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An Evaluation of Intradistrict Equity in Massachusetts

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equity in school finance

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—MRW
—FXS

EXECUTIVE SUMMARY

Ten years have passed since the Educational Reform Act of 1993 renewed the state's commitment to funding public education and created minimum spending levels or "foundation budgets" for each Massachusetts public school district. Among the results have been significant overall increases in education spending and greater parity in spending across districts. With gross disparities in spending *between* districts receding as a defining feature of public education in Massachusetts, disparities *within* districts have emerged as a potentially important source of inequity in the allocation of educational resources.

Included in the 1993 legislation was a requirement for districts to report school-level expenditures by spending category. Fiscal year 2001 was the first year for which these data were reported. With this system now in place to gather detailed school-level data on instructional expenditures, Massachusetts is well positioned to be at the forefront of research and policymaking in this area.

We have uncovered substantial variation between schools in the level of per-pupil spending on instruction within the state's seven largest school districts.

In the first independent analysis of these data, we have uncovered substantial variation between schools in the level of per-pupil spending on instruction within the state's seven largest school districts—variation that is undetectable in the aggregate data still used in most educational research. Predictably, we find that much of the variation in instructional spending between schools is attributable to the cost of special education. Within Boston, schools with a relatively large percentage of students with limited English proficiency also tend to spend more per pupil than the district's other schools.

Other results are less expected. In the six districts outside of Boston, schools with relatively high percentages of minority students tend to spend more on instruction than the other schools in the district, taking into account the observable educational characteristics of their student bodies. Within Boston, no such relationship is observed, and schools with a relatively high percentage of low-income students actually spend less per pupil than other Boston schools. Further analysis suggests that the income-related spending disparities within Boston are driven entirely by differences in spending from local revenue sources, with spending from federal and state grants playing a modest compensatory role. Outside of Boston the compensatory effect of external grants is more dramatic, while the allocation of local funds is neutral with respect to the demographic composition of schools' enrollments.

Variation of the magnitude we observe suggests that in a district operating at or near its foundation budget level, many students are likely to be in schools spending substantially less than the legislated minimum.

While variation in per-pupil spending within these districts is substantial, the level of variation is still well below the remaining disparities among Massachusetts districts. Although interdistrict variation in total educational spending in Massachusetts has declined steadily since the passage of the 1993 Education Reform Act, the lowest spending school in our Boston sample spends in excess of $500 per pupil more on instruction than the district mean for Lynn. In contrast to the situation for districts, there is no statutory regulation ensuring that individual schools are adequately financed. Variation of the magnitude we observe suggests that in a district operating at or near its foundation budget level, many students are likely to be in schools spending substantially less than the legislated minimum.

The availability of school-level data on expenditures, enrollment, and achievement as measured by MCAS scores provides researchers with the opportunity to learn a great deal about the Commonwealth's public schools. Our own analysis of funding equity

demonstrates clearly how a school-level approach can reveal relationships between variables that are obscured when the data are viewed in the aggregate. Among the issues that might be explored in future work using these data are the various processes and criteria by which funds are distributed within particular districts and whether similar patterns prevail in smaller suburban or rural districts. Furthermore, as additional years of data become available it may be possible to assess the efficacy of different patterns of resource allocation within schools (e.g., more or less on teacher salaries, professional development, etc.) as measured by the achievement gains made by the students who attend them.

An Evaluation of Intradistrict Equity in Massachusetts

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I. INTRODUCTION

At the heart of Massachusetts' landmark 1993 Education Reform Act was a straightforward bargain: The state would ensure that each school district had a minimum or "foundation" level of school funding, and schools and their students would in turn be held to higher standards for academic performance. By the 2000-01 academic year, each district in the state had reached its "foundation budget"—the state's district-by-district definition of adequate funding. This mandate for a minimum expenditure and increases in state aid have helped raise average per-pupil spending in the Commonwealth to among the highest in the nation and reduce the longstanding relationship between local property wealth and spending on local schools.[1] Yet while clear progress has thus been made toward an equitable distribution of educational resources across school districts, the distribution of resources among individual schools within districts has been largely ignored.

The importance of a school-level approach to spending equity is clear. A growing number of studies have shown that district-level analyses can conceal substantial disparities in the amount of money reaching individual students.[2] More troubling, some scholars have found that schools with a high percentage of minority and low-income students tend to receive a disproportionately smaller share of district resources. A recent study of spending in New York City public schools, for example, found that elementary schools with a higher percentage of students eligible for the federal free lunch program (a standard measure of socioeconomic disadvantage) spent significantly less than the citywide average during the 1997-98 academic year, holding constant the educational characteristics of their student bodies.[3]

While clear progress has thus been made toward an equitable distribution of educational resources across school districts, the distribution of resources among individual schools within districts has been largely ignored.

In contrast to its district-level approach to spending equity, the performance standards mandated by the 1993 Education Reform Act (ERA) operate at the level of the school—and even of the individual student. Schools deemed "chronically failing" are subject to sanctions from the state board of education, and as of spring 2003 students are required to pass the 10th grade MCAS test in order to graduate.[4] In theory, the threat of punishment for under-performing schools and students should motivate districts to ensure that each school receives an adequate share of total resources. Moreover, external grants for schools with large numbers of economically disadvantaged students should provide the means to target additional resources at those who need them most. In practice, the level of spending in different schools within the same district may reflect considerations other than the educational needs of the students. An equitable distribution of spending within districts cannot be assumed; it must be assessed empirically.

