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ABSTRACT

The aggregate measures of teaching staff per pupil or total educational staff per pupil can conceal substantial differences in the mix of educational professionals utilized and may yield erroneous conclusions about gaps in the relative educational service levels among local public schools. This study of staffing patterns in U. S. local schools, using unpublished data from a staff survey of local schools conducted by the National Center for Educational Statistics in 1970, reveals that, in general, elementary schools have more nonprofessional health staff per teaching staff and less services supporting instructional staff per teaching staff than secondary schools do. Moreover, both elementary and secondary schools in large cities have more nonprofessional staff per teaching staff and more services supporting instructional staff per teaching staff than schools do in metropolitan areas surrounding large cities and in all other areas. This analysis of local school staffing mixes indicates substantial differences in staffing patterns by location, size, and economic status of the school. These differences reinforce the hypothesis that use of aggregate pupil/teaching staffing ratios has been overemphasized and could produce inaccurate assessments of the quantity and quality of educational services by a specific school. (HMD)

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ANALYSIS OF THE EDUCATIONAL PERSONNEL SYSTEM: VI. STAFFING PATTERNS IN U.S. LOCAL PUBLIC SCHOOLS

PREPARED FOR THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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PREFACE

Under Contract OEC-0-71-2533(099) with the U.S. Office of Education, The Rand Corporation has been conducting an analysis of the educational personnel system in the United States. This is the sixth in a series of reports presenting details of Rand's research. This report examines the differences in the mix of professional and nonprofessional educational staff employed by local public schools of various levels, locations, and economic status. The differences that emerge reinforce the importance of (1) distinguishing regular classroom teachers from other teaching and supporting staff, and (2) reducing the reliance on aggregate pupil/teacher or pupil/total staff ratios as indicators of the relative quantity and/or quality of educational services provided by the local school.

The other reports in this series are:

David Greenberg and John McCall, *Analysis of the Educational Personnel System: I. Teacher Mobility in San Diego*, R-1071-HEW, January 1973.

David Greenberg and John McCall, *Analysis of the Educational Personnel System: II. A Theory of Labor Mobility with Application to the Teacher Market*, R-1270-HEW, August 1973.

Stephen J. Carroll, *Analysis of the Educational Personnel System: III. The Demand for Educational Professionals*, R-1308-HEW, October 1973.

Emmett Keeler, *Analysis of the Educational Personnel System: IV. Teacher Turnover*, R-1325-HEW, October 1973.

Stephen J. Carroll and Kenneth F. Ryder, Jr., *Analysis of the Educational Personnel System: V. The Supply of Elementary and Secondary Teachers*, R-1341-HEW, February 1974.

David Greenberg and John McCall, *Analysis of the Educational Personnel System: VII. Teacher Mobility in Michigan*, R-1343-HEW, February 1974.

Stephen J. Carroll et al., *Analysis of the Educational Personnel System: VIII. Overview and Summary*, R-1344-HEW, February 1974.

SUMMARY

The number of teaching staff per pupil or the total educational staff per pupil have been extensively used as measures of the quantity and the quality of the educational services provided by local public schools. These aggregate measures, however, can conceal substantial differences in the mix of educational professionals utilized and may therefore yield erroneous conclusions about gaps in the relative educational service levels among these different schools. A more detailed analysis of staffing patterns is needed to improve the basis for evaluating educational service gaps and to provide some insight into the resource allocation process within districts. Such analyses have been limited in the past by the lack of adequate national data on the various categories of educational personnel employed in local public schools.

CURRENT STAFFING PATTERNS AMONG LOCAL PUBLIC SCHOOLS

This study uses unpublished data from a staff survey of local public schools conducted by the National Center for Educational Statistics (NCES) in 1970. A comparison of the variations in the overall teaching staff/total staff ratios and in various staffing mixes across schools of different levels and in different locations indicates that a relatively stable aggregate ratio does, in fact, conceal substantial differences in the mix of particular types of staff. Some of these differences depend on the level and the location of the school. In general, elementary schools have more nonprofessional health staff per teaching staff, and less services supporting instructional staff per teaching staff than secondary schools. Moreover, both elementary and secondary schools in large cities have more nonprofessional staff and more services supporting instructional staff per teaching staff than schools in metropolitan areas surrounding large cities and in all other areas.

There are a number of plausible explanations for these observed differences in staffing mixes. The principal ones include differences in

- Student needs,
- Budget or total resource levels available,

- Local priorities for meeting needs,
- Relative costs of different educational personnel expressed in either dollars or full time staff equivalents, and
- Enrollment size.

THREE GENERAL BEHAVIORAL MODELS

Three general models of the behavior of a local school administrator are developed to separate the independent effects of each candidate explanation and to derive some specific hypotheses concerning particular relationships -- bureaucratic models, production (or output-oriented) models, and lexicographically ordered objectives models. These models differ primarily in the nature of the objectives of the school administrators. For the bureaucratic model, the administrator's objective is to expand his control over tangible resources to the maximum extent possible. In the production model, the administrator seeks to satisfy the needs of his students by providing as many of the critical educational services as possible. The lexicographic model differs from the others by assuming that the administrator's objectives are ordered lexicographically, regardless of whether the objectives are input- (resource) or output-oriented.

The bureaucratic and the production model yield consistent, similar hypotheses, but the lexicographic model generates fundamentally different hypotheses about the effects on staffing mix of changes in budgets or total resource levels and changes in the relative costs of different educational personnel resources.

ANALYSIS OF LOCAL SCHOOL STAFFING MIXES

Although the NCES School Staffing Survey provides a wealth of data on staff inventories within local schools, it lacks financial data on the budget or total resources available to the local school and data on the relative costs of different types of educational resources. These critical data gaps preclude a complete test of the independent effects of the factors influencing school staffing mixes. Consequently, we undertake an exploratory analysis focusing on four fundamental questions:

- How valid is the lexicographic model for describing resource allocation behavior of local school administrators?
- What are the effects of enrollment size on school staffing mixes?
- Are there significant differences in staffing mix between "rich" and "poor" schools?
- Do current staffing mixes provide any evidence of potential substitution among educational personnel?

Our test for lexicographic preference ordering among local school administrators is a comparison of the pupil/classroom teacher frequency distributions of schools with various other staff to those without them. If preference or objectives were ordered lexicographically starting with the pupil/classroom teacher ratio, the frequency distribution for those schools without supplemental staff would lie to the right (indicating higher pupil/classroom teacher ratios) of the one for schools with additional staff. Our chi-square tests for statistically significant differences among the thirty frequency distributions examined indicate that only four distributions are significantly different, with higher pupil/classroom teacher ratios. These data thus provide little support for the lexicographic behavioral model.

Simple correlation analysis is used to explore the variations in staffing mix as enrollment size changes. We find few consistent patterns across all levels and locations of schools. The relationship between size and staffing mix for elementary and secondary schools varies considerably. For example, larger secondary schools have a significantly larger pupil/classroom teacher ratio in areas of all types, but this is true only for elementary schools in nonmetropolitan areas. Larger secondary schools also have significantly more clerks and secretaries per classroom teacher than smaller schools, whereas for elementary schools in larger cities, larger schools have significantly fewer clerks and secretaries per classroom teacher.

We also use correlation analysis to determine whether significant staffing mix differentials exist between "rich" and "poor" students (e.g., students from families of high or low economic status). We investigate whether various compensatory programs have succeeded in reallocating additional resources toward poor schools and disadvantaged students. Our results indicate that poor students in large city schools obtain more regular classroom teachers per pupil and also have a richer mix of other staff per classroom teacher than do rich students. Similar significant differentials do not exist outside large cities. Moreover, within the large city schools, these differentials are not uniformly distributed; rather, they are concentrated among smaller schools.

Our test for potential substitution among various types of educational staff involved a simple correlation between the pupil/classroom teacher ratio and various staff/classroom teacher ratios. Significant positive correlations would be consistent with substitution between the particular staff type and regular classroom teachers. Consistent positive correlations were obtained only for two types of staff -- other instructional staff and clerks and secretaries. The lack of financial data was especially critical in this area, however.

FUTURE NEEDS

Our analyses of local school staffing mixes indicates substantial differences in staffing patterns by location, size, and economic status of the school. These differences reinforce our initial hypothesis that the use of aggregate pupil/teaching staffing ratios has been overemphasized and, indeed, could produce inaccurate assessments of the quantity and quality of the educational services provided by a specific school. More research on the determination of school staffing mixes is clearly needed, but until financial data on budget levels and relative resource costs can be combined with detailed staffing data like those available from the NCES's School Staffing Survey, a complete testing of our models cannot be accomplished.

CONTENTS

LIST OF SYMBOLS

STAFFING CLASSIFICATIONS

P = pupil enrollment, fall 1969; excludes prekindergarten, kindergarten, adult, and post secondary pupils

T = regular classroom teachers (FTE);* excludes prekindergarten and kindergarten instructors, and staff listed as other instructional

OI = other instructional staff (FTE); includes the FTE reported for resource teachers, specialized reading teachers, and teachers of the mentally, emotionally, or physically handicapped

TIS = total instructional staff; the sum of T + OI

ADM = administrative staff (FTE); consists of principals, assistant principals, supervisors of instruction, other administrative staff, department heads, deans, assistant deans, pupil personnel directors

SSIS = services supporting instructional staff (FTE). This group consists of librarians or media specialists, audio-visual specialists, counselors, placement officers, community workers. social workers, security officers, other supporting instructional staff, attendance officers, curriculum directors, student activity coordinators.

HS = health services staff (FTE); includes nurses, psychologists/psychometrists, speech and hearing specialists/speech pathologists, physicians, psychiatrists, dentists, dental hygienists, dieticians, physical therapists, other health services staff

TA = teacher aides (full-time only)

LA+HA = library aides and health aides (full-time only)

CL+SEC = clerks and secretaries (full-time only)

X_j = OI + TIS + ADM + SSIS + HS + TA

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*Full-Time Equivalent.

INDEXES OF ECONOMIC STATUS

I_1 = census tract designation (1970) of poverty/nonpoverty status for large city schools, with N=234 for elementary and N=219 for secondary, as compared to 294 and 273, respectively, for the entire (aggregate) samples for these classifications

I_2 = weighted wealth index; based on the subjective analysis of the distribution (percentage) of student enrollment by four broad classifications: economically very poor, moderately poor, moderately wealthy, quite wealthy, or very wealthy. The index is obtained by weighting the percentage in each of these categories by integers of 1 through 4, with a weight of 1 being used for the poorest category and a weight of 4 for the wealthiest. These weighted percentages are then summed. The result is a continuously variable index of the parental economic status of enrolled students.

I_3 = unweighted poverty index; the sum of the percentage of student enrollment reported in the two (lower) poverty classifications, varying from 0 to 100. This index is inversely, albeit imperfectly, related to index I_2.

I. INTRODUCTION

THE PROBLEM

A major analytical problem in the area of elementary and secondary education has been the lack of adequate and acceptable measures for determining the level and quality of the various educational services local public schools provide their students. Moreover, the types of educational services that schools can or perhaps should provide have also proved controversial. There seems to be general agreement, however, that educational personnel are needed to provide whatever services are offered and, further, that higher levels of service require additional personnel. Consequently, the number of educational staff members per pupil, or aggregate pupil/classroom teacher ratios, have been used as indicators of the relative quality and level of educational services provided.

The mix of the educational staff at any school or local school district has not received as extensive treatment as these aggregate pupil/classroom teacher ratios. This is unfortunate in two respects. First, the mix of educational staff may be a better indicator of *the variety of educational services offered* at a local school than the aggregate ratio. For example, two schools may have the same aggregate pupil/staff ratios, but if one lacks health professionals it does not provide the same variety of services as one with health professionals. Second, the mix of educational staff may also be a better indicator than the aggregate ratios of *the quality of specific services offered,* to the extent that particular specialists (e.g., speech therapists) more effectively provide the specific educational service than classroom teachers.

UNIT OF ANALYSIS: LOCAL SCHOOLS

In this report we examine differences in staff mixes among local schools in the United States. We use local schools as the unit of analysis, rather than local school districts, for several reasons. One reason is that analysis of staffing mixes at the level of the local school avoids serious aggregation problems encountered at the district level --

differences in the size of enrollment and in the student needs at specific schools within a district. If there are potential economies in the utilization of particular personnel associated with increased enrollments, the district staffing mix, which is an aggregation of mixes over local schools of varying enrollment levels, is less likely to reveal such economies than the individual local school mix.* Since there are different services provided at the elementary and secondary levels, the different staffing mixes associated with these will be difficult to determine from an aggregate district mix.

A second reason for using schools rather than districts is simplicity. Ultimately, we would like to predict how current staffing mixes will change in response to changes in expenditures and teacher labor-market conditions. This requires an understanding of the resource allocation process within local districts. At the district level, this process is exceedingly complex, since the total educational budget, the mix of personnel to be employed, and the wages to be paid different types of staff are simultaneously determined. At the local school level, the allocation problem is less complex, since an administrator's share of the total district budget and the trade-off rates among different staff categories often appear as constraints established by district policy.

A third reason is that the local school principal is the ultimate user of the various educational personnel resources. If his objectives are reasonably consistent with those of the district administrator and his constraints accurately reflect the constraints at the district level, his response to a change will be fairly consistent with that of the district administrator. If the principal's objectives differ and he is given freedom of choice, then the resulting staffing mix will reflect the local administrator's response. If, on the other hand, the principal's actions are constrained, the resulting mix will reflect the nature of the constraint, assuming it is binding. In any case, an analysis of staffing mixes at the local level will provide important information and some helpful insights into the allocation of educational resources within local school districts.

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*This assumes that the principal economies occur in the direct provision of services at the local school level.

THE PLAN OF THIS REPORT

In Section II we briefly describe the current (1970) staffing mix among local public schools and present possible explanations for observed differences in staffing mixes. In Section III we describe the data base -- the National Center for Educational Statistics (NCES) special sample survey of local public schools -- and discuss the limitations imposed by some critical data gaps. We also describe adjustments made to the NCES sample and compare the revised sample with the original NCES sample. In Section IV we develop an analytical framework for examining the resource allocation process in order to evaluate the various explanations; Section V presents the results of our statistical analysis. Section VI summarizes our findings about differences in staffing mixes among local schools and provides suggestions for filling current data gaps and for conducting further research when data are available.

