 50 percent of the student body achieving at very low levels. What difference does it make on student achievement growth?

In elementary schools, students who test at grade level or lower, are distinctly helped by being in a school with more high-achieving students. The students who are performing above their grade level are not

particularly affected--it is the low-achieving students who benefit most. Variations in the proportions of low-achieving students also do not have much effect on the high achievers, though being in a student body with more low achievers has a negative effect on learning for the rest. What all this seems to say, for elementary schools, is that high achievers go along on their own steam, relatively unaffected by variations in the percentage of top and bottom achievers. But, for the rest, and, in particular for the low achievers, the intellectual composition, at the extremes, of the student body has a direct impact on learning. They will be better off in schools which have a more heterogeneous student body with respect to abilities.

In junior high schools, all students benefit alike when they are part of a student body with more high achievers. Students do not seem to lose when they are part of a student body with more low achievers, however. If, therefore, junior high schools were made more heterogeneous with respect to ability, some would gain and some would lose. If concern is focused primarily on the low achiever, however, there would be a gain by such a rearrangement of students.

In senior high schools, the proportion of high- and low-achieving students referred only to performance on reading tests and the schools in the sample

had very few high achievers. The range was 0 to 30 percent. Variations in these proportions did not show any impact, but another meaningful measure--high school dropouts--did. The greater the proportion of dropouts in a high school, the more negative the impact on learning. Further, though we, of course, think of the undesirable effects of dropouts primarily in terms of the impact on the student who leaves, it is clear that there are undesirable effects on other members of the student body--on the high-achieving students in particular.

In general, then, peer group abilities have a bearing on student achievement. But the effects of racial desegregation are not significantly altered by these peer group effects. (See Tables K-1, K-2, K-3 for a comparison of the regression results with and without controlling for peer group ability.)

3. Disruption (DISRUPT.)

If a school has more disruption of a fairly serious sort--stabbings, robberties, rapes--what impact does it have on the achievement gains of students? In elementary, junior high, and senior high school, more of these harsh incidents around lowers the achievement growth of high achievers significantly, but affects the low achievers much less so. School policies which contribute to reducing the number of serious incidents,

then, will contribute to the learning of testable skills--in particular, they will contribute to the skill learning of middle- and high-achieving students.

In summary, then, a student body which is more heterogenous with respect to race and achievement levels is a student body which is likely to test out better in basic skills. Further, a school which is freer of disruption is one where more skills learning will occur.

IV. RELEVANCE TO ISSUES OF EQUITY AND EFFICIENCY

In going from the original list of variables to the equations of "best fit," we have run many regressions. We looked at many alternative specifications--nonlinear, interactive--for the variables. We have, in other words, mined the data. But we would defend this on the grounds that data are there to be looked at for what they can reveal. We start with so few hypotheses convincingly turned up by theory that classical hypothesis testing is, in this application, sterile.

The standard tests of significance provide guidance of only a very crude sort--hence, the usual asterisks are missing from the t-statistics in the tables. We threaded our way through the myriad of variable combinations with the magic 5 percent normal curve numbers. But, to the final formulations and interpretation of coefficients, we applied more informal standards. All interaction results, for example, were checked out against separate regressions based upon data sub-samples. Variables which had coefficients whose significance were very sensitive to the introduction and discarding of other variables were not retained. All the major findings were extensively tested for robustness.

We are confident that our results describe in a reasonable way this collection of 627 elementary, 553 junior high, and 716 senior high students. What we do have to be agnostic about is the absence of replication. We are now embarking on a second phase of this study using a much larger sample of data from the same period (several thousand for each level of schooling), but, unfortunately, these data are less pupil-specific.

We think that there are some things we can say, of a general sort, on the basis of our first set of results.

(A) Most of the court cases concerned with whether or not equality of educational opportunity is being achieved have recognized, in one way or another, that no clear link had been established between school resources and educational quality. There has been, to use the wording of several decisions, no "judicially manageable standard." So, as second best, they have looked at resources alone to see if they were equitably distributed, or they have looked at whether the way education was financed was equitable in relation to the amount of resources--but not at whether or not these resources have bearing on student achievement (a quality measure).

If it is the objective of the courts and school administrators to make more equal the educational achievement growth of the advantaged and the disadvantaged, then targeting which school resources are specifically helpful to the low achievers is essential. If, for example, physical facilities are not particularly helpful to achievement, then learning that schools in better condition tend to be in locations where there are fewer disadvantaged students should not necessarily lead to action to

equalize the facilities-- though, obviously, there may be other equity objectives than achievement which would lead one to advocate change. If, on the other hand, the fact that smaller classes are particularly helpful to the learning growth of low achievers is verified, then there is something specific to advocate in the quest for equity. The findings of this study suggest that there are school inputs which help the low achievers to do better--that is, that a "judicially manageable standard" can be formulated.

(B) Federal and State compensatory funds are now allocated on the basis of income and population density characteristics. Perhaps, this allocation could more usefully be predicated on concentrations of low achievers, since there appear to be a number of school resources which can help low achievers, and achievement growth is a widely accepted output measure.

(C) A precise statement of the efficiency advantages of a policy which would withdraw resources from activities where extra school inputs don't seem to contribute to achievement growth, and add resources to those activities which do seem to be productive, would require a knowledge of input prices. But, it seems clear to us that enough inputs fall into each of these categories to suggest the desirability of such shifts.

(D) Many of the school inputs varied considerably in their impact on different types of students--and, clearly, this is consistent with what educators and parents believe when they advocate individualizing education. It seems to us that much more differentiation in the application of resources to pupils is called for. Smaller classes for low achievers is not a new idea--but considerably larger classes for high achievers is.

Our evidence suggests that different measurable teacher qualities work well for different types of students. Explicitly allocating teachers in this way is not what is done.

(E) The results of our study suggest that principal and teacher salary rewards may not be tied to the characteristics which are most productive in terms of achievement growth.

In summary, our sample findings suggest (1) that when there are extensive pupil-specific data available, more impact from school resources is revealed, (2) that most of the effects of family income and race can be tagged to differential impacts of school resources, and (3) that the low achiever, the low-income student, and the Black student do respond, in terms of achievement growth, to some school inputs.

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LIST OF TABLES

TABLE A-1

INCOME DISTRIBUTION OF 6th GRADE SAMPLE BY RACE

Income Class	Total	Black	Non-Black
< $ 4,000	2.55	3.99	0
$ 4,000 - 4,999	4.31	6.23	.89
$ 5,000 - 5,999	8.45	11.97	2.21
$ 6,000 - 6,999	11.32	17.21	.89
$ 7,000 - 7,999	9.89	11.47	7.08
$ 8,000 - 8,999	15.63	13.72	19.03
$ 9,000 - 9,999	15.15	7.73	28.32
$10,000 - 12,499	27.43	22.94	35.40
$12,500 - 14,999	3.19	2.24	4.87
$15,000 +	2.07	2.49	1.33
$\bar{x}$	$8,801	$8,228	$9,819
σ	2,609	2,809	1,812
Number in sample	627	401	226

$\bar{x}$ = Mean annual family income, 1970.

σ = Standard deviation of annual income.

SOURCE: Anita A. Summers and Barbara L. Wolfe, Manual on Procedure for Using Census Data to Estimate Block Income and Block Income Estimates, City of Philadelphia, 1960 and 1970. Federal Reserve Bank of Philadelphia, forthcoming.

TABLE A-2

INCOME DISTRIBUTION OF 8th GRADE SAMPLE BY RACE

Income Class	Total	Black	Non-Black
< $ 4,000	3.07	4.44	0
$ 4,000 - 4,999	9.58	13.84	0
$ 5,000 - 5,999	7.96	11.23	.59
$ 6,000 - 6,999	11.21	15.93	.59
$ 7,000 - 7,999	15.37	18.54	8.24
$ 8,000 - 8,999	14.65	14.10	15.88
$ 9,000 - 9,999	17.54	12.53	28.82
$10,000 - 12,499	18.44	8.62	40.59
$12,500 - 14,999	1.63	.26	4.71
$15,000 +	.54	.52	.59
$\bar{x}$	$8,067	$7,235	$9,941
σ	2,351	2,160	1,549
Number in sample	553	383	170

$\bar{x}$ = Mean annual family income, 1970.

σ = Standard deviation of annual income.

SOURCE: Anita A. Summers and Barbara L. Wolfe, Manual on Procedure for Using Census Data to Estimate Block Income and Block Income Estimates, City of Philadelphia, 1960 and 1970. Federal Reserve Bank of Philadelphia, forthcoming.