In this study, we use newly available data on instructional expenditures per pupil at the level of the individual school to evaluate the distribution of educational resources within each of the Commonwealth's seven largest school districts. The districts are (in alphabetical order) Boston, Brockton, Lowell, Lynn, New Bedford, Springfield, and Worcester. The paper investigates two related issues:

1) How much school-to-school variation is there in per-pupil spending on instruction within each of Massachusetts' seven largest school districts? To address this question, we present a variety of descriptive statistics on the variation between *schools* (intradistrict equity) and compare it to the amount of variation found between *districts* for the Commonwealth as a whole (interdistrict equity).

We use newly available data on instructional expenditures per pupil at the level of the individual school to evaluate the distribution of educational resources within each of the Commonwealth's seven largest school districts.

2) Which schools receive a disproportionate share of each district's fiscal resources? We explore this issue by examining how the demographic characteristics of schools' student bodies are related to spending levels. We provide additional insight by comparing patterns of resource distribution according to the source and uses of the funds, devoting particular attention to how the allocation of local appropriations (which includes state education aid) differs from expenditures funded primarily by special federal and state grants.

Selection of Districts and Schools for Analysis

Intradistrict equity is particularly likely to be a problem in large urban school districts, which face the unenviable task of managing resource allocation among a large number of schools with varying needs. Although they represent only a small fraction of the total number of districts in the Commonwealth, nearly 20 percent of K-12 students attended a school managed by one of Massachusetts's seven largest districts during the 2000-01 school year.

Within these districts, we restrict our analysis to primary and middle schools. Even the largest districts in Massachusetts have only a few high schools, precluding systematic analysis of intradistrict spending variations at the high school level. Our analysis requires the availability of school-level data on expenditures, enrollment, and MCAS performance for regular education students in either the fourth or the eighth grade; we therefore exclude a small number of schools for which these data were not available. This approach yields a sample of schools that are roughly comparable in terms of the services they offer. The sample includes 272 schools in total, made up of 224 primary and 48 middle schools (see table A-1, page 10).

Comparing Boston and Non-Boston Districts

We also compare the distribution of spending within Boston Public Schools (BPS) to the distribution within the other districts in our sample. BPS differs from the other six districts in potentially important ways.

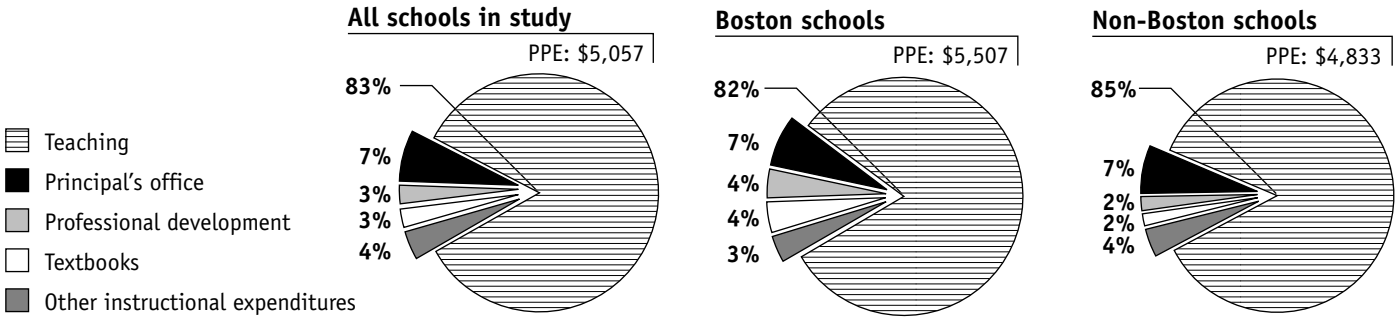
With total enrollment of nearly 63,000 students in 2000-01, the Boston school district manages 99 elementary and middle schools compared with 44 in Worcester, the district with the next highest number. The Boston Public Schools also serve a greater percentage of special education students and students with limited English proficiency (LEP) than the other districts in the sample, further complicating the task of distributing resources in an equitable manner. Finally, the relatively large percentages of low-income and minority students (87 percent and 80 percent, respectively) within BPS provide an opportunity to study the allocation of educational resources among an especially disadvantaged population.

Instructional Expenditures

Our analysis of intradistrict equity is based on *instructional* expenditures per pupil, rather than the total amount of money each school spends per student or non-financial resource measures. In Massachusetts as a whole during the 2000-01 academic year, instructional expenditures accounted for $4,834 of the $6,758 total average expenditure per pupil, or more than 70 percent. (See appendix A for information on data sources.)

Figure 1 shows the distribution of instructional expenditures per pupil in the four major categories. Teacher salaries account for 83 percent of the total across all seven districts. Spending related to the principal's office, professional development, and textbooks make up the bulk of the remainder. Although Boston spends a slightly smaller proportion of its funds on teacher salaries relative to the comparison districts and a larger proportion on professional development, these differences are relatively minor.