II. CURRENT STAFFING PATTERNS AMONG LOCAL PUBLIC SCHOOLS

DIFFERENCES IN STAFFING PATTERNS

A fundamental question concerning the educational staffing patterns among local public schools is whether and how those patterns differ. The answer will vary depending upon the degree of aggregation. Aggregate measures, such as the pupil/classroom teacher ratio or the teacher/professional staff ratio show only small differences in the average ratios across broad classes of local schools. Table 1, which shows these ratios for elementary and secondary schools by three major types of geographic areas, shows that the average teacher/total professional staff ratios range from .833 for elementary schools in large cities to .874 for secondary schools outside large metropolitan areas. In addition to the narrowness of the range, these ratios are remarkably similar for elementary and secondary schools in the same area. The differences in pupil/classroom teacher ratios between elementary and secondary schools, also shown in Table 1, are much greater than the differences in the teacher/total professional staff ratios.

Table 1

AGGREGATE STAFFING MIX AND PUPIL/TEACHER RATIOS FOR ELEMENTARY AND SECONDARY SCHOOLS

	Elementary Schools			Secondary Schools		
Ratio	Large City	Metro[a]	Other Area	Large City	Metro[a]	Other Area
Teacher/total professional staff	.833	.855	.871	.857	.867	.874
Pupil/teacher	24.66	23.59	24.73	22.27	21.83	20.88

[a]"Metro" is a term used by the National Center for Educational Statistics for metropolitan areas surrounding large cities.

These aggregate ratios conceal substantial differences in the mix of particular types of staff, however. Table 2 compares the ratios of various types of professional and nonprofessional staff per teacher for elementary and secondary schools. Among professional staff, elementary schools tend to have fewer administrative staff and supporting instructional staff per teacher but more principals and more health staff per teacher than secondary schools. The difference in the elementary and secondary principal/teacher ratios is due to differences in school sizes, with secondary schools having much larger enrollments than elementary schools. Size also explains a large part of the differences in staff ratios for different areas, since both elementary and secondary schools in large cities have larger average enrollments than schools in metropolitan areas or other areas. Average aggregate differences in the supporting instructional staff/teacher and the health staff/teacher ratios between elementary and secondary schools probably reflect differences in the general types of services required by students at these levels.

Table 2

EDUCATIONAL STAFF/TEACHER RATIOS

	Elementary Schools			Secondary Schools		
Staff/Teacher Ratio	Large City	Metro	Other Areas	Large City	Metro	Other Areas
Total professionals						
Administrative staff	.058	.054	.058	.063	.060	.055
Principals	.035	.041	.049	.014	.015	.023
Supporting Instructional staff	.052	.037	.033	.094	.085	.080
Professional health staff	.018	.019	.016	.010	.009	.009
Total nonprofessionals	.261	.194	.197	.158	.137	.119
Total aides	.200	.121	.135	.082	.049	.043
Teacher aides	.123	.078	.087	.048	.024	.017
Clerks and secretaries	.060	.073	.062	.076	.088	.076

The most striking difference in staffing mixes occurs in the nonprofessional staff/teacher ratio. As Table 2 indicates, there are substantial differences between and within levels. Elementary schools have significantly more nonprofessional staff per teacher than secondary schools; within each level, these ratios are greatest for schools in large cities. The data in Table 2 also indicate that these differences in nonprofessional staff/teacher ratios are attributable to differences in the number of aides per teacher. Furthermore, most of the differences in aides/teacher differentials are primarily due to differences in teacher aides per teacher.

POSSIBLE EXPLANATIONS

To explain these differences in staffing mixes, we need to undertake a detailed comparative analysis of staffing mixes among local schools and introduce additional explanatory variables. Such a comparative analysis is complicated, however, by a number of possible explanations.

- Staffing among various schools depends on specific *student needs*. Since the educational staff needed to provide specific services differs depending upon the type of service provided, differences in the demands for services produces different staffing mixes.
- Staffing mix varies with the amount of *total resources available*. Because of resource constraints, not all the student needs for particular educational services can be met. A critical issue is whether schools with the same types of unmet needs will react similarly given additional resources.
- Staffing mix differences may reflect differences in *local administrative priorities* for unmet needs.
- Differences in the *relative costs of various personnel* as perceived by local schools will cause different staffing mixes. These relative cost differences may be perceived as explicit price differentials or differences in available full-time faculty equivalents (FTEs). Like the total level

of resources, this trade-off ratio between different types of educational personnel is most likely established at the district level and confronts the local administrator as a constraint. A critical issue to be examined is the extent to which local administrators alter their staffing mix as these trade-off ratios vary.

- Staffing patterns will vary with differences in the *number of students served* if there are economies or diseconomies of scale for certain educational services.

These five reasons do not exhaust the set of potential explanations for expecting differences in staffing patterns among local schools. Numerous other examples could be cited: for instance, differences in the technological conditions of providing a particular service (e.g., the discovery of a new technique for teaching reading is not immediately disseminated to all schools throughout the country) or differences in "fixed" personnel resource constraints (e.g., tenured teachers with limited sets of skills). But these examples merely emphasize the complexity of the allocation process for educational personnel resources. What is needed is a reasonable model of that allocation process that allows us to examine the complex of variables affecting that process and to distinguish the independent effects of each.

III. DESCRIPTION OF THE DATA BASE

Before describing alternative models of the resource allocation process within local public schools, it would be useful to examine the existing data base. We are concerned with two aspects:

- o *Comprehensiveness of the available data* -- whether there is information on all critical variables.
- o *Adequacy of the available data* on each variable -- whether there is sufficient detail to discriminate among those classes within a variable where differentiation is essential (e.g., classroom teachers versus other professional staff).

In this section we describe both the National Center for Educational Statistics (NCES) data base and the analytical sample used in our empirical analysis. The description of the NCES data base includes an evaluation of its comprehensiveness and adequacy for empirical analysis of local school staffing; the description of our adjusted sample includes a general overview of the data, a comparison between the sample and the total NCES data base, and an explanation of the specific variables used in our empirical work.

THE NCES DATA BASE

Most national elementary and secondary education data are available at only the state or, at best, the district level. In 1970, the NCES undertook a stratified sample of 3,732 of the more than 90,000 public day schools in the United States. We used these data for our empirical tests for three reasons. First, we wanted to observe the resource allocation process within local school districts. For this we required data below the district level at the local (school-building) level. We also wanted a representative sample of school staffing for the total United States, and the NCES School Staffing Survey is the only known data base with school-building data drawn from the national U.S. population. Finally, we wanted to test the utility of this particular data base for analyzing, rather than merely describing, staffing patterns in local public schools.

The NCES School Staffing Survey consists of three separate questionnaires focusing on different aspects of resource utilization and need within a local public school. The first questionnaire, an inventory of professional and nonprofessional personnel available to the local school (staffing inventory questionnaire, Form X), was sent to 1,031 schools; the second, which compiles profiles of 11 categories of "exceptional children," was sent to 1,660 schools; the third questionnaire on teacher turnover and specific pupil characteristics, including aggressive anti-social behavior, was sent to 1,041 local public schools.* Each questionnaire had a different sampling design, and no school received all three questionnaires; consequently, it was impossible to combine data obtained from more than one questionnaire.

The "exceptional children" questionnaire focuses on the number of students in the local school that require special educational services. Eleven characteristics or classes are identified, ranging from mentally gifted to emotionally disturbed to blind or deaf pupils. The questionnaire also seeks information on (1) amount of special services provided (in terms of numbers of students served), (2) types of services provided (e.g., separate classes, individualized instruction), and (3) resources used in providing the services. Data on total enrollment (excluding kindergarten and prekindergarten), change and mobility of enrollment, racial and income characteristics of students, and racial composition of full-time teachers are also collected. There are two specific deficiencies in the design of this questionnaire. First, the questionnaire does not obtain the total number of teachers or other instructional staff at the school. Second, the survey counts all students that receive each type of service, but since these services are not mutually exclusive, there is multiple counting.

The teacher turnover questionnaire measures the gains, by source, and the losses, by category, of full-time teachers. Data on the functional mix of paid staff positions, racial composition of full-time teachers, and

*Because we could not combine data from the three samples, we used only data from the staffing inventory questionnaire.

number of teachers without full state certification are also obtained. In addition to teacher turnover and other staff data, this questionnaire obtains measures of the nonlabor inputs, such as radios, televisions, and videotape recorders; number of aggressively antisocial students and corrective actions taken; other enrollment characteristics, including racial composition, income status, size, and mobility; and types of educational service the school provides for each of the 11 "exceptional children" categories. Although the provision of the service is identified, neither the exact amount of each service, measured by the resource inputs used, nor the number of pupils served can be explicitly identified.

The Staffing Inventory Questionnaire (Form X)

The principal advantage of this data base for our analysis of staffing mix determinants is the substantial detail available on different staff categories, particularly different types of teachers. This is particularly important today when the generic term "teacher" encompasses a wide range of activities, thus rendering comparisons of aggregate teacher/pupil ratios rather meaningless. We are especially interested in distinguishing the regular classroom teacher, who provides a wide range of educational services within the classroom, from various teaching specialists who provide special instruction in separate classes or groups, or supplement the instruction provided in the classroom.

The staffing inventory questionnaire identifies four broad categories of professional staff in addition to nonprofessional staff. These are:

- *Instructional staff (teachers)*: Classroom teachers, specialized reading teachers; teachers of the mentally, emotionally, or physically handicapped; and other instructional professionals.
- *Administrative staff*: Principals, assistant principals, supervisors of instruction, department heads, deans, assistant deans, pupil personnel directors, and other administrative professionals.
- *Services supporting instructional staff*: Librarians, media specialists, audio-visual specialists, counselors, placement officers, community workers, social workers, security officers, attendance

officers, curriculum directors, student activity coordinators, and other sup orting staff.

- *Health service ff*: Nurses, psychologists/psychometricians, speech and hearing specialists/speech pathologists, physicians, psychiatrists, dentists, dental hygienists, dieticians, physical therapists, and other health services staff.

Each professional staff member is identified by full-time or part-time status, by the number of days per week spent in specific assignments explicitly enumerated, and by availability, i.e., whether permanently assigned to the school building or whether available on call either from the district or from an agency.

The nonprofessional staff (teacher aides, library and health aides, clerks and secretaries) is separately identified by full-time or part-time status. Although data on the total number of part-time nonprofessional employees are obtained, the amount of time spent by each of these employees is not available. This gap is unfortunate, since full-time equivalents (FTEs) for part-time nonprofessional staff cannot be satisfactorily calculated.

In addition to these detailed counts of different types of educational personnel, the staffing inventory questionnaire also provides information on the racial composition of full-time teachers, total school enrollment and changes in that enrollment between fall and spring, racial composition, parental economic status of the school's pupils,* type of service provided to pupils in the 11 categories of special needs (i.e., separate full-time classes, part-time classes, or special individualized assistance), and type and location of the particular school building.

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*The parental economic status is derived from a subjective estimate made by the local school administrator, but is an important variable, nonetheless, in establishing the economic status of the school's pupil population. The information on the provision of special services is of little value because neither the number of pupils receiving the particular service by type of need nor the number of educational professionals providing the specific service is identified explicitly.

Major Data Deficiencies

Despite these minor gaps, the inventory data on the professional and nonprofessional staff are reasonably complete. There are major gaps in additional information needed to undertake a thorough analysis of local school staffing patterns, however. The major deficiencies are attributable to lack of data on

- Total value of all educational personnel and nonpersonnel resources used in the local school.
- Costs of specific personnel resources, e.g., classroom teachers, relative to either other types of educational personnel or non-personnel resources.
- Experience level of educational staff personnel.
- Proportion of staff with tenure.

These gaps pose critical problems in analyzing the reasons for differences in local school staffing mixes. The lack of financial data, particularly the relative costs for various educational personnel, is especially serious. Without such data, it is virtually impossible to develop adequate proxy variables to control for budget or relative cost differences. The total number of personnel resources is available, however, and this could be used to approximate the total resource wealth of each school. Unfortunately, using these data in this manner would require two assumptions: (1) that the relative costs for different types of personnel are the same among all local schools, and (2) that the relative costs among different types of educational resources (e.g., audio-visual equipment, books, personnel, etc.) are the same among all local schools. The first assumption precludes any possibility of using cross-sectional analysis for examining educational personnel trade-offs; the second precludes any cross-sectional analysis of personnel/nonpersonnel resource trade-offs. Several such trade-off possibilities are essential to understanding differences in local school staffing mixes, and these assumptions would vitiate any usefulness in employing these NCES data to analyze local school staffing. Thus, several adjustments were required in the original NCES sample.

SAMPLE ADJUSTMENTS

The original NCES sample of 1,031 schools for the staffing questionnaire (Form X) was stratified by three organizational levels -- elementary, secondary, and combined -- and by three locational strata -- large cities, metropolitan areas surrounding large cities, and all other areas.* The numbers of schools within each of these strata are shown in Table 3. Because of the small number of observations in each of the cells for the combined schools, we exclude those 38 schools from our analysis. An additional 31 schools are excluded because of insufficient or inconsistent responses regarding the number of employed staff. Our sample thus consists of 962 schools, of which 496 are elementary and 466 are secondary.**

Table 3

ORIGINAL NCES SAMPLE FOR THE SCHOOL STAFFING SURVEY: ORGANIZATIONAL AND LOCATIONAL COMPOSITION

(number of schools)

Type of School	Location			Total
	City	Metro	Other	
Elementary	324	123	86	533
Secondary	279	111	70	460
Combined	14	10	14	38

Table 4 compares the pupil/teacher ratios for grades 1 through 12 from the original NCES sample with ratios obtained from our adjusted sample. The largest differences occur for the elementary schools, but the magnitude is not sufficiently large to create a problem. Moreover, there is no consistent bias for all three locational strata.

The three basic types of variables used were: enrollments, numbers and mix of educational staff, and economic status indicators, all derived

*We refer to these locational strata as "City," "Metro," and "Other."

**The discrepancy in the number of secondary schools is caused by our use of a different variable to classify schools by organization level.

from the staffing inventory questionnaire. To ensure comparability across elementary and secondary schools, enrollment and staff variables were limited to schools with grades 1-12. Thus, we omitted prekindergarten, kindergarten, adult and post secondary pupils, and the staff associated with providing services for those pupils.

Table 4

COMPARISON OF PUPIL/TEACHER[a] RATIOS WITH RATIOS FROM ADJUSTED SAMPLE

Samples	Elementary Schools			Secondary Schools		
	City	Metro	Other	City	Metro	Other
Original NCES	24.66	23.59	24.73	22.27	21.83	20.88
Adjusted	25.53	24.22	24.04	22.49	22.04	20.71
Difference	-.87	-.63	+.69	-.22	-.21	+.17
Percent Difference	-3.5%	-2.7%	+2.8%	-1.0%	-1.0%	+0.8%

[a]Total instructional staff.

