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There have been very few studies of how school districts spend money and allocate resources.

ESTIMATING THE DETERMINANTS OF PUPIL/TEACHER RATIOS: Evidence from the Schools and Staffing Survey

by Lawrence O. Picus

Spending on K–12 Public Education in the United States approaches $300 billion dollars a year. These funds are used to employ 2.4 million teachers and some 400,000 additional instructional staff to educate over 42 million children.[1] Despite this tremendous commitment to the education of our children, we know surprisingly little about how these funds are actually used, or how new or additional funds are likely to be spent by the nearly 16,000 school districts and more than 100,000 schools across the nation. While school districts are required to maintain detailed revenue and expenditure budgets for their operations, state level fiscal reporting requirements vary dramatically, making comparisons difficult. Moreover, there are generally few state level requirements governing the level of detail for which districts must keep school level fiscal information. While a few states, most notably Florida, have begun requiring uniform school level fiscal reporting, they are the exception, not the rule.[2] This means that very little information is available to policymakers interested in understanding how resource allocation patterns differ across schools, districts, states, and the nation; and with what effects.

While there are a number of national data collection efforts undertaken on a regular basis, Barro points out that incompatibilities across the major collection efforts result in a situation where "there is not a fully satisfactory way to answer even so seemingly straightforward a question as 'how much of total expenditure for elementary and secondary education in the United States goes to pay teachers' salaries?'"[3] Odden and Picus argue that there is a great deal of information about how dollars are distributed to school districts, but insufficient data on how to put dollars to productive use in districts, schools, and classrooms.[4] Moreover, there is little information on the equity of resource distribution to school districts across states.

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To better understand these important issues, the Finance Center of the Consortium for Policy Research in Education (CPRE) has developed a strategy for improving the current state of knowledge on the distribution of revenues to school districts across the nation, and to understand current resource allocation patterns in elementary and secondary schools. Called the Integrated, Multi-level Resource Allocation study, the Center is conducting a multi-year, multi-faceted study of "what dollars buy" in education. Specifically, Center researchers are conducting analyses of spending and resource allocation patterns at the national, state, district and school levels. The work reported here was conducted to fill a gap in the current state of knowledge about the allocation of resources within the nation's school districts. This paper discusses specifically our findings regarding the determinants of pupil/teacher ratios in schools and school districts across the United States. It relies on data from the Schools and Staffing Survey and the Census Bureau's Census of Governments to estimate how different district and school characteristics impact the pupil teacher ratio.

This paper begins with a discussion of the current state of knowledge regarding resource allocation patterns in schools. It follows with a summary of the study questions we sought to answer, and offers a brief description of the sources of data for our work. Following this discussion, our findings regarding pupil/teacher ratios and how district and school characteristics impact those ratios are described.

Current Knowledge About Resource Allocation Patterns

Over the years, only a few detailed studies of school district resource allocation patterns have been conducted. Odden, Palaich and Augenblick analyzed district spending patterns in New York for the 1977–78 school year.[5] They found that spending for instruction represented about 60 percent of state/local operating expenditures per pupil, with high spending districts devoting a slightly higher percentage of their resources to instruction than low spending districts (63 percent for the highest decile compared to 58 percent in the lowest spending decile). Odden, Palaich and Augenblick also found that higher spending districts paid teachers more and hired teachers with greater education and experience, while the pupil/teacher ratio remained approximately the same across spending levels. They did find that a slightly lower portion of instructional expenditures was devoted to teacher salaries in the high spending districts, making it possible for those districts to spend more on curriculum development, supervision and pupil services. Their study did not look specifically at variation in pupil/teacher ratios however.

A study by Hartman in Pennsylvania found similar spending patterns, with two exceptions.[6] Instructional spending as a percent of total expenditures was approximately 60 percent, but the higher spending districts tended to spend a slightly lower percentage of their funds on instruction compared to the low spending districts (58.1 percent in the high spending districts, compared to 61.3 percent in the low spending districts). Also, Pennsylvania districts seemed to spend more on reducing class size and less on increasing teacher salaries as the level of funding increased.

A related area of inquiry has been to estimate what districts will do if they receive more money. This research has typically been done with cross-sectional data bases, allowing researchers to identify how high spending districts use additional resources as compared to lower spending districts. Two of these studies, Alexander[7], and Barro and Carroll[8], analyzed data for districts with different spending levels in California and Michigan respectively. Their purpose was to determine how higher-spending districts within a state used the additional resources at their disposal. The findings from the two studies were remarkably similar. In general they found that per-pupil expenditures for teachers and for administrators increased at a slower rate than total current operating expenditures, and that

expenditures for specialists and for supplies and equipment increased at a rate faster than total spending. Barro and Carroll found that as the total budget increased by 1 percent, teacher expenditures per pupil increased by only 0.75 percent, while Alexander's research concluded that only 41 percent of each additional dollar was spent on teachers.

