Using Cost and Need Adjustments to Improve the Measurement of School Finance Equity

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Over the last 30 years, there has been a movement throughout the country to alter the sources of funding for school systems, because they are thought to be inequitable. Beginning with the McInnis v. Shapiro[1] case in 1968, the courts have been asked to review the constitutionality of educational funding systems which rely on local property tax. The focus of this debate lies in the fact that a dependence on local property tax leads to enormous disparities in education funding between school districts. It has been argued that these disparities violate the equal protection clause of state and federal constitutions as well as states' constitutional obligations and commitments with regard to education.

The legal debate over these issues has been well publicized and recognized in our society. Accompanying this public phenomenon has been a less well-known, but equally aggressive movement to analyze educational funding inequality, and to develop methods of measuring funding equity. Just as litigation in this area has grown, so to has analysis of equity within educational funding. Verstegen (1998) identifies four developments within the field of equity analysis. These include:

- Redefining the constitutionally required level of education a state must provide;
- Focusing on adequacy in addition to equity;
- Relying on the plain meaning of education clauses in state constitutions; and
- Using new criteria for measuring constitutional compliance.

The following paper will focus on the fourth of these four points. More specifically, the paper reviews two methods for adjusting per-pupil expenditure figures with the aim of more accurately measuring equity. These two methods are weighted pupil adjustments and the application of geographic cost-of-education indices. The purpose of these adjustments is to take into consideration extenuating circumstances and the additional burdens school officials face when trying to provide a quality education to students.

[1] McInnis v. Shapiro 293 F. Supp. 327 (1968).

Weighted Pupil Adjustments

The enormous differences between various communities' schools become evident immediately upon walking in the door. Not only are there obvious differences regarding the ages of the children served, the physical condition of the buildings, and the amenities provided, but also the resources and advantages or impediments which accompany children to school. The federal government has recognized the varying needs of children and in so doing has provided food and additional funds for students of varying populations, (i.e. Chapter I students, students who face language barriers, and students with special physical needs). These children require greater resources to share in comparable educational experiences with children who are not confronted with these issues. To address the varying needs of students, the federal and many state governments use a weighted student model count for the distribution of grants to school districts. Under such a system, a student with special needs might be accounted for as 1.2 or 2.3 students. The rationale for this weighted count is the needed recognition for additional resources for that particular student and the additional burden placed on the school system to provide an adequate educational experience for all the children they serve.

Much of this recognition and additional effort is mandated in P.L. 94-142, the Individuals with Disabilities Education Act (IDEA), which requires a free, appropriate public education for all children with disabilities. Passed in October 1990, this act is a reauthorization of the Education of the Handicapped Act. To meet this mandate, local school districts need to ensure that students with disabilities are placed in the least restrictive environment appropriate for their educational progress. Each student must have an Individualized Educational Plan (IEP) as well as the necessary related services.

However, these mandates, as well as services provided to students with special needs that are not covered under IDEA, (e.g., children at risk or children with limited English proficiency) can be met in a variety of ways. Services to aid these students can be provided in a self-contained classroom, resource room, residential school or through mainstreaming. Providers of such services include the district, co-operative programs, and private organizations. Moreover, in addition to special teachers, particular instructional materials, and other core educational services, additional services such as transportation and counseling may be needed to support these specialized educational experiences. On average, costs for meeting the needs of a special education child are approximately 2.3 times that of a child in regular education, which often translates into a weighted pupil system where a special education student is weighted as 2.3 students.

Studies reviewing the cost of students with . . . additional needs show that students with more prevalent disabilities tend to have lower average costs, whereas students dealing with less prevalent issues have higher costs.

Studies reviewing the cost of students with special vulnerabilities or additional needs show that students with more prevalent disabilities tend to have lower average costs, whereas students dealing with less prevalent issues have higher costs. Average special education costs can range from approximately $1,000 per pupil for students with speech or language impairments to over $30,000 per pupil for those who are deaf and blind.[2] Programs that utilize resource rooms have lower average costs, while self-contained classrooms and residential schools yield higher costs. Costs in this area may also be distinguished as either "Supplementary Costs" or "Replacement Costs." "Supplementary Costs" refer to services that are provided in addition to regular education costs while "Replacement Costs" refer to programs and services provided instead of regular education. Two important criteria for determining the cost of these programs for students are the eligibility and placement criteria used with regard to the student and

[2] Stephen Chaikind, Louis C. Danielson, and Marsha L. Braun. "What Do We Know About the Costs of Special Education? A Selected Review." *The Journal of Special Education 26,* (4)(1993):344–370.

the budgetary environments under which jurisdictions operate.

The use of weighted pupil counts represents one important way analysts may denote the additional financial burdens school officials face when working with special-needs students. It is one ingredient in the construction of a framework within which school systems must learn to function. A second tool for recognizing special circumstances faced by school systems is a geographic cost-of-education index.

Cost-of-Education Indices

For the past three decades, researchers have conducted studies to develop methodologies and empirical estimations of cost-of-education indices (CEIs). The purpose of these indices is to put into context the value of educational dollars by adjusting for differences in the purchasing power of different school systems. CEIs may be used for resource analysis in two ways. First, CEIs may influence analyses regarding estimating funds needed for educational services. Second, cost-of-education adjustments may be necessary when comparing the financial resources available to students with similar educational needs in geographically disparate locations.

The purpose of these indices [cost-of education indices] is to put into context the value of educational dollars by adjusting for differences in the purchasing power of different school systems.

When exploring the role of indices, one must note that conceptually similar geographic cost-adjustment indices rely on different approaches to account for contextual differences in the hopes of providing an accurate assessment of resources and costs. Examples of these indices include "Average-teacher-salary index" (Barro, 1992, "Cost of Living Index" (McMahon and Chang, 1991), and "Teacher Cost Index" (Chambers and Fowler, 1995). These works focus on developing an adequate methodology for determining differences in personnel costs across locations. The rationale for focusing on personnel costs is that they account for 80 percent of local school budgets (Chambers, 1996). The Barro, McMahon, and Chang, and Chambers and Fowler cost indices were calculated using the Schools and Staffing Survey (SASS) developed by the National Center for Education Statistics (NCES), Census data, the U.S. Geological Survey, and the National Climatic Data Center, data from the Bureau of Labor Statistics, and data from the American Chamber of Commerce Research Association (see Chambers and Fowler, 1995 for details). In each case, cost estimates are presented for all fifty states and provide state and regional comparisons of the alternative teacher cost indices.

Average-teacher-salary index

Barro (1992) developed a model that adjusts for variations in teacher salaries based on their level of education and experience. Referred to as the Average Teacher Salary (ATS) index, the measurement is calculated by statistically controlling for such factors as the highest degree earned by the teacher, the number of years the teacher has taught, and whether or not the teacher has professional certification. This cost index implicitly attributes all remaining variation in teachers' salaries, both above and beyond the differences in education and experience, to differences in geographic costs. Thus, all remaining differences in teacher salaries are attributed to such features as disparities in living conditions, teacher quality, local amenities, and random error. Although this model represents an improvement over using average teacher salary, Chambers and Fowler (1995) argue that it does not systematically account for other teacher characteristics (e.g., personal attributes) or attributes of the work environment that might affect the level of teacher compensation. They maintain that such variations must be addressed when assessing variations in teacher costs.