All professional staff are FTEs. The three types of nonprofessionals are full-time only; part-time nonprofessionals are excluded since FTEs could not be estimated for those staff members. Three economic status indexes are used -- I_1, I_2, I_3. The first index, I_1, is strictly a locational variable dichotomizing schools into poverty or nonproverty categories, depending upon the schools's location within or outside a census poverty tract in 1970. These census poverty tracts were only designated for central city areas within SMSAs. Hence, the I_1 index is applicable only for elementary and secondary schools in large cities.*

The I_2 and I_3 indexes are derived from the local administrator's subjective evaluation of his pupils' parental economic status. The staffing inventory questionnaire obtained estimates of the percentage of students whose parental economic status could be classified as very poor, moderately poor, moderately wealthy, quite wealthy, or very wealthy. The

*Of the 294 elementary and 273 secondary schools in large cities in our sample, only 234 elementary and 219 secondary schools were included in the I_1 index.

I_2 index is a weighted average of these percentage distributions. The result is a "wealth index" varying from 1 to 4, with 1 signifying a school with all very poor students and 4 indicating a school with all wealthy students. The I_3 index represents the total percentage of the school's enrollment classified as very poor or moderately poor. Since higher I_2 values indicate wealthier students, while higher I_3 values indicate poorer students, the two indexes are inversely related and are designated as our wealth and poverty indexes, respectively.

DATA OVERVIEW

Table 5 provides some summary statistics on averages and standard deviations for variables in our sample.

Table 5

SUMMARY STATISTICS FOR SAMPLE OF LOCAL PUBLIC SCHOOLS
(standard deviations in parentheses)

	Elementary Schools			Secondary Schools		
Variables	City	Metro	Other	City	Metro	Other
Average enrollment	678.9 (348.2)	542.1 (273.3)	400.7 (244.2)	1562.5 (860.1)	1417.6 (857.3)	846.6 (539.2)
Average number of classroom teachers (FTE)	25.19 (14.31)	21.28 (12.14)	15.48 (9.35)	66.02 (36.80)	62.46 (35.88)	38.85 (23.22)
Average P/T ratio	27.21 (4.81)	26.23 (4.59)	25.58 (6.13)	23.84 (3.73)	23.05 (4.96)	21.68 (4.82)
Average P/TIS ratio	25.53 (4.75)	24.22 (4.15)	24.04 (5.54)	22.49 (3.70)	22.04 (4.81)	20.71 (4.21)
Wealth index I_2	2.30	2.75	2.54	2.43	2.79	2.57
Poverty index I_3	51.6	30.3	41.0	46.0	27.0	40.3
Sample size (N)	294	119	83	273	115	78

The data in Table 5 indicate that

- o Elementary school enrollments are smaller than secondary school enrollments.
- o Large city school enrollments are larger than enrollments of metropolitan or other area schools.

- Elementary schools have higher pupil/teacher ratios for both regular classroom teachers and total instructional staff than secondary schools.
- The parental economic status of enrolled pupils is highest in metropolitan area schools and lowest in large city schools.
- Pupil/teacher ratios for both regular classroom teachers and total instructional staff are lowest for schools in other areas and highest for large city schools.

Most of these observations are consistent with other findings about differences in school characteristics among different locales; and this further supports the representative nature of our sample. However, these data also reemphasize the importance of distinguishing classroom teachers from other instructional staff. The difference in the pupil/total instructional staff ratio between schools in large cities and those in other areas is smaller than the differences in their pupil/classroom teacher ratios. Two implications of this are, first, large city and metropolitan area schools tend to obtain more other instructional staff members than other area schools, although this additional teaching staff does not completely equalize aggregate pupil/total teacher ratios; and second, aggregate pupil/teacher ratio comparisons can conceal some important differences in school staffing mixes.

A more detailed view of staffing mixes among different types of local public schools is presented in Appendix A. The appendix tables examine the average staff/pupil ratio for schools at the same level, in the same type of location and, most importantly, with similar pupil/classroom teacher ratios. These data provide two types of parametric analysis: The first is a comparison of trends in particular staff/pupil ratios within schools in the same location as the pupil/classroom teacher ratio varies; the second, a comparison of differences in staff/pupil ratios among schools in different areas with the same pupil/classroom teacher ratios.

Since the existence of significant trends in the staff variables will be directly established later, we examine here only the trends in the poverty variables, which are summarized in Table 6.

Table 6

VARIATION IN POVERTY INDEX I_3

(percent)

P/T Ratio	Elementary Schools City	Elementary Schools Metro	Elementary Schools Other	Secondary Schools City	Secondary Schools Metro	Secondary Schools Other
< 18	58.1	(a)	58.2	69.8	24.9	38.7
18-20	72.2	(a)	(a)	62.4	28.3	(a)
20-22	71.1	31.5	(a)	42.7	21.5	44.4
22-24	55.4	31.2	32.8	51.5	22.8	36.8
24-26	51.4	35.2	36.4	40.7	38.8	43.4
26-28	51.7	22.5	38.8	30.8	26.6	(a)
28-30	53.0	26.9	28.5	54.3	(a)	(a)
30-32	37.1	31.5	55.9	24.7	(a)	(a)
32-34	42.3	(a)	(a)	(a)	---	---
34-36	53.4	(a)	(a)	(a)	---	---
36-38	41.8	(a)	(a)	---	---	(a)
> 38	76.9	(a)	(a)	---	(a)	---

[a]Cells with less than eight observations were excluded from this table.

These data indicate that poor students in large city and other area elementary schools are disproportionately found in schools with either extremely low (below 22) or extremely high (greater than 30 or 38) pupil/classroom teacher ratios. This is not true for elementary schools in metropolitan areas, nor for students in secondary schools. In fact, poor students in large city secondary schools are found disproportionately in schools with extremely low pupil/classroom teacher ratios.

Table 7 presents a comparison of the staffing patterns in elementary and secondary schools in different areas but with approximately the same pupil/classroom teacher ratios. When this ratio is held constant, some interesting differences in locational staffing patterns emerge. For elementary schools with an average pupil/classroom teacher ratio of about 27, other area schools have substantially fewer other instructional staff and health staff members than city or metropolitan area schools, while metropolitan area schools have fewer services supporting instructional staff members than the other two. Probably the most dramatic difference, however, is the substantially greater number of teacher aides found in

Table 7

STAFFING PATTERNS OF ELEMENTARY AND SECONDARY SCHOOLS

Area	Variables		Average Supplementary Staff Ratios[a]							Average Indexes		(N)
	Average P	P/T	OI	ADM	SSIS	HS	TA	LA+HA	CL+SEC	I_2	I_3	
Elementary Schools with P/T Ratios between 26 and 28[b]												
City	665	27.0	31.1	24.7	18.9	8.5	30.9	2.1	21.6	2.35	51.7	61
Metro	591	27.0	33.2	21.2	10.3	7.1	15.9	1.8	23.3	2.90	22.5	27
Other	565	27.2	24.3	21.3	16.2	1.9	18.4	2.8	18.4	2.60	38.8	17
Secondary Schools with P/T Ratios between 22 and 24[b]												
City	NA	23.2	27.7	24.6	40.3	5.1	13.5	3.9	29.5	2.37	51.5	58
Metro	NA	23.1	18.7	25.3	38.3	3.5	7.5	5.2	37.1	2.86	22.8	24
Other	981	23.0	18.6	26.4	31.2	3.3	9.5	3.0	25.7	2.60	36.8	18

[a] These other staff/pupil ratios are expressed in 10^4.

[b] These ranges approximate the average values for our sample shown in Table 5.

NA: Not Available.

large city schools, even among schools with the same pupil/classroom teacher ratio. Our economic status indexes again reconfirm the fact that pupils in metropolitan area schools have the highest economic status while those in large city schools have the lowest. It also appears that elementary schools in large cities allocate more of their educational staff to instructional activities, since the two largest supplemental staff categories are other instructional staff and teacher aides, while metropolitan and other area schools have other instructional staff, administrative staff, and clerks and secretaries as their three largest supplemental categories.

Different patterns exist for secondary schools with an average pupil/classroom teacher ratio of about 23. Thus, large city secondary schools appear to use more other instructional staff, more health staff, and more teacher aides than secondary schools in metropolitan or other areas. Likewise, secondary schools in metropolitan areas apparently use more clerks and secretaries, while other area secondary schools use fewer services supporting instructional staff.

Even though the pupil/classroom teacher ratios differ (23 for secondary versus 27 for elementary), the data in Table 7 reveal some striking differences in staffing patterns between elementary and secondary schools, regardless of location. Elementary schools tend to use relatively more other instructional staff, teacher aides, and health staff per pupil than secondary schools. On the other hand, secondary schools tend to use relatively more services supporting instructional staff, more library and health aides, and more clerks and secretaries than elementary schools. Surprisingly, both tend to use about the same number of administrative staff per pupil. The difference between elementary and secondary school staffing patterns can be best illustrated by a comparison between the different groups comprising the largest pupil/staff category for each. For elementary schools, this is other instructional staff, whereas for secondary schools, it is services supporting instructional staff. Clearly, these differences reflect the different types of educational services provided at these two levels.

The data contained in the staffing inventory questionnaire are sufficiently detailed to provide a thorough description of the differences among local school staffing mixes. The major deficiencies in these data, particularly the lack of financial data, create problems for analyzing the reasons for the observed staffing pattern differences. As we noted earlier, there are a number of reasons for these different staffing patterns due to the complexity of the allocation process for educational personnel resources. In order to understand that process, in Section IV we examine some alternative models for the allocation of educational resources within local public schools.

IV. MODELING THE RESOURCE ALLOCATION PROCESS WITHIN LOCAL PUBLIC SCHOOLS

Two fundamental problems confront any effort to model the resource allocation process within a local public school: First, there is little general agreement about the specific outputs of education or the educational services the school system provides its students; second, the objectives of the administrators allocating educational resources are not well defined. The two problems are not independent -- the inability to define either educational outputs or objectives led past research efforts to concentrate on inputs as proxy measures for both outputs and objectives. Moreover, because of these problems, a number of different models have been developed to explain staffing mixes used in local public schools.

THREE GENERAL BEHAVIORAL MODELS

We can group these models into three broad generic classes -- bureaucratic models, production (or output-oriented) models, and lexicographically ordered objectives models. These models differ primarily in the nature of the objectives of the school administrators. For the bureaucratic model, the administrator's objective is to expand his control over tangible resources to the maximum extent possible. In the production model, the administrator seeks to satisfy the needs of his students by providing as many of the critical educational services as possible. The lexicographic model differs from the others by assuming that the administrator's objectives are ordered lexicographically, regardless of whether the objectives are input- (resource) or output-oriented.

The bureaucratic and production models are familiar models borrowed from economic theory. The lexicographic model, also borrowed from economics, is less well known. Its application is suggested by comments in education literature such as the following:

> In arriving at their demand decision, districts forecast enrollment for each school and the district. Typically, each school, under staffing guidelines set by the district, indicated its estimate of its effective personnel demand

> to the central office . . . *The first priority for most schools and districts was to satisfy their requirement for regular classroom teachers* [italics added].*

This is similar to lexicographically ordered preferences, wherein each element in the objective function is uniquely ordered and pursued sequentially. In this case, no other type of educational staff would presumably be hired until the "requirement" for regular classroom teachers is met. Each of the three models is described more fully in Appendix B.

IMPLICATIONS OF THE MODELS

These models permit us to identify and separate conceptually the independent impacts of the complex of variables influencing the staffing mix in local public schools; they also provide some a priori expectations about the nature and direction of some of these independent relationships. The magnitude of the various relationships can be obtained only by testing particular forms of the models empirically, using detailed accurate data and appropriate statistical procedures. Many of the explicit hypotheses to be tested, however, are derived directly from our conceptual models.

In some cases, all three types of models generate similar expectations or hypotheses. For example, all three would predict that a change in priorities would alter the staffing mix toward those individual resources required to deliver the more preferred service. Likewise, an increase (decrease) in one of the additional constraints (e.g., the number of tenured teachers) would cause the mix of other staff per constrained resource (e.g., per classroom teacher) to decline (rise) if the constraint were binding.

In other cases, the models may indicate different hypotheses. This is especially true for the lexicographic model. The most obvious example is the relationship between the budget or resource constraint and the

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*Office of Education, U.S. Department of Health, Education, and Welfare, *The Education Professions 1971-72: An Annual Report on the People Who Serve Our Schools and Colleges -- 1971-72 -- as Required by the Education Professions Development Act*, Part I -- The Need for Teachers in Our Schools and Colleges, U.S. Government Printing Office, Washington, D.C., 1972, p. 33.

staffing mix at a local school. For the production and bureaucratic models, a change in the budget constraint causes a change in the utilization of all types of (variable) resources. The effect on staffing mix is indeterminate because this change need not be equally proportionate for all resources.

There is no similar indeterminacy for the lexicographic model, however. In this case, a change in the budget constraint results in a definite change in the staffing mix since, within certain limits, only one resource is affected. The change in the staffing mix depends only upon the direction and size of the budget change and the initial staffing mix.

A similar difference in expectations exists for changes in the resource trade-off ratios. Both the production and bureaucratic models would predict a negative relationship between the trade-off ratio for two particular resources and the staffing mix ratio for those same resources. For example, if the cost of classroom teachers increases while everything else remains the same, these models would predict increases in the number of other staff per classroom teacher. For the lexicographic model, however, a change in the trade-off ratio with no change in the effective budget level (i.e., a compensated price change in economic terminology) would have no effect on the staffing mix for the particular resources affected by the change (see Appendix B).

Because of these different a priori expectations, it is important to establish the validity of the lexicographic model for describing the resource allocation process within local public schools. Since the bureaucratic and the production models yield similar explicit hypotheses for testing, we need not distinguish between them to establish the basic determinants of school staffing mixes.

TESTING THE VALIDITY OF THE LEXICOGRAPHIC MODELS

In the remainder of this section we focus on the question: How valid is the lexicographic model for describing the resource allocation behavior of local school administrators? Although it is difficult to test directly for the validity of the lexicographic model, we can construct an indirect test using the NCES staffing data and the theoretical difference in administrative behavior given changes in the availability of educational personnel resources. The specific test involves a comparison of the frequency distributions of pupil/classroom teacher ratios for schools with and without certain categories of supplemental staff.