Interestingly, both studies found that much of the increased expenditures on teachers was not used for increased salaries. Rather most of the new money, 63 percent in Barro and Carroll's study and just over half in Alexander's, was used to hire more teachers, effectively reducing the pupil/teacher ratio. The studies also found that beginning teacher salaries were similar across spending levels.

Kirst analyzed how spending changed in five low spending districts that received 15 percent funding increases as a result of the school finance reforms enacted in response to *Serrano*.[9] Kirst found that most of the new funds were used to hire additional instructional personnel, either to reduce class size, add more class periods, or provide new specialists. In all five districts salary increases were relatively small, and most of the funds were spent on hiring additional staff.

A just completed study of eight school districts across the country by Bruce Cooper looked closely at district and school spending patterns by function.[10] Within eight sample districts, Cooper found that between 79.6 and 94.1 percent of total per-pupil expenditures were spent at school sites, and that overall between 57.9 and 62.8 percent of total expenditures were devoted to instruction. Cooper also found that virtually all instructional expenditures were made at the school site. His research also found that expenditures for administration varied from 8.1 to 17.1 percent of total district expenditures, and that in six of the eight districts, school site administrative costs represented the larger share of total administrative costs. There does not appear to be any relationship between the level of spending per pupil and the percent spent for either instruction or administration in Cooper's sample.

In a time series analysis of unified school districts in California between 1980–81 and 1985–86, Picus found that the proportion of total expenditures devoted to instruction increased in response to fiscal incentives designed to increase the length of the school day and school year.[11] He also found evidence that as the incentive funds were integrated into district general revenues, there was a tendency for spending on instruction to revert to previous proportional levels.

In a recently completed comparison of three major data sets, the NCES Common Core of Data, the NCES Schools and Staffing Survey (SASS), and the expenditure, salary and staffing data provided by the National Education Association (NEA), Barro found a number of differences in estimates of how much money is available, and more importantly, how educational resources are used.[12] He shows that in 1988–89, per pupil expenditures for current operations varied from a high of $6,888 in the District of Columbia to a low of $2,413 per pupil in Utah, a ratio of 2.9:1 When these figures are adjusted for price differentials across states, the ratio decreases to 2.3:1 with cost adjusted expenditures in the District of Columbia of $6,064 (still the highest), and $2,638 in Utah (still the lowest).[13]

Perhaps more important than how much is spent is how those resources are used. The single largest expenditure item for school districts is teacher salaries. On average, teacher salaries account for 45 to 50 percent of a school district's budget. Teacher compensation (salaries and benefits) generally amount to between 55 and 60 percent of expenditures.[14] Average teacher salary in 1991–92 ranged from a low of $23,300 in South Dakota to a high of $47,300 in Connecticut.

Equally important is the access students have to a teacher's time and attention. This is most directly measured through analyses of pupil/teacher ratios which provide an estimate of average class size.[15] Barro's analysis of spending patterns in 1988–89 shows that the pupil/teacher ratio varies dramatically across the states.[16] The average pupil/teacher ratio in 1988–89 across the United States was 17.3 pupils per teacher. This ranged from a low of 13.0 in Connecticut to a high of 24.5 in Utah. When teachers, other professional staff and teacher aides were considered as a group, the ratio of pupils to instructional personnel dropped to 13.4 for the United States as a whole, and ranged from a low of 10.1 in Connecticut to a high of 19.5 in Utah.

Barro also looked at the relationship between per pupil spending and the pupil/teacher ratio. He found that on average, the pupil/teacher ratio decreases by about six percent for each ten percent increase in per pupil expenditures. Moreover, Barro attempted to measure the marginal propensity of schools to spend additional resources on teachers. Specifically he found that for each $100 increase in per pupil spending, a state with U.S. average expenditures per pupil would devote approximately $42.50 to additional teacher compensation, of which $32.90 would go to reducing class size, and $10.60 would be used to increase teacher salaries. The balance of these funds would be expected to be used for the compensation of other professional staff members and to other personnel and non-personnel expenditure items.

Picus analyzed school district level expenditure patterns and found that there is substantially less equity in educational expenditures per pupil across school districts than is apparent when analyzing state level fiscal data bases.[17] District per pupil expenditures for education ranged from under $1,000 per pupil to over $50,000 in 1987–88, the most recent year for which SASS data are currently available. The coefficient of variation for per pupil expenditures was 0.524. When adjusted for differences in the cost of education across states, the coefficient of variation declined to 0.476. Even this cost adjusted figure is considerably larger than the coefficient of variation found in any individual state. This implies that a considerable school funding equity problem continues to exist across our nation.