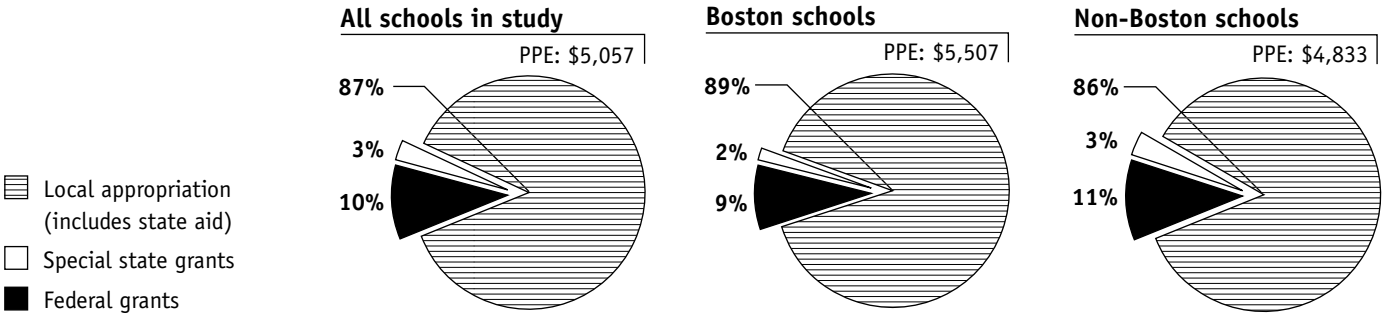
Figure 1: Instructional Expenditures Per Pupil by Spending Categories, by percentage of total



Note: All spending figures are cost-adjusted and weighted by enrollment. Other instructional expenditures include spending on supervisory, technology and guidance/counseling.

Figure 2 breaks out total spending on instruction into three categories according to revenue source. More than 87 percent of instructional spending is funded by revenues classified as local appropriations, a significant portion of which is derived from state education funding. Federal grants comprise another 10 percent, while special state grants account for virtually all of the remainder.

Figure 2: Instructional Expenditures Per Pupil by Revenue Source, by percentage of total



Note: All spending figures are cost-adjusted and weighted by enrollment. A third source, "revolving and special revenue funds," is not included in the figure because only a small number of schools receive funds through these sources, producing a district-wide average from this third source of less than $3/pupil in Boston and less than $1/pupil in the non-Boston districts.

II. HOW MUCH DOES SPENDING VARY WITHIN DISTRICTS?

All seven districts have coefficients of variation for per-pupil instructional expenditures between 0.12 and 0.2 when we look at primary and middle schools combined, which indicates significant variation in spending.

We use two figures to provide an initial description of the amount of school-to-school variation in funding. Figure 3 plots the ratio between the per-pupil instructional expenditure level calculated for each school and the enrollment-weighted mean value for all the schools in the district.[5] The figure confirms substantial dispersion, particularly at the upper end of the distribution. The highest spending school relative to its district mean is B. B. Russell Junior High in Brockton, with instructional expenditures of more than 218 percent of the enrollment-weighted mean for Brockton primary and middle schools. And Russell Junior High is not the only big spender; four other schools spend more than 150 percent of the mean for their districts, and 59 of 272 schools spend more than 110 percent.

It is not surprising that there are some high spending schools, as some schools offer special programs that require additional resources. Russell Junior High, for example, offers an alternative education program for students who have had disciplinary problems at other Brockton schools. Equally important is the fact that no one is likely to complain if his or her school receives more than its fair share. This same logic might lead us to expect dispersion below the mean to be less dramatic: schools require some minimum level of resources simply to remain in operation, and leaders of underfunded schools are likely to take action to move themselves in line with their district peers.

Figure 3. Overall Variation in Per Pupil Spending

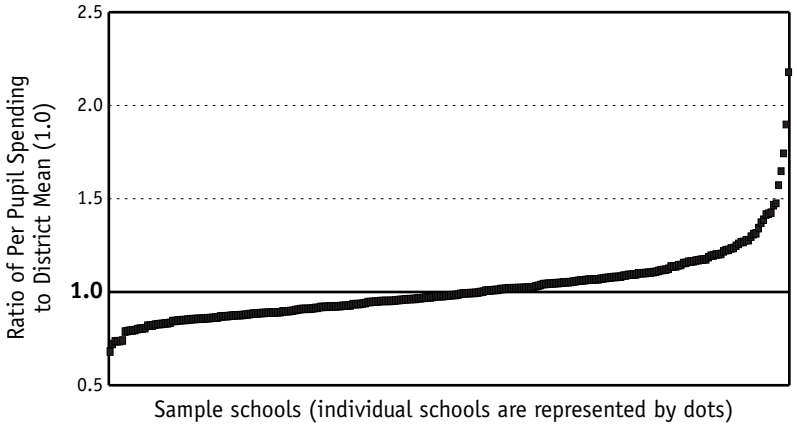


Figure 3 confirms the absence of strong outliers at the bottom of the distribution, as no school is found to be spending less per pupil on instruction relative to other schools in its district than the 68 percent spent by Edward A. Sisson Elementary in Lynn. The next five lowest spenders in relative terms are all elementary schools in Worcester, each spending between 72 and 75 percent of the Worcester mean. Fully 74 of the 272 schools in our sample report per-pupil expenditures on instruction of less than 90 percent of the district mean.