We can assume that part of the variation in pupil/classroom teacher ratios among schools is caused by budget differences. If school administrators have lexicographically ordered preferences commencing with the pupil/classroom teacher ratio, we would expect schools with limited financial resources to concentrate their resources on obtaining classroom teachers. Whether they reach their "target" level would depend on the total amount of resources available. Schools with various kinds of supplemental staff would have met their target level for their pupil/classroom teacher ratio. If classroom teachers are the first priority objective, and if the objectives are ordered lexicographically, we would expect to find the schools without various supplemental staff having a larger pupil/classroom teacher ratio than those with various kinds of supplemental staff. A simple test of averages is too restrictive because the target levels vary. This variation in targets can be overcome by comparing the frequency distribution of the pupil/classroom teacher ratio for schools with and without supplemental staff. If those frequency distributions for schools with supplemental staff are consistently distributed around a significantly lower pupil/classroom teacher ratio than those without supplemental staff, we could conclude that these data are consistent with behavior indicated by the lexicographic model.

Table 8 displays the chi-square values obtained in each of the 30 frequency distribution comparisons we were able to make. There were only seven cases in which the distributions were significantly different at the 10-percent confidence level.* Of these, there were four cases in which the distribution without supplemental staff implied a higher pupil/classroom teacher ratio than schools with supplemental staff: (1) services supporting instructional staff for large city elementary schools, (2) services supporting instructional staff for metropolitan area elementary schools, (3) health staff for large city secondary schools, and

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*These seven cases are shown graphically in Appendix C.

(4) library and health aides for large city secondary schools. In two cases there were lower pupil/classroom teacher ratios for schools without supplemental staff than for schools with this staff: teacher aides in metropolitan area secondary schools and clerks and secretaries in other area elementary schools. Finally, the frequency distribution for elementary schools in other areas without other instructional staff was bimodal, and was thus significantly different from the frequency distribution for those with other instructional staff.

Table 8

RESULTS OF CHI-SQUARE TEST OF DISTRIBUTIONS OF SCHOOLS WITH AND WITHOUT SUPPLEMENTAL STAFF, BY PUPIL/TEACHER RATIO INTERVALS

Supplemental Staff	Elementary Schools			Secondary Schools		
	City	Metro	Other	City	Metro	Other
OI	2.8271	1.8612	12.0485[a]	2.9070	6.0781	4.2879
ADM	NA	NA	NA	NA	NA	NA
SSIS	15.3316[a]	8.8478[a]	2.4692	NA	NA	NA
HS	5.9699	2.5514	4.9408	8.5758[a]	4.3772	1.9479
TA	4.8771	6.1593	3.6526	3.9041	14.8917[a]	3.1988
LA+HA	2.6735	5.8734	2.0538	14.5899[a]	2.6868	2.4211
CL+SEC	2.4771	3.9184	8.9209[a]	NA	NA	NA

NOTE: All values are based on four degrees of freedom.

NA: Not Available. The chi-square test is not appropriate because of insufficient frequencies and/or existence of cells with expected values of less than 1.

[a]Significant at the .10 level.

In summary, the evidence from these chi-square tests of the frequency distributions for schools with and without various supplemental staff does not support the validity of lexicographically ordered preferences commencing with the pupil/classroom teacher ratio. These simple tests are far from conclusive; nonetheless, they suggest that indiscriminate use of models implying lexicographically oriented behavior is unwarranted unless that assumed behavior is explicitly verified.

This tentative conclusion about the validity of the lexicographic model is quite important for an analysis of the differences in local school staffing mixes. Since the bureaucratic and production models imply similar administrative behavior in response to changes in total resource availabilities (i.e., budget changes) and in specific resource trade-off ratios, it is possible to use standard economic tools to analyze the response in the staffing mix to changes in these elements and to determine the magnitude of that response.

V. ANALYSIS OF LOCAL SCHOOL STAFFING MIXES

The bureaucratic and production models described in Section IV provide clear conceptual distinctions and consistent a priori expectations about the principal causes for differences in staffing patterns among local public schools. Our initial plan was to use multivariate regression analysis to determine the specific portion of the variation in staffing patterns attributable to differences in such factors as total budget, relative resource costs, student needs, scale, and constrained resources such as tenured teachers. The NCES data base, however, lacks data on the total value of the resources available to local schools (i.e., their budgets), the direct (or implied) costs of specific educational resources, various staff personnel, and the experience level or the tenure status of particular types of educational personnel. These data gaps preclude a rigorous empirical analysis of the determinants of local school staffing mixes.

In this section, we present results from a more basic series of statistical analyses involving simple correlations and chi-square tests for differences among frequency distributions to examine whether consistent relationships exist among particular staffing mixes within broad categories of local public schools. More specifically, we analyze the relationship between the pupil/classroom teacher ratio and the mix of other professional and nonprofessional staff for local public schools in terms of school characteristics, organization, location, enrollment size, and parental economic status.

Our exploratory analysis focuses on three fundamental questions:

1. Do particular staffing mixes vary consistently with the enrollment size of the school?
2. Are there significant differences in the staffing mix between "rich" and "poor" schools?
3. Do current staffing mix differences among local public schools provide any evidence of possible trade-offs (substitution) among specific types of professional and/or nonprofessional staff?

We discuss these questions in the remainder of this section.

EFFECTS OF ENROLLMENT SIZE ON SCHOOL STAFFING

The data from the NCES staffing inventory questionnaire permit some direct parametric tests of the effects of enrollment size on school staffing mix. Table 9 presents the simple correlation coefficients for the relationships between the enrollment size of the school, P, and three other variables, the pupil/classroom teacher ratio, P/T, the other types of staff/pupil ratios, X_j/P, and the mix of other staff per classroom teacher, X_j/T. A positive coefficient for the correlation P:P/T and negative coefficients for $P:X_j/P$ indicate that teachers and other staff increase less rapidly than enrollment size. These results would be consistent with potential economies of scale that are realized with schools of larger size.* These simple correlations indicate a positive relationship between the pupil/teacher ratio and the level of enrollment. The degree and significance of the correlations are greatest for secondary schools and for schools in nonmetropolitan areas. The presence of higher pupil/teacher ratios for schools with higher enrollments may imply the existence of scale efficiency factors with respect to classroom teachers. We would expect stronger correlations for secondary schools because these teachers would tend to be more specialized in subject areas and would therefore require a larger number of students to be fully utilized than would elementary teachers.

The increase in the strength of the relationship observed for schools in nonmetropolitan areas as opposed to those in large cities and metropolitan areas is not as easily explained. One possible explanation is that large city and metropolitan schools have higher pupil/classroom teacher ratios and higher average enrollment sizes than their counterparts in other areas (see Table 9). As a result, these schools may be sufficiently large to take full advantage of economies of scale. The second possible interpretation is that there are restrictive budget effects. That is, if larger schools in some areas face smaller budgets on a per pupil basis, we may expect larger pupil/classroom teacher ratios for these schools.

There are few consistent significant correlations between enrollment size and ratios of various staff per pupil for schools across all levels

*We must emphasize that consistency does not imply causality. Economies of scale may or may not explain these observed correlations; our point is merely that they are a viable candidate.

Table 9

CORRELATIONS BETWEEN STAFF RATIOS AND ENROLLMENT SIZE

(standard deviations in parentheses)

Correlation Variables	Elementary Schools			Secondary Schools		
	City	Metro	Other	City	Metro	Other
P/T:P	+.0893[a]	+.0222[a]	+.3211	+.1952	+.2505	+.3054
X_j/P:P						
OI	-.1353	-.1163[a]	.1156[a]	-.3075	-.2282	-.0542[a]
ADM	-.2349	-.3901	-.2669	-.1324	-.0418[a]	-.3301
SSIS	.0368[a]	.0225[a]	-.0115[a]	-.1189	-.0518[a]	.0116[a]
HS	-.1941	-.2233	-.1970	-.2795	-.1204[a]	.2256
TA	-.0699[a]	.0778[a]	.1321[a]	-.0426[a]	.0643[a]	-.2025
LA+HA	-.1347	-.0324	.1185	-.0169[a]	.0763[a]	-.0792[a]
CL+SEC	-.3490	.0572[a]	.0776[a]	-.1028	.1799	.3086
X_j/T:P						
OI	-.1222	-.0785[a]	.1381[a]	-.2630	-.1990	.0011[a]
ADM	-.2827	-.4168	-.2663	-.0775[a]	.0523[a]	-.2084
SSIS	.0365[a]	.0278[a]	.1606[a]	-.0256[a]	.0753[a]	.2076
HS	-.2052	-.2167	-.0704[a]	-.2694	-.0386[a]	.2433
TA	-.0765[a]	.0926[a]	.1636[a]	-.0164[a]	.1195[a]	-.1928
LA+HA	-.1264	-.0350[a]	.1030[a]	.0212[a]	.0887[a]	.0754[a]
CL SEC	-.3634	.0543	.1209[a]	.0137[a]	.2935	.4903
Average P/T	27.7	26.2	25.6	23.8[a]	23.1	21.7
	(4.8)	(4.6)	(6.1)	(3.7)	(5.0)	(4.8)
Average P	679	542	401	1563	1418	847
	(348)	(273)	(244)	(800)	(857)	(539)

[a]Insignificant at the .05 level.

and locations. The exception is the ratio for administrative staff per pupil. This ratio exhibits a significant negative correlation in every case except in secondary schools in metropolitan areas, although even here the insignificant correlation is negative.

Organization level is also important in distinguishing significant consistent patterns between enrollment size and staffing. For example, there is a significant negative correlation between health staff per pupil and enrollment size for all three elementary strata, but for secondary schools, the correlation is significantly negative for large city schools and significantly positive for schools in other areas. Likewise, there is a significant negative correlation between other instructional staff per pupil and enrollment size for secondary schools in large city and metropolitan areas, but only elementary schools in large city areas have a significant negative correlation. In fact, there is a positive, albeit insignificant, relationship between other instructional staff per pupil and enrollment size for elementary schools in other areas.

The use of clerks and secretaries, however, tends to vary systematically according to location. As the data in Table 9 indicate, the number of clerks and secretaries per pupil are positively correlated with enrollment size for all metropolitan and other area schools. Although only secondary schools have significant correlations, they are negatively and significantly correlated for elementary and secondary schools in large cities.

The correlations between various types of other staff per classroom teacher and enrollment size indicate how staffing mixes vary as school enrollment size increases. We can compare the two extremes -- elementary schools in large cities and secondary schools in other areas -- to determine the range of differences in staffing mixes as enrollments grow. For elementary schools in large cities, all correlations between the staff per classroom teacher and enrollment size are negative, except for five significant correlations for services supporting instructional staff, whereas for secondary schools in other areas only the correlations between administrators per teacher and teacher aides per teacher and enrollment size were negative and significant. The remaining five correlations are positive, with significant ratios for services supporting instructional staff, health staff, and clerks and secretaries per teacher. Obviously, the changes in the staffing mix as enrollment increases are substantially different between these two types of schools: Elementary schools in large cities tend to enrich their classroom teacher mix as enrollment increases, while secondary schools in other areas tend to enrich their mix of other types of staff relative to classroom teachers.

POVERTY-AREA SCHOOLS AND STAFFING MIX

In the previous discussion we observed that the change in staffing mixes as enrollment increases depends upon the level and the location of the school. We now extend that analysis further by examining the correlations between staff per classroom teacher and enrollment size for large city schools located in poverty areas. The implications for the impact of compensatory education on the allocation of educational personnel resources within local schools derived from this analysis are reinforced by additional correlation analyses between the parental economic status of enrolled pupils and staffing mixes at those local schools.

The data in Table 10 indicate differences in the changes in both the pupil/classroom teacher ratio and the staff/teacher ratios as enrollment increases for large city schools in poverty areas relative to those in nonpoverty areas. For elementary and secondary schools in poverty areas, larger schools have significantly higher pupil/classroom teacher ratios, but this does not hold for nonpoverty-area schools. Poverty-area secondary schools also have significantly fewer administrative staff per classroom teacher in larger schools, but this does not hold for secondary schools outside poverty areas.

Table 10

CORRELATIONS BETWEEN STAFFING MIX RATIOS AND ENROLLMENT SIZE, LARGE CITY POVERTY AND NONPOVERTY SCHOOLS

Correlation Variable	Elementary Schools			Secondary Schools		
	Poverty	Nonpoverty	All[a]	Poverty	Nonpoverty	All[a]
P/T:P	.2260	-.0018[b]	.0893[b]	.2707	.0582[b]	.1952
X_j/T:P						
OI	-.1966	-.0712[b]	-.1222	-.2618	-.2726	-.2630
ADM	-.3846	-.2121	-.2827	-.2571	.0425[b]	-.0775[b]
SSIS	-.0395[b]	.1656	.0365[b]	.1666[b]	.1145[b]	-.0256[b]
HS	-.1994	-.1319[b]	-.2052	-.2469	-.2285	-.2624
TA	-.1788	.1438	-.0765[b]	-.1160[b]	.1039[b]	-.0164[b]
LA+HA	-.2164	-.0354[b]	-.1264	.0315[b]	.0040[b]	.0212[b]
CL+SEC	-.3727	-.2756	-.3634	-.1628[b]	.0682[b]	.0137[b]
(N)	101	134	294	81	138	273

[a]Totals are from Table 9. Total sample exceeds poverty/nonpoverty components because some large city schools lack a census poverty/nonpoverty designation.

[b]Insignificant at the .05 level.

The most significant differences in staff ratios relative to enrollment size occur for elementary schools. Elementary schools in poverty areas have lower staff/classroom teacher ratios in larger schools for all seven staff categories, with the exception of the services supporting instructional staff category, which is insignificant. For nonpoverty-area elementary schools, on the other hand, there are significantly lower staff/classroom teacher ratios in larger schools for only two staff categories: administrative staff and clerks and secretaries. Moreover, for these schools, there are significantly larger staff/classroom teacher ratios in larger schools for both services supporting instructional staff and teacher aides. Within poverty-area elementary schools, larger schools have significantly fewer educational personnel resources per student for all types of personnel (except services supporting instructional staff) than smaller schools, but outside poverty areas the distribution of personnel resources per student is not uniformly in favor of smaller schools. Clearly, children attending elementary schools in poverty areas in large cities obtain more staff inputs per student if they attend a smaller school.

