Getting Less For More:
Lessons in Massachusetts Education Reform

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Executive Summary

The Massachusetts Comprehensive Assessment System (MCAS) has become an important rite of passage for Bay State public school students. Beginning next year, high school seniors will have to pass the test in order to graduate.

In view of the importance of the test, the release of 2001 MCAS test scores brought relief as well as an apparent reaffirmation of the wisdom behind the 1993 Education Reform Act. Student test scores, most significantly those of 10th graders, had increased dramatically. It appeared that the state would be spared the agony of denying graduation to many seniors and that the increase in state spending carried out under Education Reform had paid off.

A careful examination of the role of increased spending suggests that efforts by the state to make more resources available to the schools have had little to do with, and might well have detracted from, students' ability to pass the MCAS test.

It may be too soon, however, to celebrate. An examination of the 2001 MCAS test results reveals that a quarter of 10th graders have yet to pass the exam and that the performance of 4th and 8th graders did not show a dramatic improvement over previous years. More importantly, it turns out that the surge in test scores may have had little to do with the increases in state education spending that have been carried out in the name of Education Reform. Specifically:

- Spending more on instruction, whether by raising teachers' salaries or by hiring additional teachers, worsens school performance.
- Spending more on management (principals) improves the performance of those schools that have a history of doing well on standardized tests ("high-performing schools," in the language of this report). Spending more for any other purpose (raising teachers' salaries, spending more for non-instructional purposes, adding teachers in order to reduce class size) generally worsens the performance of those schools.
- Socioeconomic factors and prior performance on standardized tests, along with various "intangible" factors, are far more important than increased spending as determinants of performance.

One such intangible factor is accountability. It is the threat of failing that has caused schools to concentrate their efforts on getting students to pass the test and caused students to apply themselves to learning and passing the test. As passing the MCAS test has grown closer to becoming a graduation requirement, schools, teachers and students have concentrated their minds on getting students to pass the test. Teachers have succeeded in teaching to the test.

This report suggests the importance of accountability. Under the MCAS, the state test students in English and Mathematics at the 4th, 8th and 10th grade level and classifies test results as: "Warning," "Needs Improvement," "Proficient" or "Advanced." We predict MCAS test scores for:

> ***It is the threat of failing that has caused schools to concentrate their efforts on getting students prepared to pass the test.***

- each grade – 4th, 8th and 10th;
- each subject – English and Math;
- each performance category – Warning, Needs Improvement, Proficient, Advanced and All (meaning the first four categories combined into one); and
- three categories of past performance – whether, for 1994 test results, the district fell into the bottom third (to be designated “low-performing”), the middle third (“average-performing”) or the top third (“high-performing”) of all districts.

We find that the number of students who fall in the Warning category is significantly less than we would expect from considering only tangible factors, such as spending, prior test scores and socioeconomic factors. The discrepancy is greatest for 10th grade students. The apparent explanation is accountability: The impending graduation requirement is impelling schools and students to pass, i.e., avoid a Warning.

Not everyone will interpret this finding as good news. The very fact that schools and students are focused on avoiding a Warning label gives weight to the misgivings expressed by MCAS test opponents: By putting so much emphasis on the MCAS test, schools are neglecting learning of the kind that is not and cannot be measured by that test.

Whether or not improved performance on the MCAS test translates to better educated citizens is, indeed, a question worth debating. The purpose of this study, however, is to determine which variables do the best job of explaining and predicting MCAS test scores. Once we know what those variables are, and the direction in which they work, we can help policy makers fashion an education policy that will improve MCAS test scores, if that is their goal. We leave it to others to debate the worthiness of that goal.

Background

The MCAS test was born of a bargain made under Education Reform. Districts would be funded by the state at a higher equalized rate and would in turn produce students that met a higher standard of educational achievement, as measured by the MCAS test. The state now funds 41% of education spending, compared to the 30% it funded at the start of Education Reform, in 1993. Further, total net school spending in the state has increased from $4.3 billion in 1993 to $7.3 billion in 2001. The question to be asked now is whether this near doubling in education expenditures has resulted in parallel increases in educational attainment. Has pumping more money into the schools created a return in the form of better-educated young citizens, as measured by good performance on the MCAS test? This report is aimed at answering these questions.

