

CODEBOOK SUPPLEMENT

APPENDIX #11

The material which follows originated in Determinants of Early Labor Market Success Among Young Men: Race, Ability, Quantity and Quality of Schooling, Andrew I. Kohen, Ph. D. dissertation, January 1973. The discussion and results reported here, though based on the National Longitudinal Surveys of Young Men 14-24, apply equally well to the Surveys of Young Women 14-24.

APPENDIX C

CONSTRUCTION OF AN INDEX OF SCHOOL QUALITY

Introduction and Literature Review

Because of both conceptual and empirical ambiguities, measurement of the quality of schooling is a less than straightforward task. At the conceptual level, the conventional assumption is that the quality of schooling can be enhanced by increasing the quantity and/or quality of resources devoted to it.¹ This has a clear intuitive appeal to the economist in conceiving of educational "production functions" to describe the operation of schools. Yet, even at this level of abstraction there is debate about the outputs and inputs which characterize the production function. Thus, for example, at one point Burkhead, et al., assert that "Educational product is the output of the system measured in terms of the skills and aptitudes transmitted to students."² In contrast, Thomas presents a taxonomy of educational production functions which identifies several "outputs" of educational systems, only one of which is equivalent

¹See, for example, Jesse Burkhead with Thomas G. Fox and John W. Holland, Input and Output in Large-City High Schools (Syracuse: Syracuse University Press, 1967), p. 5 (Hereinafter referred to as Input and Output in Schools.); Harold F. Clark, Cost and Quality in Public Education (Syracuse: Syracuse University Press, 1963) and Samuel M. Goodman, The Assessment of School Quality (Albany: University of the State of New York and State Education Department, 1959).

²Burkhead, Fox, and Holland, Input and Output in Schools, p. 4. At later points in the monograph the authors do recognize the multiple character of output. See pp. 12, 24.

to the concept offered by Burkhead.³ Among the additional perspectives in Thomas's work is that attitudes, as well as aptitudes, are produced by schools. Thus, it seems clear that the school is more appropriately viewed as a multiproduct firm to which it may be theoretically necessary to apply the rather underdeveloped theory of joint production.⁴

Adding to the conceptual vagueness of this area of inquiry is the fact that theories of learning and attitude formation do not provide the basis for unambiguously enumerating the relevant inputs of an educational production function. Furthermore, there are no theoretical guidelines regarding the relative importance of the many suggested inputs. Finally, there is no consensus among theoreticians or practitioners about the "true" mathematical function which relates educational inputs to outputs.

There are two principal reasons that a wide range of variables has been used in empirical research to operationalize the inputs and outputs of educational production functions. First, there is the lack of conceptual precision alluded to above. Second, there is substantial variability in the data available to researchers. This variability exists both with regard to the specific pieces of information which are collected by schools and with regard to the reliability of the available statistics.

One of the most commonly used proxies for output of a school (or school system) is the average scholastic-achievement-test score of some cohort in the school, where the cohort is usually defined by the grade

³J. Alan Thomas, The Productive School (New York: John Wiley and Sons, Inc., 1971), pp. 11-30.

⁴Ibid., p. 11, fn. 3.

level it attends.⁵ The typical justification for using average test scores to measure output is that they are commonly accepted gauges of skill acquisition "and whatever limitations attach to contemporary tests and testing procedures, they are the best we have."⁶ Most researchers have also recognized that the theoretically sound approach to an educational production function is in terms of the value added by the school. In the absence of longitudinal data, the operational responses to this recognition have been varied and ingenious.⁷ In their study of the Chicago Schools, Burkhead, et al., analyzed the residuals of average 11th-grade test scores from predicted 11th-grade scores, where the latter are predicted by average 9th-grade scores.⁸ In his study of Iowa

⁵See, for example, Samuel Bowles and Henry M. Levin, "More on Multicollinearity and the Effectiveness of Schools," Journal of Human Resources, III (Summer 1968), pp. 393-400 (Hereinafter referred to as "Effectiveness of Schools."); Samuel Bowles, "Towards an Educational Production Function," Education, Income, and Human Capital, ed. by W. Lee Hansen, NBER Studies in Income and Wealth, No. 35 (New York: Columbia University Press, 1970); Burkhead, Fox, and Holland, Input and Output in Schools; Elchanan Cohn, "An Economic and Statistical Analysis of Quality in High School Education: The Case of Iowa" (unpublished Ph.D. dissertation, Iowa State University, 1968) (Hereinafter referred to as "Quality in High School Education."); James S. Coleman, et al., Equality of Educational Opportunity (Washington, D.C.: U.S. Office of Education, 1966); Martin T. Katzman, "Distribution and Production in a Big City Elementary School System" (unpublished Ph.D. dissertation, Yale University, 1967) (Hereinafter referred to as "Production in a Big City School System.").