Although these correlation analyses provide an important insight into the uneven distribution of educational staff resources per pupil among poverty-area elementary schools of different size, they do not address the fundamental compensatory education issue concerning the distribution of resources between pupils from families of different economic status. Table 11 presents the average pupil/classroom teacher ratio and the average staff/classroom teacher ratios for these large city elementary schools in poverty and nonpoverty areas. The average enrollment and pupil/classroom teacher ratio is about the same for these poverty- and nonpoverty-area elementary schools. However, poverty-area elementary schools appear to have higher proportions of supplementary staff relative to classroom teachers than do their nonpoverty counterparts. This difference is greatest for teacher aides, where there is a differential of more than 4 to 1, and for other instructional staff, where poverty-area schools have about twice as many of these staff members per teacher as nonpoverty-area schools. This, together with the apparent similarity in average pupil/classroom teacher ratios, implies that compensatory education has resulted in a redistribution of educational personnel resources toward poverty-area schools. Moreover, as our previous correlation analysis indicated, compensatory staffing appears to be greatest for the smaller schools.

Table 11

VARIABLES FOR PUPILS IN LARGE CITY ELEMENTARY SCHOOLS, POVERTY AND NONPOVERTY AREAS

Variables	Poverty-Area Schools	Nonpoverty-area Schools	Aggregate
Average X_j/T:			
OI	.1230	.0682	.0946
ADM	.0771	.0635	.0689
SSIS	.0666	.0474	.0535
HS	.0214	.0214	.0230
TA	.2030	.0437	.1131
LA+HA	.0118	.0079	.0096
CL+SEC	.0660	.0594	.0638
Correlation			
P/T:P	.2260	-.0018[a]	.0893[a]
Average P	716	700	679
Average P/T	27.7	27.7	27.7
I_2	1.7	2.7	2.3
(N)	101	134	294

[a]Insignificant at the .05 level.

Although the average parental economic status of pupils enrolled in poverty-area elementary schools is substantially lower than for those enrolled in nonpoverty-area elementary schools, it is important to distinguish poverty-area schools, defined by location in census poverty tracts, from poor schools, defined by the relative parental economic status of enrolled pupils. Despite the consistency of the means for elementary schools in large cities, the two definitions can produce somewhat different classes of poverty schools for the entire sample. Table 12 compares the distribution of poverty schools obtained by the location measure, with the distribution of poor schools, where a poor school has an I_3 index greater than 50 percent. If the two indexes produced similar classifications, we would observe few poor schools in nonpoverty areas, and few wealthy schools in poverty areas. As Table 12 indicates, there are few wealthy schools in poverty areas in large cities. However, there are substantial numbers of poor schools in nonpoverty areas. In fact, for elementary schools, more than one-half the poor schools in large cities are not in poverty areas. Clearly, if the critical target population of compensatory programs were *disadvantaged (poor) students* rather than *poverty-area schools*, our previous conclusions about the impact of such programs are suspect unless they are supported by results using the I_2 or I_3 poverty index.

Table 12

COMPARISON OF POVERTY INDEXES
(percent)

Index	Elementary Schools		Secondary Schools	
	Poverty	Nonpoverty	Poverty	Nonpoverty
$I_3 > 50$	26.1	26.5	27.2	22.0
$I_3 < 50$	21.0	45.3	4.4	46.5

Table 13 presents results of our correlation analyses between the wealth index, I_2, and various staffing mixes and staff/pupil ratios. The significant positive correlation between the wealth index and enrollment size for all secondary schools indicates that poor students attend smaller secondary schools. At the elementary level, on the other hand, the significant negative correlation for large city schools indicates that poor students attend larger elementary schools at least in the large cities.

One direct measure of a reallocation of classroom teachers toward poor students would be a positive correlation between our wealth index, I_2, and the pupil/classroom teacher ratio. Our data indicate that a significant positive correlation exists, but only for students in large city schools. Since most compensatory education funding has been concentrated in urban-area schools, it would appear that, at least in large cities, compensatory programs have been effective in increasing the classroom teacher/pupil ratios for economically disadvantaged pupils.

Table 13

CORRELATIONS BETWEEN POVERTY INDEXES AND ENROLLMENT AND STAFFING MIX RATIOS

Correlation Variables	Elementary Schools			Secondary Schools		
	City	Metro	Other	City	Metro	Other
I_2:P	-.1519	.1014[a]	.1301[a]	.1774	.2392	.3300
I_2:P/T	.1654	-.0027[a]	.0251[a]	.2995	-.0325[a]	-.0736[a]
I_2:X_j/P						
OI	-.2436	-.1119[a]	-.2882	-.3392	-.0661[a]	-.1910
ADM	-.2097	-.1260[a]	-.0828[a]	-.3090	-.1490[a]	-.1007[a]
SSIS	-.2722	-.1066[a]	-.0091[a]	-.2888	.1019[a]	.1268[a]
HS	-.0985	-.0406[a]	.0136[a]	-.2278	.2168	-.1141[a]
TA	-.4253	-.1782	-.3302	-.2582	-.0890[a]	-.4013
LA+HA	-.1465	-.2681	-.2213	-.1113	-.0449[a]	-.0978[a]
CL+SEC	-.1638	-.0539[a]	-.0403[a]	-.1813	.0656[a]	.1821[a]
I_2:X_j/T						
OI	-.2193	-.0330[a]	-.2682	-.3132	-.0598[a]	-.2033
ADM	-.1365	-.1164[a]	-.1049[a]	-.2718	-.1891	-.2407
SSIS	-.2369	-.1166[a]	.0520[a]	-.2426	.1066[a]	.1609[a]
HS	-.0540[a]	-.0415[a]	.0592[a]	-.1948	.2616	-.1453[a]
TA	-.4088	-.1608	-.3140	-.2436	-.0851[a]	-.3947
LA+HA	-.1350	-.2444	-.2409	-.0941[a]	-.0687[a]	-.1310[a]
CL+SEC	-.0781[a]	-.0419[a]	-.0368[a]	-.0756[a]	.0586[a]	.2090

[a]Insignificant at the .05 level.

The other correlations in Table 13 between I_2 and either staffing mix ratios or other educational staff per pupil ratios reinforce our tentative conclusion that compensatory programs have affected the level and mix of educational staff inputs received by poor students. For both these simple correlations, a negative relationship indicates that poor students (low I_2) receive more educational staff inputs per student (higher X_j/P) or obtain more other educational staff per classroom teacher (high X_j/T) than wealthier students. As the data indicate, both sets of correlations are consistently negative for large city elementary and secondary schools. Moreover, the negative correlations between I_2 and the various staff/pupil ratios are significant for every type of educational staff in large city schools. Furthermore, the consistent negative correlations between the wealth index, I_2, and the various staff/classroom teacher ratios indicate that poor students in large city schools also receive a richer mix of educational personnel. Finally, although the pattern of significant negative correlations is not as pervasive outside large city schools, a significant positive correlation occurs in only two cases -- the mix of health staff per teacher and the ratio of health staff per student in metropolitan-area secondary schools. For other area schools, poor students receive significantly more other instructional staff and teacher aides per student, in addition to a richer mix of these staff per classroom teacher than wealthier students.

A compensatory reallocation of educational personnel resources toward poor students is least in metropolitan-area schools, but even here poor elementary students receive significantly more teacher aides, library and health aides per student, and a richer mix of these personnel per classroom teacher than wealthier students.

SUBSTITUTION POSSIBILITIES AMONG DIFFERENT EDUCATIONAL STAFF

The final issue addressed in our empirical analysis was whether differences in school staffing patterns reflected differences in trade-off or substitution possibilities among different types of educational staff and/or the extent to which local schools utilized such trade-off potential. Our approach on the issue of substitution between regular classroom teachers and other staff involved analyzing the correlations between pupil/classroom teacher ratio and the ratio of various other staff per classroom teacher, designated X_j/T. A positive correlation between the pupil/teacher ratio and the number of j-type educational staff per classroom teacher would be consistent with the possibility of substitution between classroom teachers and the j-type of educational personnel.

These correlations are not sufficient evidence, however, to conclude that substitution between classroom teachers and other educational personnel exists in any great detail. For example, a positive correlation between the pupil/teacher ratio and the staff mix between other instructional staff would be consistent with the substitution hypothesis and other hypotheses. Two possibilities are differential scale and budget effects. Our previous analysis indicates that larger schools tend to have larger pupil/teacher ratios. If these larger schools have about the same other instructional staff per pupil (i.e., if there were no corresponding scale economies for other instructors) we would observe a positive correlation between P/T and X_j/T. Alternatively, if all schools buy proportionately more teachers than other instructional staff as their budgets increase, and if the wealthier schools have lower pupil/teacher ratios, the positive correlation between P/T and X_j/T would reflect only wealth differences among the schools in the sample. In summary, without explicit controls for budget differences, enrollment level differences, and differences in the mix of educational services provided among the schools in our sample, we cannot distinguish substitution effects from other explanatory effects.

Although this is a serious deficiency in our correlation analysis, the analysis can still provide some useful insights. First, positive correlations will indicate which other types of educational staff are potentially substitutable for classroom teachers. Second, we can use alternative analysis to eliminate some of the explanatory effects currently indistinguishable from substitution effects. Thus, we can use the behavior of staffing mix relative to enrollment size to determine whether differential scale effects are consistent with the observed correlation. Finally, we can examine the results for consistent and significant differences among different schools of different level, location, or poverty status.

Table 14 summarizes the correlations obtained between the pupil/classroom teacher ratio and the ratios of seven categories of other educational staff per classroom teacher.

Results for Other Instructional Staff, Clerks and Secretaries

Only two of the seven staff categories consistently have significant positive correlations. The positive correlation between the pupil/classroom teacher ratio and the mix of other instructional staff per classroom teacher is significant for all levels and locations except secondary schools in large cities and metropolitan areas. Although the correlation between pupil/classroom teacher ratio and the number of clerks and secretaries per classroom teacher is also positive in all six subsamples, it is significant only for large city elementary and secondary schools and for elementary schools in other areas. The same positive correlation is

Table 14

CORRELATIONS BETWEEN THE PUPIL/CLASSROOM TEACHER AND STAFFING MIX RATIOS

Correlation Variables	Elementary Schools			Secondary Schools		
	City	Metro	Other	City	Metro	Other
Total Sample[a]						
$P/T:X_j/T$						
OI	.1043	.3385	.2425	.0597	.1022[b]	.4737
ADM	-.0479[b]	.1867	-.0660[b]	-.2875	.0867[b]	.0963[b]
SSIS	-.1537	-.1317[b]	.0247[b]	-.1365	-.0930[b]	-.0165[b]
HS	-.1440	-.0736[b]	-.1049[b]	-.1533	-.2226	.1034[b]
TA	-.0017[b]	-.1494	.0682[b]	-.0573[b]	.1503[b]	.1957
LA+HA	-.0142[b]	-.1767	.2610	-.0114[b]	-.0746[b]	-.2156
CL+SEC	-.1055	.0693[b]	.2719	.1187	.1001[b]	.0061[b]
Subsamples[c]						
$P/T:X_j/T$						
OI	.1273	.3677	.2031[b]	.0606[b]	.1482[b]	.5411
ADM	-.0479[b]	.1867	-.2092	-.2830	.0867[b]	.0903[b]
SSIS	-.1061[b]	-.0587[b]	.0735[b]	-.1252	-.0415[b]	.0252[b]
HS	-.1156[b]	-.1033[b]	-.1520[b]	-.1010[b]	-.2023	-.0428[b]
TA	-.0010[b]	-.1597[b]	-.0978[b]	-.0990[b]	.1516[b]	.3370[b]
LA+HA	.1103[b]	.1270[b]	.4950	-.1410	.0354[b]	-.3014[b]
CL+SEC	.1146	.1256[b]	.2139[b]	.1263	.1369[b]	.0851[b]

[a]Correlations based on the total sample of schools.

[b]Insignificant at the .05 level.

[c]Correlations for each staff category based on a subsample containing schools with at least one member of the staff type.

maintained even when the schools without other instructors or clerks and secretaries are excluded from the sample. In this case, however, the significance of the correlations diminishes, in part because of the smaller sample sizes. For example, the positive correlations for other area elementary schools are no longer significant either for other instructional personnel or for clerks and secretaries.

Intuitively, we would expect other instructional staff to be most directly substitutable for classroom teachers, and the observed positive correlations certainly support this expectation. Moreover, our previous scale analyses (Table 9) indicated that the mix of other instructional staff to classroom teacher tended to decrease with enrollment size, thereby eliminating differential scale effects as an explanation for the positive correlation. While not conclusive, this positive correlation is consistent with possible substitution between other instructional staff and classroom teachers.

Although the substitution potential between classroom teachers and clerks and secretaries may not be as obvious, it is possible that clerks relieve classroom teachers of administrative tasks, thus allowing teachers additional time to provide instruction or other direct educational services. For clerks and secretaries, however, it is possible that differential scale effects may be partly responsible for the positive correlation, since the ratio of clerks and secretaries to classroom teachers is positively and significantly correlated with enrollment size in three of the six subsamples shown in Table 9. But Table 9 also indicates a significant negative correlation for large city elementary schools and an insignificant correlation for large city secondary and other area elementary schools -- the three cases in which the positive correlation between the pupil/classroom teacher ratio and the mix of clerks and secretaries per classroom teacher was most significant. Thus, scale differentials do not explain the entire story, and substitution still remains a viable possibility.

Results for Health and Services Supporting Instructional Staff

Two of the staffing category correlations in Table 14 manifest a pattern of significant negative correlations. These are health staff, with three of six significant negative correlations, and services supporting instructional staff, with only two significant and three insignificant negative correlations. These negative correlations are consistent with dominant budget effects. Thus, if poor schools have high pupil/classroom teacher ratios, they are also less likely to have additional supporting staff members, especially those who provide only indirect educational support. It is particularly interesting that these significant negative correlations, indicative of the dominance of budget effects, occur consistently in large city schools. Indeed, there is only one significant negative correlation for services supporting instructional staff and health staff outside large city schools, and that occurs for health staff in metropolitan area secondary schools. As expected, the correlations for only those with at least one member of the specific staff group tend to be less significant.

Results for Other Types of Staff

None of the other three types of staff manifested any consistent pattern in their correlations with the pupil/classroom teacher ratio. This was surprising because we expected to observe a strong negative correlation for administrators and library and health aides. Our scale analysis (Table 9) showed that as enrollment increases, the mix of administrators per classroom teachers tended to decrease. This differential scale effect should have produced a negative correlation between the pupil/classroom teacher ratio and the ratio of administrative staff per classroom teacher. The lack of such a negative correlation indicates that some other effect, either a differential budget effect that favors classroom teachers relative to administrators or possible substitution between administrators and classroom teachers, is present in sufficient strength to offset the expected scale effect. Our expectation of a negative correlation for the mix of health and library aides per teacher and the pupil/classroom teacher ratio was based on anticipated wealth differences, since these staff personnel, like health and services supporting instructional staff, provide only indirect educational support.