Assessing Education Reform

The BHI Education Assessment Model, first applied to 1998 MCAS test results, identifies and assesses the importance of various explanatory variables that may influence a school district's performance on the MCAS test. As a *value-added* model, the BHI model allows us to explain the influence of changes in school spending on the probability of students' passing the test.

Most models look at levels of spending rather than changes in spending and thereby consider contemporaneous relationships only. A value-added model differs from this approach by showing how changes in policy variables "add value" to – which is to say, improve upon – school performance. The model bases current student performance on the track record of a school district, measured by its prior performance. Any change in performance is postulated to be due to percentage changes in variables that measure spending and in other variables.

This report also overcomes a problem associated with other studies, which aggregate school spending into a single variable. In order to study the effectiveness of Education Reform, we have identified four broad indicators of education policy, each of which represents a possible use of taxpayer dollars. This gives us variables (1)-(4), which are percentage changes in:

(1) teachers' average salary;

(2) expenditures on non-instructional items (including administration, athletics, transportation, maintenance and health);

(3) expenditures on management (principals and vice principals); and

(4) the student-teacher ratio (with lower ratios requiring increased spending and permitting reductions in class size).

Applying the BHI Education Assessment Model, we have determined which of these variables have a positive or negative effect (or no effect) on MCAS test results.

In addition to the four policy variables mentioned above, the model includes the following variables, (5)-(9), which are percentage changes in:

(5) the Equalized Valuation Index (EQV), which measures property values in a district;

(6) the participation rate in the free/reduced price lunch program, which measures poverty;

(7) the proportion of single mothers with children under 18;

(8) the proportion of students in the public schools; and

(9) the dropout rate (for 10th graders only).

Finally we include variable (10), which is 1994 Massachusetts Educational Assessment Program (MEAP) scores.

Of these, variables (5)-(7) represent changes in the socioeconomic character of a district. Variables (8) and (9) bear on student choices (the decision to stay in, or drop out of, the public school). Variable (10) measures performance prior to Education Reform. We applied the model to 2001 MCAS test scores for districts reporting data on all explanatory variables. The model shows whether a change in each variable exerts a significant positive effect, a significant negative effect or no significant effect on performance. We report 104 findings.[1] See Table A.

Table A: Results of the BHI Education Assessment Model

	Grade 4		**Grade 8**		**Grade 10**	
Variable	**English**	**Math**	**English**	**Math**	**English**	**Math**
Increase in Teachers' Average Salary						
Low-Performing Districts	Worsens	Worsens	Worsens	Worsens	Worsens	Worsens
Average-Performing Districts	Worsens	Worsens	Worsens	Improves	Worsens	NA
High-Performing Districts	Worsens	Worsens	Worsens	Worsens	NA	NA
Increase in Non-Instructional Expenditures						
Low-Performing Districts	NA	Improves	Worsens	Improves	NA	NA
Average-Performing Districts	NA	NA	Worsens	Worsens	Improves	NA
High-Performing Districts	Worsens	Worsens	Worsens	Worsens	Worsens	Worsens
Increase in Expenditure on Management						
Low-Performing Districts	Improves	NA	NA	NA	Worsens	Worsens
Average-Performing Districts	NA	NA	NA	Worsens	Worsens	Worsens
High-Performing Districts	NA	Improves	Improves	Improves	Improves	Improves
Decrease in the Student-Teacher Ratio						
Low-Performing Districts	Worsens	Worsens	Worsens	Worsens	Worsens	NA
Average-Performing Districts	NA	Worsens	NA	NA	Worsens	NA
High-Performing Districts	Worsens	Worsens	Worsens	NA	NA	Worsens
Increase in the Equalized Valuation Index	Improves	Improves	Improves	Improves	Improves	Improves
Increase in the Free/Reduced Price Lunch Participation Rate	Worsens	Worsens	Worsens	Worsens	Worsens	Worsens
Increase in the Proportion of Single Mothers	Worsens	Worsens	Worsens	Worsens	NA	Worsens
Increase in the Proportion of Students in Public Schools	Worsens	Worsens	Worsens	NA	NA	Worsens
Decrease in the Dropout Rate	--	--	--	--	Improves	Improves
Prior Scores in 1994	Improves	Improves	Improves	Improves	Improves	Improves

Note: NA means that the variable has a statistically insignificant influence on student performance. Dropout rate is used as an explanatory variable only with respect to 10th graders.