TABLE A-3

INCOME DISTRIBUTION OF 12th GRADE SAMPLE BY RACE

Income Class	Total	Black	Non-Black
< $ 4,000	2.51	2.87	0
$ 4,000 - 4,999	10.46	11.80	1.11
$ 5,000 - 5,999	8.51	9.57	1.11
$ 6,000 - 6,999	11.71	12.92	3.33
$ 7,000 - 7,999	12.97	13.24	11.11
$ 8,000 - 8,999	17.43	16.27	25.55
$ 9,000 - 9,999	18.69	17.07	30.00
$10,000 - 12,499	16.04	15.15	22.22
$12,500 - 14,999	1.53	1.12	4.44
$15,000 +	.14	0	1.11
$\bar{x}$	$7,995	$7,780	$9,490
σ	2,264	2,203	2,124
Number in sample	717	627	90

$\bar{x}$ = Mean annual family income, 1970.

σ = Standard deviation of annual income.

SOURCE: Anita A. Summers and Barbara L. Wolfe, Manual on Procedure for Using Census Data to Estimate Block Income and Block Income Estimates, City of Philadelphia, 1960 and 1970. Federal Reserve Bank of Philadelphia, forthcoming.

TABLE B

DISTRIBUTION OF IQ
OF 6TH GRADE SAMPLE BY RACE

IQ*	Total	Black	Non-Black
80	16.11	19.70	9.74
90	22.97	25.94	17.70
100	23.92	23.94	23.89
110	18.02	16.71	20.35
120	13.40	9.73	19.91
130+	5.58	3.99	8.41
$\bar{x}$	100.65	98.28	104.86
σ	14.46	13.923	14.46
Number in sample	627	401	226

$\bar{x}$ = mean IQ.

σ = Standard deviation of IQs.

*As measured by the Philadelphia Verbal Ability Test, which is graded in units of 10 points.

TABLE C-1

DISTRIBUTION OF 3RD GRADE AND 6TH GRADE IOWA TEST OF BASIC SKILLS SCORES OF 6TH GRADE SAMPLE BY RACE AND INCOME GROUPS

Scores (in Grade Equivalent Form)[1]	Total	Black	Non-Black	Income < $7,000	Income $7,000 - 9,000	Income $9,000 +
3rd Grade Scores						
1.0 - 1.9	3.67	4.24	2.66	5.99	2.5	3.0
2.0 - 2.9	43.86	50.13	32.74	47.31	55.0	36.0
3.0 - 3.9	29.03	26.43	33.63	25.75	28.13	31.33
4.0 - 4.9	18.02	15.71	22.12	16.77	12.50	21.67
5.0 +	5.42	3.49	8.85	4.19	1.88	8.00
$\bar{x}$	3.21	3.07	3.47	3.06	2.99	3.42
σ	.97	.92	1.00	.96	.85	.99
6th Grade Scores						
< 3.0	4.32	4.49	3.98	4.79	8.13	2.00
3.0 - 3.9	18.66	23.44	10.18	20.96	25.0	14.00
4.0 - 4.9	24.40	27.68	18.58	37.72	20.63	19.00
5.0 - 5.9	20.89	19.70	23.01	17.96	23.75	21.00
6.0 - 6.9	17.38	14.96	21.68	10.78	14.38	22.67
7.0 - 7.9	8.93	5.99	14.16	4.79	5.00	13.33
8.0 +	5.42	3.74	8.41	3.00	3.13	8.00
$\bar{x}$	5.24	4.97	5.72	4.83	4.89	5.66
σ	1.52	1.43	1.55	1.36	1.43	1.53
Number in sample	627	401	226	167	160	300

[1]The Grade Equivalent Score is measured on a scale indicating the grade level and month in which the median student would receive the corresponding raw score, i.e., 4.0 indicates that the median of the students in the norming population attained this raw score when they entered the fourth grade.

SOURCE: Individual Pupil Records, Form EH-7.

TABLE C-2

DISTRIBUTION OF 6TH GRADE AND 8TH GRADE IOWA TEST OF BASIC SKILLS SCORES OF 8TH GRADE SAMPLE BY RACE AND INCOME GROUPS

6th Grade Scores

Scores	Total	Black	Non-Black	Income < $7,000	Income $7,000 - 9,000	Income $9,000 +
< 3.0	1.27	1.31	1.18	1.14	1.81	0.95
3.0 - 3.9	12.30	16.45	2.94	21.59	9.04	7.11
4.0 - 4.9	34.00	40.47	19.41	44.89	37.95	21.80
5.0 - 5.9	22.06	21.67	22.94	16.48	26.51	23.22
6.0 - 6.9	17.00	13.84	24.12	11.36	15.66	22.75
7.0 - 7.9	9.04	5.48	17.06	3.41	7.23	15.17
8.0 +	4.34	0.78	12.35	1.14	1.81	9.01
$\bar{x}$	5.32	4.96	6.13	4.77	5.20	5.88
σ	1.33	1.11	1.41	1.08	1.18	1.40

8th Grade Scores

< 4.0	5.42	6.00	4.12	7.95	4.82	3.79
4.0 - 4.9	16.28	20.63	6.47	26.14	17.47	7.11
5.0 - 5.9	24.23	30.81	9.41	31.25	28.31	15.17
6.0 - 6.9	16.09	15.93	16.47	14.20	13.86	19.43
7.0 - 7.9	14.11	13.58	15.29	10.80	13.86	17.06
8.0 - 8.9	13.20	9.40	21.77	6.82	15.06	17.06
9.0 - 9.9	5.97	2.87	12.94	2.27	4.22	10.43
10.0 +	4.70	.78	13.53	0.57	2.41	9.94
$\bar{x}$	6.49	5.99	7.62	5.72	6.32	7.27
σ	1.81	1.53	1.89	1.50	1.68	1.85
Number in sample	543	383	160	176	166	211

SOURCE: Individual Pupil Records, Form EH-7.

TABLE C-3

DISTRIBUTION OF SCAT TEST TAKEN IN 9TH GRADE AND CAT OR CTBS IN 12TH GRADE FOR 12TH GRADE SAMPLE BY RACE AND INCOME GROUPS

Scores (in National Percentile Form)	Total	Black	Non-Black	Income < $7,000	Income $7,000 - 9,000	Income $9,000 +
9th Grade Score						
0 - 4.9%	22.59	23.92	13.33	31.09	18.35	18.39
5.0 - 9.9	11.44	11.80	8.89	14.29	10.09	9.96
10.0 - 14.9	11.30	12.12	5.56	13.87	12.84	7.66
15.0 - 19.9	10.74	11.16	7.78	7.98	10.55	13.41
20.0 - 24.9	6.56	7.34	1.11	5.46	6.88	7.28
25.0 - 29.9	10.32	10.52	8.89	7.56	10.09	13.03
30.0 - 34.9	2.51	2.07	5.56	2.52	1.83	3.07
35.0 - 39.9	4.88	4.47	7.78	5.04	5.50	4.21
40.0 - 49.9	5.72	5.42	7.78	2.94	5.96	8.05
50.0 - 59.9	5.30	4.78	8.89	3.78	6.88	5.37
60.0 - 69.9	4.60	3.51	12.22	3.36	5.96	4.60
70.0 - 79.9	2.09	1.59	5.56	.84	3.21	2.30
80.0 - 89.9	1.12	.96	2.22	.42	.92	1.92
90.0 +	.84	.32	4.44	.84	.92	.77
$\bar{x}$	22.93	20.95	36.80	17.74	25.57	25.48
σ	21.42	19.65	27.42	19.15	22.31	21.84
12th Grade Score						
0 - 4.9%	19.11	19.78	14.44	18.07	19.72	19.54
5.0 - 9.9	11.16	10.69	14.44	7.98	12.84	12.64
10.0 - 14.9	11.30	12.28	4.44	15.55	9.17	9.20
15.0 - 19.9	5.44	5.26	6.67	4.62	5.50	6.13
20.0 - 24.9	13.11	14.51	3.33	18.91	9.63	10.73
25.0 - 29.9	4.18	4.47	2.22	2.94	6.42	3.45
30.0 - 34.9	9.76	10.05	7.78	16.39	8.26	4.98
35.0 - 39.9	3.49	3.51	3.33	3.78	3.67	3.07
40.0 - 49.9	7.95	7.66	10.00	5.04	9.17	9.57
50.0 - 59.9	4.88	4.46	7.77	2.94	6.88	4.98
60.0 - 69.9	4.18	3.19	11.12	1.26	4.12	6.89
70.0 - 79.9	2.51	2.55	2.22	.84	.92	5.37
80.0 - 89.9	1.53	.80	6.66	.84	2.30	1.53
90.0 +	1.50	.80	5.55	.84	1.38	1.92
$\bar{x}$	25.19	23.62	36.11	22.05	25.36	27.90
σ	22.17	20.46	29.51	17.68	22.44	25.14
Number in sample	717	627	90	238	218	261

SOURCE: 9th grade - Individual Pupil Records, Form EH-7. 12th grade tapes from Districts 1, 2, 3, 4, School District of Philadelphia.