⁶Burkhead, Fox, and Holland, Input and Output in Schools, p. 25.

⁷The lone study employing longitudinal data used individual student gains on 42 separate achievement tests administered as part of Project TALENT. Marion F. Shaycoft, The High School Years: Growth in Cognitive Skills (Pittsburgh: American Institutes for Research, University of Pittsburgh, 1967), as cited in Henry S. Dyer, "School Factors and Equal Educational Opportunity," Equal Educational Opportunity (Cambridge: Harvard University Press, 1969), pp. 47-48.

⁸Burkhead, Fox, and Holland, Input and Output in Schools, pp. 53-56. In the study of Atlanta schools 10th and 12th grade scores were used.

high schools, Cohn employed the difference between the average 12th-grade test score for the class of 1963 and the average 10th-grade test score for the class of 1961.⁹ Bowles' attempt to adjust his results to reflect the value-added approach was more complex and roundabout. It took the form of correcting for an omitted-variable bias in his estimated production function, where the measure of output in the latter was 12th-grade test score and the "omitted variable" was initial student endowment of ability. In order to perform this correction he relied on exogenous information concerning the intertemporal correlation of IQ scores along with estimates of the effects of family background factors on 1st-grade test scores.¹⁰ One of the output measures used by Katzman in his study of Boston public elementary schools was the median gain in reading achievement scores between the 2nd and 6th grades.¹¹ Finally, it should be noted that the contributors to one of the largest studies, i.e., the Coleman Report, addressed the value-added issue only by

Note that this approach is quite different from using longitudinal data because the mean scores are based on entirely different groups of individuals.

⁹Cohn, "Quality in High School Education." Note that this is closer to using longitudinal differences than is the method used by Burkhead, et al. There is considerable overlap in the membership of the two groups for whom the mean scores are computed, though school changing, mortality, and dropping out introduce substantial uncertainty about the precise extent of overlap.

¹⁰Bowles, "Towards an Educational Production Function," pp. 26-30, 46-49. It should also be noted that the units of observation in this study were individual students rather than schools or school systems.

¹¹Katzman, "Production in a Big City School System."

including student background measures in their equations designed to predict test scores.¹²

In recognition of the fact that test scores or changes therein are imperfect measures of school output, many researchers have also employed other proxies. Katzman and Burkhead, et al., used another widely accepted criterion of a school's performance, namely the dropout rate.¹³ A third variable which has been used is the rate of matriculation of seniors (or graduates) into the next level of schooling.¹⁴ The remaining output variables which have been utilized, albeit less frequently, include the following: the proportion of students in the high school aspiring to continue full-time education after graduation, the percent of students in the school employed after school hours, and the proportion of high school graduates employed full time one year after graduation.

¹²This is only one of many sources of criticism of the study. For elaboration of this point and other criticisms see Glen G. Cain and Harold W. Watts, "Problems in Making Policy Inferences from the Coleman Report," American Sociological Review, XXXV (April 1970), pp. 228-42; Samuel Bowles and Henry M. Levin, "The Determinants of Scholastic Achievement-An Appraisal of Some Recent Evidence," Journal of Human Resources, III (Winter 1968), pp. 3-24; Bowles and Levin, "Effectiveness of Schools," and Harvard Educational Review, Equal Educational Opportunity.

¹³Katzman actually used the additive inverse of this rate, i.e., the retention rate. "Production in a Big City School System." In the Chicago study Burkhead, Fox, and Holland used the ratio of voluntary dropouts to adjusted membership of the school. In the Atlanta study they also broke down the rate by sex. Input and Output in Schools, pp. 43, 62. Also, see Robert E. Herriott and Benjamin J. Hodgkins, Sociocultural Context and the American School: An Open-Systems Analysis of Educational Opportunity (Washington, D.C.: U.S. Department of Health, Education and Welfare, 1969), pp. 70-72.