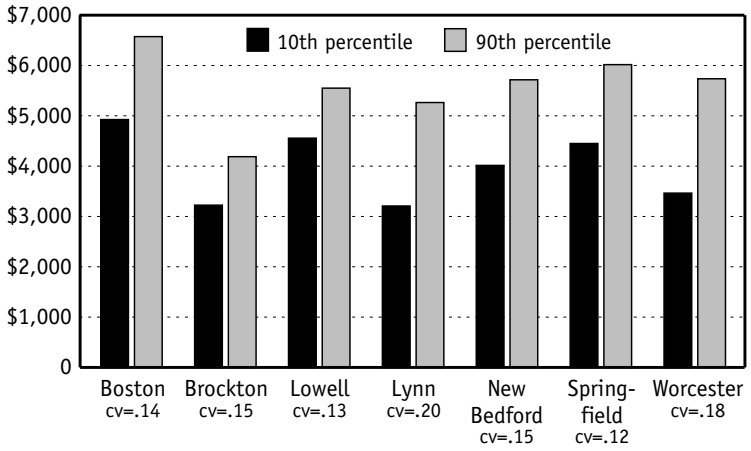
We can summarize the extent of variation both overall and within each district with a single number called the *coefficient of variation*, a commonly used measure in equity analyses. The coefficient of variation is calculated by dividing the standard deviation of a set of observations by its mean. It thus provides a sense of the degree to which observations are spread around their average value. The coefficient of variation can range from 0 to any positive value, with 0 representing perfect equity. In studies of interdistrict finance, coefficients of variation above 0.1 are generally considered to indicate substantial inequity.

By this measure, the distribution of expenditures overall among our sample districts is somewhat inequitable, with an aggregate coefficient of variation of 0.16 when each school's spending is measured relative to its district mean. This same conclusion applies when we look at each district individually. All seven districts have coefficients of variation for per-pupil instructional expenditures between 0.12 and 0.2 when we look at primary

and middle schools combined, which indicates significant variation in spending. Looking only at primary schools, Brockton's coefficient of variation is 0.1 exactly; the remaining six districts remain above this threshold. The coefficients for three districts increase when middle schools are excluded, with Worcester's jumping all the way to 0.2.

Variation in spending can also be seen by comparing schools at the top and bottom of the spending distribution. For each of the seven districts included in our analysis, we ranked the schools from top to bottom according to the amount of money spent annually on instruction for each student. Figure 4 compares per-pupil spending on instruction in the school attended by the student in the 10th percentile of each district's distribution with the school attended by its 90th percentile student. The difference in heights between the two bars in each district indicates how much more schools at the top end of each district's distribution spend on instruction than schools at the bottom. In Worcester, for example, where this difference is largest in absolute terms, the 10th percentile school spends $3,464, as compared with $5,736 in the 90th percentile school. The figure confirms that the disparities apparent in figure 3 are not concentrated exclusively within a few districts. The amount of variation in spending across schools appears to be roughly comparable across our seven sample districts.

Figure 4. Comparison of Per Pupil Spending in 90th and 10th Percentiles in Seven Massachusetts Districts



We can also compare the coefficient of variation with the amount of variation in spending currently observed across all 378 of the state's operating school districts. Unfortunately, data on instructional expenditures for all programs are not available by district, forcing us to rely instead on total spending per pupil for instructional and non-instructional purposes. By this measure, interdistrict variation in educational spending in Massachusetts has declined steadily since the passage of the 1993 Education Reform Act, from an enrollment-weighted coefficient of variation of 0.35 in 1993-94 to 0.28 in the 2000-2001 school year.

On the whole, then, intradistrict variation in per-pupil spending on instruction in our sample districts appears to be somewhat less pronounced than the remaining variation between districts in the Commonwealth as a whole. The continued salience of interdistrict variation can be demonstrated even within our own sample by the fact that the lowest spending school in our Boston sample spends in excess of $500 per pupil more on instruction than the district mean for Lynn.

Intradistrict variation in per-pupil spending on instruction in our sample districts appears to be somewhat less pronounced than the remaining variation between districts in the Commonwealth as a whole.

In contrast to the situation for districts, there is no statutory regulation ensuring that individual schools are adequately financed. Variation of the magnitude we observe suggests that in a district operating at or near its foundation budget level, many students are likely to be in schools spending substantially less than the legislated minimum—a possibility that makes an examination of the correlates of different spending levels all the more salient.

III. INTRADISTRICT VARIATION IN SPENDING AND STUDENT CHARACTERISTICS

What school and student characteristics are associated with the observed variation in instructional expenditures within districts? To identify the factors associated with higher and lower instructional expenditures per pupil, we use two models of Ordinary Least Squares (OLS) regression, which are each applied to all seven districts (a), Boston only (b), and the six non-Boston districts (c). District dummy variables are included in models (a) and (c) to controls for differences in average spending between districts. The first model accounts for the size of the school's enrollment, whether the school is a middle school, the percentages of special education and LEP students, and the school's MCAS performance during the previous academic year;[6] the second accounts for these variables as well as the percentages of minority and low-income students. Each of the enrollment variables is standardized by district to ensure that the analysis looks exclusively at intradistrict variation. That is, we ask whether schools spend more or less than their district peers when they have more students with a given characteristic relative to the other schools in the same district. (Complete model specifications appear in appendix A.)