Picus also found that most districts spent approximately 60% of their resources on direct instruction (as defined by the Census Bureau). Moreover, there was considerably less variation in the share of expenditures devoted to instruction, than in the total spending per pupil. The coefficient of variation was only 0.106, indicating very little variation exists in the share of total resources that are devoted to instruction. Not only is this an important finding, its consistency is surprising. It means that as districts get more funds, they continue to spend each additional dollar in roughly the same proportion as the dollars they received previously. The strength of this finding is remarkable. Cooper, using a methodology that analyzes school district spending from the "bottom up" by aggregating school level expenditures, has also found that instruction consistently accounts for 60 percent of a district's spending.[18]

This finding does not mean that all children are treated equally however. As the data presented above indicate, there are dramatic disparities in the level of per pupil expenditures across school districts. This means that a district spending $10,000 per pupil still has twice as much money to spend on instruction as a district spending $5,000 per pupil. Not surprisingly, we found that as a district's expenditures increase, the average class size declines, and average teacher increases somewhat. Moreover, one would expect that additional services for children are more readily available in high spending districts than in low spending districts.

These findings imply that efforts to force districts to direct new funds to preferred programs, such as instruction, may face considerable difficulty. Picus' study of the use of incentive funds in California in the first half of the 1980s lends further evidence to the finding that districts continue spending in the same proportions regardless of the amount of money available.[19]

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Picus' 1993 district level analysis also found that spending tends to be higher in larger metropolitan areas. Specifically, Picus found that as the size of a central city increased, so did per pupil spending.[20] Moreover suburban districts surrounding large and very large cities tended to spend more than the central cities they surround. The opposite was true in medium size cities, but for small and medium cities, overall spending levels were below those for large and very large cities and their suburbs. Finally, rural areas had the second lowest per pupil spending level, exceeding only the average spending of school districts in small cities.

Picus and Bhimani analyzed the SASS teacher questionnaire and found evidence to support teacher arguments that they have much larger classes than most national and state specific pupil/teacher ratio data indicate.[21] They found that at the district and school level, the pupil/teacher ratio for elementary grades (K–6) is between 17.68 (district) and 18.77 (school) pupils per teacher. However, the mean teacher reported class size for self-contained classrooms is 24.21, some 29 to 36 percent larger than estimates based on district and school data.

Similarly, the average secondary school pupil/teacher ratio as reported on the district level SASS questionnaires was 14.41. At the school level, the mean pupil/teacher ratio was 16.38 for intermediate schools and 16.55 for secondary schools. On the other hand, the self reported average class size for departmentalized classes amounted to 22.65. The difference between self-reported class size and the pupil/teacher ratios computed through district and school averages, while disconcerting, was not unexpected given that teachers have been making similar claims for a number of years. As this brief review shows, there have been very few studies of how school districts spend money and allocate resources. What the few studies have shown is that allocations for instruction are remarkably consistent across districts and over time, averaging approximately 60 percent of total expenditures. Unfortunately, it is hard to draw any general conclusions about school district resource allocations given the few studies and small samples involved. Also, there has been little research on how factors such as average teacher salary, the pupil/teacher ratio and per pupil expenditures impact these patterns.

Research Questions

The research summarized above shows there has been relatively little research on how resources are allocated and used by school districts. One of the most important resources used in education is teachers. In fact, expenditures for teacher salaries and benefits are the single largest component of school district spending.[22] The work described in this paper represents an initial step in adding to that knowledge by analyzing pupil/teacher ratios for a nationally representative sample of school districts and schools. The specific questions this research was designed to answer are:

1. How do pupil/teacher ratios vary among school districts and schools?
2. How do variations in pupil/teacher ratios relate to district and student characteristics and community type?

Description of the Data Base

The analyses described in this paper rely on data from a number of sources. Primary among them are two large-scale federal data bases, the NCES Schools and Staffing Survey (SASS) for 1987–88, and the U.S. Census Bureau's 1987 Census of Governments. The Census files contain expenditure data for the 1986–87 fiscal year, one year before the data collected through the SASS. Similar expenditure data for the universe of school districts is not available for 1987–88.

Although the merged data base has a one year lag between the expenditure variables and the staffing variables, this analysis still provides valuable information to educational policymakers because school district spending habits and resource allocation patterns generally show relatively small incremental changes from year to year as evidenced by the few studies that have been conducted in the past and summarized above. Consequently, the relationships found between spending and staffing patterns are unlikely to vary dramatically from what would be expected if fiscal and staffing data were available for the same fiscal year.

By merging the expenditure data from the Census Bureau with the staffing and enrollment information from SASS, it is possible for the first time to analyze educational resource allocation and staffing patterns at the state, school district and school and even individual classroom level. Detailed information on each of the data bases is provided below.

The Schools and Staffing Survey

The 1987–88 Schools and Staffing Survey (SASS) is a comprehensive, nationally representative, survey conducted by the National Center for Education Statistics of 5,592 public school districts, 9,317 public schools in those districts, and over 56,242 teachers at these same schools. Similar surveys of private schools were conducted. Since resource allocation patterns in the public school system is the focus of this paper, this discussion is limited to the public school component of the SASS. The SASS sample was not designed to be representative of individual states. As a result estimates of individual state level resource allocation patterns in school districts can not be undertaken with these data.