¹⁴Burkhead, Fox, and Holland used this measure only in the Atlanta study. Input and Output in Schools, p. 62. See, also Werner Z. Hirsch, Analysis of the Rising Costs of Public Education (Washington, D.C.: U.S. Government Printing Office, 1959) and Frank W. Musgrave, "The Educational Production Process: A Study of Measures of Quality in New

The list of variables which have been employed as measures of inputs is considerably longer than the corresponding list of output variables and is too extensive for enumeration and citation here. Suffice it to say that all of the studies have incorporated at least one measure of each of the following classes of inputs: raw material (student backgrounds, aptitudes, and attitudes), physical capital (buildings and equipment), labor (characteristics of teachers and other personnel), and organization (input ratios, teaching load and curriculum).¹⁵

Data Available for This Study

The principal source of data on school characteristics used in this study is a 1968 mailed survey of the most recent secondary school attended by members of the two youth samples of the National Longitudinal Surveys Project.¹⁶ The survey was conducted by the Bureau of the Census and was characterized by extensive follow-up procedures to minimize non-responses. In order to supplement this procedure, the survey returns were hand edited by the author and several sources of published statistics were consulted in an attempt to fill in gaps in the data files.¹⁷

Jersey High School Districts" (unpublished Ph.D. dissertation, Rutgers The State University, 1968) (Hereinafter referred to as "Educational Production Process.").

¹⁵Burkhead, Fox, and Holland refer to this last class of variables as process variables and aptly note that "the practical applications of the distinction between input and process variables are, however, most difficult . . ." Input and Output in Schools, p. 30.

¹⁶The survey instrument appears in Appendix G.

¹⁷Annual Report of the Superintendent of Public Instruction to the Governor of Arizona for Fiscal Year 1967-68 (Phoenix: 1968); Annual Report 1967-1968--Statistical Section (Dover: Delaware Department of Public Instruction, 1968); Annual Statistical Report of the Superintendent of Public Instruction, State of Illinois--July 1, 1967 to June 30, 1968 (Springfield: 1968); Annual Report of the Department of Education

All in all, some information is available for about 95 percent of the 3,030 schools attended by the 10,384 members of the youth samples.¹⁸ Nevertheless, complete information is available for only 75 percent of the schools. The single most frequently missing piece of data is district-wide current annual expenditures per pupil in average daily attendance--i.e., it is not available for nearly one-fifth of the schools.¹⁹

Unfortunately, the cases of missing data do not appear to be randomly distributed. For one thing, whereas about one-third of the sample consists of schools located in the South, about two-fifths of the schools with incomplete information are in the South. There are three reasons that this particular nonrandomness is not too surprising. First, rural schools are both more prevalent in the South and notorious for inadequate record keeping. Second, the major federal thrust into desegregation in the past decade undoubtedly has made Southern educational

for the Year Ending June 30, 1968--Commonwealth of Massachusetts (Boston); Annual Educational Summary 1967-68 Statistical and Financial Summary of Education in New York State for the Year Ending June 30, 1968 (Albany: 1969); Annual Statistical Report 1967-68, Part II (Austin: State Department of Education of Texas); North Carolina Public School Bulletin (Raleigh: 1968), Thirty-ninth Biennial Report of the Superintendent of Public Instruction of the State of South Dakota--July 1, 1966 to June 30, 1968 (Pierre: 1968).

¹⁸The proportion cited in the text along with all subsequent citations of statistics unaccompanied by tables are drawn from unpublished memoranda in the files of the Center for Human Resource Research.

¹⁹The statistic clearly is not applicable to some of the schools in the sample--i.e., nonpublic schools which are not part of a larger system of schools. It is also worthwhile noting that this statistic was missing with much greater frequency based solely on the returns of the mailed survey. It was also the "easiest" datum to gather from the published sources cited in n. 17 above.

administrators reluctant to participate voluntarily in federally sponsored national school surveys. Finally, the secular trend in the consolidation of rural schools, along with the desegregation programs, resulted in closing some schools which may well have been attended by members of the youth samples.²⁰ Another group which is disproportionately represented among those with incomplete data consists of nonpublic schools. Whereas 13 percent of the schools whose ownership could be identified are nonpublic, nearly 25 percent of those lacking some information are nonpublic.²¹ If one accepts common conceptions of school quality, the nature of the schools with incomplete information implies that studies from the National Longitudinal Survey Project which use the measures of school facilities probably somewhat underrepresent students from low quality schools.²²