Cost-of-Living Index

Unlike Barro's salary index, McMahon and Chang (1991) developed a method for estimating a cost-of-living (COL) index to account for differences in the purchasing power of educational dollars. McMahon and Chang assert that in order to compare salaries across geographic locations, it is necessary to adjust those salaries by the cost of living in different locations. The COL index adjusts for per capita personal income, the median sale prices of existing single family homes, and the percent change in population in the preceding years by state and region using 1981 data from the Bureau of Labor Statistics and 1990 data from the American Chamber of Commerce Research Association (see Chambers and Fowler, 1995 for details). Like Barro's (1992) salary index, the COL index does not take into consideration other important variations in the cost of school personnel. For example, the COL index does not consider that teacher salaries are higher in districts serving more challenging students or those located in high crime areas in order to compensate for the more difficult working conditions (Chambers and Fowler, 1995).

Teacher Cost Index

In addition to including the geographic cost of living, Chambers and Fowler (1995) extend the analysis of teacher costs to include amenities of the labor markets in which public school districts are located. Their teacher cost index (TCI) is based on a hedonic wage model which takes into consideration conditions that attract workers to a geographic area or a certain teaching position. This model captures variations in teacher costs through a comprehensive analysis of the patterns of teacher compensation. The TCI portrays the complexities of employment transactions between individual teachers and their school districts. In addition, it accounts for school district preferences for teacher qualifications and individual teacher preferences for working and living conditions in local communities (Chambers and Fowler, 1995). Specifically, the TCI simulates the effects of factors that reflect differences in cost of living and geographic attractiveness of local communities (e.g., climatic conditions, amenities of urban and rural life, the incidence of crime). The attractiveness of a job assignment is estimated by controlling for personal background characteristics of teachers (e.g., college major, age) and job assignment characteristics (e.g., class size, students' behavior problems).

When exploring issues of equity, the education research field . . . have relied on a variety of measures, each of which pursues different, . . . ways of gauging the magnitude of unequal distribution of resources.

In reviewing cost-of-education indices, it becomes apparent that these instruments are designed to contextualize the value of education dollars by adjusting for differences in the purchasing power of different locations. CEIs are important for estimating both need within a location or locations and equity among locations. Three CEIs were reviewed and presented in this paper, the ATS index, the COL index, and the TCI, and all indices employ different methods to adjust for local variations. The ATS index adjusts for teacher preparation and experience. The COL index adjusts for the cost of living in local communities. The TCI adjusts for personal characteristics of teachers, variations in local amenities, and the job environment. These indices are related and generally provide similar cost estimates across states. However, some interesting variations emerge. These variations suggest that in some localities, teacher costs are more strongly influenced by certain features than others (e.g., cost of living versus teacher preparation and experience). Thus, not only are there variations in the value of currency, but also differences in the cause of such variations. To further highlight the power these indices hold, we now turn to employing such indices when conducting analysis of equity in funding and the correlations between spending and measures of wealth.

Equity Analysis

When exploring issues of equity, the education research field, as well as other disciplines has relied on a variety of measures, each of which pursues different, and not always consistent, ways of gauging the magnitude of unequal distribution of resources. In so doing, the measures represent different aspects of the inequality that can exist in a distribution. Below is a description of four such measures. These include the variance, the Gini coefficient, the McLoone Index, and the slope coefficient.

Variance

Variance is the average difference between the resources received by each unit and the average amount of resources supplied. In an educational example, variance is the difference between dollars received by each school district and the average dollars administered within a state. A large variance statistic indicates a wide diversity of funding and unequal distribution of financial resources. A second way this concept is articulated is as the “coefficient of variation.” The coefficient of variation is 100 times the standard deviation divided by the mean. It roughly indicates the percentage above or below the mean within which two-thirds of the observations lie. The coefficient of variation can take on any positive value, with zero indicating perfect equity. It assists standardizing and comparing variances in different locations with different mean spending values.

When used alone, the variance statistic can be somewhat misleading. Because each school district is treated equally, the variance measure is sensitive to extreme cases. Within a given state, one extreme school district, either receiving relatively large or small amounts of money, may result in a large variance statistic and lead to a conclusion of inequality despite the fact that all of the remaining districts received relatively the same amount of resources. Thus, the distribution of resources may be equitable in that state, except for one unusual district. This is a significant problem in educational applications because the distribution of educational resources is often characterized by extreme cases. Generally, to avoid this problem, educational researchers employ a weighting system that weights school district spending by the size of the school district (in enrollment). Large school districts with many students influence the equity measure more than a single, small outlier.

. . . the distribution of educational resources is often characterized by extreme cases.

Gini coefficient

The Gini coefficient is based on the Lorenz curve, which shows the cumulative proportion of the aggregated value of a variable plotted against the cumulative portion of units, when units are ranked in ascending order by the variable. Stated more simply, the Lorenz curve is calculated by first ranking units based on the magnitude that they possess of the variable being measured. In the example below, school districts serve as the units ranked and per-pupil expenditure serves as the variable. The second step is to calculate the cumulative percent distribution. One method of doing this would be to calculate the total share of the variable (e.g., per-pupil expenditures) being received by the lowest 10 percent of the recipients in the distribution, then calculate the percentage of the total received by the lowest 20 percent and so on, until the percentage of the total received by the lowest 90 percent is reached. These figures, one for each 10 percent interval, are then plotted. The axes on the graph are measured in terms of the percentages. The Lorenz curve is created by connecting these points. If the variable has the same value in every unit, the Lorenz curve is a straight line elevating at a positive 45-degree angle. The Lorenz curve would bow downward if the lowest 10 percent received less than 10 percent. The greater the departure from the diagonal, the more pronounced the inequality.

The Gini coefficient is a summary statistic that represents the departure of the Lorenz curve from the diagonal. This coefficient is estimated by calculating the ratio of the area between the diagonal and the Lorenz curve and the total area beneath the diagonal. The larger the Gini coefficient, the greater the inequality. The coefficient ranges from 0 to 1, with 0 indicating perfect equity.

McLoone coefficient

Unlike the variance and Gini coefficients, the McLoone index is sensitive to where along the distribution the inequality exists.[3] The index is used to assess equity in the distribution of variables among units in the lower half of the distribution. It compares what recipients below the median in the

[3] David H. Monk. *Educational Finance: An Economic Approach*. New York: McGraw-Hill (1990).

distribution actually received with the amount they would have received had they been given the same amount as the median recipient. As recipients in the lower half receive similar amounts to those at the middle of the distribution, the McLoone index becomes larger in absolute value. In contrast to the variance and Gini coefficients, this index may be viewed as a measure of *equality* because the measure becomes larger as the distribution becomes more equal. The other statistics may be considered measures of inequality since they become larger as inequality increases.