[1] Given four policy variables, i.e., variables (1)-(4), two subject areas, three grade levels and three performance categories, we get 72 findings. There are 18 findings for the socioeconomic variables (5)-(7), six for the choice variable (8) two for the choice variable (9), and six for variable (10), for a total of 104.

In Section VII, Tables 9, 10 and 12 we provide these findings for our model. There each finding is a number whose sign, positive or negative, shows whether a change in the variable exerts a positive or negative effect on performance and whose associated "t-statistic" shows whether the effect is statistically significant or not.

Increases in teachers' average salary generally worsen student performance.

In Table A, we summarize those findings by showing how a given change (increase or decrease) in a particular variable affects (worsens or improves) performance in each category. We define good performance as scoring at the Advanced or Proficient level. For all but two variables – student-teacher ratio and dropout rates – the table identifies the influence of *increases* in the independent variables on the dependent variable, namely, performance on the 2001 MCAS test. For the other two variables, it identifies the influence of *decreases* in that variable.

Policy Variables

The most striking result is that increased spending on education generally *worsens* student performance:

- Increases in teachers' average salary generally worsen student performance. They worsen performance for 4th and 8th graders in low and high-performing districts and for 10th graders in low-performing districts. The effect is insignificant 10th grade Math in average-performing districts and for 10th grade English and Math in high-performing districts. The only instance in which a higher teachers' average salary is found to improve performance is 8th grade Math in average-performing districts.
- Decreases in the student-teacher ratio and therefore in class size generally worsen or have no effect on performance.
- For the other two policy variables, the results are mixed but, on balance, still negative for the effect of spending on school performance. There is only one pattern of results that supports the argument for increased spending: Increased expenditures on management (which is expenditures by and on principals and vice-principals) generally improve performance for high-performing districts. On the other hand, increased expenditures for non-instructional purposes worsen performance for high-performing districts in all instances.

Socioeconomic Variables

For the socioeconomic variables, the results prove what conventional wisdom would indicate and what numerous past studies have already shown.

- In all categories, an increase in property values (measured by the Equalized Valuation Index) has a positive effect on performance.
- Increased participation in the free/reduced price lunch program has a negative effect on performance.

- An increase in the number of single mothers with children under 18 generally within the school district, a measure of family stability and of economic security, has a negative effect on performance.

Remaining Variables

The remaining variables relate to student choice and to prior test scores:

- An increase in the proportion of students in public schools worsens performance in all but two categories. This result supports the argument that when students voluntarily choose private over public schools they put pressure on the public schools to improve performance.
- A lower dropout rate improves a district's test scores. While this is a "choice" variable, it also reflects the failure of families and schools to keep students in school. The implication is that conditions that encourage students to drop out have a negative effect on performance on standardized tests. This variable is applied only to 10^{th} graders.
- A strong prior performance on standardized exams significantly improves performance on the MCAS test. These results are consistent across the three grade levels considered here.

Interpreting the Results

The most striking conclusion is that increases in school spending worsen performance in 39 of the 72 instances considered. Increases in school spending have no effect on performance in 23 of the remaining instances and improve performance in only 10.

How is it that higher teachers' average salary and lower student-teacher ratios generally worsen performance?

The answer could lie partly with the procedures that determine teachers' salaries. Perhaps schools offer higher salaries to attract better teachers but, in the process, divert funds from other, more urgent needs. Perhaps, on the contrary, education funding has operated to reward veteran teachers who enjoy the most job security at the expense of their newer, more energetic counterparts. Either interpretation is feasible.

As for class size, perhaps students benefit from the more competitive environment created by larger classes than they do from the personal attention made possible by smaller classes. Perhaps large classes are conducive to learning of the kind that is required for success on standardized tests. To improve MCAS test results, the job of the teacher is not to encourage discussion, criticism and the general-give-and take that small classes encourage. Rather the job of the teacher is to drill the students on methods for providing the right answers to test questions.