TABLE D-1

REGRESSION RESULTS FOR THE SAMPLE OF 6TH GRADERS

Dependent Variable: 6th Grade Iowa Test of Basic Skills Test Score, Composite Minus 3rd Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables		β	t	$\bar{x}$	σ
1.	SEX	- .89	-1.39	.48	.50
2.	IQ	.13	3.71	100.65	14.46
3.	IQ 110+	.16	1.49		
4.	B(IQ 110+)	- .23	-1.90		
5.	UNEXCUSED	.11	.44	2.33	4.48
6.	Y(UNEXC.)	- .05	-1.80		
7.	LATE	- 1.16	-3.80	2.02	3.58
8.	Y(LATE)	.11	3.33		
9.	DGOURMAN	13.61	2.49	.05	.22
10.	Y(DGOUR)	- .99	-1.77		
11.	TEACH. EXP.	- .48	-1.87	6.58	3.71
12.	3I(TEACH. EXP.)	.02	2.43		
13.	TEACH. SCORE	- .02	-2.71	606.83	58.93
14.	BKS/PUPIL	- .51	-2.43	6.98	2.37
15.	CLASS $\geq$ 34	- 2.08	-2.36		
16.	CLASS 28-33	- 4.33	-2.08		
17.	3I(CLASS 28-33)	.13	2.18		
18.	SCHOOL SIZE	- .002	-1.06	917.35	336.05
19.	B(SCH. SIZE)	- .005	-3.75		
20.	20-40%B	3.28	2.27		
21.	40-60%B	5.59	3.49		
22.	60% + B	4.25	2.91		
23.	%HIGH	.64	2.41	3.95	5.96
24.	3I(% HI)	- .01	-2.10		
25.	%LOW	- .08	-2.33	48.69	18.48
26.	DISRUPT	1.93	4.04	2.89	2.31
27.	3I(DISR.)	- .05	-3.36		
	Constant	23.75			
	Adj. R^2/SE	.28	7.79		
	N	627			

NOTE: When run with 6th grade Iowa Test of Basic Skills Test Score Composite as dependent variable, adding 3rd grade score as independent variable, the Adj R^2 is .74, the β of the 3G score is .98.

TABLE D-1

Key

1. Dummy variable: 0 = female, 1 = male.
2. Score on 1st grade Philadelphia Verbal Ability Test.
3. Additional effect of 110 or more on I. Q. test; interpreted by adding β of I. Q. and β of I. Q. 110+. Form is a two-piece linear function with corner at 110.
4. Interaction: Black with additional effect of 110 or more, on I. Q. test.
5. Average number of unexcused absences per year during study, 1967/68 - 1970/71.
6. Interaction: Income with unexcused abaences.
7. Average number of latenesses per year during study, 1967/68 - 1970/71.
8. Interaction: Income with latenesses.
9. Dummy variable: Gourman rating of 6th grade teacher's undergraduate college. 0 = <525, 1 = ≥525.
10. Interaction: Income with Gourman rating dummy.
11. 6th grade teacher's experience, in years up to 11.
12. Interaction: 3rd grade score with teacher's experience.
13. 6th grade teacher's National Teacher Exam Score.
14. Number of library books per pupil.
15. Dummy variable: 1 = class size ≥ 34.
16. Dummy variable: 1 = class size ≥ 28 and ≤ 33.
17. Interaction: 3rd grade score with class size 28 - 33.
18. Number of pupils enrolled in school.
19. Interaction: Black with school enrollment.
20. Dummy variable: 1 = % Black in school ≥ 20% and < 40%.
21. Dummy Variable: 1 = % Black in school ≥ 40% and < 60%.
22. Dummy variable: 1 = % Black in school ≥ 60%.
23. Average % in pupil's 5th and 6th grades who scored above the 84th National Percentile on Iowa Test of Basic Skills.

TABLE D-1 - Key (cont'd)

24. Interaction: 3rd grade score with % high achievers.

25. Average % in pupil's 5th and 6th grades who scored below the 16th National Percentile on Iowa Test of Basic Skills.

26. Annual number of disruptive incidents in school.

27. Interaction: 3rd grade score with disruptive incidents.

TABLE D-1

TESTS OF SIGNIFICANCE* FOR INTERACTION VARIABLES

Interaction with Income

Variable	UNEXCUSED	LATE	DGOURMAN
α	.11	- 1.16	13.61
β	- .05	.11	- .99
y* (in thousands)			
4	- .67	-3.88	2.86
5	-1.23	-3.83	3.00
6	-1.99	-3.66	3.16
8	-3.90	-2.42	3.34
10	-4.39	- .14	2.40
15	-3.17	2.23	- .34

Interaction with 3rd Grade Score

Variable	TEACH. EXP.	CLASS 28 - 33	% HIGH	DISRUPT
α	- .48	-4.33	.64	1.93
β	.02	.13	- .01	- .05
y* (in months of grade equivalent units)				
10	-1.58	-1.97	2.45	4.18
20	- .91	-1.62	2.46	4.18
30	.70	- .39	2.32	2.93
40	2.26	1.20	1.58	.03
50	2.64	1.79	.19	-1.51

Interaction with Race

Variable	IQ 110+	School Size
α	.16	- .002
β	- .23	- .005
y*		
1	- .69	- 3.91

*TEST: $\tilde{\theta} = \dfrac{\hat{\alpha} + \hat{\beta}y^*}{\sqrt{\hat{\sigma}_{\hat{\alpha}}^2 + \hat{\sigma}_{\hat{\beta}}^2 y^{*2} + 2\hat{\sigma}_{\hat{\alpha}\hat{\beta}}}}$

TABLE D-2

REGRESSION RESULTS FOR THE SAMPLE OF 8TH GRADERS

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables	β	t	$\bar{x}$	σ
1. SEX	.74	.84	.46	.50
2. L(SEX)	-2.72	-2.30		
3. 2ND GENERATION	3.98	1.88		
4. 3G SCORE	.51	2.35	32.26	8.35
$(3G\ SCORE)^2$	- .004	-1.47		
5. 6G SCORE	- .34	-2.02	53.21	13.26
6. UNEXCUSED	.35	1.74	6.25	7.86
7. 6I(UNEXC.)	- .01	-2.53		
8. DAYS PRES.	.05	1.35	168.56	12.47
9. MOVES	3.20	1.04	.20	.52
10. 6I(MOVES)	- .10	-1.56		
11. SS. TEACH. GOUR	- .03	-1.63	415.84	61.27
12. 6I(SS. GOUR)	.0006	1.73		
13. ENG. TEACH. EXP.	- .49	- .71	5.51	3.13
14. ENG. EXP.(-3)	.09	.12		
ENG. EXP.(-10)	4.16	2.65		
15. MATH TEACH. RACE = PUPIL RACE	2.11	2.14		
16. MATH TEACH. EXP.	- .02	- .03	5.26	3.10
17. MATH EXP.(-3)	.42	.55		
MATH EXP.(-10)	-2.51	-1.49		
18. SS. TEACH. SCORE	.08	1.30	64.58	5.96
19. %B. TEACHERS	- .15	-3.01	35.71	16.67
20. BKS/PUPIL	- .63	-1.72	6.78	2.29
21. 6I(BKS/PP)	.02	2.72		
22. REM. EXP./L	.03	1.92	38.58	24.06
23. L(REM. EXP./L)	- .05	-1.77		
24. CLASS $\geq$ 32	-6.15	-2.45		
25. Y(CLASS $\geq$ 32)	.37	1.30		
26. ELEM. SCHOOL	4.22	3.06		
27. %BLACK	.05	1.02	65.64	36.04
28. B(%BLACK)	- .04	-1.01		
29. %BLACK(-50)	- .18	-1.63		
30. B(%B[-50])	.30	2.88		
31. DISRUPT	.05	.58	10.64	6.77
32. M(DISR.)	- .03	- .31		
33. H(DISR.)	- .14	-1.18		
Constant	1.07			
Adj. R^2/SE	.31	7.07		
N	553			

NOTE: When run with 8th grade Iowa Test of Basic Skills as the dependent variable, the Adj R^2 is .85, the coefficient on 6G Score .66.

TABLE D-2

Key

1. Dummy variable: 0 = female, 1 = male.

2. Interaction: Dummy if low achiever[1] with sex.

3. Dummy variable: 1 = Second generation American.

4. Quadratic: Score on Iowa Test of Basic Skills given at end of 3rd grade; proxy for initial ability.

5. Score on Iowa Test of Basic Skills given at end of 6th grade.

6. Average number of unexcused absences per year during study, 1968/69 - 1970/71.

7. Interaction: 6th grade score with unexcused absences.

8. Average number of days present per year in school during study, 1968/69 - 1970/71.

9. Total number of residential moves of pupil during years under study.

10. Interaction: 6th grade score with moves.

11. 8th grade Social Studies teacher's undergraduate college, Gourman rating.

12. Interaction: 6th grade score with Social Studies teacher's Gourman rating.

13. 8th grade English teacher's experience, in years to 11.

14. Two additional pieces of a three-piece linear function of English teacher experience with corner points at 3 and 10 years,
Eng. Exp. (-3) = maximum (0, years of experience - 3);
Eng. Exp. (10) = maximum (0, years of experience - 10).