The public school component of SASS consisted of four separate questionnaires. They include:

1. Teacher Demand and Shortage Questionnaire for public School Districts, distributed to school district administrators.
2. Public School Questionnaire, distributed to school principals
3. School Administrator Questionnaire, distributed to school principals
4. Public School Teachers Questionnaire, distributed to public school teachers.

Census

Data on school district expenditures were taken from the Census of Governments, 1987: Finances of Public School systems - File D, which provides data for the universe of 16,921 public elementary–secondary school districts and local institutions of higher education. Available data include district expenditures and revenues including breakdowns on the source of revenue and current expenditures for instruction, support services, food services and all others. Data on capital expenditures are also available. Data on current expenditures were the primary focus of the research reported here.

Merged Data Set

The first step in creating an analysis data set was to merge the data from the four SASS questionnaires. This was accomplished by comparing the control numbers on each form of the SASS data tapes provided by NCES. The second, and more complicated process was to merge this data set with the Census data. With the help of NCES staff, we were able to combine our merged SASS file with the Census of Governments—File D. Our final sample contained a total of 30,362 teachers in 6,388 schools and 4,370 districts. The fall-off in number of districts, and consequently schools and teachers, results from two factors—non-response rates on the SASS questionnaires and inability to find matches for all of the SASS districts in the Census data. According to NCES, the response rate for the questionnaires was 89.4 percent for the District level survey of teacher supply and demand; 91.9 percent for the public school

questionnaire and 94.2 percent for the administrator questionnaire, both of which went to school principals; and 86.5 percent for the teacher survey. For a district to be included in our sample, responses from all four levels had to be available.

Variation in Pupil/Teacher Ratios at the District Level

The largest single item of expenditure in school districts is for the compensation of teachers. Barro states that teacher compensation (salaries and benefits) accounts for 53 percent of all current spending by school districts.[23] Thus, studying the number of teachers employed, and the salaries they are paid provides a great deal of information on how school systems choose to allocate the resources available to them. This section describes how teacher staffing patterns, specifically pupil/teacher ratios vary across school districts and schools in the SASS/Census sample.

Variation in Pupil/Teacher Ratios at the District Level

Pupil/teacher ratios were calculated for districts as a whole, and for elementary and secondary groupings. Using the district level Teacher Demand and Shortage questionnaire from SASS, the number of pupils in grades K–12 was divided by the reported number of teachers in each district. In addition, for all school districts that reported having students in any of grades K–6, a similar pupil/teacher ratio was calculated, as was the ratio for all districts reporting any enrollment in grades 7–12. Table 1 summarizes the overall pupil/teacher ratios for the SASS sample of 4,370 school districts. The mean pupil teacher ratio for the sample is 16.59, ranging from a low of 2 to a high of 40.50. The standard deviation is 3.92 and the coefficient of variation 0.236. Table 1 also displays similar data for the pupil teacher ratio in grades K–6 and grades 7–12. The table shows that the average pupil/teacher ratio in the lower grades is more than three pupils per teacher larger. The table also shows more variation in the pupil teacher ratio for the two sub-groups than for the sample as a whole. The standard deviation for K–6 is 7.92 and for 7–12 it is 6.23. Moreover, the coefficient of variation for both subgroups increases to over 0.36.

Tables 2 and 3 summarize the demographic characteristics of the SASS sample districts. Table 2 provides the means and standard deviations for student and teacher variables, while Table 3 provides information on the type of community in which each school district is located. Table 2 shows that the average district in the sample had 5,742 students in 1987–88. Across districts, an average of 28.68 percent of the students qualify for free or reduced price lunches, and on average 13.15 percent of the students are minorities. The SASS Teacher Demand and Shortage Questionnaire asked respondents to indicate what their district's average teacher salary was, as well as to provide information on their district's salary schedule at three points—bachelor's degree with no previous teaching experience, master's degree (or its equivalent in credits beyond the bachelor's degree) with no previous teaching experience and master's degree with 20 years of teaching experience. The average teacher salary that year was $25,431. Table 2 also displays the average salary at three steps on the salary schedule—BA with no experience, MA with no experience and MA with 15 years of experience. Interestingly, the standard deviation of the salary schedule variables increases with education and experience. This indicates that beginning teacher salaries vary less across the nation than do salaries for teachers with more education and experience.

To determine the impact of location on school district resource allocation patterns, the type of community in which a district is located was also used in the models described below. Table 3 shows the distribution of districts by community type. As the table shows, the largest group of school districts are rural, representing over 43 percent of the total sample. The next largest group is districts in small cities, which make up nearly 30 percent of the districts in the sample. Only 1.21 percent of the districts in the sample, 53 districts, are in cities with over 500,000 residents. Even smaller numbers of districts are located on military bases and Indian reservations. Because a district can only be assigned to one community type, a set of nine dummy variables were used in the regression models for community type. In the regressions, rural districts served as the base case to which all other community types were compared. Consequently, in the regressions that follow, a dummy variable for rural districts does not appear. The next section of this paper looks at these district characteristics affect variations in per pupil expenditures, pupil teacher ratios and teacher salaries.