Slope coefficient

Unlike previously discussed indicators, the slope coefficient provides insight into who is receiving more or less. It does this by identifying the strength of the relationship that exists between two attributes of the units measured. Specifically, the slope coefficient measures the change in one attribute associated with a change in another attribute. In the example below, average household income within a school district represents one attribute and per-pupil expenditure of that district, a second. It is then possible to plot these attributes for each district, draw a line that best represents the degree to which the two attributes correspond, and calculate a slope for that line. This slope would then be the slope coefficient. In this example, a positive slope would indicate that with every unit increase in household income, there is an increase in per-pupil expenditure (i.e., as household income increases, per-pupil expenditure increases). A negative slope would indicate that an increase in household income coincides with a decrease in per-pupil expenditure. The magnitude of the coefficient indicates how much change in per-pupil expenditure is associated with every unit change in household income. Generally, educational researchers wish the relationship between school district wealth and per-pupil spending to be weak, since much of the cause of school district spending differences is the result of local property wealth.

The purpose of this case study is to gauge the impact these adjustments may have on educational analysis, as well as the influence they hold in swaying conclusions drawn.

A Case Study Employing Adjustments and Indices

To understand the power student demographic and cost-of-education adjustments hold, we now turn to a case study of financial equity for school districts within the state of New York. The purpose of this case study is to gauge the impact these adjustments may have on educational analysis, as well as the influence they hold in swaying conclusions drawn. Data for this case study comes from the Common Core Data (CCD). The CCD is the National Center for Education Statistics' (NCES) primary database on elementary and secondary public education in the United States and provides an annual, comprehensive, national statistical database of all public elementary and secondary schools and school districts. The CCD comprises a set of five surveys sent to state education departments. Most of the data are obtained from administrative records maintained by the state education agencies (SEAs). Statistical information is collected annually from public elementary and secondary schools, public school districts and the 50 states, the District of Columbia and outlying areas. The SEAs compile CCD requested data into prescribed formats and transmit the information to NCES. The five data sets within CCD can be used separately or in conjunction with one another to provide information on many topics of interest.

For issues of clarity, we chose to study financial equity within the state by conducting two sets of analyses, one including New York City and one excluding New York City. This is because large metropolitan areas often face very different issues than the surrounding districts and which can mislead equity analyses and their conclusions. By conducting two separate analyses, we hope to minimize this potential problem.

In both sets of analyses, we employed a weighted pupil model and a cost-of-education index, the TCI, to develop four different data sets. One data set includes "Unadjusted" data. A second data set presents “Needs Adjustment” data, based on a weighted pupil model. A third provides regional “Cost Adjusted” data, based on the TCI index, and a fourth set presents data that has been both “Needs and Cost Adjusted.” Data used for the analyses were total expenditures per district, total students per district, the number of students with an “Individual Educational Plan” (IEP), the percent of all at-risk children enrolled in school, and the percent of children who speak English “Not Well.”

To construct a weighted per-pupil average, we adopted the same method as the state government of New York. Student needs adjustments were calculated by weighting student categories as follows: students with IEPs were multiplied by 2.3, while limited English proficiency and at-risk students were weighted by a factor of 1.2. These multipliers were used on the aggregate for each district, so that an individual student may belong to more than one category and would be multiplied under each classification. Once a weighted student population was determined, “Needs Adjusted” district per-pupil expenditures were calculated by taking the “Total Expenditures” and dividing by the weighted student population.

To determine a “Regional Cost Adjusted” per-pupil expenditure, we divided “Total Current Expenditures” by “Total Students” and then multiplied this figure by the corresponding TCI adjustment. Lastly, to construct a data set that took into consideration a student need and regional cost adjustment, we took the “Needs Adjusted” data and multiplied it by the appropriate TCI adjustment used in the “Regional Cost Adjusted” data. See figures 1, 2, and 3 for graphic displays of the data set distributions. Figure 4 shows the impact adjustments may have when comparing a limited number of districts.

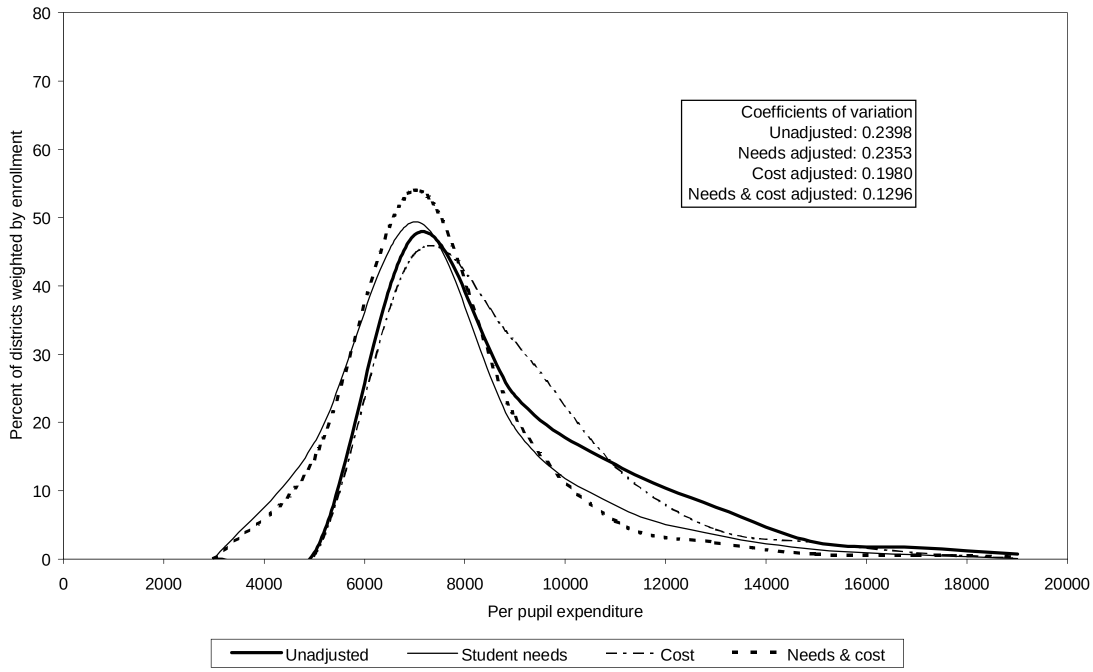
Once the four data sets were created, we applied the four different equity measures noted earlier to determine how these adjustments may affect equity analysis. Table 1 presents comparisons of the three of these equity measures, variance coefficient, Gini coefficient, McLoone coefficient, when applied to the various data sets. The first column is the variance coefficient. The Gini and McLoone coefficients are presented in the second and third columns, respectively. For purposes of comparison, it is important to remember what these coefficients measure. The variance and Gini coefficients measure *inequity* (higher coefficients reflect greater inequity). In contrast, the McLoone coefficient represents *equity* (higher coefficients reflect greater equity). Differences in per-pupil expenditures are estimated for each of the three equity measures based on each of the four data sets. Part A of the table estimates the observed inequity or equity for each of the data sets excluding New York City. Part B estimates the observed inequity or equity for each data set including New York City.