Results for Teacher Aides

The mixed results for teacher aides may be due to two offsetting effects. On the one hand, teacher aides may be good substitutes for classroom teachers, relieving them of many of the mundane instructional tasks (e.g., grading papers). If this effect predominates, one would expect to observe a positive correlation between the pupil/classroom teacher ratio and the teacher aide/classroom teacher ratio. On the other hand, teacher aides may be viewed as supplemental resources to augment and improve the delivery of educational services in the classroom. If this were true, one would expect wealthier schools to have a higher teacher aide/classroom teacher mix than poor schools, and this would be consistent with a negative correlation between these two ratios. We can dismiss differential scale effects since our scale analysis indicated only one significant correlation between the teacher aide/classroom teacher mix and enrollment size.*

Only two significant correlations were obtained between the teacher aide/classroom teacher ratio and the pupil/classroom teacher ratio. For elementary schools in metropolitan areas we obtained a significant *negative* correlation, consistent with a dominant budget or wealth effect. For secondary schools in other areas we obtained a significant *positive* correlation. In both instances, however, the correlations become insignificant when those schools without any teacher aides are excluded. This is particularly interesting for the negative correlation since it implies that those schools without any teacher aides have higher pupil/teacher ratios on the average than those with aides, thus reenforcing the dominant budget effect interpretation.

Differences by Level and by Location

The correlations shown in Table 14 can also be compared by school level and by location. Some differences are apparent. For example, elementary schools have more significant positive correlations between the pupil/classroom teacher ratio and the other instructional staff per classroom teacher mix than do secondary schools. The same difference also applies to the positive correlations obtained for clerks and secretaries. If our substitution hypothesis were correct, these results would suggest greater substitution possibilities at the elementary level for these types of staff members.

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*The one significant correlation was negative for secondary schools in other areas.

VI. CONCLUSIONS

Although our analysis of staffing data from the NCES School Staffing Survey (staffing inventory questionnaire, Form X) indicates the importance of distinguishing classroom teachers from other types of teaching staff and of examining the mix of educational staff for schools of different level, location, and economic status, there are serious data gaps that prevent a complete and thorough test of the various explanations for the observed staff patterns. The most critical gaps are the lack of relative costs for different educational staff and the absence of total budget or resource levels available to the specific school. Consequently, we resort to some simple exploratory analyses.

Our exploratory analysis of staffing patterns focuses on four major questions:

1. How valid is the lexicographic model for describing resource allocation behavior of local school administrators?
2. Do staffing patterns vary significantly with a school's enrollment size?
3. Do "poor" schools have different staffing patterns than "rich" schools?
4. Can we identify which types of staff are mutually substitutable?

VALIDITY OF THE LEXICOGRAPHIC MODELS

Our theoretical analysis demonstrates that the lexicographic models generate substantially different hypotheses about the local school administrator's responses to either a change in his budget or resource constraint or a change in his trade-off ratio between different resources than the bureaucratic or production models. Since the hypotheses derived from the other two types of models are basically the same, it is important to determine the validity of the lexicographic model. We compare the pupil/classroom teacher ratio frequency distributions for schools with and without various types of supplemental educational staff. If the lexicographic model were accurate, we would observe significantly different distributions, with the schools without supplemental staff having a distribution lying to the right.* Using chi-square tests to determine the statistical significance of the observed differences we find that:

- Of the thirty cases tested, only seven have significantly different pupil/regular teacher ratio frequency distributions, and
- Of these seven, only four are in the expected direction.*

These findings provide little support for the accuracy of the lexicographic type of behavioral models.

SCALE AND STAFFING PATTERNS

We examine the correlations of pupil/classroom teacher ratios (P/T) and compare other staff per pupil ratios (X_j/T) to enrollment size (P) in order to identify potential economies of scale. A positive correlation between P/T and P or a negative correlation between X_j/P and P would be consistent with potential scale economies for the specific staff category. Our principal results are:

- Larger schools have significantly larger pupil/teacher ratios at all levels and locations except elementary schools in large cities and metropolitan areas.
- These negative correlations between classroom teachers and enrollment size are more frequent for secondary schools.
- Larger schools also have significantly lower administrator/pupil and health staff/pupil ratios.
- Larger schools outside large cities tend to have more clerks and secretaries per pupil and this correlation is significant for secondary schools.
- Larger schools have significantly lower staffing mix ratios of administrators and health staff relative to regular classroom teachers.

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*That is, higher pupil/classroom teachers ratios for schools without supplemental staff.

- In all secondary schools in large cities and metropolitan areas, larger schools have significantly lower staffing mix ratios of other instructional staff per teacher.

POVERTY/NONPOVERTY DIFFERENTIALS

We compare staffing patterns for poverty and nonpoverty schools to determine whether various compensatory programs have any influence on levels of staff or staffing mixes. Two criteria, school location and the estimated parental economic status of enrolled pupils, are used to dichotomize the sample.

For the poverty/nonpoverty locational dichotomy, our principal results are:

- Large schools in poverty areas have significantly higher pupil/classroom teacher ratios, but this does not apply in nonpoverty areas.
- Large schools in poverty areas have lower nonclassroom teacher to classroom teacher staffing mixes for all staff categories except administrators than small schools; but in nonpoverty areas, large schools have higher staffing mix ratios for services supporting instructional staff and teacher aides and lower staffing mix ratios for administrators and clerks and secretaries than small schools.
- Poverty-area schools have about the same pupil/classroom teacher ratio as nonpoverty-area schools but appear to have greater ratios for other educational staff per pupil.
- Consequently, children attending a poverty-area school are better off (in terms of staff inputs per pupil) in a small school, whereas if they attend a nonpoverty-area school they are better off (in terms of teacher aides and services supporting instructional staff) in a large school.
- On the average, poverty-area schools are better off (in terms of other educational staff inputs per pupil) than nonpoverty schools, which suggests that compensatory programs have had some impact on relative input levels.

- This compensatory program is not uniform among all poverty-area schools but has a greater effect on smaller schools.

Our results for the parental economic status of pupils support our conclusion concerning the positive impact of compensatory programs. In examining the correlations between the wealth index and enrollment size and staffing mix ratios, we find that for elementary schools in large cities:

- Pupils from lower economic backgrounds attend larger schools.
- They face lower pupil/classroom teacher ratios.
- They obtain larger other educational staff inputs per pupil.
- They face higher staffing mix ratios of other staff per classroom teacher for all staff categories except health staff and clerks and secretaries.
- These same differences are not significant for either elementary or secondary schools outside large cities.
- These differences apply to large city secondary schools with one exception -- pupils from lower economic backgrounds attend smaller secondary schools.

POTENTIAL SUBSTITUTION AMONG EDUCATIONAL STAFF

Although our correlation analyses of pupil/teacher ratios and various staffing mix ratios are intended to determine whether substitution among various educational staff is occurring, we are limited by a lack of data on resource (budget) levels and relative price differentials among schools in the sample.

For classroom teachers our correlation analyses suggest:

- Substitution possibilities are most apparent for other instructional staff and for clerks and secretaries.
- Substitution possibilities are least apparent for health staff and for services supporting instructional staff.
- The substitution possibilities for other instructional staff and for clerks and secretaries appear more significant for

elementary than secondary schools, but the implications for health staff and services supporting instructional staff do not differ significantly by level.

- The implications for health staff and services supporting instructional staff are significant for large city schools.

FUTURE NEEDS

While many of these preliminary results are suggestive, they are not conclusive explanations for the differences in staffing patterns observed in our sample. Our theoretical models, at least the bureaucratic and production models, generated some specific hypotheses concerning the nature of the relationships between the staffing mix and these various explanations. If financial data on relative resource costs and total resource (budget) levels had been available, we would have been able to test our candidate explanations simultaneously with multiple regression techniques to determine the independent effects of each. This would be the next step once the data gaps are eliminated.

Appendix A

AVERAGE STAFF/PUPIL RATIOS, BY PUPIL/CLASSROOM TEACHER INTERVALS
(Staff Ratio Values in 10^4)

Table 15

ELEMENTARY SCHOOLS IN LARGE CITIES

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	LA+NA	CL+SEC	I_2	I_3	(N)
<18	868	16.2	43.8	59.8	49.7	25.3	138.0	0	37.7	1.45	58.1	8
18–20	824	18.9	37.4	28.4	49.8	14.7	70.1	7.4	34.2	1.91	72.2	8
20–22	563	21.0	54.0	35.1	26.7	14.5	70.6	13.6	32.9	1.85	71.1	14
22–24	590	23.0	30.1	30.1	22.9	12.1	31.8	1.1	24.1	2.25	55.4	25
24–26	561	25.2	46.5	29.7	25.1	9.8	56.0	5.1	27.4	2.36	51.4	44
26–28	665	27.0	31.1	24.7	18.9	8.5	30.9	2.1	21.6	2.35	51.7	61
28–30	765	28.8	27.5	22.1	16.9	5.8	41.5	4.2	21.0	2.30	53.0	48
30–32	693	30.9	30.2	21.9	14.5	6.8	31.6	1.1	21.3	2.56	37.1	39
32–34	698	32.5	21.1	19.8	15.5	5.9	23.6	5.2	19.5	2.44	42.3	22
34–36	765	34.9	30.8	19.5	15.5	5.2	27.2	2.5	20.1	2.22	53.4	8
36–38	664	36.7	28.0	21.3	12.3	5.6	14.8	6.0	20.5	2.54	41.8	9
≥38	869	40.7	76.2	18.1	9.4	7.0	83.8	0	21.5	1.84	76.9	8

Table 16

ELEMENTARY SCHOOLS IN METROPOLITAN SURROUNDING AREAS

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	LA+HA	CL+SEC	I_2	I_3	(N)
<18	546	16.6	7.2	38.9	9.6	31.2	9.6	0	33.6	3.17	27.5	2
18-20	655	19.0	57.6	20.8	32.5	12.4	112.8	14.2	28.8	2.77	28.8	4
20-22	531	21.1	15.0	28.1	20.8	7.7	11.2	2.1	25.7	2.72	31.5	14
22-24	562	23.2	44.1	28.8	22.4	12.9	14.3	4.9	32.7	2.70	31.2	22
24-26	411	25.2	19.4	24.4	13.4	10.0	3.7	0	14.5	2.61	35.2	17
26-28	591	27.0	33.2	21.2	10.3	7.1	15.9	1.8	23.3	2.90	22.5	27
28-30	534	29.1	27.2	25.3	7.1	7.5	5.1	0	22.5	2.74	26.9	14
30-32	546	30.8	6.3	25.3	17.6	4.4	2.5	1.6	16.7	2.69	31.5	8
32-34	440	32.2	59.7	33.4	4.1	7.0	23.0	0	17.2	2.69	26.3	3
34-36	577	35.2	47.1	17.6	11.4	2.4	5.3	0	10.8	2.70	33.7	3
36-38	612	37.6	15.4	16.9	6.8	10.2	0	0	16.9	1.83	69.5	2
≥38	643	39.5	170.7	21.8	10.2	8.6	4.9	0	30.1	3.35	50.0	3

Table 17

ELEMENTARY SCHOOLS IN OTHER AREAS

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	HA+LA	CL+SEC	I_2	I_3	(N)
<18	184	14.1	16.0	58.9	26.8	17.6	7.4	2.4	19.8	2.27	58.2	10
18–20	92	18.7	27.8	46.2	22.5	7.2	92.6	0	0	2.19	48.5	2
20–22	157	21.8	12.7	12.7	12.7	15.3	0	0	0	2.85	40.0	1
22–24	424	23.0	23.6	28.3	8.4	15.6	26.9	3.6	14.7	2.70	32.8	13
24–26	391	25.3	29.9	30.6	12.0	7.4	32.5	6.4	22.9	2.59	36.4	18
26–28	565	27.2	24.3	21.3	16.2	1.9	18.4	2.8	18.4	2.60	38.8	17
28–30	396	29.2	6.1	29.4	8.4	5.8	17.2	2.4	16.6	2.77	28.5	8
30–32	414	30.7	33.1	20.6	11.3	4.6	33.7	5.1	20.6	2.27	55.9	8
32–34	235	33.6	0	42.6	42.6	21.3	0	0	42.6	2.30	55.0	1
34–36	534	34.8	19.5	13.8	18.8	5.5	17.5	0	18.8	2.49	41.5	2
36–38	525	37.5	41.9	19.1	0	13.3	38.1	19.1	19.1	2.90	20.0	1
≥38	310	43.8	61.1	12.8	0	0	0	13.2	20.8	2.16	55.0	2

Table 18

SECONDARY SCHOOLS IN LARGE CITIES

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	LA+HA	CL+SEC	I_2	I_3	(N)
<18	NC	16.1	39.6	59.0	83.3	11.1	11.1	3.7	52.9	1.97	69.8	19
18-20	NC	18.9	36.0	43.4	56.5	8.7	38.8	3.8	37.2	1.93	62.4	22
20-22	NC	21.1	27.8	37.9	48.1	5.6	13.6	3.6	34.0	2.52	42.7	38
22-24	NC	23.2	27.7	24.6	40.3	5.1	13.5	3.9	29.5	2.37	51.5	58
24-26	NC	25.0	20.8	23.5	36.6	4.5	9.7	1.4	28.8	2.48	40.7	58
26-28	NC	27.0	24.0	21.7	34.0	4.4	6.2	1.6	31.0	2.76	30.8	46
28-30	NC	28.8	34.1	22.9	37.5	3.2	14.8	4.1	27.1	2.36	54.3	20
30-32	NC	30.7	22.0	17.9	33.0	1.9	14.7	3.2	34.7	2.92	24.7	10
32-34	NC	38.3	14.1	14.1	30.1	0	4.7	0	51.7	2.41	48.0	1
34-36	NC	34.3	72.3	27.1	47.9	13.6	0	0	36.1	1.80	80.0	1
36-38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
≥38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA: Not Available.
NC: Not Calculated.