15. 8th grade Math teacher's race is same as pupil's race.

16. 8th grade Math teacher's experience, in years to 11.

17. Two additional pieces of a three-piece linear function for Math teacher experience with corner points at 3 and 10 years, Math Exp. (-3) = maximum (0, years of experience - 3);
Math Exp. (-10) = maximum (0, years of experience - 10).

18. 8th grade Social Studies teacher's National Teacher Exam Score on Social Studies test.

19. % of Black teachers in school.

20. Number of library books per pupil.

TABLE D-2 - Key (cont'd)

21. Interaction: 6th grade reading score on Iowa Test of Basic Skills with books per pupil.

22. Average expenditure on remedial education per low achieving pupil.

23. Interaction: Dummy if low achiever,[1] with remedial expenditure per low achiever.

24. Dummy variable: 1 = class size $\geq$ 32.

25. Interaction: Income with class size $\geq$ 32.

26. Dummy variable: 1 = 8th grade in elementary school.

27. % Black in school.

28. Interaction: Black with % Black in school.

29. Second piece of two-piece linear function of % Blacks with corner point at 50%; % Black (-50) = maximum (0, % Black - 50).

30. Interaction: Black with % Black (-50).

31. Annual number of disruptive incidents in school.

32. Interaction: Dummy if average achiever[2] with disruptive incidents.

33. Interaction: Dummy if high achiever[3] with disruptive incidents.

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[1]Low achievers are those whose 6th grade scores are $\leq$ 5.1.

[2]Average achievers are those whose 6th grade scores are > 5.1 and < 6.9.

[3]High achievers are those whose 6th grade scores are $\geq$ 6.9.

TABLE D-2

TESTS OF SIGNIFICANCE* FOR INTERACTION VARIABLES

Interactions with Income

Variable	CLASS ≥ 32
α	-6.15
β	.37
y* (in thousands)	
4	-3.16
6	-3.73
8	-3.81
10	-2.49
15	- .26

Interactions with 6th Grade Score

Variable	UNEXCUSED	MOVES	SS. TEACH. GOUR	BKS/PP (with 6th Grade Reading)
α	.35	3.20	- .03	- .63
β	- .01	- .10	.001	.02
y* (in months of grade equivalent units)				
30	.48	.16	-1.40	- .62
40	- .75	-1.04	-1.08	.11
50	-2.34	-2.82	- .24	1.01
60	-3.12	-2.74	.88	1.87
70	-3.22	-2.40	1.41	2.45
80	-3.16	-2.20	1.59	2.77

Interaction with Race

Variable	% Black	% Black (-50)
α	.05	- .18
β	- .04	.30
y*		
1	.28	1.77

*TEST: $\tilde{\theta} = \dfrac{\hat{\alpha} + \hat{\beta}y^*}{\sqrt{\delta_{\hat{\alpha}}^2 + \hat{\sigma}_{\hat{\beta}}^2 y^{*2} + 2\delta_{\hat{\alpha}\hat{\beta}}}}$

TABLE D-3

REGRESSION RESULTS FOR SAMPLE OF 12TH GRADERS

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Scores, Reading in National Percentile Rankings Minus 9th Grade Cooperative School and College Abilities Test, Reading in National Percentile Rankings.

Independent Variables		β	t	$\bar{x}$	σ
1.	SEX	3.45	1.89	.53	.50
2.	9%(SEX)	- .10	- 1.77		
3.	RACE	20.21	2.22	.88	.33
4.	7I(RACE)	- .35	- 2.41		
5.	7G SCORE	.99	6.71	55.91	11.15
6.	9G SCORE(%)	- 1.94	- 4.29	22.94	21.42
7.	UNEXCUSED	- .08	- 1.46	10.53	10.93
8.	LATE	.04	.52	12.75	12.91
9.	9%(LATE)	- .01	- 2.46		
10.	ENG. TEACH. SCORE	- .12	- .84	66.80	5.56
11.	9%(ENG. SCORE)	.01	2.36		
12.	ENG. CLASS	- 1.13	- 2.23	24.68	2.52
13.	9%(ENG. CL.)	.04	4.11		
14.	% DROPOUTS	.20	.56	14.64	3.71
15.	9%(% DR.)	- .02	- 2.91		
16.	SCHOOL SIZE	- .003	- 2.35	3445.25	925.89
17.	%BLACK	.10	1.67	84.29	16.39
	Constant	- 9.91			
	Adj R^2/SE	.32	14.29		
	N	717			

NOTE: When run wit 12th grade score as dependent variable, the Adj R^2 is .58 and the coefficient on 9G Score is -.94.

TABLE D-3

Key

1. Dummy variable: 0 = female, 1 = male.
2. Interaction: 9th grade score with sex.
3. Dummy variable: 0 = non-Black, 1 = Black.
4. Interaction: 7th grade score with race.
5. Score on Iowa Test of Basic Skills given Spring of 7th grade; proxy for initial ability.
6. National Percentile score on 9th grade Cooperative School and College Abilities Test.
7. Average number of unexcused absences per year, 1968/69 - 1971/72.
8. Average number of latenesses per year, 1968/69 - 1971/72.
9. Interaction: 9th grade score with latenesses.
10. 12th grade English teacher's National Teachers Exam score on English exam.
11. Interaction: 9th grade score with English teacher's score.
12. Number of pupils in English class.
13. Interaction: 9th grade score with English class size.
14. Average high school dropout rate.
15. Interaction: 9th grade score with dropout rate.
16. Number of pupils enrolled in school.
17. % of Black pupils in school.

TABLE D-3

TESTS OF SIGNIFICANCE* FOR INTERACTION VARIABLES

Interaction with 9th Grade Score

Variable	SEX	LATE	ENG. TEACH. SCORE	ENG. CLASS	% DROPOUTS
α	3.45	.04	- .12	-1.13	.20
β	- .10	- .01	.01	.04	- .02
y* (in National percentiles)					
5	1.81	.09	- .52	-1.93	.32
10	1.69	- .44	- .12	-1.57	.03
20	1.19	-1.63	.89	- .66	- .65
30	.39	-2.43	1.80	.46	-1.45
40	- .33	-2.74	2.30	1.58	-2.26
50	- .79	-2.82	2.50	2.48	-2.91

Interaction with 7th Grade Score

Variable	RACE
α	20.21
β	- .35
y*	
50	1.05
60	- .48
70	- 1.91
80	- 2.36
90	- 2.47

*TEST: $\tilde{\theta} = \dfrac{\hat{\alpha} + \hat{\beta}y^*}{\sqrt{\sigma_{\hat{\alpha}}^2 + \sigma_{\hat{\beta}}^2 y^{*2} + 2\sigma_{\hat{\alpha}\hat{\beta}}}}$

TABLE E-1

REGRESSION RESULTS FOR THE 6TH GRADE SAMPLE
DROPPING IQ VARIABLES

Independent Variables		Basic Equation β	Basic Equation t	Equation without IQ Variables β	Equation without IQ Variables t
1.	SEX	- .89	-1.39	- 1.08	-1.66
2.	IQ	.13	3.71		
3.	IQ 110+	.16	1.49		
4.	B(IQ 110+)	- .23	-1.90		
5.	UNEXCUSED	.11	.44	.05	.19
6.	Y(UNEXC.)	- .05	-1.80	- .05	-1.59
7.	LATE	- 1.16	-3.80	- 1.16	-3.72
8.	Y(LATE)	.11	3.33	.11	3.27
9.	DGOURMAN	13.61	2.49	12.82	2.30
10.	Y(DGOUR)	- .99	-1.77	- .86	-1.51
11.	TEACH. EXP.	- .48	-1.87	- .76	-2.95
12.	3I(TEACH. EXP.)	.02	2.43	.03	3.71
13.	TEACH. SCORE	- .02	-2.71	- .01	-2.56
14.	BKS/PUPIL	- .51	-2.43	- .53	-2.45
15.	CLASS $\geq$ 34	- 2.08	-2.36	- 1.93	-2.14
16.	CLASS 28-33	- 4.33	-2.08	- 5.47	-2.59
17.	3I(CLASS 28-33)	.13	2.18	.17	2.68
18.	SCHOOL SIZE	- .002	-1.06	- .001	- .89
19.	B(SCH. SIZE)	- .005	-3.75	- .005	-4.12
20.	20-40% B	3.28	2.27	3.17	2.15
21.	40-60% B	5.59	3.49	5.24	3.21
22.	60% + B	4.25	2.91	3.63	2.44
23.	% HIGH	.64	2.41	.53	1.99
24.	3I(% HIGH)	- .01	-2.10	- .01	-1.70
25.	% LOW	- .08	-2.33	- .09	-2.50
26.	DISRUPT	1.93	4.04	1.82	3.78
27.	3I(DISR.)	- .05	-3.36	- .05	-3.18
	Constant	23.75		37.98	
	Adj. R^2/SE	.28	7.79	.24	7.98
	N	627		627	

TABLE E-2

REGRESSION RESULTS FOR THE 8TH GRADE SAMPLE DROPPING THE 6TH GRADE SCORE AND THEN THE 3RD GRADE SCORE

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite.