Schools with larger enrollments tend to spend less per pupil.

All Districts

Looking first across all seven districts in our sample, we find that schools with larger enrollments tend to spend less per pupil. The relationship between enrollment size and spending is highly statistically significant. Assuming the quality of education provided is the same in small and large schools, this suggests that there are modest economies of scale in educating a larger number of students. The first model (1a) estimates that each additional student in a school is associated with approximately one dollar less in per-pupil spending on instruction, holding constant the educational and demographic characteristics of its student body. These relatively large spending differences are likely driven by the fact that districts typically allocate some salaried positions (e.g., school librarian or nurse) by school rather than according to the number of students enrolled. This finding confirms the importance of controlling for relevant school characteristics that may affect per-pupil costs when assessing variations in spending.

Across all seven districts, schools whose special education enrollment is relatively higher spend more per pupil on instruction.

In these analyses we assume that the relationship between a given characteristic (e.g., percent minority) and spending is the same within each of the seven districts, but the magnitude of the variation is measured relative to the amount of variation in the district. Across all seven districts, schools whose special education enrollment is higher by one standard deviation spend in excess of $350 more per pupil on instruction. The school-level standard deviation in the percentage of students in special education ranges from just 3.2 percent in Lowell to 7.4 percent in Boston, suggesting that relatively small differences in the percentage of students in special education are associated with fairly substantial variations in spending. Table 1 gives the mean and standard deviation by district for each of the enrollment variables.

Perhaps surprisingly, the relationship between the percentage of students with limited English proficiency (LEP) and per-pupil instructional expenditures is considerably less pronounced. Despite substantial variation between schools in the percentage of students with limited English proficiency, a standard deviation difference in the percentage of LEP students within a given district is associated with only $100 in additional instructional

spending per pupil. And even this modest relationship loses statistical significance when demographic controls are introduced (model 2a). Special programs for students lacking proficiency in English do not appear to account for a very large share of intradistrict variations in spending in our sample as a whole.

Table 1. School District Characteristics, Mean and Standard Deviation (SD), 2000-01

	% Special Ed		% LEP		% Minority		% Low income	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Boston	20.0	7.4	21.0	17.2	87.2	11.3	80.1	7.0
Brockton	12.1	4.5	7.1	9.9	57.2	8.4	42.9	19.9
Lowell	10.7	3.2	12.8	8.5	55.9	10.1	66.9	13.6
Lynn	12.7	3.8	14.5	9.7	56.6	19.6	65.4	20.2
New Bedford	16.9	6.9	4.0	5.4	33.2	15.8	65.5	16.0
Springfield	14.1	4.4	12.0	9.1	76.8	9.8	72.7	17.0
Worcester	14.4	6.2	7.3	9.5	47.5	9.5	55.5	19.4

Still looking collectively at all seven of our sample districts (model 2a), the percentage of minority and low-income students relative to other schools in the same district are both statistically unrelated to per-pupil spending on instruction. Nor do the schools with particularly low MCAS scores the previous year, relative to the district mean, receive a disproportionately high or low share of their district's spending on instruction.

Boston vs. Non-Boston

When we compare the allocation of resources in Boston and non-Boston districts, we see that the magnitude of the relationships between special education and spending on instruction as well as LEP students and spending on instruction varies considerably. Model 2b (Boston only) indicates that a one standard deviation (equal to 7.4 percentage points) increase in the percentage of students in special education in a given school within Boston is associated with more than $600 in additional spending per pupil. Meanwhile, an increase of one standard deviation in the percentage of special education students within the non-Boston districts—equivalent to a change of about 5 percentage points on average across the six districts—is associated with just $250 of additional spending per pupil (model 2c). In Boston, moreover, a one standard deviation (17.2 percentage points) increase in the percentage of LEP students is associated with approximately $200 of additional spending on instruction per pupil. Outside of Boston, the relationship between spending and percentage of LEP students disappears entirely. This difference likely reflects the fact that Boston has a higher percentage of LEP students overall, larger differences between schools in the percentage of LEP students, and a more linguistically diverse group of students in need of language instruction.

In the six non-Boston districts, schools with more minority students spend considerably more per student.

We can also compare spending on minority and low-income students in Boston and non-Boston districts. In the six non-Boston districts, schools with more minority students spend considerably more per student (model 2c), even after controlling for their educational characteristics. A one standard deviation difference in the percentage of students who are minorities in these districts is associated with more than $130 in additional spending on each student. Within Boston, however, no such relationship is observed; in fact, the sign of the coefficient is actually negative, although statistically insignificant.

Boston schools with large low-income populations actually spend substantially less per pupil on instruction, a result that remains statistically significant even when controlling for the educational characteristics of the student body (model 2b). Among Boston

schools, a one standard deviation (7.0 percentage points) difference in the percentage of low-income students is associated with some $135 less in instructional spending per student. The corresponding estimate for the six non-Boston districts, although indistinguishable from zero statistically, is positive and substantial in magnitude (roughly $85).