Table 19

SECONDARY SCHOOLS IN METROPOLITAN SURROUNDING AREAS

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	LA+HA	CL+SEC	I_2	I_3	(N)
<18	NC	16.1	20.7	44.5	57.8	12.0	11.5	5.5	56.4	2.79	24.9	12
18-20	NC	19.0	21.2	26.1	41.1	5.8	8.9	3.7	35.0	2.75	28.3	16
20-22	NC	21.0	21.7	28.4	41.5	4.2	1.4	4.9	34.2	2.96	21.5	22
22-24	NC	23.1	18.7	25.3	38.3	3.5	7.5	5.2	37.1	2.86	22.8	24
24-26	NC	25.0	22.3	24.2	34.7	2.0	7.8	4.7	27.2	2.50	38.8	19
26-28	NC	26.7	20.7	22.3	31.0	2.4	7.6	3.2	34.5	2.83	26.6	10
28-30	NC	28.5	21.9	24.7	47.5	2.2	15.9	3.1	26.8	3.05	17.6	5
30-32	NC	31.1	26.0	23.7	14.3	1.4	15.7	3.2	27.6	2.43	48.8	4
32-34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34-36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
36-38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
≥38	NC	43.0	9.1	17.6	14.8	2.9	4.9	0	25.3	2.90	17.0	3

NA: Not Available.
NC: Not Calculated.

Table 20

SECONDARY SCHOOLS IN OTHER AREAS

Intervals	Average Variables		Average Supplementary Staff Ratios							Average Indexes		
P/T	P	P/T	OI	ADM	SSIS	HS	TA	LA+HA	CL+SEC	I_2	I_3	(N)
<18	611	15.0	20.2	50.5	46.8	3.8	7.9	7.6	36.6	2.61	38.7	16
18–20	714	19.2	17.4	27.1	40.7	6.8	5.7	10.3	33.4	2.63	37.6	7
20–22	778	20.8	15.8	27.8	42.6	4.3	10.3	5.0	31.8	2.51	44.4	17
22–24	981	23.0	18.6	26.4	31.2	3.3	9.5	3.0	25.7	2.60	36.8	18
24–26	954	24.7	16.3	19.8	22.0	1.2	12.5	1.5	29.0	2.52	43.4	8
26–28	934	27.2	18.1	18.9	34.6	3.3	7.1	3.2	17.0	2.59	40.4	5
28–30	NC	28.6	19.2	20.7	31.4	4.9	6.8	2.1	27.4	2.77	29.8	4
30–32	374	31.4	53.2	49.6	9.0	5.2	52.4	0	0	1.93	70.0	2
32–34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34–36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
36–38	744	36.5	80.6	30.2	13.4	0	0	0	13.4	2.49	36.0	1
≥38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA: Not Available.
NC: Not Calculated.

Appendix B
ALLOCATION MODELS FOR EDUCATIONAL RESOURCES

This appendix provides detailed descriptions of the three basic theoretical models discussed in the text: the bureaucratic, production, and lexicographic models.

THE BUREAUCRATIC MODEL

In its simplest form, the bureaucratic model can be represented by the set of equations in Eq. (1). The first equation represents the value of each personnel resource to the local school administrator; the second equation, the total resource constraint imposed on the administrator by the school district. To maximize the value he receives from control over specific personnel resources, the local administrator (bureaucrat) trades off among the different resources (along the resource constraint given him by the district) until the incremental value of each, relative to its trade-off rate, is equal for all types of resources (Eq. 1c). This is represented graphically in Fig. 1 by the tangency between R reflecting the resource constraint for personnel resources x_1 and x_2, and V, a curve reflecting a specified level of value achieved with different combinations of the x_1 and x_2. Thus,

$$V = v(x_1, x_2, \ldots x_i) \qquad i = 1 \ldots n \qquad \text{(1a)}$$

$$R = r_1x_1 + r_2x_2 + \ldots + r_ix_i \qquad i = 1 \ldots n \qquad \text{(1b)} \qquad \text{(1)}$$

$$\frac{v_1}{r_1} = \frac{v_2}{r_2} = \frac{v_i}{r_i}\text{, where } v_i = \frac{\partial V}{\partial x_i}\ . \qquad \text{(1c)}$$

Additional limitations or requirements restrict the range over which the administrator can trade off between x_1 and x_2, but the basic solution remains unchanged. For example, the administrator may be required to maintain at least a given amount of x_1 represented by $\overline{x}_1$ in Fig. 1. If x_1 represents classroom teachers, $\overline{x}_1$ might represent the number of teachers with tenure. The effect of this additional limitation is to restrict the administrator's trade-off opportunities to the area in Fig. 1 lying above the perpendicular to x_1 at $\bar{x}_1$. Since the original tangency solution lay within this region, this restriction does not affect the original result.

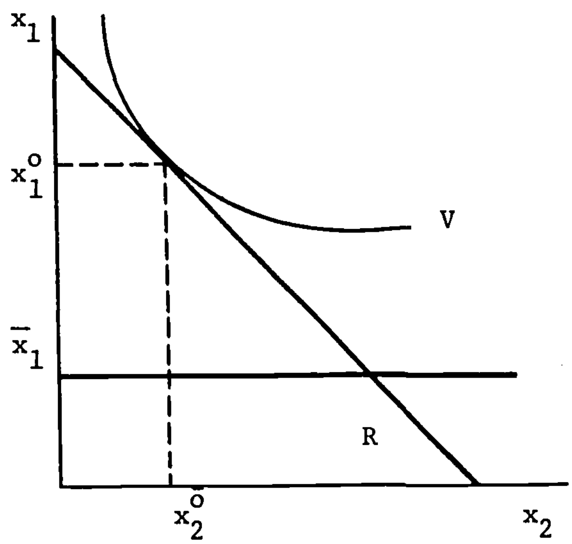

Fig. 1--Simple bureaucratic model

THE PRODUCTION MODEL

A simplified version of the "production" model is represented by the set of equations in Eq. (2). The first equation reflects the objectives of the administrator. Each element, Q_i, indicates a particular type of educational service, and the value or priority the administrator assigns it is represented by the functional V. The second equation indicates that the amount of any educational service, Q_i, depends upon the amount of resources, x_j, used to provide that service. The differences in the resources or combinations of resources required to provide each service are represented by the specific functional notation f_i. The third equation is the same resource constraint presented in the previous "bureaucratic" model. The fourth equation represents the necessary conditions for obtaining the maximum value from the educational services provided. This occurs when the trade-off ratio between any two resources (e.g., r_1/r_2) is equal to the ratio of the value of the increments in an educational service provided by an additional unit of the resource. Thus,

$$
\left.\begin{aligned}
V &= v_i(Q_i) && i = 1 \ldots n && && \text{(2a)}\\
Q_i &= f_i(x_j) && i = 1 \ldots n && j = 1 \ldots m && \text{(2b)}\\
R &= r_1x_1 + r_2x_2 + \ldots r_jx_m && && j = 1 \ldots m && \text{(2c)}\\
\frac{r_j}{r_k} &= \frac{\Sigma\, v_i\, f_{i,k}}{\Sigma\, v_i\, f_{k,k}} && && && \text{(2d)}
\end{aligned}\right\} \quad (2)
$$

The solution to the production model can also be illustrated graphically assuming that only two resources, x_1 and x_2, are used to produce two educational services, Q_1 and Q_2. The second and third equations in Eq. 2 are combined to produce a product trade-off frontier, depicted in Fig. 2 by the concave curve AB. This frontier represents the maximum amount of the two services that can be provided for different mixes of resources, x_1 and x_2, along the resource constraint. Movements along this frontier represent the cost or the resource trade-off in terms of one educational services, say Q_1, necessary to obtain additional amounts of the other service, Q_2. The actual mix of the two services the administrator chooses depends upon the relative costs of providing the two services (reflected in the shape of the product trade-off frontier) and the relative value of the two services, indicated by the V curve in Fig. 2. Because higher V curves reflect greater value (i.e., $V_1 > V_0$), the actual mix of services is determined by the tangency point between the V curves and the product trade-off frontier. Thus, the administrator in our example would select Q_1^o and Q_2^o as his preferred mix of the two educational services.

As in the bureaucratic model, additional requirements or limitations can be imposed, but they only restrict the range of feasible trade-off possibilities. For example, principals or local administrators may be required to provide at least minimum amounts of certain educational services, or they may be required to retain at least the classroom teachers with tenure. Each of these additional limitations can be easily incorporated in the production model, and the effect on the administrator's trade-off choice range similarly can be shown.

The requirement to provide at least minimum amounts of particular educational services restricts the range of choice along the product trade-off frontier. This is depicted in Fig. 2 by the perpendicular

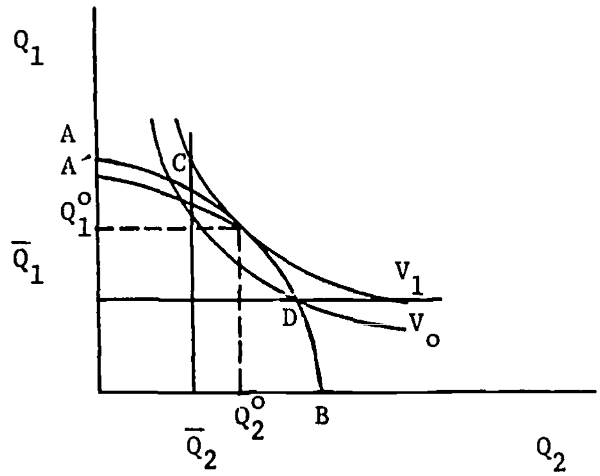

Fig. 2--Simple production model

lines drawn to the two product axes at the minimum product points $\overline{Q}_1$ and $\overline{Q}_2$. The feasible product trade-off frontier is represented by the range between points C and D, rather than the entire frontier AB. If the tangency point between the frontier and the value curves lies between points B and C on the frontier, these minimum constraints do not affect the allocation decision. If, however, the original tangency point lies outside the "feasible" range, the choice of output mix is restricted to the minimum point (i.e., the additional constraint) nearest the original tangency point.

A restriction on the amount of particular resources imposes a similar limitation on the resource trade-off constraint used to derive the product trade-off frontier. For example, by requiring that at least $\overline{x}_2$ of resource x_2 be employed, combinations of outputs Q_1 and Q_2, which require a resource mix x_2 less than $\overline{x}_2$, are no longer feasible. Hence, some parts of the original product trade-off frontier AB (those lying closest to the axis of the service that is x_1 intensive will now become infeasible and the feasible frontier will be below the original one (e.g., A'B). As before, the constraint will affect the product mix only if the original tangency point was on that part of the product trade-off frontier that is now rendered infeasible by the constraint.

THE LEXICOGRAPHIC MODEL

Unlike the bureaucratic and production models, the lexicographic model assumes that, regardless of the specific arguments in the administrator's set of objectives, these arguments are ordered in a unique, lexicographic manner. This implies not only that the specific objectives are explicitly ranked, but, more importantly, that they are pursued and achieved sequentially. Furthermore, lexicographic ordering implies that at any point, the satisfaction level of an administrator depends on only one objective. This model is best exemplified by the following description. Local school administrators give first priority to their pupil/classroom teacher ratio, and devote all their resources to reducing that ratio until it reaches a generally acceptable standard. Once the pupil/classroom teacher ratio target is achieved, they devote all additional resources to achieving another minimally acceptable target. This process continues for each objective in the administrators' set of objectives.

Figure 3 depicts this type of lexicographic ordering for two objectives, the teacher/pupil ratio, with an initial target of $\overline{T/P}$, and a teacher aid/pupil ratio, with a minimally acceptable target of $\overline{TA/P}$. Assuming that the teacher/pupil ratio is assigned the first priority, the locus of points 0 $\overline{T/P}$ AB* indicates the increase in the satisfaction level of a local school administrator as we sequentially increase, first, the teacher/pupil ratio (up to $\overline{T/P}$); then the teacher aide/pupil ratio (up to $\overline{TA/P}$); and then the teacher/pupil ratio. The actual mix of teachers and teacher aides the administrator selects will depend upon the utility expansion path -- more specifically, the target levels determining the slope changes in the path and the resource constraint. This resource constraint is depicted in Fig. 3 by the straight line R. Hence, the administrator selects a $\overline{T/P}$ teacher/pupil ratio and a teacher aide/pupil ratio of $(TA/P)^{o}$.

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*This locus of points is hereafter referred to as the "utility expansion path."

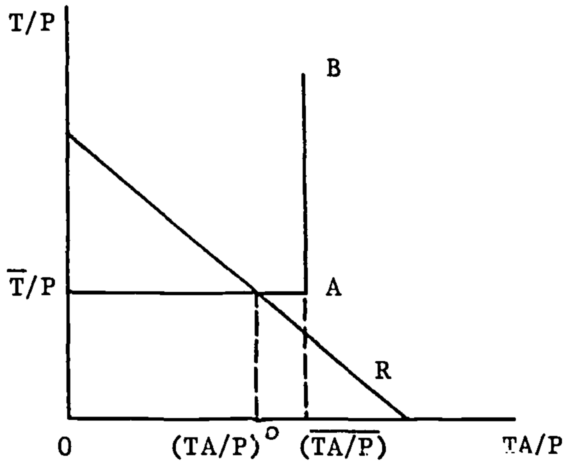

Fig. 3--Simple lexicographic model

LACK OF SUBSTITUTION EFFECTS WITH LEXICOGRAPHIC MODELS

An important feature of this utility expansion path is that it is the same regardless of the relative prices for the two resources, T and A. This constancy helps to explain the fundamental difference between this case and the standard economic preference function -- the lack of any substitution effects. This is demonstrated in Fig. 4, which contains the utility expansion path from Fig. 3 and three budget constraints.

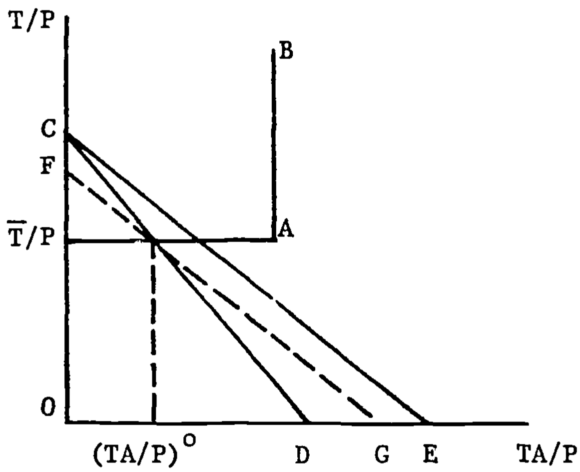

Fig. 4--Price and income effects, lexicographic model

Restraint CD reflects the initial resource restraint, R (from Fig. 3); restraints CE and FG reflect an assumed decrease in the price of TA. Restraint FG represents both the "cost difference" and "compensating income" variations due to the price change. Because of the shape of the preference map, the tax required to constrain the administrator to his old resource mix or his old utility level at the new price set is exactly the same. More importantly, the change in prices excluding the income effect (restraint FG) does not change the quantities of the resources purchased, even though the administrator is free to substitute along the restraint FG. In other words, a change in relative prices does not induce any substitution effect in favor of the lower-priced resource given lexicographically ordered preferences. With either budget restraint FG or CD, the administrator maximizes utility by purchasing $\overline{T}/P$ of T/P and $(TA/P)^o$ of TA/P.