	Basic Equation		Dropping 6th Grade Score		Dropping 3rd Grade Score	
Independent Variables	β	t	β	t	β	t
SEX	.74	.84	.68	.77	.66	.74
L(SEX)	-2.72	-2.30	- 2.57	-2.17	-2.36	-1.98
2ND GENERATION	3.98	1.88	3.97	1.87	4.20	1.96
3G SCORE	.51	2.35	.51	2.30		
$(3G\ SCORE)^2$	- .004	-1.47	- .004	-1.47		
6G SCORE	- .34	-2.02			- .30	-1.75
UNEXCUSFD	.35	1.74	.33	1.64	.40	2.00
6I(UNEXC.)	- .01	-2.53	- .01	-2.49	- .01	-2.78
DAYS PRES.	.05	1.35	.05	1.21	.06	1.39
MOVES	3.20	1.04	3.76	1.22	4.11	1.33
6I(MOVES)	- .10	-1.56	- .11	-1.73	- .12	-1.84
SS. TEACH. GOUR	- .03	-1.63	.003	.26	- .04	-1.85
6I(SS. GOUR)	.001	1.73	- .00	- .23	.001	1.96
ENG. TEACH. EXP.	- .49	- .71	- .51	- .74	- .55	- .80
ENG. EXP. (-3)	.09	.12	.12	.14	.19	.23
ENG. EXP. (-10)	4.16	2.65	4.10	2.60	4.06	2.55
MATH TEACH.	2.11	2.14	2.11	2.13	1.83	1.84
RACE = PUPIL RACE						
MATH TEACH. EXP.	- .02	- .03	- .03	- .05	- .01	- .01
MATH EXP. (-3)	.42	.55	.45	.59	.42	.55
MATH EXP. (-10)	-2.51	-1.49	- 2.84	-1.70	-2.22	-1.31
SS. TEACH. SCORE	.08	1.30	.07	1.17	.08	1.32
%B. TEACHERS	- .15	-3.01	- .15	-2.99	- .14	-2.92
BKS/PUPIL	- .63	-1.72	- .43	-1.21	- .68	-1.83
6I(BKS/PP)	.02	2.72	.01	2.25	.02	2.71
REM. EXP./L	.03	1.92	.03	1.89	.04	2.06
L(REM. EXP./L)	- .05	-1.77	- .04	-1.46	- .05	-1.90
CLASS $\geq$ 32	-6.15	-2.45	- 5.99	-2.38	-6.73	-2.65
Y(CLASS $\geq$ 32)	.37	1.30	.34	1.19	.43	1.47
ELEM. SCHOOL	4.22	3.06	4.32	3.12	4.33	3.10
%BLACK	.05	1.02	.05	1.04	.06	1.11
B(%BLACK)	- .04	-1.01	- .04	-1.05	- .05	-1.43
%BLACK(-50)	- .18	-1.63	- .19	-1.68	- .21	-1.86
B(%B[-50])	.30	2.88	.31	2.97	.35	3.26
DISRUPT	.05	.58	.06	.76	.05	.64
M(DISR.)	- .03	- .31	- .04	- .47	- .01	- .17
H(DISR.)	- .14	-1.18	- .18	-1.50	- .12	-1.00
Constant	1.07		-15.54		9.98	
Adj. R^2/SE	.31	7.07	.31	7.09	.30	7.16
N	553		553		553	

TABLE E-3

REGRESSION RESULTS FOR THE 12TH GRADE SAMPLE
DROPPING THE 9TH GRADE SCORE AND THEN THE 7TH GRADE SCORE

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Scores, Reading in National Percentile Rankings Minus 9th Grade Cooperative School and College Abilities Test, Reading in National Percentile Rankings.

		Basic Equation		Equation without 9 G. Score		Equation without 7 G. Score	
	Independent Variables	β	t	β	t	β	t
1.	SEX	3.45	1.89	4.97	2.74	4.46	2.38
2.	%(SEX)	- .10	- 1.77	- .16	- 2.88	- .15	- 2.62
3.	RACE	20.21	2.22	23.97	2.62	-32.30	- 6.77
4.	%(RACE)	- .35	- 2.41	- .42	- 2.83	.50	6.82
5.	7 G. SCORE	.99	6.71	1.02	6.82		
6.	9 G. SCORE (%)	- 1.94	- 4.29			- 2.07	- 4.44
7.	UNEXCUSED	- .08	- 1.46	- .08	- 1.35	- .08	- 1.44
8.	LATE	.04	.52	.07	1.05	.06	.91
9.	%(LATE)	- .01	- 2.46	- .01	- 3.11	- .01	- 3.04
10.	ENG. TEACH. SCORE	- .12	- .84	.17	1.29	- .10	- .66
11.	%(ENG. SCORE)	.01	2.36	- .004	- 1.25	.01	2.58
12.	ENG. CLASS	- 1.13	- 2.23	- .04	- .10	- 1.36	- 2.63
13.	%(ENG. CL.)	.04	4.11	.01	1.46	.05	4.31
14.	% DROPOUTS	.20	.56	.65	1.91	- .30	- .85
15.	%(%DR)	- .02	- 2.91	- .02	- 3.89	- .01	- 1.71
16.	SCHOOL SIZE	- .003	- 2.35	- .003	- 2.33	- .003	- 2.95
17.	% BLACK	.10	1.67	.15	2.58	.04	.65
	Constant	- 9.91		-70.34		66.11	
	Adj. R^2/SE	.32	14.29	.30	14.47	.27	14.74
	N	717		717		717	

TABLE F-1

PEGRESSION RESULTS FOR 6TH GRADE SAMPLE DROPPING ATTENDANCE VARIABLES TO LOOK AT A PROBLEM OF SIMULTANIETY

Dependent Variable : 6th Grade Iowa Test of Basic Skills Test Score, Composite Minus 3rd Grade Iowa Test of Basic Skills Test Score, Composite.

	Basic Equation		Equation Without Attendance Variables	
Independent Variables	β	t	β	t
SEX	- .89	-1.39	- 1.00	-1.52
IQ	.13	3.71	.15	4.18
IQ 110 +	.16	1.49	.10	.95
B(IQ 110 +)	- .23	-1.90	- .19	-1.52
UNEXCUSED	.11	.44		
Y(UNEXC.)	- .05	-1.80		
LATE	- 1.16	-3.80		
Y(LATE)	.11	3.33		
DGOURMAN	13.61	2.49	13.08	2.34
Y(DGOUR)	- .99	-1.77	- .99	-1.73
TEACH. EXP.	- .48	-1.87	- .45	-1.69
3I(TEACH. EXP.)	.02	2.43	.02	2.34
TEACH. SCORE	- .02	-2.71	- .01	-2.20
BKS/PUPIL	- .51	-2.43	- .62	-2.85
CLASS $\geq$ 34	- 2.08	-2.36	- 2.05	-2.27
CLASS 28-33	- 4.33	-2.08	- 4.52	-2.12
3I(CLASS 28-33)	.13	2.18	.14	2.18
SCHOOL SIZE	- .002	-1.06	- .001	- .95
B(SCH. SIZE)	- .005	-3.75	- .005	-3.89
20-40% B	3.28	2.27	3.30	2.22
40-60% B	5.59	3.49	6.00	3.64
60% B	4.25	2.91	4.71	3.15
% HIGH	.64	2.41	.55	2.05
3I(% HI)	- .01	-2.10	- .01	-1.70
% LOW	- .08	-2.33	- .10	-3.02
DISRUPT	1.93	4.04	1.58	3.25
3I(DISR.)	- .05	-3.36	- .04	-2.85
CONSTANT	23.75		21.26	
ADJ. R^2/SE	.28	7.79	.23	8.03
N	627		627	

TABLE F-2

REGRESSION RESULTS FOR 8TH GRADE SAMPLE DROPPING ATTENDANCE VARIABLES TO LOOK AT A PROBLEM OF SIMULTANIETY

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite.