Whatever the explanation, it appears that, when expenditures are disaggregated into categories of the kind considered here, there is nothing in the data to suggest that increased education spending generally improves performance. To understand the recent surge in test scores, it is necessary to look elsewhere.

Socioeconomic and demographic characteristics are, as often found in past studies, profoundly and consistently important for their effects on performance. Also, past test scores are good predictors of current test scores.

Because these characteristics lie outside the immediate control of policy makers, it follows that, but for the graduation requirement now attached to the MCAS test, Education Reform has been generally ineffective at improving student performance on standardized tests or, one might suspect, on any objective set of tests.

There appear to be two areas in which policy makers can influence outcomes. The first relates to choice. By expanding opportunities for students to opt out of the public school system, policy makers can put pressure on the public schools to improve performance. By adopting policies that discourage dropping out, they can improve the performance of 10th graders.

A recent Supreme Court ruling upholding the constitutionality of Cleveland's school voucher program has rekindled a nationwide interest in school choice. Supporters of school vouchers hail this decision as "path breaking." Our findings provide evidence that school choice improves school performance on the MCAS test by creating competition and by offering options that discourage dropping out.

As it turns out, the same circumstances that improve performance on the MCAS test also appear to discourage students from dropping out.

The second area has to do with the allocation of education dollars between policy options. While our results are decidedly negative for most policy variables, one opportunity to improve results seems to present itself: High-performing schools would benefit by *increasing* expenditures on management and by *reducing* expenditures in other areas (teachers' salaries, non-instructional spending and class size).

Learning from the Model

Education officials rate schools according to their performance on MCAS tests. This procedure is incomplete and unfair, in that it fails to take into account the heavy dependence of test scores on socioeconomic and other factors that are beyond the control of teachers and administrators. The BHI Education Assessment Model for Massachusetts permits policy makers to determine how well schools perform, given these important factors. Educators can use the model to learn what individual districts do correctly – and what they do incorrectly – in teaching and in managing their schools.

The finding that lower dropout rates improve the performance of 10th graders argues against the notion that the MCAS graduation requirement has the effect of driving poor students from the public schools.

Because the model does a good job of predicting school performance (see Table 8), we can draw inferences about a school's teaching and management skills if we find that its actual test results deviate substantially from its predicted test results. Hence, we provide rankings (see Appendix, Tables 1A-3A) of districts according to whether and to what extent their actual performance exceeds their predicted performance. For example, for 4th graders, the Petersham school district ranked 22 based on actual 2001 MCAS test results. In fact, however, considering socioeconomic and other key factors, the Petersham school district did the best job in outperforming our model's predictions, and therefore we rank this district first among the 266 districts (see Appendix, Table 1A).

We examine Everett for its ability to outperform the model's predictions. Everett does a good job in outperforming the model in all three-grade levels (see Appendix, Table 3A). The highly structured focus on system-wide effectiveness is at the root of Everett's success on the MCAS test.

Conclusion

The 2001 MCAS test showed significant improvement by 10th graders over earlier tests. That improvement has little to do, however, with the increase in education spending that has taken place under Education Reform. Rather, it is explained by the socioeconomic character of the individual districts, by pressure from students choosing private over public schools, by (at the 10th grade level) efforts to discourage students from dropping out and by prior test scores. It is explained, finally, by the fact that high school seniors who do not pass the test will be denied graduation.

The BHI Education Assessment Model provides a method for predicting, at a high level of accuracy, school district performance on the MCAS test. Because the model is so accurate a predictor of performance, we can use the model to rank schools according to their success in preparing students for the MCAS test, given socioeconomic factors that are beyond their control. If and only if a school district does substantially better than predicted by our model (or a similar such model) does it deserve a high ranking and the praise and rewards that go with good performance. Conversely, if and only if a school district does substantially worse than predicted does it deserve a low ranking and thus criticism for its performance.

Rankings based on raw scores are not useful, insofar as they do *not* control for socioeconomic factors beyond the reach of school administrators and teachers. Education officials and other interested persons who wish to rate schools according to their performance on the MCAS test should eschew the raw data and consider instead the school's ability to perform well despite socioeconomic factors that otherwise hinder their performance. The BHI model makes it possible to identify those schools and to avoid the mistake of rewarding schools for success that has more to do with external, socioeconomic factors than with the efforts of administrators and teachers.