Because none of the direct proxies for school output which have been used in earlier work are available for use as an index of quality, this study is forced to rely on variables representing school inputs. As can be seen by examining the survey instrument, the available data fall into three of the classes of inputs referred to above, namely physical capital, labor and organization.²³ It is also possible to

²⁰Some members of the sample of youth last attended a secondary school as early as 1958.

²¹See n. 19 above.

²²Of course, this applies only to studies which omit all observations that have less than complete information. It is impossible to be any more precise about the potential bias because of the way the data are coded--i.e., confidentiality constraints preclude identification of the school attended by an individual respondent in the youth sample.

²³The only direct measure of organization is the range of curricula which are available--i.e., whether the school is a comprehensive or vocational high school.

construct approximate measures of organization insofar as these are represented by ratios of inputs--e.g., the ratio of enrollment to staff is a widely used proxy for class size.

Indices of School Quality

Because of the embryonic state of the arts in conceptualizing and estimating educational production functions it was decided to employ two separate indices of schooling quality in the study of the determinants of early labor market success. The first measure of quality is an ordinal index of school inputs. The four elements upon which its construction is based are as follows: (1) per-pupil availability of library facilities, (2) pupils per full-time teacher, (3) full-time-equivalent counselors per 100 pupils and (4) annual salary of a beginning teacher with a bachelor's degree and no experience, adjusted for geographic differences in price levels.

Before describing the actual technique of index construction a detailed discussion of the elements of the index is in order. Per-pupil availability of library facilities is used as a representation of the instructional physical capital in the school's production function.²⁴ Several previous investigations have incorporated a comparable measure

²⁴The variable is not defined as library volumes per student for two reasons. First, for the few all-inclusive schools (kindergarten or first grade through twelfth grade) the variable is the ratio of total library volumes to enrollment in the third through twelfth grades. This procedure was based on the elementary level of reading skills of children below the third grade and the observation that reading material for these children is usually kept in the classroom. Second, students in a high school which contains no library in the building, nonetheless, probably are required to use the resources of a library as part of their educational experience. Therefore, schools which either reported no library or did not respond to item 5a were assigned an arbitrary positive value on the per-pupil availability measure, if they indicated the type and size of a library to which students have regular access.

with admittedly mixed results.²⁵ Although the measure is crude and has the shortcoming of not embodying information on differential use of a given stock of books due to, say, a difference in the number of librarians, it is the only available measure of physical capital. Further, it is one of the criteria used by a major school-accrediting organization.²⁶ The pupil-teacher ratio is included as a proxy for the demands placed on teachers and class size, and it is assumed to be negatively related to the quality of instruction. Ideally, the measure would be standardized for variation in daily teaching load and for teacher training and experience in order to speak in terms of "efficiency units" of teacher input, but the data simply do not permit this degree of precision. As is true of the library measure, this variable has been used by other researchers with mixed findings.²⁷

²⁵Coleman, et al., reported that this variable showed no relation to achievement scores. Equality of Educational Opportunity, p. 193. Most of the re-analysis of this report's data has focused on science laboratory facilities rather than library facilities. See, for example, Bowles and Levin, "Effectiveness of Schools." Burkhead, Fox, and Holland reported similar findings of nonsignificance for a measure of expenditures on libraries in their studies of Chicago and Atlanta, but they also found volumes/12th grader to be a significant determinant of 12th-grade reading residuals in small communities. Input and Output in Schools, p. 84. Finally, the researchers in a major national study found library facilities to be among the most important school characteristics associated with high English-test achievement. See John C. Flanagan, et al., Project TALENT-A Survey and Follow-up Study of Educational Plans and Decisions in Relation to Aptitude Patterns: Studies of the American High School (Pittsburgh: University of Pittsburgh, 1962), p. 9-36.

²⁶See Policies and Criteria for Approval of Secondary Schools (Chicago: North Central Association of Colleges and Secondary Schools, 1964) (Hereinafter referred to as Criteria for Approval of Secondary Schools.), pp. 18-19. Thanks are due to Mr. Albert Kaplan of the Detroit Public Schools for bringing this point to my attention.