Table 1.—Comparisons of Type I equity measures: Analysis of New York State

	Variance coefficient	Gini coefficient	McLoone index
A. Excluding New York City			
Unadjusted	0.2398	0.1265	0.8878
Needs adjusted	0.2353	0.1227	0.8991
Cost adjusted	0.1980	0.1017	0.8859
Needs and cost adjusted	0.1296	0.0974	0.8947
B. Including New York City			
Unadjusted	0.2096	0.0983	0.9292
Needs adjusted	0.2093	0.0966	0.9252
Cost adjusted	0.2404	0.1240	0.7978
Needs and cost adjusted	0.2421	0.1256	0.7966

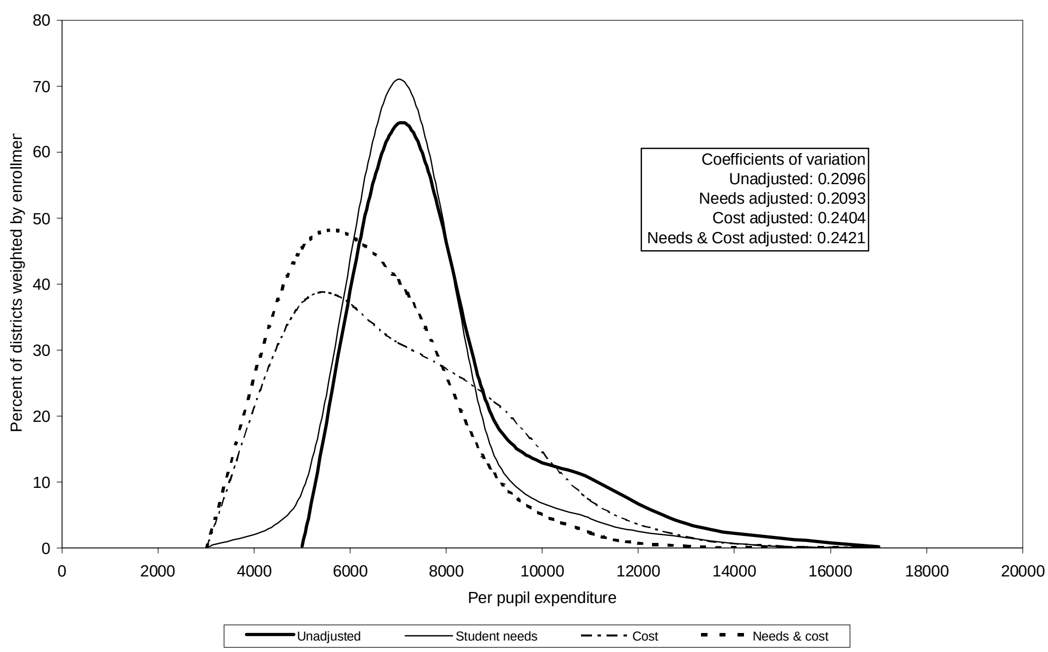
SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 1.—Data set distribution: Analysis of New York State excluding New York City



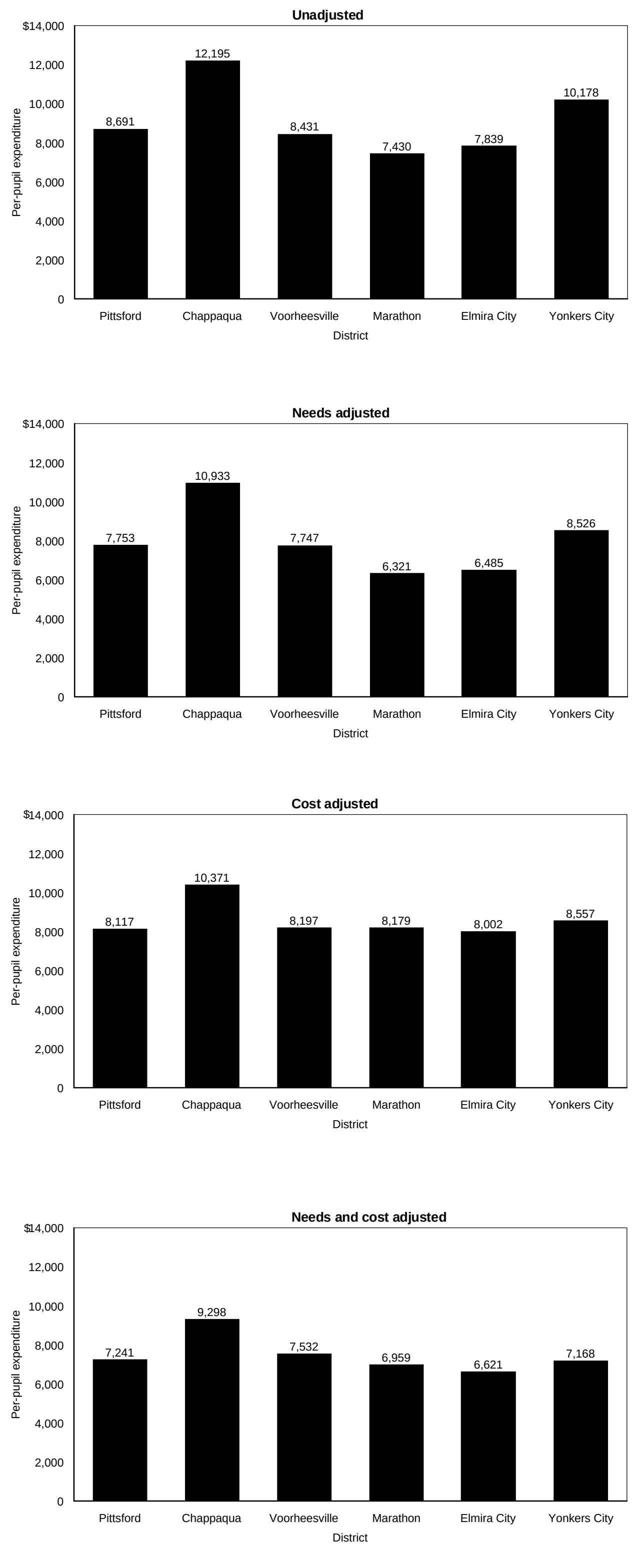
SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 2.—Data set distribution: Analysis of New York State including New York City