The SASS data collection allows analysis of variations in pupil/teacher ratios from a number of perspectives. The discussion that follows provides a picture of how staffing patterns are related to a variety of variables including district size, geographic region, community type, percentage of pupils receiving free or reduced price lunches (a proxy for poverty level), the minority enrollment of the district, and expenditure levels. To ascertain the impact of these district characteristics on the teacher/pupil ratio, a series of multiple regressions were estimated. Using the teacher/pupil ratio as the dependent variable and district characteristics as the independent variables, the individual impact of each factor, holding the others constant, was estimated.

Three separate regression equations were estimated, and the results are displayed in Table 4. The first used the teacher/pupil ratio for grades K–12 as the dependent variable, while the second and third used the ratios for elementary (K–6) and secondary (7–12) grades respectively.[24] The independent variables included price adjusted per pupil expenditures, school district enrollment, the percentage of students qualifying for free or reduced price lunches, the percentage of students in each district who are ethnic minorities, the district average salary, and a series of dummy variables to reflect community type.

The last row of Table 4 displays the R^2 for each of the three equations. That row shows that the equation for K–12 teacher/pupil ratio accounted for over 29 percent of the variation in the ratio, while the elementary and secondary grade equations explained a much smaller share of the variance in the respective ratios for those grade levels. The secondary equation only explains about 6 percent of the variation in the teacher pupil ratio found in grades 7–12, whereas the elementary equation accounts for nearly 19 percent of the variation in grades K–6.

The impact of expenditures per pupil (PPEXP) shows the expected positive sign for all three equations, and although the coefficients appear very small, they are statistically significant at the 0.01 level. For example, the coefficient of 0.0000033 in the K12 equation implies that when per pupil expenditures increase by $1,000 the teacher/pupil ratio increases by 0.0033. At the mean, this corresponds to an increase in the teacher/pupil ratio from 0.0603 to 0.0636, or a decrease in the pupil/teacher ratio of 0.84 students. The corresponding pupil/teacher ratio decrease for a $1,000 increase in per pupil spending at the elementary level is 0.91 pupils and in secondary schools 0.23 pupils. This means at the elementary school level each additional $1,000 in per pupil spending results in pupil/teacher ratios that are almost one student smaller, while at the high school level, it would take just over $4,000 to achieve the same result. This is no doubt in part because the secondary school pupil/teacher ratios are already considerably smaller than the elementary grade classes.

Not surprisingly, districts with higher enrollments have higher pupil/teacher ratios. However, these increases are quite modest. The coefficient for enrollment (LEAENR1) in the K–12 equation is -0.000000064, and is statistically significant at the 0.01 level. This coefficient indicates that an additional 1,000 students in a school district (a substantial influx of new students for most school districts across the nation) leads to, at the mean, a reduction in the

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teacher/pupil ratio of -0.000064, from 0.0603 to 0.0602. This translates to an increase in the pupil/teacher ratio from 16.59 to 16.61. Similarly small effects can be found in the equations for the elementary and secondary grades, although the secondary finding is not statistically significant.

The negative signs associated with the coefficients for average teacher salary (SALAVG) indicate that higher salaries are associated with larger classes. The coefficients are statistically significant at the 0.01 level in all three equations. The Coefficient of -0.000000555 for SALAVG in the K–12 equation implies that in districts where the average teacher salary is $1,000 above the mean, the teacher/pupil ratio is -0.000555 lower. This corresponds to an increase in the pupil/teacher ratio of 0.13 students. Thus, even salary differentials of as much as $8,000 lead to pupil/teacher ratio increases of only one student, indicating that districts make greater efforts to maintain those pupil/teacher ratios than pay teachers more.

With the exception of a small increase in pupil/teacher ratio as the proportion of students who qualify for free and reduced price lunches goes up in the K–12 equation (significant at the 0.05 level), neither this proxy for poverty nor the district minority enrollment have a statistically significant impact on a district's pupil/teacher ratio. In the K–12 equation, if the share of students qualifying for free and reduced price lunches increases by 10 percent, the corresponding increase in the pupil/teacher ratio is a negligible 0.06 students. Across the spectrum this translates into a pupil/teacher ratio increase of 0.3 students for districts with half of their students qualifying for free or reduced price lunches compared to districts with no students meeting the income level qualifications for this program.

Interestingly, the effect of community type on the teacher/pupil ratio was most obvious in the K–12 equations, where all of the coefficients were statistically different from zero at least at the 0.05 level. The negative coefficients reported for all of the community type variables imply that the smallest classes are found in rural areas. In fact, with the exception of military bases and Indian reservations, the magnitudes of the coefficients have the same ranking as the magnitude in the difference between rural pupil/teacher ratios and the pupil/teacher ratios in other types of communities. This finding did not hold up for Indian reservations and military bases due to the small number of districts in each of those groups and the fact that these schools typically operate under different circumstances than other school districts in the United States.