	Basic Equation		Equation Without Attendance Variable	
Independent Variables	β	t	β	t
SEX	.74	.84	.92	1.02
L(SEX)	-2.72	-2.30	- 2.78	-2.29
2nd GENERATION	3.98	1.88	3.54	1.63
3G. SCORE	.51	2.35	.50	2.24
$(3G. SCORE)^2$	- .004	-1.47	- .004	-1.33
6G. SCORE	- .34	-2.02	- .36	-2.08
UNEXCUSED	.35	1.74		
6I(UNEXC.)	- .01	-2.53		
DAYS PRES.	.05	1.35		
MOVES	3.20	1.04	2.76	.88
6I(MOVES)	- .10	-1.56	- .10	-1.54
SS. TEACH. GOUR	- .03	-1.63	- .03	-1.69
6I(SS. GOUR)	- .0006	1.73	- .0006	1.69
ENG. TEACH. EXP.	- .49	- .71	- .53	- .76
ENG. EXP. (-3)	.09	.12	.20	.24
ENG. EXP. (-10)	4.16	2.65	4.01	2.48
MATH TEACH. RACE = PUPIL RACE	2.11	2.14	1.93	1.91
MATH TEACH. EXP.	- .02	- .03	- .30	- .48
MATH EXP. (-3)	.42	.55	.69	.89
MATH EXP. (-10)	-2.51	-1.49	- 2.01	-1.17
SS TEACH. SCORE	.08	1.30	.08	1.34
% B. TEACHERS	- .15	-3.01	- .12	-2.51
BKS/PUPIL	- .63	-1.72	- .67	-1.79
6I(BKS/PP)	.02	2.72	.02	2.57
REM. EXP./L.	.03	1.92	.04	2.17
L(REM. EXP./L.)	- .05	-1.77	- .05	-1.95
CLASS $\geq$ 32	-6.15	-2.45	- 5.98	-2.34
Y(CLASS $\geq$ 32)	.37	1.30	.39	1.34
ELEM. SCHOOL	4.22	3.06	4.13	2.92
% BLACK	.05	1.02	.03	.64
B(%BLACK)	- .04	-1.01	- .03	- .83
% BLACK (-50)	- .18	-1.63	- .16	-1.38
B (% B[-50])	.30	2.88	.27	2.51
DISRUPT	.05	.58	.05	.61
M (DISR.)	- .03	- .31	- .04	- .55
H (DISR.)	- .14	-1.18	- .16	-1.29
CONSTANT	1.07		12.20	
R^2/SE	.31	7.07	.28	7.26
N	553		553	

TABLE F-3

REGRESSION RESULTS FOR 12TH GRADE SAMPLE DROPPING ATTENDANCE VARIABLES TO LOOK AT A PROBLEM OF SIMULTANIETY

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Scores, Reading, in National Percentile Ranking Minus 9th Grade Cooperation School and College Abilities Test, Reading, in National Percentile Ranking.

Independent Variables	β	t	β	t
SEX	3.45	1.89	3.69	2.02
9%(SEX)	- .10	- 1.77	- .13	- 2.37
RACE	20.21	2.22	22.39	2.47
7I(RACE)	- .35	- 2.41	- .41	- 2.82
7G. SCORE	.99	6.71	1.03	6.96
9G. SCORE(%)	- 1.94	- 4.29	- 2.05	- 4.55
UNEXCUSED	- .08	- 1.46		
LATE	.04	.52		
9%(LATE)	- .006	- 2.46		
ENG. TEACH. SCORE	- .12	- .84	- .13	- .90
9%(ENG. SCORE)	.01	2.36	.01	2.49
ENG. CLASS	- 1.13	- 2.23	- 1.26	- 2.52
9%(ENG. CL.)	.04	4.11	.04	4.17
% DROPOUTS	.20	.56	.25	.71
9%(% DR.)	- .02	- 2.91	- .02	- 2.83
SCHOOL SIZE	- .003	- 2.35	- .002	- 1.66
% BLACK	.10	1.67	.11	1.80
CONSTANT	- 9.91		-12.33	
ADJ. R^2/S. E.	.32	14.29	.30	14.41
N	717		717	

TABLE G-1

REGRESSION RESULTS FOR THE 6TH GRADE SAMPLE
ADDING INCOME AND RACE VARIABLES

Dependent Variable: 6th Grade Iowa Test of Basic Skills Test Score, Composite Minus 3rd Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables		β	t
	SEX	- .88	-1.38
	IQ	.13	3.68
	IQ 110+	.15	1.45
	B(IQ 110+)	- .23	-1.85
	UNEXCUSED	.13	.51
	Y(UNEXC.)	- .06	-1.84
	LATE	- 1.11	-3.41
	Y(LATE)	.11	2.93
	DGOURMAN	13.95	2.52
	Y(DGOUR)	- 1.03	-1.81
	TEACH. EXP.	- .49	-1.89
	3I(TEACH. EXP.)	.02	2.45
	TEACH. SCORE	- .02	-2.71
	BKS/PUPIL	- .51	-2.40
	CLASS $\geq$ 34	- 2.05	-2.30
	CLASS 28-33	- 4.29	-2.06
	3I(CLASS 28-33)	.13	2.17
	SCHOOL SIZE	- .002	-1.10
	B(SCH. SIZE)	- .005	-2.89
	20-40% B	3.29	2.27
	40-60% B	5.55	3.36
	60% + B	4.17	2.70
	% HIGH	.64	2.39
	3I(% HI)	- .01	-2.08
	% LOW	- .07	-2.06
	DISRUPT	1.93	4.04
	3I(DISR.)	- .05	-3.36
(1)	INCOME	.07	.38
(2)	RACE	- .13	- .09
	Constant	23.05	
	Adj. R^2/SE	.28	7.81
	N	627	

Key: (1) Estimated family income in thousands.
(2) Dummy variable: 0 = Non-Black, 1 = Black.

TABLE G-2

REGRESSION RESULTS FOR THE 8TH GRADE SAMPLE
ADDING INCOME AND RACE VARIABLES

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables		β	t
	SEX	.75	.85
	L(SEX)	-2.76	-2.33
	2nd GENERATION	4.23	1.92
	3 G. SCORE	.51	2.34
	(3 G. SCORE)^2	- .004	-1.44
	6 G. SCORE	- .35	-2.06
	UNEXCUSED	.36	1.78
	6I(UNEXC.)	- .01	-2.59
	DAYS PRES	.05	1.36
	MOVES	3.18	1.02
	6I(MOVES)	- .10	-1.56
	SS. TEACH. GOUR	- .03	-1.67
	6I(SS. GOUR)	.00	1.76
	ENG. TEACH. EXP.	- .48	- .71
	ENG. EXP. (-3)	.11	.14
	ENG. EXP.(-10)	3.99	2.51
	MATH TEACH. RACE = PUPIL RACE	2.16	2.05
	MATH TEACH. EXP.	- .03	- .04
	MATH EXP.(-3)	.42	.54
	MATH EXP.(-10)	-2.42	-1.44
	SS. TEACH. SCORE	.08	1.37
	% B. TEACHERS	- .16	-3.13
	BKS/PUPIL	- .67	-1.81
	6I(BKS/PP)	.02	2.79
	REM. EXP./L	.04	2.04
	L(REM. EXP./L.)	- .04	-1.72
	CLASS $\geq$ 32	-7.10	-2.62
	Y(CLASS $\geq$ 32)	.50	1.58
	ELEM. SCHOOL	4.54	3.20
	% BLACK	.05	1.08
	B(% BLACK)	- .05	-1.03
	% BLACK (-50)	- .18	-1.64
	B (% B[-50])	.32	2.82
	DISRUPT	.05	.65
	M(DISR.)	- .02	- .27
	H(DISR.)	- .14	-1.19
(1)	INCOME	- .19	- .95
(2)	RACE	.28	.16
	Constant	2.42	
	Adj. R^2/SE	.31	7.07
	N	553	

Key: (1) Estimated family income in Thousands.
(2) Dummy variable: 0 = Non-Black, 1 = Black.

TABLE G-3

REGRESSION RESULTS FOR THE 12TH GRADE SAMPLE
ADDING AN INCOME VARIABLE

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Scores, Reading in National Percentile Rankings Minus 9th Grade Cooperative School and College Abilities Test, Reading in National Percentile Rankings.

Independent Variables	β	t
SEX	3.54	1.93
9%(SEX)	- .10	- 1.79
RACE	19.41	2.12
71(RACE)	- .35	- 2.37
7 G. SCORE	.99	6.71
9 G. SCORE(%)	- 1.92	- 4.22
UNEXCUSED	- .09	- 1.52
LATE	.03	.48
9%(LATE)	- .01	- 2.47
ENG. TEACH. SCORE	- .12	- .85
9%(ENG. SCORE)	.01	2.36
ENG. CLASS	- 1.10	- 2.18
9%(ENG. CL.)	.04	3.99
% DROPOUTS	.15	.41
9%(% DR.)	- .02	- 2.91
SCHOOL SIZE	- .002	- 2.29
% BLACK	.10	1.67
(1) INCOME	- .00	- .73
Constant	- 7.69	
Adj R^2/SE	.31	14.30
N	717	

Key

(1) Estimated family income in thousands.

TABLE H

REGRESSION RESULTS SHOWING EFFECT
OF HEADSTART ON 3RD GRADE ACHIEVEMENT SCORE
FOR THE 6TH GRADE SAMPLE

Dependent Variable: 3rd Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables	β	t
1. HEADSTART	1.94	1.15
2. INCOME	.21	1.56
3. RACE	- .92	- 1.01
4. SEX	- 1.17	- 1.90
5. IQ	.37	16.12
6. ADA	.13	1.98
7. 3 G. CLASS SIZE	- .09	- 1.83
8. % BLACK, 1967	- .02	- 1.25
9. CLASSIF.	.20	1.00
Constant	-14.61	
Adj. R^2/SE	.38	7.64
N	627	

Key

1. Dummy variable: 1 = attended Headstart Program.
2. Family Income Estimate Based on Census data.
3. Dummy variable: 1 = Black, 0 = non-Black.
4. Described in Table D-1 Key.
5. Described in Table D-1 Key.
6. Average Daily Attendance, 1969.
7. 3rd grade class size.
8. % Black in school, 1967.
9. School District classification of schools.