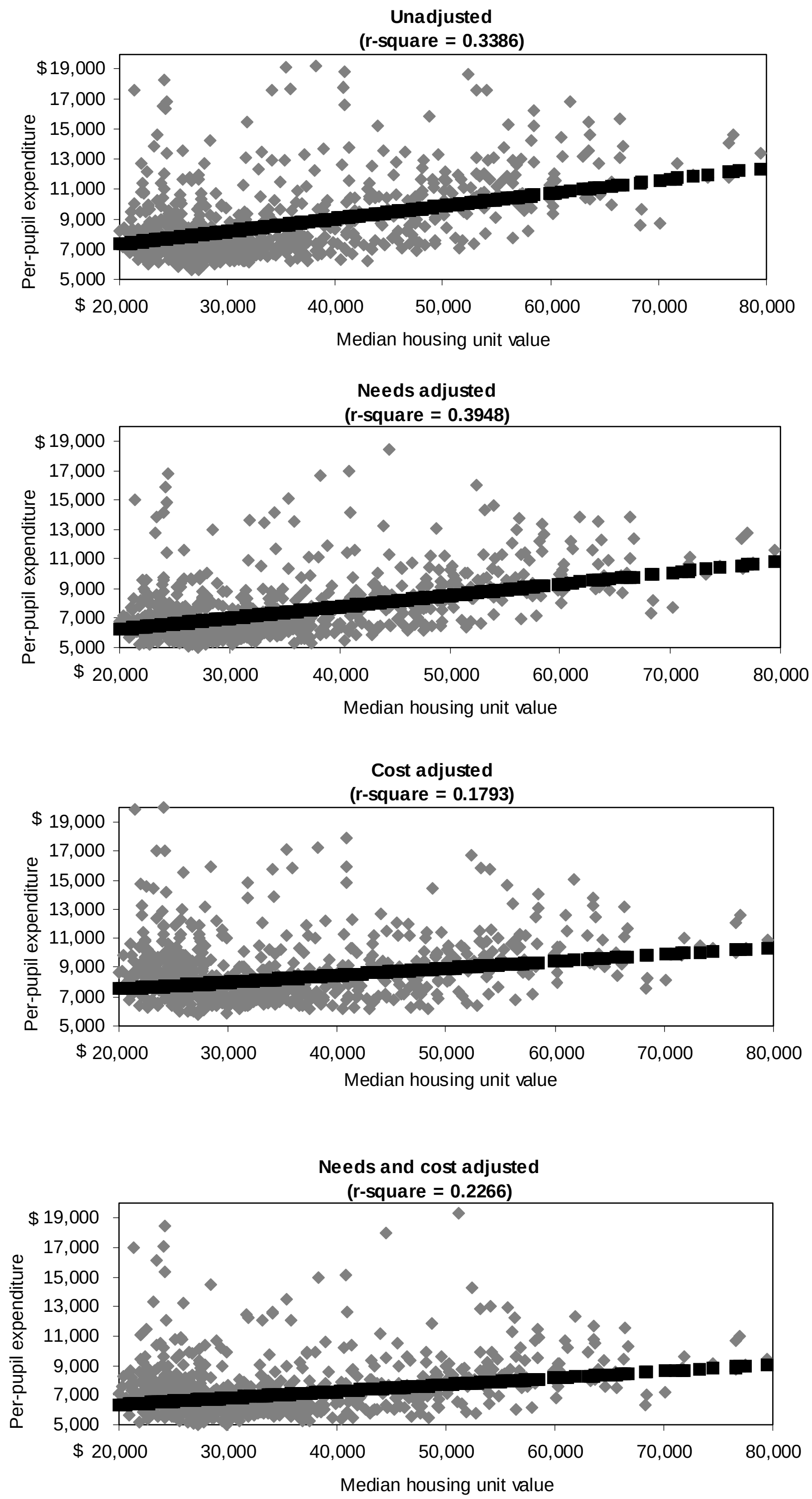
SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 3.—Per-pupil expenditures for selected school districts



SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 4.—Regression analysis of per-pupil expenditure by median household income: Analysis of New York State excluding New York City



SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

With regard to the coefficient of variation presented in Part A, the greatest measured inequity appears present when no adjustments are made to the data. The value of this is 0.2398. Once a needs adjustment is made, the situation appears to improve slightly to 0.2353. This improvement may be viewed by some as so small to be deemed insignificant. Remember that a coefficient of variation of 0.24 indicates approximately the percentage above or below the mean within which two-thirds of the observations lie.

However, regional cost adjustments appear to have a stronger impact in this case than do the needs adjustment, decreasing the coefficient to 0.1980. Interestingly, the impact of the needs adjustment increases significantly when coupled with the cost adjustment. In this instance, the variance coefficient decreases to 0.1296. Thus, employing both a cost and need adjustment almost halves the coefficient of variation.

Similar findings hold true when employing the Gini coefficient in measuring equity. "Unadjusted" data provides the most significant measures of inequity (0.1265), followed by "Needs Adjusted" (0.1227), "Cost Adjusted" (0.1017), and lastly "Needs and Cost Adjusted" (0.0974).

The McLoone Coefficient, in contrast, shows a different picture. In this case, the greatest inequity in measurement appears using "Cost Adjusted" data (0.8859), followed by "Unadjusted" data (0.8878), and "Needs and Cost Adjusted" data (0.8947). The greatest measured equity occurs when the data set is only "Needs Adjusted" (0.8891). The difference in this outcome from the previous two equity measures may be traced back to the focus of the McLoone coefficient, that being the lower half of the data set distribution. The McLoone coefficient compares what recipients below the median distribution received with the amount they would have received assuming an equal distribution. In comparing the McLoone index with the variance and Gini coefficient, one may ascertain where the greatest amount of equity or inequity lies within a distribution between the various data sets.

Also of interest are the changes in equity measurement when comparing the data sets that include New York City with those that do not. When New York City is included, the "Unadjusted" and "Needs Adjusted" data set show increased equity, with regard to the variance and Gini coefficient. However, the "Cost Adjusted" and "Needs and Cost Adjusted" indicate greater inequity when New York City is included in the analyses. This information indicates that although at first glance funding for education in New York City seems strongly in line with funding levels in the rest of the state, the issues addressed under the "Cost Adjusted" and "Need and Cost Adjusted" data have a very different impact on funding in New York City than they do in other school districts within the state of New York.

Moreover, focusing solely on data sets that include New York City, applying a regional cost adjustment to the data appears to increase the variance and Gini coefficients indicating greater levels of inequity. This appears to be the case whether one applies it to "Unadjusted" or "Needs Adjusted" data. In both instances, the "Cost Adjusted" and "Needs and Cost Adjusted" indices produce measures indicating greater inequity. A nominal increase in measured equity does occur when using a "Needs Adjusted" data set. The greatest inequity is calculated when "Needs and Cost Adjusted" data are included. Once again, the impact of these cost adjustments indicates that issues considered within the cost adjustment provide a much different burden for the city of New York than they do for the rest of the districts within the state. A final point of interest that should be made is the size of the New York City school district compared with the rest of the state. Approximately one-half of the children attending public school in the state of New York attend New York City schools. This means that if New York City is included in the analysis, then approximately one-half of the data points in the analysis reflect the policies and resources of New York City.