These results show that the pupil/teacher ratio is related to a number of school district characteristics. Specifically, districts that spend more money per pupil tend to have lower pupil/teacher ratios. Those districts that pay more for their teachers, tend to have higher pupil/teacher ratios, and as shown above, the pupil/teacher ratio is consistently smaller in secondary schools than in elementary schools. Although rural districts tend to have the lowest pupil/teacher ratios, and suburbs seem to have lower ratios than cities, the differences across medium, large and very large cities or suburbs are not as pronounced. As district size increases, so does the pupil/teacher ratio.

Variation in Pupil/Teacher Ratios at the School Level

To ascertain the impact of the individual factors reported above on the pupil/teacher ratio at the school level, a second series of multiple regressions were estimated. Using the teacher/pupil ratio as the dependent variable and the factors cited above as independent variables, the impact of each, holding the others constant can be estimated.[25] Three separate regression equations were estimated, one for elementary schools, one for intermediate schools and one for secondary schools. Independent variables included district per pupil expenditures, school enrollment, the percentage of students qualifying for free or reduced price lunches, the percentage of students in each school who are ethnic minorities, and a series of dummy variables to reflect community type. Since rural districts represent one of the largest community groups, they were again used as the basis for comparison with the other dummy variables. Descriptive statistics for the variables are displayed in Table 5, and the results of the modeling are presented in Table 6.

This model is virtually identical to the model used to estimate the determinants of the teacher/pupil ratio at the district level. Left out of the model is average teacher salary, a variable for which we only had district level data. Because average salary is correlated with per-pupil expenditures, and both are district level variables, only one per-pupil expenditure was included in the final model. The results of this analysis are similar to the district level modeling efforts.

The factors that have the most impact on teacher/pupil ratios at the school level are the school's enrollment, the percent of pupils qualifying for free and reduced price lunches and the district's per pupil expenditures. Community type seemed to have less impact on pupil/teacher ratios at the school level than at the district level, and as Table 6 shows, the coefficients on the various community type variables were generally not significant. Moreover, there was no pattern to the significant coefficients for community type across the three equations.

As anticipated, the signs on the coefficients for per pupil expenditures are positive, indicating that as expenditures increase, the number of teachers per pupil also increases, or conversely, the number of pupils per teacher declines. Although the coefficients are very small, there is an impact to be discerned. For example, the coefficient of 0.000002232 for per pupil expenditures in the elementary school equation implies that a $1,000 increase in per pupil expenditures is associated with an increase in the teacher pupil ratio of 0.002232. At the mean this corresponds to a change in the teacher/pupil ratio from 0.05432 to 0.05209 or a decrease in the pupil/teacher ratio of 0.73 students.

Similarly, in intermediate schools, this model predicts that a $1,000 increase in district level per pupil expenditures would result in a reduction of the pupil/teacher ratio by 1.5 students, and at the secondary level such an increase in spending would also lead to a reduction of 1.5 students. This finding seems to imply that increases in revenues are more likely to be used to reduce the pupil/teacher ratio at intermediate and secondary schools, than to reduce elementary school pupil/teacher ratios.

The coefficients on enrollment are all negative, implying that as school enrollments increase, so does the pupil/teacher ratio (the teacher/pupil ratio declines). It is not clear why the teacher/pupil ratio increases with the percent of children qualifying for free and reduced price lunches, although it does so at all three school levels. The most likely explanation for this is that schools with higher proportions of children qualifying for free and reduced price lunches are schools where family income is low, and thus also qualify for Chapter 1 funds. If those funds are used to purchase additional teacher resources, we would expect the pupil/teacher ratio decline. Since the expenditure data do not provide detail on the source of funds, it is impossible to test this theory at the present time. Future data from the 1990–91 Census of governments and the 1990–91 SASS may enable us to answer this question.

The results of this analysis of pupil/teacher ratios at the school level are not as clear as our results from the analysis of this important variable at the district level. The data presented above confirm our most important finding that pupil/teacher ratios are higher at the elementary level than at the secondary level. This analysis found little evidence of differences by community type, although in secondary schools the pupil teacher ratio was still lowest in rural areas.

As with our district findings, it seems that schools with the lowest percent of students qualifying for free and reduced price lunches and the schools with the highest percent of such children seemed to have the lowest pupil/teacher ratio, with mixed

results for those in-between. Interestingly, our modeling found a stronger relationship between pupil/teacher ratio and this proxy for income levels than did our district level models.

Conclusion

The analyses presented above offer some insight into how school districts allocate teacher resources. It is clear from the results of our modeling that the impact of such variables as per pupil expenditures, student enrollment, and percentage of students from low income households or who are ethnic minorities is discernible, but relatively small. For example, at the secondary level, a decrease in the pupil teacher ratio of one student per teacher was associated with a $4,000 increase in per pupil spending. At the elementary level, a similar decrease was associated with a spending increase of approximately $1,000 per pupil, still a substantial jump in available resources.