²⁷Burkhead, Fox, and Holland reported nonsignificance of class size in their study of small community schools, omitted the variable from the analysis of Chicago schools, but showed regular negative coefficients

The counselors/100 pupils variable is used to reflect the increase in school productivity which accompanies specialization of personnel.²⁸ This measure is still another whose form is less than ideal. For example, it probably should be normalized for the training of counselors.²⁹ Once again, the studies which have used a comparable measure have produced conflicting results,³⁰ and the variable is another of the criteria used in granting accreditation to high schools.³¹ The fourth

for it in many of regression analyses of Atlanta's schools. Input and Output in Schools, pp. 48, 68, 78-84. Bowles reported both significant and nonsignificant effects of class size in some re-analysis of Coleman Report data. "Towards an Educational Production Function," pp. 43-45. Though Cohn's results uniformly denied the significance of class size, his suggested index of school quality still contained the measure. "Quality in High School Education," p. 115. Musgrave's study of New Jersey schools reported a strong positive effect of a variable which approximates the inverse of the teacher-pupil ratio--i.e., staff per 1,000 pupils. "Educational Production Process," Table 14.

²⁸ The variable is constructed in this particular form because its multiplicative inverse exhibits no meaningful quantitative measure of the [lack of] counseling facilities for schools with no counselors. For the computation of the ratio it is assumed that a part-time counselor is equivalent to one-third of a full-time counselor. Though the weight of one-third is somewhat arbitrary, the survey instrument specifies that at least one-quarter time be devoted to counseling for those designated as part-time counselors, and comparison of the computed ratios with the results of another national study provides confidence in the procedure. See Phillip A. Perrone, A National School Counselor Evaluation of Occupational Information (Madison: University of Wisconsin Industrial Relations Research Institute, 1968).

²⁹ This is suggested by the wide variance in counselor training reported by Flanagan, et al., in Project TALENT: Studies of the American High School, pp. 3-24-3-25.

³⁰ The work by Bowles unambiguously supports the significance and relevance of a measure of counseling facilities. "Towards an Educational Production Function," pp. 44-55. Goodman's correlational analysis of achievement and special staff/1,000 pupils also supports this position as cited in Dyer, "School Factors," p. 46. On the other hand, the study by Coleman, et al., found that counseling availability was not a significant correlate of achievement. On this point see Dyer, "School Factors," pp. 52-54.

³¹ Criteria for Approval of Secondary Schools, p. 17.

element upon which the school quality index is based--i.e., teachers' salaries--is used in an attempt to take account of differences in teacher productivity. This measure probably is further from ideal than the other three because it is not school-specific and it is a measure of starting, rather than average, salary. As a consequence, all of the intradistrict, interschool variation in salaries is averaged out. However, the consistent conclusion from prior research is that a measure of teacher characteristics is most important.³² Because this study employs a national sample of schools and because there are considerable geographic differences in the price level, the reported salary figures were deflated by an index of inter-city relative prices in 1967.³³ The use of the price-deflated salary data further diminishes the variation exhibited by the measure of teacher quality (i.e., the coefficient of variation declines by about 15 percent), but this is the desired effect.

The actual process of combining the four variables into a single index was as follows: (1) the nearly 2,500 schools for which information on all four components was available were rank ordered on each of the components, (2) the rank scores were normalized by subtracting the median rank and dividing by the standard deviation of the ranks, (3) the

³² Apparently, the contributors to the Coleman Report never directly examined the effect of teachers' salaries on scholastic achievement, though they reported findings concerning the significance of a constellation of teacher characteristics, Equality of Educational Opportunity, Tables 3.25.1-3.25.3. Bowles and Levin did examine the effect of salary using the same data and found it to be significant. "Effectiveness of Schools," p. 399. Cohn's results for Iowa schools also supported the importance of the salary variable. "Quality in High School Education," Tables 3-1 to 3-3. Burkhead, Fox, and Holland reported similar findings in the portion of the study dealing with Atlanta schools and schools in small communities. Input and Output in Schools, pp. 69-70, 81.