With regard to the McLoone index, in comparing analyses excluding New York City with analyses including New York City, if New York City is included, the measures of equity increase for "Unadjusted" and "Needs Adjusted" data, but decrease for "Cost Adjusted" and "Needs and Cost Adjusted" data. In reviewing analyses that include New York City, one again sees that applying a cost adjustment to the data, whether it is "Unadjusted" or "Needs

Adjusted," produces measures of greater inequity, 0.7978 and 0.7966 with "Needs and Cost Adjusted" data indicating the greatest inequity (see table 1). "Unadjusted" data provide measurements of greatest equity, 0.9292, followed by "Needs Adjusted" data, 0.9252.

Lastly, we applied these adjustments to data when employing the slope coefficient. Eight regression equations were modeled, analyzing the effect of either median household income or median housing unit value on one of the four measures of per-pupil expenditure as weighted by enrollment. These regressions were performed both including and excluding New York City, resulting in sixteen regression results. An analysis of these results again reveals the impact of cost and needs adjustments when examining the disparity in per-pupil expenditures.

The parameter coefficients presented in tables 2 and 3 and figure 4–7 indicate the change in per-pupil expenditure predicted by a one dollar increase in the independent variable. A positive, statistically significant relationship was found in 14 of the 16 regressions. The "Cost Adjusted" and "Need and Cost Adjusted" regressions on housing value failed to reveal a statistically significant relationship when New York City was included in the sample.

When excluding New York City, an 8.48-cent increase in per-pupil expenditure is expected when there is a one dollar increase in median household income, based upon the "Unadjusted " data set. The r-square explains that 0.3386 of the variation in per-pupil expenditure is explained by median household income using an "Unadjusted" data set. The increase in per-pupil expenditure was 7.7 cents when a "Need Adjusted" data set was used. However, the ability for median household income to explain a change in per-pupil expenditure increases slightly when the data are adjusted for student need, 0.3948. When a "Cost Adjusted" data set is employed, the relationship between median household income and per-pupil expenditure decreases to 0.1793. When using "Cost Adjusted" data, a dollar increase in median household income predicts a 4.8-cent increase in per-pupil expenditure. Lastly, the slope coefficient drops to its lowest value with regard to median household income when a "Need and Cost Adjusted" data set is used. In this case a dollar increase in household income leads to a predicted value of only a 4.5-cent increase in per-pupil expenditure, with household income explaining 0.2266 of the change in per-pupil expenditure.

If one includes New York City, the relationship between household income and per-pupil expenditure increases as does the explanatory power of median household income. However, the same pattern of explanatory power resonates with a dollar increase in household income utilizing "Unadjusted" data reflecting the greatest increase in per-pupil expenditure, 8.99 cents. A dollar increase based upon "Needs Adjusted" data indicates a 8.23-cent increase, "Cost Adjusted" 7.59 cents and "Needs and Cost Adjusted" 6.96 cents. "Needs Adjusted" data shows median household income to have the strongest explanatory power, 0.4509, "Unadjusted" data providing the second strongest explanatory power, 0.3908, and cost adjusted data the weakest relationship, 0.2748.

With regard to housing unit value, excluding New York City, once again using "Unadjusted" data provides the largest slope coefficient, 0.0188, indicating a dollar increase in housing unit value predicts a 1.88-cent increase in per-pupil expenditure. "Needs Adjusted" data indicate a 1.64-cent increase in per-pupil expenditure. "Cost Adjusted" indicates a 1.11-cent increase and "Needs and Cost Adjusted" indicates a 0.98 cent increase. "Needs Adjusted" data provide evidence for the greatest explanatory power, 0.5278, with "Unadjusted" data second, 0.4895, "Needs and Cost Adjusted" third, 0.3575, and "Cost Adjusted" data showing the weakest relationship, 0.2853. Including New York City does not appear to significantly change these relationships. "Unadjusted" data still provides for the greatest increase in per-pupil expenditure, 1.88 cents, followed by "Needs Adjusted," 1.64 cents, "Cost Adjusted," 0.14 cents, and "Needs and Cost Adjusted," 0.12 cents. This time "Needs Adjusted" and "Unadjusted" data both provide the strongest evidence for the explanatory power of housing unit value, 0.2161, with "Cost Adjusted" and "Need and Cost Adjusted" data providing negligible explanatory power, 0.0031 and 0.0015, respectively.

Table 2.—Type II equity measures: Median household income

	Slope coefficient	Standard error	R-square
A. Excluding New York City			
Unadjusted	0.0848	0.0045*	0.3386
Needs adjusted	0.0770*	0.0036	0.3948
Cost adjusted	0.0480	0.0039*	0.1793
Needs and cost adjusted	0.0450	0.0032*	0.2266
B. Including New York City			
Unadjusted	0.0899	0.0043*	0.3908
Needs adjusted	0.0823	0.0034*	0.4509
Cost adjusted	0.0759	0.0047*	0.2748
Needs and cost adjusted	0.0696	0.0039*	0.3121

*Significance at p = 0.001.

SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Table 3.—Type II equity measures: Median housing unit value

	Slope coefficient	Standard error	R-square
A. Excluding New York City			
Unadjusted	0.0188	0.0007*	0.4895
Needs adjusted	0.0164	0.0006*	0.5278
Cost adjusted	0.0111	0.0006*	0.2853
Needs and cost adjusted	0.0098	0.0005	0.3175
B. Including New York City			
Unadjusted	0.0118	0.0009*	0.2161
Needs adjusted	0.0100	0.0007*	0.2161
Cost adjusted	0.0014	0.0010	0.0031
Needs and cost adjusted	0.0012	0.0008	0.0015