It is unfortunate that we are unable to estimate spending at the individual school level. This is particularly disappointing since the factor that seems to have the most substantial impact on the pupil/teacher ratio is school type. Secondary schools have a pupil/teacher ratio that is on average three pupils per teacher lower than do elementary schools. Attempting to control for these differences by estimating separate equations resulted in models that only explain a small portion of the variation found in these ratios. It is possible that if the per pupil spending at each school were available, a larger portion of this variation could be explained. We are currently working with data from the state of Florida to see if this theory yields any important new information. However, because Florida has succeeded in reducing the variation in per pupil spending across districts (and most likely as a consequence across schools), it is unlikely that we will find a definitive answer to this question until more states make school level expenditure data available.

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13. It is important to take interstate variations in the cost of education into account in analyzing revenue and expenditure data. Unfortunately, little work has been done to estimate what those variations are. In this section, all data have been cost adjusted using either Barro's cost of education index (See Barro, 1992), or an index prepared by the American Federation of Teachers based on differences in personnel salaries (Nelson, 1991).
14. NEA, *Op. Cit.*
15. Note that the figures reported in the discussion that follows indicate class sizes substantially smaller than the average teacher reports. This is because the teacher counts reported to NCES and the NEA include teachers of special education classes which typically have fewer children, and teachers in various "pull-out" programs. Unfortunately, the nationally available data sets do not make it possible to separate these teachers from those in regular classrooms. While the data presented may thus underestimate the number of students a teacher sees in a day, the relative rankings of the states are unlikely to change significantly.
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24. It should be noted that for the purposes of this analysis, the teacher/pupil ratio is used as the dependent variable rather than the pupil teacher ratio reported above. Although this may cause readers some confusion, the teacher/pupil ratio makes the analysis of multi-variate models more straightforward since the signs on the coefficients are easier to interpret. For example, higher spending would be expected to correlate with lower class size, and thus negative coefficients. Since the teacher/pupil ratio is the reciprocal of the pupil/teacher ratio, as expenditures increase, the teacher/pupil ratio would also be expected to increase (more teachers for a given number of students and thus smaller classes), resulting in positive signs for the coefficient. The more traditional pupil/teacher ratio was used above as it is easier for most readers to interpret.
25. Note that the teacher pupil ratio is again used as the dependent variable.

Table 1. Summary Statistics for Pupil Teacher Ratio: 1987–88

Statistic	Pupil Teacher Ratio Grades K–12 PTLK12	Pupil Teacher Ratio Grades K–6 PTLK6	Pupil Teacher Ratio Grades 7–12 PTL712
Mean	16.59	18.54	15.47
Standard Deviation	3.92	7.92	6.23
Maximum	40.50	40.50	40.50
Minimum	2.00	2.00	2.00
Median	16.40	17.85	14.97
Inter-quartile range	4.66	5.18	5.68
Coefficient of Variation	0.236	0.367	0.398
Number of Observations	4,370	4,225	4,257

Table 2. Summary of School District Demographic Characteristics

Variable	Mean	Standard Deviation
Per Pupil Expenditures (PPEXP)	$3,698	$1,759
Enrollment (LEAENR1)	5,742	18,484
Percent of Students Qualified for Free/Reduced Lunch (POVL)	28.68%	23.78%
Percent Minority Enrollment (MINPUL)	13.15%	21.24%
Average Teacher Salary (SALAVG)	$25,431	$5,393
Teacher Salary, BA With No Experience (SALBA0)	$17,543	$2,277
Teacher Salary, MA With No Experience (SALMA0)	$19,188	$2,738
Teacher Salary, MA With 20 Years Exp. (SALMA20)	$29,441	$5,835

Table 3. Distribution of Sample School Districts by Community Type

Community Type	Number of Districts	Percent of Districts (%)
Rural[1]	1921	43.96
Small City	1292	29.57
Medium City	283	6.48
Medium Suburb	207	4.74
Large City	112	2.56
Large Suburb	266	6.09
Very Large City	53	1.21
Very Large Suburb	198	4.53
Military Base	20	0.46
Indian Reservation	18	0.41

[1]Note that in the regressions, rural districts served as the "base case" to which all other community types were compared. Consequently a dummy variable for RURAL does not appear in Table 5.