TABLE I-1

REGRESSION RESULTS FOR THE 6TH GRADE SAMPLE
ADDING ON ADDITIONAL TEACHER VARIABLES*

Dependent Variable: 6th Grade Iowa Test of Basic Skills Test Score, Composite Minus 3rd Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variables		β	t	β	t
1.	SEX	- .89	-1.39	- .87	-1.36
2.	IQ	.13	3.71	.13	3.72
3.	IQ 110+	.16	1.49	.16	1.51
4.	B(IQ 110+)	- .23	-1.90	- .23	-1.90
5.	UNEXCUSED	.11	.44	.10	.40
6.	Y(UNEXC.)	- .05	-1.80	- .05	-1.75
7.	LATE	- 1.16	-3.80	- 1.14	-3.75
8.	Y(LATE)	.11	3.33	.11	3.27
9.	DGOURMAN	13.61	2.49	13.53	2.48
10.	Y(DGOUR)	- .99	-1.77	- 1.02	-1.82
11.	TEACH. EXP.	- .48	-1.87	- .53	-2.02
12.	3I(TEACH. EXP.)	.02	2.43	.02	2.46
13.	TEACH. SCORE	- .02	-2.71	- .02	-2.77
14.	BKS/PUPIL	- .51	-2.43	- .52	-2.46
15.	CLASS $\geq$ 34	- 2.08	-2.36	- 2.04	-2.32
16.	CLASS 28 - 33	- 4.33	-2.08	- 4.37	-2.11
17.	3I(CLASS 28 - 33)	.13	2.18	.14	2.20
18.	SCHOOL SIZE	- .002	-1.06	- .002	-1.08
19.	B(SCH. SIZE)	- .005	-3.75	- .005	-3.68
20.	20-40% B	3.28	2.27	3.28	2.27
21.	40-60% B	5.59	3.49	5.53	3.45
22.	60%+ B	4.25	2.91	4.14	2.83
23.	%HIGH	.64	2.41	.66	2.50
24.	3I(%HI)	- .01	-2.10	- .01	-2.19
25.	%LOW	- .08	-2.33	- .07	-2.18
26.	DISRUPT	1.93	4.04	1.91	4.01
27.	3I(DISR.)	- .05	-3.36	- .05	-3.37
28.	[1]TEACH. ED.			.65	1.02
	Constant	23.75		23.22	
	Adj. R^2/SE	.28	7.79	.28	7.79
	N	627		627	

*6th grade teacher's education: 1 = B. A., 2 = M. A., 3 = M. A. + 30, 4 = Ph. D.

TABLE I-2

REGRESSION RESULTS FOR 8TH GRADE SAMPLE
ADDING ON ADDITIONAL TEACHER VARIABLES BY SUBJECT

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite.

	Basic Equation		With Math Teacher Variables		With English Teacher Variables		With Social Studies Teacher Variables	
Independent Variables	β	t	β	t	β	t	β	t
1. SEX	.74	.84	.71	.80	.73	.82	.72	.82
2. L(SEX)	-2.72	-2.30	-2.65	-2.22	-2.72	-2.28	-2.69	-2.26
3. 2ND GENERATION	3.98	1.88	3.92	1.84	3.97	1.86	3.91	1.84
4. 3G SCORE	.51	2.35	.51	2.30	.51	2.32	.51	2.30
$(3G\ SCORE)^2$	- .004	-1.47	- .004	-1.43	- .004	-1.46	- .004	-1.42
5. 6G SCORE	- .34	-2.02	- .33	-1.94	- .34	-2.00	- .34	-2.04
6. UNEXCUSED	.35	1.74	.34	1.69	.35	1.74	.35	1.73
7. 6I(UNEXC.)	- .01	-2.53	- .01	-2.48	- .01	-2.53	- .01	-2.51
8. DAYS PRES.	.05	1.35	.05	1.35	.05	1.32	.05	1.34
9. MOVES	3.20	1.04	3.11	1.00	3.09	.99	3.24	1.05
10. 6I(MOVES)	- .10	-1.56	- .10	-1.52	- .10	-1.52	- .10	-1.56
11. SS. TEACH. GOUR	- .03	-1.63	- .03	-1.60	- .03	-1.60	- .03	-1.66
12. 6I(SS. GOUR)	.0006	1.73	.0006	1.66	.0006	1.69	.0007	1.75
13. ENG. TEACH. EXP.	- .49	- .71	- .43	- .63	- .45	- .64	- .48	- .70
14. ENG. EXP.(-3)	.09	.12	.03	.04	.05	.06	.07	.09
ENG. EXP.(-10)	4.16	2.65	4.20	2.66	4.20	2.65	4.19	2.64
15. MATH TEACH. RACE = PUPIL RACE	2.11	2.14	2.14	2.14	2.10	2.12	2.05	2.06
16. MATH TEACH. EXP.	- .02	- .03	- .005	- .008	- .02	- .03	- .004	- .007
17. MATH EXP.(-3)	.42	.55	.41	.53	.42	.55	.38	.50
MATH EXP.(-10)	-2.51	-1.49	-2.58	-1.53	-2.49	-1.46	-2.31	-1.36
18. SS. TEACH. SCORE	.08	1.30	.08	1.24	.08	1.31	.08	1.24
19. %B. TEACHERS PRS.	- .15	-3.01	- .15	-3.02	- .15	-3.00	- .14	-2.95
20. BKS/PUPIL	- .63	-1.72	- .61	-1.64	- .64	-1.74	- .63	-1.71
21. 6I(BKS/PP)	.02	2.72	.02	2.72	.02	2.74	.02	2.70
22. REM. EXP./L	.03	1.92	.03	1.91	.03	1.93	.03	1.92
23. L(REM. EXP./L.)	- .05	-1.77	- .05	-1.77	- .04	-1.73	- .05	-1.80
24. CLASS $\geq$ 32	-6.15	-2.45	-6.19	-2.45	-6.19	-2.46	-6.31	-2.50
25. Y(CLASS $\geq$ 32)	.37	1.30	.37	1.29	.38	1.30	.39	1.35
26. ELEM. SCHOOL	4.22	3.06	4.26	3.05	4.24	3.05	4.18	2.99
27. %BLACK	.05	1.02	.05	.91	.05	1.05	.06	1.10
28. B(%BLACK)	- .04	-1.01	- .04	- .99	- .04	-1.02	- .04	-1.04
29. %BLACK(-50)	- .18	-1.63	- .17	-1.50	- .18	-1.63	- .19	-1.67
30. B(%B[-50])	.30	2.88	.30	2.82	.31	2.89	.31	2.91
31. DISRUPT	.05	.59	.05	.64	.04	.54	.04	.54

TABLE I-2 (cont'd)

Independent Variables	Basic Equation β	Basic Equation t	With Math Teacher Variables β	With Math Teacher Variables t	With English Teacher Variables β	With English Teacher Variables t	With Social Studies Teacher Variables β	With Social Studies Teacher Variables t
32. M(DISR.)	- .03	- .31	- .03	- .33	- .02	- .29	- .03	- .31
33. H(DISR.)	- .14	-1.18	- .14	-1.22	- .14	-1.16	- .14	-1.22
(1) MATH TEACH. GOUR			.003	.53				
(2) MATH TEACH. SCORE			- .02	- .31				
(3) MATH TEACH. ED.			- .20	- .28				
(4) ENG. TEACH. GOUR					- .002	- .43		
(5) ENG. TEACH. SCORE					.003	.05		
(6) ENG. TEACH. ED.					- .03	- .04		
(7) SS. TEACH. EXP.							.004	.03
(8) SS. TEACH. ED.							.36	.56
Constant	1.07		1.02		1.46		.60	
R^2/SE.	.31	7.07	.31	7.09	.31	7.09	.31	7.08
N	553		553		553		553	

Key

(1) = 8th grade math teacher's undergraduate college, Gourman rating.

(2) = 8th grade math teacher's score on National Teacher Exam in Social Studies.

(3) = 8th grade math teacher's education, 1 = B. A., 2 = M. A., 3 = M. A. + 30, 4 = Ph. D.

(4) = 8th grade English teacher's undergraduate college, Gourman rating.

(5) = 8th grade English teacher's score on National Teacher Exam in English.

(6) = 8th grade English teacher's education, 1 = B. A., 2 = M. A., 3 = M. A. + 30, 4 = Ph. D.

(7) = 8th grade Social Studies teacher's experience 1 to 11.