Among Boston schools, a one standard deviation (7.0 percentage points) difference in the percentage of low-income students is associated with some $135 less in instructional spending per pupil.

In sum, the implications of intradistrict variations in resources for minority and low-income students appear to be quite different in Boston and non-Boston districts in our sample—a difference that is obscured when we look at all seven districts together. Further analysis suggests that the inverse relationship between percent low-income and instructional spending per pupil in Boston is driven predominantly by non-teaching expenses.[7] This is particularly puzzling given that spending on teachers' salaries accounts for so large a portion of Boston's total spending on instruction (more than 81 percent).

On the other hand, the positive relationship between percent minority and spending outside of Boston emerges for both teaching and non-teaching expenditures. Likewise, the additional money spent in schools with a large percentage of students in special education both inside and outside of Boston appears to be divided among teaching and non-teaching expenses roughly in proportion to their respective shares of total spending on instruction.

Spending by Source: Local Appropriations vs. State and Federal Grants

As figure 2 indicates, non-local funding is largely made up of federal (and to a lesser extent, state) grants. Spending patterns within our sample of districts differ considerably according to funding source. Within Boston, spending from local appropriations is distributed inequitably with respect to the percentage of low-income students in a school. By contrast, money from external revenue sources appears to be allocated in a compensatory manner with respect to low-income students, although this relationship is only statistically significant at the 0.125 level. A positive relationship between grant money and our best measure of socioeconomic disadvantage is expected, since most federal and state grants are explicitly targeted at schools with disadvantaged student bodies. But as the overall spending patterns discussed above confirm, within Boston this targeting is far from sufficient to make up for the gross disparities in local appropriations reaching these schools. Additional money spent on special education and on LEP students in Boston comes almost exclusively from local appropriations.

Within Boston, spending from local appropriations is distributed inequitably with respect to the percentage of low-income students in a school. By contrast, money from external revenue sources appears to be allocated in a compensatory manner with respect to low-income students.

Outside of Boston, the compensatory allocation of federal and state grants is even more pronounced, with large and statistically significant relationships with both percent low-income and percent minority. Indeed, spending from grant money alone is able to account for virtually all of the positive relationship between the percentage of minority students and total instructional spending. In contrast to Boston, spending from local appropriations in these six districts appears to be distributed neutrally with regard to the socioeconomic status of a school's student body.

These results suggest that federal grant programs for at-risk students such as Title I are effectively reaching their target populations, while locally appropriated funds are not being specifically directed to low-income students. Within Boston, schools with a high percentage of low-income students actually receive less in local appropriations. This raises the possibility that districts may be reducing funding for low-income students, allowing external funds to make up some of the difference. Our data unfortunately do not allow us to gain further leverage on this question. It seems clear that districts should be careful not to rely exclusively on external grants to serve their at-risk student populations. If state or

federal economic climates force cutbacks in education funding, districts that rely heavily on external grant funds may end up with severe inequities. Federal and state grant makers interested in equity will want to take measures to ensure that schools targeted for grants receive their fair share of local funds; the Boston Public Schools would be a good place for them to start.

IV. RECOMMENDATIONS FOR FUTURE RESEARCH

The availability of school-level data on expenditures, enrollment, and achievement as measured by MCAS scores provides researchers with the opportunity to learn a great deal about the Commonwealth's public schools. Our own analysis of funding equity demonstrates clearly how a school-level approach can reveal relationships between variables that are obscured when the data are viewed in the aggregate. Among the issues that might be explored in future work using these data are the various processes and criteria by which funds are distributed within particular districts and whether similar patterns prevail in smaller suburban or rural districts. Furthermore, as additional years of data become available it may be possible to assess the efficacy of different patterns of resource allocation within schools (e.g., more or less on teacher salaries, professional development, etc.) as measured by the achievement gains made by the students who attend them.

Future work might explore the various processes and criteria by which funds are distributed within particular districts and whether similar patterns prevail in smaller suburban or rural districts.

APPENDIX A

1. School Expenditure Data: We use FY 01 (academic year 2000-01) instructional expenditures data as reported by each district to the Massachusetts Department of Education on the form "Schedule 3 Individual School Expenditures For FY 2001." Instructional expenditures are the only type of spending for which the state Department of Education currently collects data at the level of the individual school. The fact that this was the first year in which school-level expenditure data were collected suggests the need for some caution in interpreting our results. The staff of the Massachusetts Department of Education did provide guidance to districts throughout the data collection process and ran extensive plausibility tests on the data submitted by each district prior to its release.

Each school's expenditure data are organized according to the source and to how the funds are allocated. In addition to total instructional expenditures, we consider spending in seven subcategories: supervisory; principal; teaching; professional development; textbook and instructional equipment; technology and media; and guidance and psychological. Expenses not included in any of these broad categories are classified as non-instructional expenditures and consist primarily of spending on administration, maintenance, and employee benefits.