I. Introduction

Education Reform is an issue that concerns not just the state of Massachusetts but every state in the nation. Education has become a top national issue as studies reveal the poor performance of U.S. students compared to their counterparts in other industrialized countries.[2]

Massachusetts Education Reform is the result of *McDuffy* v. *Robertson*, in which the Massachusetts Supreme Judicial Court stated that funding disparities harmed the quality of education for some students, denying them the education to which they were constitutionally entitled.[3] Under this decision, the state was compelled to equalize education across municipalities. The result was the Massachusetts Education Reform Act of 1993.

Prior to 1996, the Massachusetts Board of Education regarded test scores as only one among many measures of school success and accountability. As testing became increasingly popular as a yardstick to measure the results of increased education spending, the Board began development of its own testing program to satisfy the provisions of the Education Reform Act. To this end, the Board appointed committees of educators and parents to help ensure that the program to be implemented was meaningful, fair and free from bias. The eventual result was the Massachusetts Comprehensive Assessment System (MCAS).

The state administers MCAS tests to 4th, 8th and 10th graders annually to determine the education attainment of students and the success of the school system across the state in educating their pupils. The MCAS, which replaced the Massachusetts Educational Assessment Program (MEAP), was first administered in 1998. The class of 2003, who were 10th graders when they took the 2001 tests, will be required to pass the MCAS test by 2003 in order to graduate.

The results of the 2001 MCAS test were perceived as a triumph by the supporters of testing. Tenth graders' scores improved dramatically over the previous years.

The question remains whether the spending policies put in motion by Education Reform deserve credit for this success. Education spending increased at double-digit rates between 1993

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[2] Results from the 2000 Program for International Student Assessment (PISA) of 15-Year-Olds in Reading, Mathematics, and Science Literacy, released by the U.S. Education Department's National Center for Education Statistics (NCES) and the Paris-based Organization for Economic Cooperation and Development (OECD) show that among 32 of the most industrialized countries, the U.S. ranks as "average" across the board.

[3] *McDuffy* v. *Robertson*, 615 N.E.2d 516 (Massachusetts 1993).

and 2001. Did this additional spending result in parallel improvements in education achievement? The BHI Education Assessment Model is aimed at answering this question.

BHI developed its Education Assessment Model to identify and assess the importance of factors that both explain and help to predict the performance of Massachusetts' schools. This sophisticated value-added model allows policy makers to see how changes in policy variables "add value" to – which is to say, improve upon – school performance. In January 2001, BHI released its first application of this model in a study entitled *Promoting Good Schools Through Wise Spending*. The model examined changes in test scores over the period 1994 to 1998.

In that report, we found that Education Reform led to a substantial rise in per-pupil spending and a noticeable decline in student-teacher ratios. The rise in spending was found to yield almost no improvement in school performance, while the decline in student-teacher ratios had mixed effects. The most prominent finding, however, was the overwhelming importance of factors beyond the immediate reach of education policy makers. Whatever new efforts the government might make to improve school performance the outcome depends heavily on past performance and on the socioeconomic character of the community.

In 2002 we have updated this analysis by incorporating 2001 MCAS test scores and by making a few important modifications to the model. Rather than, as last year, considering school spending as a single category, we consider four policy variables that constitute school spending inputs, namely the percentage change in (a) teachers' average salary, (b) expenditure on management, (c) non-instructional expenditure and (d) student-teacher ratios. This distinction among categories of expenditure is often overlooked in the extant literature. We allow the influence of all school inputs to differ between low, average and high-performing districts. We have expanded our data set to include more schools and have also acquired longitudinal data on the socioeconomic variables to create a true value-added model. All the variables considered in the model, both policy variables as well as socioeconomic variables, are measured as percentage changes over time.

II. The Massachusetts Education Reform Act of 1993

Prior to 1993, public education in Massachusetts was considered to be mainly a local responsibility. The state, and to a far lesser extent, the federal government provided financial aid, but the responsibility for producing educated students lay mainly with the local government. Beginning in the late eighties, however, sentiment grew that public schools were failing to deliver an effective and meaningful education that met the demands of a competitive, global economy. Parents, businesses and public officials began to call upon state and federal government to take up the mantel for education reform.