(8) = 8th grade Social Studies teacher's education, 1 = B. A., 2 = M. A., 3 = M. A. + 30, 4 = Ph. D.

TABLE I-3

REGRESSION RESULTS FOR THE 12TH GRADE SAMPLE
ADDING ON ADDITIONAL ENGLISH TEACHER VARIABLES

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Scores, Reading in National Percentile Rankings Minus 9th Grade Cooperative School and College Abilities Test, Reading in National Percentile Rankings.

Independent Variables		β	t	β	t
1.	SEX	3.45	1.89	3.49	1.90
2.	9%(SEX)	- .10	- 1.77	- .10	- 1.81
3.	RACE	20.21	2.22	20.87	2.29
4.	7I(RACE)	- .35	- 2.41	- .37	- 2.51
5.	7G. SCORE	.99	6.71	1.01	6.83
6.	9G. SCORE(%)	- 1.94	- 4.29	- 1.93	- 4.19
7.	UNEXCUSED	- .08	- 1.46	- .09	- 1.55
8.	LATE	.04	.52	.03	.40
9.	9%(LATE)	- .01	- 2.46	- .01	- 2.38
10.	ENG. TEACH. SCORE	- .12	- .84	- .15	- .96
11.	9%(ENG. SCORE)	.01	2.36	.01	2.46
12.	ENG. CLASS	- 1.13	- 2.23	- 1.14	- 2.15
13.	9%(ENG. CL.)	.04	4.11	.04	3.87
14.	% DROPOUTS	.20	.56	.32	.89
15.	9%(%DR.)	- .02	- 2.91	- .02	- 3.02
16.	SCHOOL SIZE	- .003	- 2.35	- .002	- 1.76
17.	%BLACK	.10	1.67	.10	1.58
(1)	ENG. TEACH. EXP.			- .23	- .93
(2)	ENG. TEACH. GOUR			.003	.58
(3)	ENG. TEACH. ED.			- .96	- .79
	CONSTANT	- 9.91		-10.42	
	ADJ. R^2/SE.	.32	14.29	.32	14.29
	N	717		717	

(1) = 12th grade English teacher's experience 1 to 11.

(2) = 12th grade English teacher's undergraduate college, Gourman rating.

(3) = 12th grade English teacher's education, 1 = B. A., 2 = M. A., 3 = M. A. + 30, 4 = Ph.D

TABLE J

LIST OF ALL VARIABLES USED IN THIS STUDY

The following data classified as socioeconomic, school resources, and school climate were examined for all three levels:

Socioeconomic

Sex
Race
"Family" income
Density of Census tract
Days present
Unexcused absences
Latenesses
Marital status of parents
IQ*
Residential moves
Pupil born in U. S.
Second-generation American
Iowa test scores (reflecting initial abilities)

School Climate

% High achievers in pupil's grade
% Low achievers in pupil's grade
% Negro pupils
% High school dropouts**
% Spanish-speaking pupils
% Low-income pupils (free lunches)
% High achievers in school****
Student mobility****
Average income, school feeder area, 1970
Average education level, adults 25+, school feeder area
Change in feeder area income, 1960-70
No. disruptive incidents
Average daily attendance
% 1972 graduates planned to continue education**
% 1972 graduates unemployed, Nov. 1972**
% 1972 graduates attending college, Nov. 1972**

School Resources

Headstart participation*
Size of school
Size of class
No. pupils per lab***
Playground footage per pupil*
Condition of school
Classification of school
Date school built
Capacity utilization
Basic grade organization
Library books per pupil
No. school librarians
No. nonteacher professionals
Teacher's experience
Teacher's exam score - common
Teacher's exam score - subject
Gourman rating, teacher's undergraduate college
Teacher's credits beyond B. A.
Teacher's race
% Negro teachers
% Teacher vacancies
Principal's experience
Principal's credits beyond M. A.
Principal's additional degrees
Total expenditure per pupil
Total Federal funds expenditure per pupil
Counseling expenditure
Remedial education expenditure
Basic skills expenditure*

*Elementary only.
**High school only.
***Not elementary school.
****Not high school.

TABLE K-1

REGRESSION RESULTS FOR 6TH GRADE SAMPLE SHOWING EFFECT OF VARIATION IN RACIAL COMPOSITION WITHOUT CONTROLLING FOR ABILITY MIXTURE

Dependent Variable: 6th Grade Iowa Test of Basic Skills Test Score, Composite Minus 3rd Grade Iowa Test of Basic Skills Test Score, Composite

Independent Variable	β	t
SEX	- .83	-1.27
IQ	.14	3.80
IQ 110+	.11	1.04
B(IQ 110+)	- .17	-1.35
UNEXCUSED	- .11	- .41
Y(UNEXC.)	- .03	-1.06
LATE	- 1.28	-4.13
Y(LATE)	.13	3.63
DGOURMAN	10.49	1.88
Y(DGOUR)	- .60	-1.05
TEACH. EXP.	- .39	-1.68
3I(TEACH. EXP.)	.02	2.73
TEACH. SCORE	- .02	-2.72
BKS/PUPIL	- .42	-1.99
CLASS ≥ 34	- 2.53	-2.86
CLASS 28-33	- 2.77	-1.31
3I(CLASS 28-33)	.09	1.40
SCHOOL SIZE	- .00	- .02
B(SCH. SIZE)	- .005	-3.62
20-40% B	2.29	1.64
40-60% B	3.38	2.18
60% B	2.39	1.75
DISRUPT	1.54	3.26
3I(DISR.)	- .04	-2.95
CONSTANT	19.75	
ADJ. R^2/S. E.	.24	7.99
N	627	

TABLE K-2

REGRESSION RESULTS FOR THE 8TH GRADE SAMPLE SHOWING EFFECT OF VARIATION IN RACIAL COMPOSITION WITHOUT CONTROLLING FOR ABILITY MIXTURE*

Dependent Variable: 8th Grade Iowa Test of Basic Skills Test Score, Composite Minus 6th Grade Iowa Test of Basic Skills Test Score, Composite.

Independent Vairables	β	t
SEX	.82	.93
L(SEX)	-2.78	-2.33
2nd GENERATION	3.85	1.80
3G. SCORE	.54	2.46
$(3G. SCORE)^2$	- .005	-1.59
6G. SCORE	- .36	-2.11
UNEXCUSED	.31	1.54
6I(UNEXC.)	- .01	-2.38
DAYS PRES.	.05	1.17
MOVES	3.32	1.07
6I(MOVES)	- .10	-1.62
SS. TEACH. GOUR	- .03	-1.53
6I(SS. GOUR)	.0006	1.68
ENG. TEACH. EXP.	- .37	- .54
ENG. EXP. (-3)	- .09	- .11
ENG. EXP. (-10)	4.57	2.89
MATH TEACH. RACE = PUPIL RACE	2.17	2.18
MATH. TEACH. EXP.	- .004	- .006
MATH EXP. (-3)	.40	.53
MATH EXP. (-10)	-1.97	-1.17
SS. TEACH. SCORE	.05	.80
% B. TEACHERS	- .13	-2.75
BKS/PUPIL	- .65	-1.77
6I(BKS/PP)	.02	3.01
REM. EXP./L	.04	2.36
L(REM. EXP./L.)	- .05	-2.07
CLASS ≥ 32	-6.68	-2.65
Y(CLASS ≥ 32)	.43	1.48
ELEM. SCHOOL		
% BLACK	.009	.18
B(%BLACK)	- .02	- .63
% BLACK (-50)	.12	-1.06
B (%B[-50])	.26	2.46
DISRUPT	.04	.46
M.(DISR.)	- .04	- .52
H (DISR.)	- .15	-1.29
CONSTANT	4.85	
R^2/S. E.	.30	7.12
N	553	

*Variable dropped is ELEM. SCH., which is variable used in place of % HIGH.

TABLE K-3

REGRESSION RESULTS FOR THE 12TH GRADE SAMPLE SHOWING EFFECT OF VARIATION IN RACIAL COMPOSITION WITHOUT CONTROLLING FOR % DROPOUTS

Dependent Variable: California Aptitude Test or Comprehensive Test of Basic Skills Test Score, Reading in National Percentile Ranking Minus 9th Grade Cooperative School and College Abilities Test, Reading in National Percentile Ranking.

Independent Variable

SEX	3.54	1.93
9%(SEX)	- .11	- 1.97
RACE	17.80	2.00
7%(RACE)	- .30	- 2.10
7G. SCORE	.96	6.58
9G. SCORE(%)	- 2.02	- 4.65
UNEXCUSED	- .08	- 1.35
LATE	.03	.50
9%(LATE)	- .006	- 2.33
ENG. TEACH. SCORE	- .13	- .93
9%(ENG. SCORE)	.009	1.98
ENG. CLASS	- 1.15	- 2.42
9%(ENG. CL.)	.04	3.97
SCHOOL SIZE	- .002	- 2.22
% BLACK	.13	2.99
CONSTANT	- 8.22	
ADJ. R^2/SE	.30	14.41
N	717	