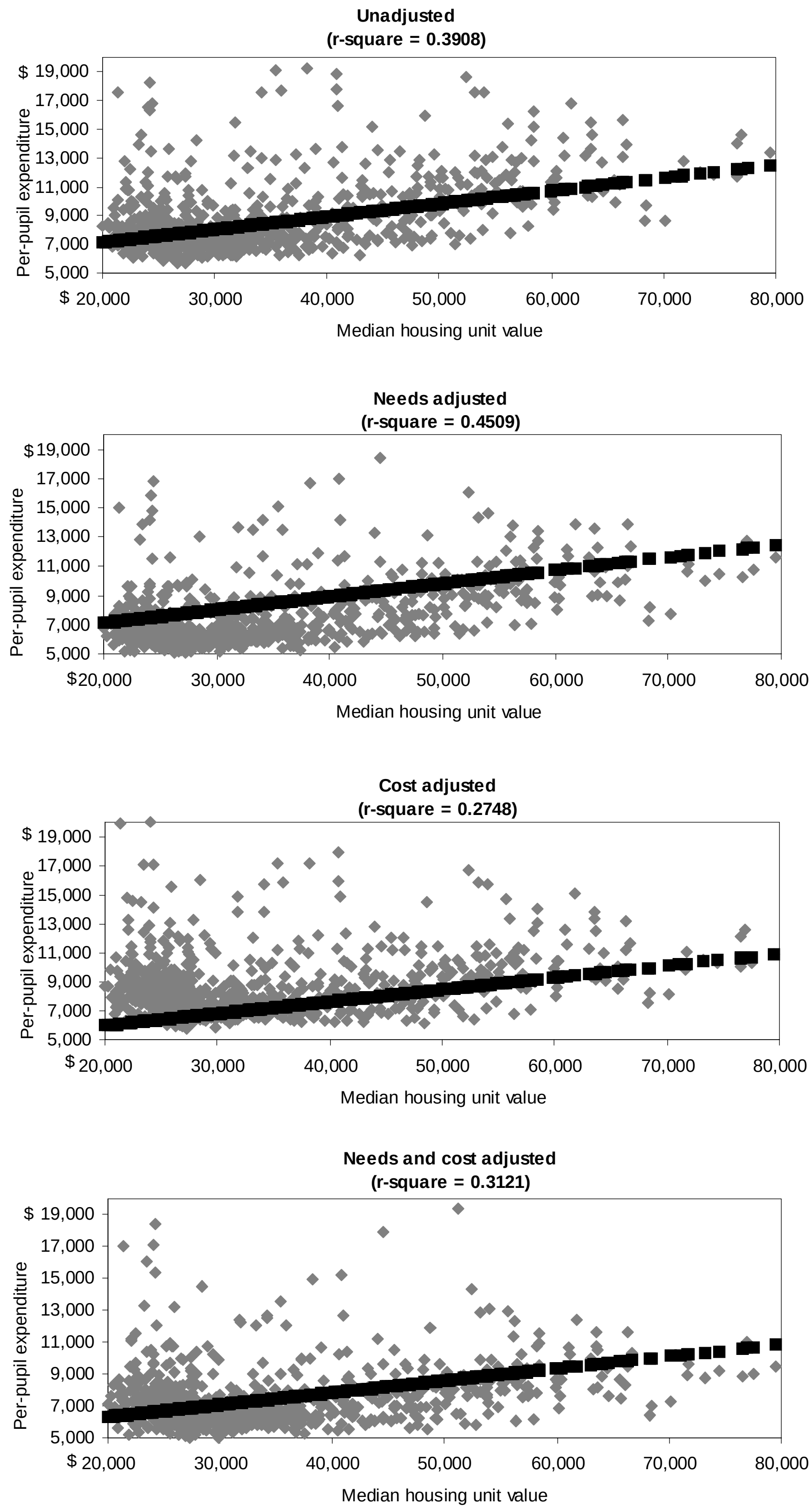
*Significance at p = 0.001.

SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

To interpret these findings, one might conclude that cost adjustments hinder the explanatory power of median household income and housing unit value because many of the issues these adjustments address are already taken into consideration and serve as components contributing to the housing unit value and household income. In contrast, student needs adjustments serve to increase the explanatory power of the items because they provide no overlapping of issues and instead present a more accurate portrayal of the burden faced by each school district. Thus, the importance of the relationship between PPE and the independent variables depends upon the relative size of each adjustment. In addition, conclusions regarding the relationship of school district wealth and school district spending are affected by the type and nature of the measurement of school district wealth and the adjustment employed.

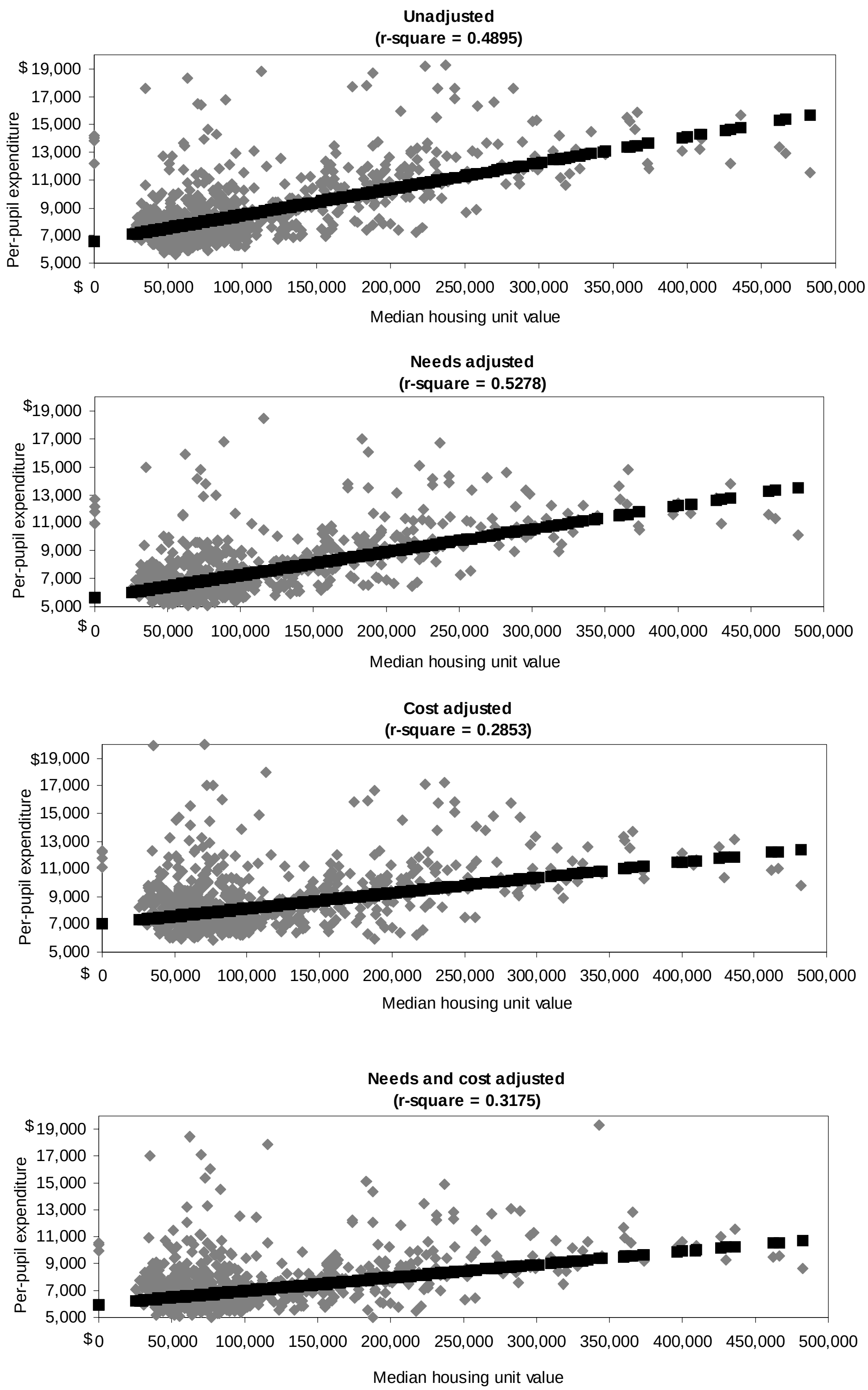
A second dynamic that is interesting to note, is that median housing unit value has a larger effect