Table A-1. Number of Schools with Complete Expenditure and Enrollment Data, by District and School Type[a]

	Primary schools	Middle schools	Total # schools	District enrollment
Boston	79	20	99	62,731
Brockton	15	5	20	16,582
Lowell	20	7	28	16,496
Lynn	18	3	21	15,051
New Bedford	22	3	25	15,393
Springfield	31	5	36	26,332
Worcester	39	5	44	25,633
TOTAL	**224**	**48**	**272**	**178,218**

[a] School type was determined according to the National Center for Education Statistics' standard definitions (NCES 2001) as follows: "Primary schools are those with a low grade of PK through grade 3 and a high grade of up to 8. Middle schools contain a low grade of 4 to 7 and a high grade ranging from 4 to 9."

Local appropriations are also broken down according to educational program. We exclude spending not assigned either to regular day, bilingual, or special education programs or as undistributed. With only a few exceptions, schools generally spent very little or nothing at all in the categories we exclude. Dropping them thus amounts to little or no change in our expenditure data.

2. School Enrollment Data: We calculate the amount spent on instruction per pupil during the 2000-01 academic year for each of the schools in our sample by merging the school-level spending data with data on enrollment from the Department's Individual School Reports, now available on the Massachusetts Department of Education's website at **www.doe.mass.edu**. The report records each school's attendance on October 1 and accordingly does not reflect the actual enrollment fluctuations that occur throughout the year.

These enrollment data include total number of students in each school, number of students by race, number of students who are eligible for the free and reduced-price lunch programs, and the percentage of students with Limited English Proficiency (LEP).

When examining variation in school-level instructional expenditures per pupil within districts, we are interested in the socioeconomic and educational characteristics of each student body relative to those of other schools within the district. We found the average values of many of the enrollment variables to vary widely across the districts in our sample (see table 1). We therefore standardize each of the enrollment variables to have

a mean of zero and a standard deviation of one. In other words, we look at the percentage of minorities (LEP, low income, and special education) in each school relative to the mean percentage in the same district.

3. Special Education Enrollment Data: Unfortunately, only in FY 2002 did the state begin to gather special education enrollment data at the school level. To generate a variable for the percentage of special education students in each school in the 2000-01 academic year, we divided the number of special education students enrolled in 2001-02 by the total enrollment in 2000-01. Since the vast majority of students in each school remain the same between the two years, this approach should provide good proxies for FY 2001 percentages of special enrollment students in each primary and middle school.

4. Model Specifications

[1]

$$PPE_k = \beta_0 + \beta_1 SPECIAL\_ED_k + \beta_2 LEP_k + \beta_3 ENROLL + \beta_4 MIDDLE_k + \beta_5 BOSTON + \beta_6 BROCKTON + \beta_7 LOWELL + \beta_8 LYNN + \beta_9 NEWBEDFORD + \beta_{10} SPRINGFIELD,$$

[2]

$$PPE_k = \beta_0 + \beta_1 SPECIAL\_ED_k + \beta_2 LEP_k + \beta_3 LOW\_INCOME_k + \beta_4 MINORITY_k + \beta_5 MCAS_k + \beta_6 ENROLL + \beta_7 MIDDLE_k + \beta_8 BOSTON + \beta_9 BROCKTON + \beta_{10} LOWELL + \beta_{11} LYNN + \beta_{12} NEWBEDFORD + \beta_{13} SPRINGFIELD.$$

where:

PPE_k = Per-pupil expenditures, unadjusted for cost differences, for school k in 2000-01 school year.

$ENROLL_k$ = Total enrollment in school k in 2000-01 school year.

$MIDDLE_k$ = Dichotomous (1,0) variable indicating if the school is a middle school.

$SPECIAL\_ED_k$ = Estimated % of special education students in school k in 2000-01 school year, standardized by district.

LEP_k = % of students enrolled in school k in 2000-01 school year who are LEP, standardized by district.

$MINORITY_k$ = % of non-white students enrolled in school k in 2000-01 school year, standardized by district.

LOW_INCOME_k = % of students enrolled in school k in 2000-01 school year who qualify for free or reduced-price lunch, standardized by district.

BOSTON, … SPRINGFIELD = Dichotomous (1,0) variables indicating if the school is in the particular district or not.

$MCAS_k$ = % of students (in grade 4 and/or 8) in school k who were proficient or advanced on the MCAS in spring 2000.

Table A-2. Ordinary Least Squares Regression Analysis of Variation in PPE[a]; Coefficient and (Standard Error) Reported

	All Districts		Boston		Non-Boston	
	Model 1a +Educational	*Model 2a +SES*	*Model 1b +Educational*	*Model 2b +SES*	*Model 1c +Educational*	*Model 2c +SES*
Special ed[b]	364.97***	357.56***	592.70***	608.58***	278.73***	250.25***
	(49.41)	(49.83)	(80.59)	(81.52)	(62.74)	(62.10)
LEP[b]	90.21**	66.58	160.85**	201.89***	72.72	7.22
	(42.85)	(45.28)	(71.64)	(74.16)	(55.36)	(58.73)
MCAS 2000[c]	-72.29	-2.56	80.40**	43.50	-104.69	-34.45
	(51.89)	(4.76)	(94.7)	(101.59)	(63.57)	(66.35)
Low-income[b]	–	33.90	–	-135.65*	–	84.77
		(48.72)		(76.61)		(61.65)
Minority[b]	–	-61.69	–	-20.33	–	134.40**
		(50.89)		(72.75)		(68.14)
Enrollment	-0.95***	-0.96***	-1.12***	-1.10***	-0.89***	-0.84***
	(0.21)	(0.21)	(0.34)	(0.34)	(0.28)	(0.28)
Middle school	259.44*	226.44*	-32.50*	-39.42	355.42**	280.19*
	(123.47)	(123.42)	(171.85)	(174.00)	(174.54)	(172.66)
District dummy variables?	Yes	Yes	No	No	Yes	Yes
Intercept	6119.74***	6164.51***	6243.37***	6238.88***	5061.72***	5060.31***
	(119.05)	(128.41)	(176.03)	(176.10)	(170.23)	(167.26)
Adj. R^2	0.58	0.58	0.44	0.42	0.44	0.46
F	34.65	29.55	14.60	11.14	14.27	13.25
N	272	272	99	99	173	173