³³ For a detailed discussion of the price deflator see Appendix D.

normalized ranks on each component were summed to yield a composite score for each school³⁴ and (4) the composite scores were grouped to approximate a normal frequency distribution over eleven categories.³⁵

Two measures of school inputs which are available in the data bank and which frequently appear in studies of school output were not utilized in the index construction.³⁶ The first is current annual expenditures per pupil-in-average-daily-attendance (ADA). The principal reason for excluding it from the index is that it is a summary measure of all inputs and would, therefore, result in some double counting. For this reason and for the sake of comparison with other research on the effect of school quality on individual earnings, it was decided to use the expenditure/ADA variable alone as an alternative to the school facilities index. This measure was deflated by the same index of inter-area price levels as was used to adjust teachers' salaries.

As is true of the school facilities index, the expenditure/ADA variable has some shortcomings which must be acknowledged. First, the

³⁴The first three steps of the procedure were suggested in Herriott and Hodgkins, Sociocultural Context and the American School, pp. 40-48. Equal weights were used to compute the composite rank because an alternative set of weights (i.e., the factor loadings from a principal components analysis) were not visibly superior and would have substantially increased the difficulty of computations.

³⁵In fact, the scores were first grouped into percentiles and then condensed into the eleven-valued scale. The condensation assumed the following normal distribution: 11 = highest 1 percent, 10 = next 3 percent, 9 = next 7 percent, 8 = next 12 percent, 7 = next 17 percent, 6 = next 20 percent (the middle quintile), 5 = next 17 percent, 4 = next 12 percent, 3 = next 7 percent, 2 = next 3 percent and 1 = lowest 1 percent. If the top two categories are combined and the bottom two categories are combined, the resultant distribution is equivalent to what is called a "stanine distribution."

³⁶It should be noted that exclusion of expenditure/ADA permitted the index to be constructed for 84 percent of the schools rather than only the 75 percent for which data were available on all five measures.

data refer to district-wide averages rather than to specific schools and there is considerable intradistrict, inter-school variation in the allocation of resources which is averaged away. Second, even if each school spent the same number of dollars per ADA, use of this figure implies that each school does do with equal efficiency, which is a moot point. Third, there is inter-district variation in the distribution of enrollment between secondary and elementary school students, which is relevant because the expenditure/ADA in primary schools is approximately only 60 percent of that for secondary schools.

Because per-pupil expenditure is one of the most readily available statistics it has been the most frequently used measure in investigations of the relationship between school inputs and outputs. However, as multivariate techniques of analysis began to predominate in this area of inquiry, the relevance of the variable declined. Thus, the empirical results concerning its importance are mixed. In their study of Atlanta high schools Burkhead, et al., found that in a series of multiple regressions, the expenditure/pupil variable was significantly related only to dropout rates, and then in the direction opposite to the hypothesized one.³⁷ Goodman's analysis showed a fairly strong partial correlation between per-pupil expenditure and 7th grade achievement score, after controlling for the socioeconomic status of the student body.³⁸ However, Goodman concluded that "these consistently positive correlations document an abiding relationship between system expenditure

³⁷The authors' expost explanation of this finding was that it reflected (1) compensatory spending, (2) the high cost of vocational schools and (3) the concentration of low-income white pupils in small (expensive) schools. Input and Output in Schools, p. 70.

³⁸Goodman, Assessment of School Quality, Table 10.

and system effectiveness. . ." but, "The size of the correlation suggests that the educational benefits of additional funds are not automatic."³⁹ Other researchers who have examined a measure of expenditure/pupil with mixed results and interpretations include Clark, Cohn, Coleman, et al., and Flanagan, et al.⁴⁰

The other school characteristic which was excluded from the index of facilities is size. There are two main reasons for this omission. First, there seems to be no reason to believe that, ceteris paribus, the output of a small high school will be inferior to that of a large one. That is, whatever economies of scale accompany the organization of schools probably are reflected in the included variables.⁴¹ Second, there is some evidence that net scale economies do not characterize the entire range of a school's production function,⁴² i.e., that there is a range of sizes within which net diseconomies of scale prevail. Consequently, the output-size relationship may well be characterized by a quadratic function (e.g., a parabola) rather than by a monotonic one

³⁹Ibid., pp. 31-32.

⁴⁰Clark, Cost and Quality in Public Education. Cohn, "Quality in High School Education." Coleman, et al., Equality of Educational Opportunity. Flanagan, et al., Project TALENT: Studies of the American High School.