The Massachusetts Education Reform Act of 1993 promoted comprehensive reform of K-12 education in the Commonwealth of Massachusetts. It provided for more equitable funding of schools and created statewide standards for students, educators, schools and districts. At the core was the creation of statewide education standards for:

1. what students should know and be able to do;
2. what the state and each municipality should contribute to each school;
3. school performance; and
4. the performance of teachers and administrators.

The Education Reform Act also attempted to bring about improvements in curriculum, infrastructure, staffing and teacher qualifications.

Education Reform was meant to be a two-way street: The state would provide more money, and schools and students would be held to higher standards. The goal was to achieve "better educated young citizens" as predicated on the belief that improvements in students' performance is the real measure of success or failure.[4] In order to accomplish the goal, the state would provide for adequate, equitable and stable financial support for public education.

The program put into place a new standard for assessing the adequacy of school financing and established how much state and local governments should each contribute toward school financing. This program has been codified in Chapter 70 of the Massachusetts General Laws and is intended to ensure that every public school system has adequate funding, regardless of the wealth of the local community. The most important standard of financial support is related to the determination of "adequate funding." To this end, the Education Reform Act created a "foundation budget" for each school based on the particular number and mix of students in that school. The

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[4] Massachusetts Taxpayers Foundation, *The State Investment in Education: School Finance Reform 1993-1996,* (Boston: Massachusetts Taxpayers Association, June 1996).

basic concept behind the Chapter 70 formula is that the prime responsibility for financing public schools falls on the community, after which, if funds prove insufficient to meet the prescribed foundation budget, the state must account for the deficiency.

The foundation budget is the minimal budget that the legislature determines to represent "adequate funding." During the budgetary process, the legislature establishes a minimum amount for each of nineteen categories of functional expenditure and determines the proportion of that amount that should be spent for different categories of students. Using the enrolment structure from October of the previous school year, each school district determines its total foundation budget and the average per-pupil foundation budget. These per-pupil amounts are adjusted annually for inflation and then multiplied by the district's current enrolment.

The initial goal of the Chapter 70 formula was to bring each school district's per-pupil expenditure up to its foundation budget by the year 2000. Two major criteria were used to determine the amount of state aid allocated to each school district: (1) the extent to which spending was below the foundation budget in previous years and (2) local tax and spending "effort," as measured by the amount of property tax monies that localities allocate for schools as a percent of the local income-adjusted property tax base.

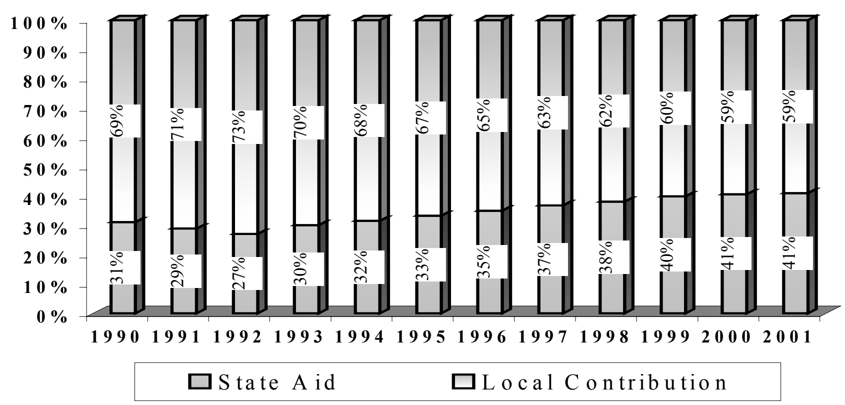
Table 1: Total Education Spending
(FY 1984 – FY 2001)