*** = Sig. at .01; ** = Sig. at .05; * = Sig. at .1.

[a] PPE reflects all school committee expenditures on regular day, bilingual, and special education programs, undistributed school committee expenditures, and all grant spending, divided by total enrollment.
[b] All four enrollment variables are standardized relative to other schools in the same district.
[c] Averaged English and Math MCAS scores of regular education students, standardized by district.

Table A-3. Ordinary Least Squares Regression Analysis of Variation in PPE from Local and External Revenues; Coefficient and (Standard Error) Reported[a]

	Boston		Non-Boston	
	Local	*External*	*Local*	*External*
Special ed	561.83***	15.99	202.41***	47.83
	(81.57)	(18.28)	(55.7)	(34.7)
LEP	169.87**	18.34	18.98	-11.76
	(72.58)	(16.27)	(52.68)	(32.81)
Minority	-6.15	-3.48	28.44	105.96***
	(71.41)	(16)	(61.12)	(38.07)
Low-income	-128.71*	27.39†	9.29	75.48**
	(78.83)	(17.67)	(55.3)	(34.45)
MCAS 2000	69.29	-17.78	-16.97	-17.48
	(99.59)	(22.32)	(59.51)	(37.07)
Enrollment	-0.85***	-0.17**	-0.41*	-0.43***
	(0.33)	(0.07)	(0.25)	(0.16)
Middle school	168.02	-179.14***	622.52***	-342.33***
	(170.15)	(38.13)	(154.86)	(96.46)
District dummy variables?	No	No	Yes	Yes
Intercept	5450.34***	732.79***	3805.74***	1254.57***
	(174.04)	(39)	(150.02)	(93.44)
Adj. R^2	0.4285	0.332	0.3683	0.5715
F	11.28	7.82	9.36	20.12
N	97	97	173	173

*** = Sig. at .01; ** = Sig. at .05; * = Sig. at .1; † = Sig. at .125.

[a] Local funding sources include all revenues from the school committee appropriation. External funding sources include all revenues from federal and state grants as well as revolving and special revenue funds.

Note: All four enrollment variables are standardized relative to other schools in the same district.

ENDNOTES

[1] The National Education Association ranked Massachusetts fifth among the states in per-pupil spending for school year 2001-2002, behind the District of Columbia, New York, New Jersey, and Connecticut. *Rankings & Estimates, Rankings of the States 2002 and Estimates of School Statistics 2003,* NEA Research, May 2003, p. 55. Available online at **http://www.nea.org/edstats/images/03rankings.pdf**. For a summary of the issues surrounding the Commonwealth's approach to funding public schools, consult S. P. Crosby, "Wheel of Fortune," *Commonwealth* (Fall 2001): 7-12.

[2] For a comprehensive early review of this research, see S. M. Burke, "An Analysis of Resource Inequality at the State, District, and School Levels," *Journal of Education Finance* 24 (Spring 1999): 435-458; see also J. R. Betts, K. S. Reuben, and A. Dannenberg, *Equal Resources, Equal Outcomes? The Distribution of School Resources and Student Achievement in California.* San Francisco, CA: Public Policy Institute of California, 2000; T. Owens, and J. Maiden, "A Comparison of Interschool and Interdistrict Funding Equity in Florida," *Journal of Education Finance* 24 (Spring 1999): 503-518; M. Roza and K. Hawley-Miles, "Moving Toward Equity in School Funding within Districts," presentation available at **http://www.schoolcommunities.org:16080/images/Presentation.pdf**; L. Stiefel, R. Rubenstein, and R. Berne, "Intra-District Equity in Four Large Cities: Data, Methods, and Results," *Journal of Education Finance* 23 (Spring 1998): 447-467.

[3] P. Iatarola, and L. Stiefel, "Intradistrict Equity of Public Education Resources and Performance," *Economics of Education Review*, 22 (February 2003): 69-78.

[4] The Massachusetts Comprehensive Assessment System (MCAS) includes tests in various subjects for various grade levels. Currently, the graduation requirement consists of a passing score on 10th grade tests in Math and English/Language Arts.

[5] To weight the district mean by enrollment, we multiply each school's per-pupil expenditure by the number of pupils, add the totals, and then divide by the number of students in the district.

[6] Our measure of MCAS performance is the average of the percentage of regular education students in each school receiving a score of proficient or better on the math and reading exams.

[7] Complete results of the separate analyses of teaching and non-teaching expenditures are available from the authors upon request.

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