Constrained Income Effects

With standard assumptions concerning the utility function and two normal resources, the income effect derived from a fall in the price of one of the resources should produce increases in the demand for both. The change in the relative quantities obtained would depend upon the relative income elasticities. With lexicographic ordering, however, a positive income effect will produce an increase in demand for only one of the resources. The resource that has an increase in its demand depends upon the region in which the impact of the price change is located. Basically, a price change favoring one resource will produce an increased demand for that resource only in those regions where utility (output) depends upon the amount of resources used. For example, in region 2* utility levels depend upon the amount of TA used; hence a price change favoring TA that occurs in region 2 will yield an increase in the demand for TA. However, a reduction in the price of TA that occurs in region 3

*The utility expansion path shown in Figs. 3 and 4 can be divided into three regions: region 1, the distance between 0 and $\overline{T}/P$; region 2, the distance between $\overline{T}/P$ and A; and region 3, the distance between A and B.

can produce no change in the demand for TA and an increase in the demand for T, even though both T and TA are normal resources.*

IMPLICATIONS OF THE MODELS FOR LOCAL SCHOOL STAFFING PATTERNS

Each of the three types of models -- bureaucratic, production, and lexicographic -- provides a clear conceptual distinction among the principal causes for staffing pattern differences. Need or priority differences are conceptually represented by alternatively shaped V curves in Figs. 1 and 2 and a different utility expansion path in Fig. 3. The effect of budget differences on staffing patterns is represented in Figs. 1 and 3 by parallel shifts in the straight line R curves; in Fig. 2 a similar shift underlies the parallel change of the product trade-off frontier. The effect of different trade-off ratios (relative prices) among specific resources is represented by a change in the slope of the straight line R curves (Figs. 1 and 3) or in the product trade-off frontier (Fig. 2). Changes in the additional limitations can also be conceptually separated and examined individually. For example, a change in the number of tenured teachers would result in a shift in the restraint represented by the perpendicular at $\bar{x}_1$ in Fig. 1.**

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*If the change occurs in region 1, there is no impact at all; no TA is purchased, hence there is no income effect due to the savings from a price reduction.

**Differences in staffing patterns due to the scale economies cannot be easily illustrated by these diagrams.

Appendix C

PUPIL/CLASSROOM TEACHER RATIO FREQUENCY DISTRIBUTIONS

(Schools with and without Supplementary Staff)

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
1	(3%)	29	(11%)
4	(12)	43	(16)
5	(15)	97	(37)
13	(39)	55	(21)
10	(30)	37	(14)
33	(99%)	261	(99%)

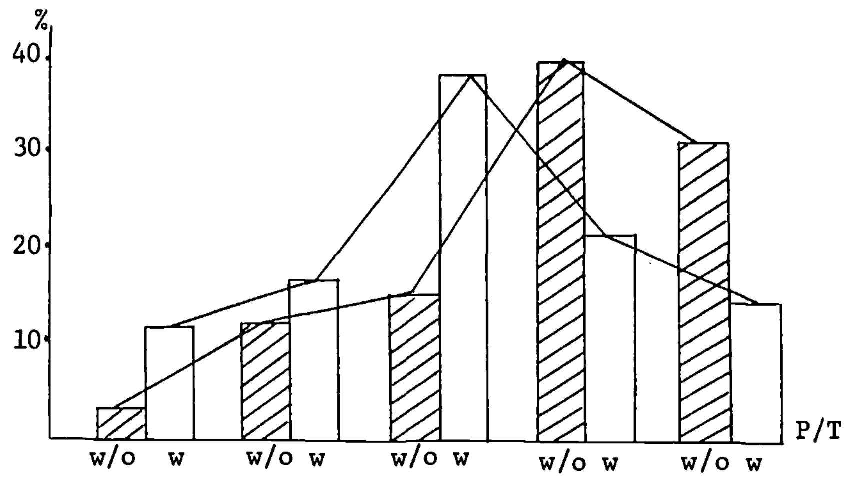

Fig. 5—χ^2 for SSIS, large city elementary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
2	(9 %)	18	(19 %)
2	(9)	30	(31)
10	(43)	29	(30)
6	(26)	11	(11)
3	(13)	8	(8)
23	(100 %)	96	(99 %)

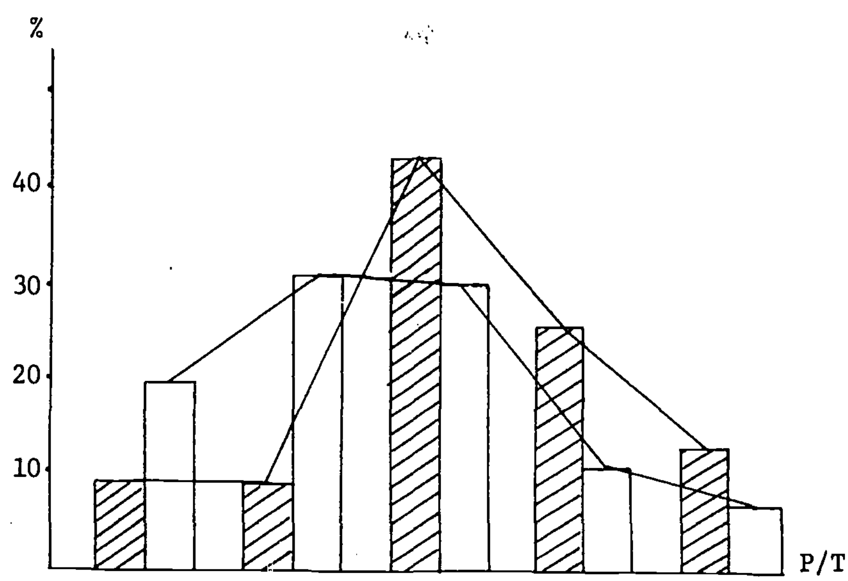

Fig. 6—χ^2 for SSIS, metropolitan area elementary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
7	(23%)	6	(11%)
10	(33)	12	(23)
4	(13)	24	(45)
8	(27)	6	(11)
1	(3)	5	(9)
30	(99%)	53	(99%)

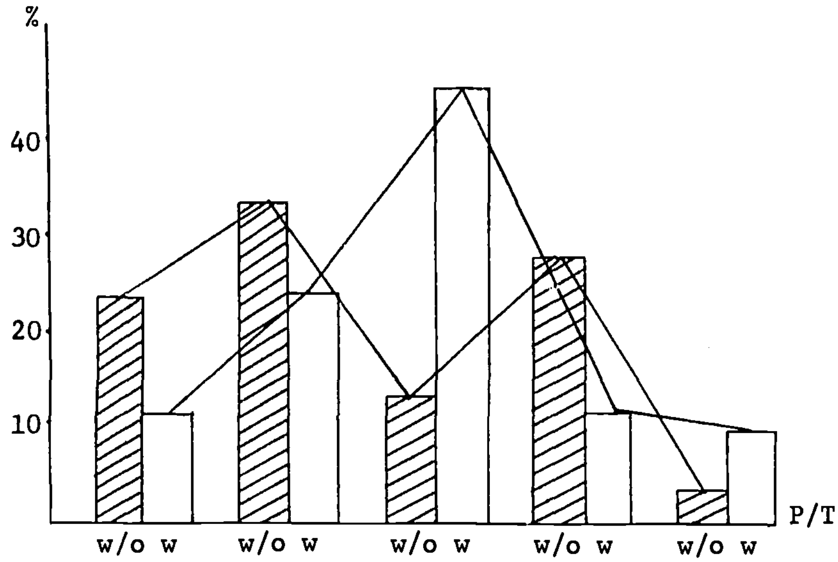

Fig. 7--χ^2 for OI, other area elementary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
4	(7%)	9	(31%)
15	(28)	7	(24)
21	(39)	7	(24)
9	(17)	5	(17)
5	(9)	1	(3)
54	(100%)	29	(99%)

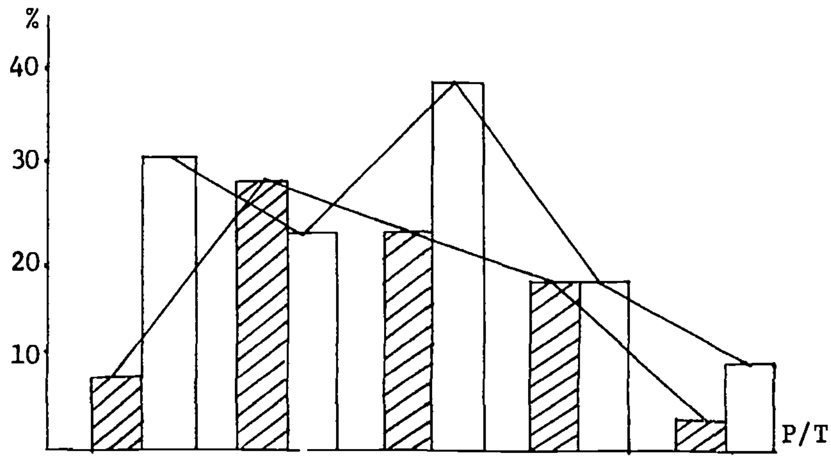

Fig. 8--χ^2 for CL+SEC, other area elementary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
3	(4%)	16	(8%)
9	(11)	36	(19)
27	(33)	64	(34)
28	(34)	58	(30)
15	(18)	17	(9)
82	(100%)	191	(100%)

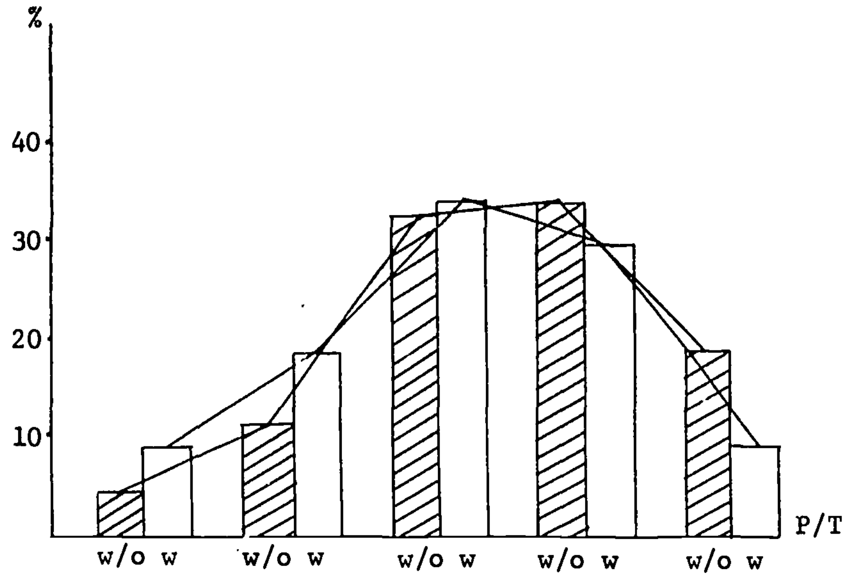

Fig. 9--χ^2 for HS, large city secondary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
14	(7 %)	5	(6 %)
33	(17)	12	(14)
56	(30)	35	(42)
70	(37)	16	(19)
16	(8)	16	(19)
189	(99 %)	84	(100 %)

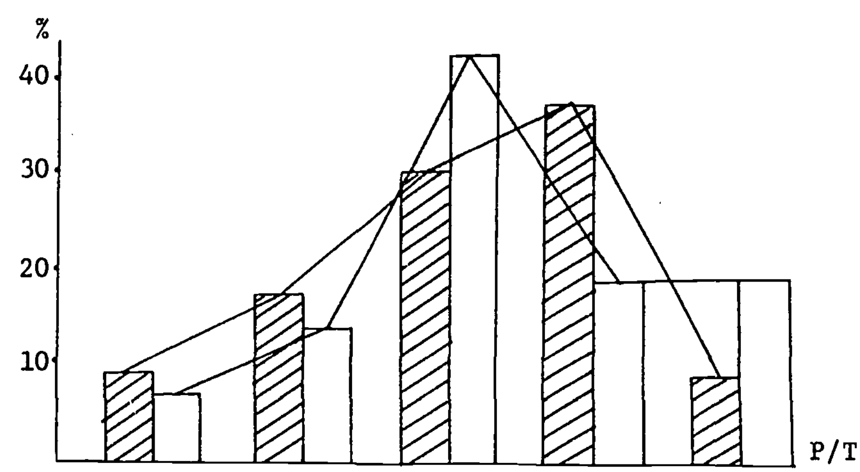

Fig. 10--χ^2 for LA+HA, large city secondary schools

Frequency Distribution

Without Supplementary Staff		With Supplementary Staff	
5	(7%)	7	(17%)
26	(36)	4	(10)
20	(27)	18	(43)
17	(23)	6	(14)
5	(7)	7	(17)
73	(100%)	42	(101%)

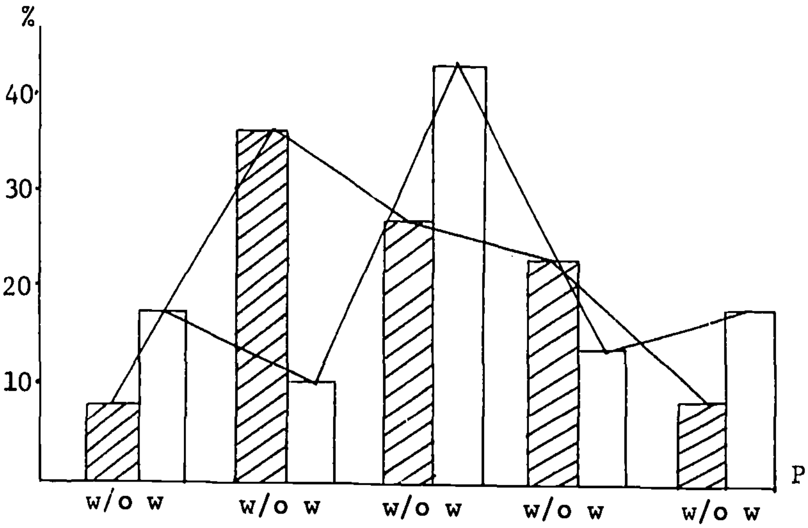

Fig. 11--χ^2 for TA, metropolitan area secondary schools

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