⁴¹For example, in their Chicago study Burkhead, et al., found that the size variable became statistically nonsignificant when other school characteristics entered the regression equation. They concluded that "The size of the high school, again within the range of Chicago school size, is not uniformly important as an educational variable." Input and Output in Schools, p. 56.

⁴²The studies which found significant net effects of scale include Katzman, "Production in a Big City School System," and Musgrave, "Educational Production Process." Among those which did not find such effects are Bowles, "Towards an Educational Production Function," Cohn, "Quality in High School Education," and Flanagan, et al., Project TALENT: Studies of the American High School.

(linear or nonlinear).⁴³ Some evidence on this nonmonotonic relationship is provided by the regression equations below which were based on data for 2,199 schools in the data bank of the National Longitudinal Survey Project. The numbers in parentheses are t-ratios.

$$(C.1) \quad B/P = 14.9 - .007S + .0000001 S^2 \quad \bar{R}^2 = .14, F = 178.1$$

(14.2) (9.9)

$$(C.2) \quad C/100P = .32 - .00014S + .00000006S^2 \quad \bar{R}^2 = .01, F = 11.3$$

(4.31) (3.45)

$$(C.3) \quad P/T = 18.7 + .0018S - .0000003S^2 \quad \bar{R}^2 = .02, F = 26.9$$

(5.41) (3.13)

The variables are defined as follows:

S = Size of enrollment in the seventh through twelfth grades.

B/P = Availability of library facilities per pupil.

C/100P = Full-time-equivalent counselors per 100 pupils.

P/T = Pupils per full-time teacher.

To conclude this consideration of measuring school quality, some tabular results concerning the "face-validity" of the index of school facilities are presented in Tables C-1 to C-3. Each table of results relates the computed school quality index to a commonly accepted correlate of schooling quality. The index appears to behave as expected. That is, young whites are more likely than young blacks to attend a high quality school, and within each color group there is a positive association between parental family income and quality of school attending. Furthermore, the distribution of students across quality of school is very close to normal.

⁴³See Donald D. Osburn, "Economies of Size Associated with Public High Schools," Review of Economics and Statistics, LII (February 1970), pp. 113-15.

TABLE C-1

QUALITY OF SCHOOL^a ATTENDING BY COLOR:
 MALES 14 TO 24 YEARS OF AGE, ENROLLED
 IN GRADES 9 THROUGH 12 IN 1966

(Unweighted Percentage Distributions)

Quality of school ^a	WHITES	BLACKS
10-11	4	3
9	7	6
8	12	6
7	16	17
6	21	14
5	17	15
4	12	15
3	7	12
1-2	3	12
Total percent	100	100
Total number	1,041	360

Source: Data bank of the National Longitudinal Surveys Project.

^aQuality is measured by the constructed index of school facilities.
 High scores are presumed to measure high quality.

TABLE C-2

QUALITY OF SCHOOL^a ATTENDING BY PARENTAL FAMILY INCOME,
1965: WHITE MALES 14 TO 24 YEARS OF AGE ENROLLED
IN GRADES 9 THROUGH 12 IN 1966

(Unweighted Percentage Distributions)

Quality of school ^a	Family Income, 1965		
	Under \$6,000	\$6,000-\$9,999	\$10,000 or more
10-11	2	4	4
9	8	9	6
8	11	11	13
7	18	16	16
6	18	20	22
5	16	17	19
4	15	13	11
3	10	8	6
1-2	4	3	2
Total percent	100	100	100
Total number	250	380	345

^aSee note, Table C-1.

TABLE C-3

QUALITY OF SCHOOL^a ATTENDING BY PARENTAL FAMILY INCOME,
 1965: BLACK MALES 14 TO 24 YEARS OF AGE ENROLLED
 IN GRADES 9 THROUGH 12 IN 1966

(Unweighted Percentage Distributions)

	Family Income 1965		
	Under \$3,000	\$3,000-\$5,999	\$6,000 or more
10-11	1	5	3
9	3	7	10
8	3	3	10
7	9	22	18
6	14	12	17
5	14	16	16
4	15	15	14
3	18	13	4
1-2	22	6	8
Total percent	100	100	100
Total number	132	121	96

^aSee note a, Table C-1.