Table 4. Determinants of Teacher/Pupil Ratios:

Independent Variable	Dependent Variable Teacher Pupil Ratio		
	Grades K–12 TPLK12	Grades K–6 TPLK6	Grades 7–12 TPL7–12
Intercept	0.06987* (0.00140)	0.061* (0.002)	0.0831* (0.0054)
Per Pupil Expenditures (PPEXP)	0.0000033* (0.00000009)	0.0000028* (0.0000001)	0.00000093* (0.00000066)
Enrollment LEAENR1)	-0.000000064* (0.00000001)	-0.000000043* (0.000000020)	-0.000000095 (0.000000060)
% Free/Reduced Lunch (POVL)	-0.0000257** (0.0000120)	-0.000009 (0.000013)	0.0000779 (0.0000463)
% Minority Enrollment (MINPUPL)	-0.0000222 (0.0000132)	0.000004 (0.000015)	-0.000072 (0.000051)
Average Salary (SALAVG)	-0.000000555* (0.000000050)	-0.00000046* (0.00000006)	-0.00000159* (0.00000023)
Small City (COMMUN2)	-0.0041* (0.0006)	-0.0015** (0.00067)	-0.0072* (0.0023)
Medium City (COMMUN3)	-0.0060* (0.0011)	-0.0033* (0.0012)	-0.0092** (0.0041)
Medium Suburb (COMMUN4)	-0.0048* (0.0012)	-0.0022 (0.0013)	-0.0072 (0.0046)
Large City (COMMUN5)	-0.0077* (0.0016)	-0.0045** (0.0019)	-0.0114 (0.0063)
Large Suburb (COMMUN6)	-0.0041* (0.0011)	-0.0018 (0.0012)	-0.0061 (0.0043)
Very Large City (COMMUN7)	-0.0057** (0.0024)	-0.0038 (0.0028)	-0.0076 (0.0093)
Very Large Suburb (COMMUN8)	-0.0031** (0.0013)	-0.0009 (0.0015)	-0.0032 (0.0051)
Military Base (COMMUN9)	-0.0082** (0.0038)	-0.0074 (0.0041)	-0.0066 (0.0143)
Indian Reservation (COMMUN10)	0.0214* (0.0041)	0.0099** (0.0045)	0.0245 (0.0160)
R-Square	0.296	0.189	0.060

Standard Errors are in parentheses
*Significant at the 0.01 level
**Significant at the 0.05 level

Table 5. Summary of School Demographic Characteristics

Variable	Mean	Standard Deviation
Elementary Schools (N=3415)		
Enrollment (ELENR)	429.15	800.72
% Free and Reduced Price Lunch (PPOVS)	26.71	67.38
% Minority Enrollment (PMINPUPS)	35.99	86.97
Intermediate Schools (N=1204)		
Enrollment (MIDENR)	568.53	904.66
% Free and Reduced Price Lunch (PPOVS)	30.77	67.38
% Minority Enrollment (PMINPUPS)	26.20	86.97
Secondary Schools (N=1876)		
Enrollment (SECENR)	823.37	1677.04
% Free and Reduced Price Lunch (PPOVS)	22.46	72.40
% Minority Enrollment (PMINPUPS)	23.02	52.88

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Table 6. Determinants of Teacher/Pupil Ratios at the School Level

Independent Variable	Dependent Variable Teacher Pupil Ratio		
	Elementary Schools	Intermediate Schools	Secondary Schools
Intercept	0.0586* (0.0013)	0.0499* (0.0031)	0.0605* (0.0019)
Per Pupil Expenditures (PPEXP)	0.000002232* (0.00000024)	0.000006357* (0.00000065)	0.000005888* (0.0000004)
Enrollment (ELENR, MIDENR, SECENR)	-0.0000226* (0.0000016)	-0.0000253* (0.0000026)	-0.0000133* (0.0000009)
% Free/Reduced Lunch (PPOVS)	0.0000603* (0.000015)	0.000308* (0.000036)	0.0000927 (0.0000303)
% Minority Enrollment (PMINPUPS)	-0.0000053 (0.0000151)	-0.000174* (0.000032)	-0.0000473** (0.0000240)
Small City (COMMUN2)	-0.0016 (0.000959)	0.0041** (0.0019)	-0.0058** (0.0014)
Medium City (COMMUN3)	-0.00299** (0.00130)	0.0041 (0.0027)	-0.0039 (0.0022)
Medium Suburb (COMMUN4)	-0.00163 (0.00167)	0.0071** (0.0033)	-0.0047 (0.0024)
Large City (COMMUN5)	-0.00144 (0.00138)	0.0028 (0.0028)	-0.0045** (0.0023)
Large Suburb (COMMUN6)	-0.00055 (0.00152)	0.0093* (0.0030)	-0.0062* (0.0022)
Very Large City (COMMUN7)	-0.00021 (0.00176)	0.0050 (0.0040)	-0.0054 (0.0028)
Very Large Suburb (COMMUN8)	0.00369** (0.00180)	0.0068** (0.0034)	-0.0052** (0.0025)
Military Base (COMMUN9)	-0.00579 (0.00442)	-0.0037 (0.0088)	0.0114 (0.0211)
Indian Reservation (COMMUN10)	0.00412 (0.00643)	-0.0092 (0.0164)	-0.0008 (0.0122)
Adjusted -Square	0.105	0.198	0.270

Standard Errors are in parentheses
*Significant at the 001 level
**Significant at the 0.05 level