Figure 5.—Regression analysis of per-pupil expenditure by median household income: Analysis of New York State including New York City



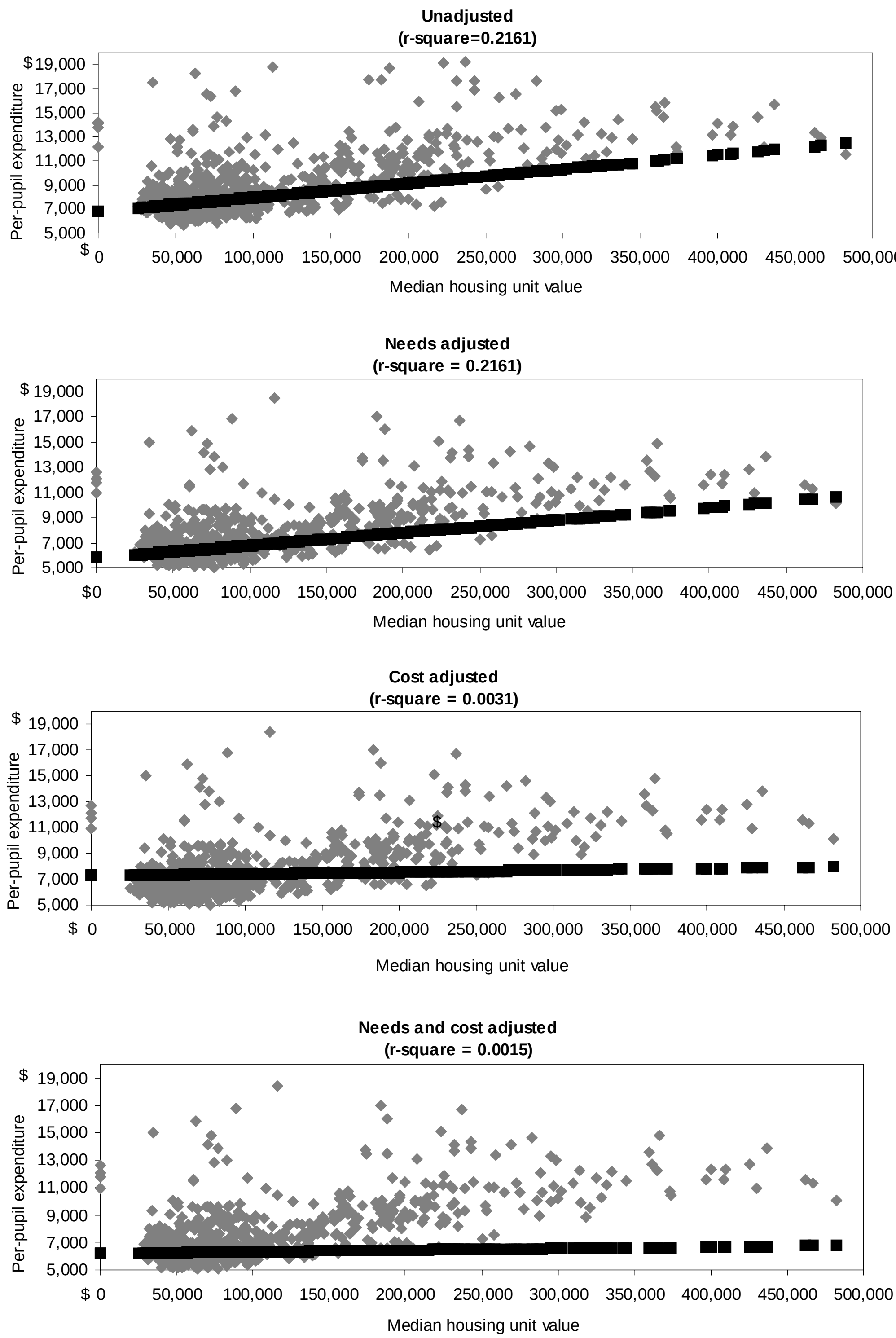
SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 6.—Regression analysis of per-pupil expenditure by median housing unit value: Analysis of New York State excluding New York City



SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

Figure 7.—Regression analysis of per-pupil expenditure by median housing unit value: Analysis of New York State excluding New York City



SOURCE: Special tabulation by authors from the Common Core of Data (CCD) using only New York State.

with per-pupil expenditure when New York City is excluded, but median household income has a larger effect when New York City is included. This difference may be attributed to the fact that New York City real estate is exceedingly expensive and not necessarily reflective of the city population's ability to financially support education. Household income, in contrast, is not as inflated when compared to the rest of the state.

In summary, results presented in this case study demonstrate the varying impact different adjustments may have depending upon what geographic locations are included within the data set and what measures and types of analyses are employed within one's work. Clearly, no uniform conclusions can be reached. Measures of equity do not always increase or decrease depending on the adjustment employed. Instead, these results indicate one's need to be aware of the basis for the adjustments and the power they hold when considering whether or not to employ them in one's work.

. . . student needs adjustments serve to increase the explanatory power . . . because they provide no overlapping of issues and instead present a more accurate portrayal of the burden faced by each school district.

Conclusion

This study investigated a number of methods to measure and adjust for contextual variations in the cost of education based on the student population served and the costs experienced with different geographic regions. The paper began by identifying and defining various adjustments. These adjustments included a weighted pupil model and three cost-of-education indices that have been developed in prior research [i.e., Average-teacher-salary index (Barro,1992); Cost of Living Index (McMahon and Chang, 1991); Teacher Cost Index (Chambers and Fowler, 1995)]. These indices are related and generally provide similar cost estimates across states. However, some interesting variations emerge when comparing indices. These variations suggest that in some localities, teacher costs are more strongly influenced by particular features than others (e.g., cost of living versus teacher preparation and experience, or hedonic considerations). Thus, not only is there great diversity in funding, but there is diversity across local communities in the types of characteristics that influence this diversity.

The second section of the paper then defined and compared four types of equity measures previously established in the literature (i.e., coefficient of variance, the Gini coefficient, the McLoone Index, and a slope coefficient). Lastly, the final section of this paper presented a case study which applied the weighted pupil model and the TCI index to equity analyses to determine what impact these adjustments may have upon financial analyses.

Results from the study indicate that adjustments may impact results in a variety of fashions depending on the information included in the data set and the type of analyses conducted. For the state of New York, the TCI adjustment appeared to have a far more significant impact on the analysis than the needs adjustment. This may not be true in other states. In New York, the McLoone index also appeared to provide some provocative insight that the variance and Gini coefficient did not present. Once again, this is in part a function of the data sets and adjustments used and may not always appear.

These findings illustrate is the sensitivity of equity analyses and the varying and significant impact of cost and student need adjustments on the conclusions. One must be mindful of the power of these cost and student need adjustments and thoughtful in their utilization.

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