Year	Total Spending	State Aid	Local Contribution	State Share (%)	Local Share (%)
1984	2,439,899,799	910,374,624	1,529,525,175	37	63
1985	2,609,440,126	1,039,420,245	1,570,019,881	40	60
1986	2,833,258,002	1,099,382,416	1,733,875,586	39	61
1987	3,084,766,670	1,240,803,011	1,843,963,659	40	60
1988	3,384,302,162	1,348,049,167	2,036,252,995	40	60
1989	3,692,801,672	1,428,147,254	2,264,654,418	39	61
1990	3,926,038,700	1,221,012,065	2,705,026,635	31	69
1991	4,056,331,858	1,172,296,225	2,884,035,633	29	71
1992	4,070,676,560	1,102,155,351	2,968,521,209	27	73
1993	4,287,184,895	1,288,777,773	2,998,407,122	30	70
1994	4,539,959,338	1,432,831,982	3,107,127,356	32	68
1995	4,878,239,998	1,622,681,700	3,255,558,298	33	67
1996	5,227,135,081	1,831,653,335	3,395,481,746	35	65
1997	5,592,649,791	2,061,572,182	3,531,077,609	37	63
1998	6,012,310,841	2,288,742,702	3,723,568,139	38	62
1999	6,434,570,684	2,566,134,016	3,868,436,668	40	60
2000	6,896,659,348	2,803,320,443	4,093,338,905	41	59
2001	7,295,228,124	2,990,396,788	4,304,831,336	41	59

Source: Massachusetts Department of Education

Table 1 shows that eight years after the passage of Education Reform, total net school spending for all districts in the state increased from approximately $4.3 billion to almost $7.3 billion annually. As of fiscal year 2001, education spending in almost every school district in the Commonwealth met or exceeded the foundation budget. Throughout this process, there has been a significant increase in both local and state contributions to public schools. However, the increase in state aid has been much greater than the increase in local contributions. From fiscal years 1993-2001, local contributions to school funding increased by an average of 4.62% per year while state aid increased by 11.09% per year. As a result of this asymmetrical evolution in local and state contributions to school funding, the weight of state support of total school spending has increased significantly, from approximately 30% in FY 1993 to over 41% in FY 2001 (see Figure 1).

Figure 1: Education Spending - State and Local Contributions
(FY 1990 - FY 2001)



Education Reform promised that these increases in spending would help to create better educated young citizens. In return for increased monetary support, students, teachers and administrators would be held to higher achievement standards. This report will assess the success and value of this bargain.

III. The Massachusetts Comprehensive Assessment System

In order to address curriculum deficiencies and to provide measurement standards, the Massachusetts Department of Education devised a statewide assessment program for public schools. This program, the Massachusetts Comprehensive Assessment System (MCAS), measures the performance of students, schools and districts against the learning standards established in the Massachusetts Curriculum Framework.

The MCAS test replaced the previous statewide assessment program, which was the Massachusetts Educational Assessment Program (MEAP). MEAP tests were administered every two years from 1986 to 1996, and the MCAS tests have been administered in 1998 and every year thereafter. The primary difference between the MCAS and MEAP is that the MCAS reports individual student results, whereas after 1988, the MEAP reported only school and district results. Also the MCAS test is administered every year and to virtually all students before their graduation.

Despite the initial relief at the 2001 MCAS test results, a closer look at performance indicates that one in every four members of the class of 2003 (the first year for which MCAS test becomes a requirement for graduation) have yet to pass the MCAS test.[5] Over the eight-year period, FY 93-01, annual state aid for local schools increased from around $1.3 billion to over $2.9 billion. See Table 2.

Table 2: Chapter 70 State Aid
(1993-2001)

FY	Annual Total	Increase	Cumulative Increase
1993	1,288,777,773	-	-
1994	1,432,831,704	144,053,931	144,053,931
1995	1,622,501,870	189,670,166	333,724,097
1996	1,831,818,548	209,316,678	543,040,775
1997	2,061,593,725	229,775,177	772,815,952
1998	2,288,742,702	227,148,977	999,964,929
1999	2,566,134,016	277,391,314	1,277,356,243
2000	2,803,332,955	237,198,939	1,514,555,182
2001	2,990,396,788	187,063,833	1,701,619,015

Source: Massachusetts Department of Education

Along with increases in state aid to education, there has been a corresponding rise in per-pupil expenditures in Massachusetts, from $5,035 to $7,149 for all day programs and from $4,268 to $5,876 for the regular day program.[6] See Table 3.

[5] "One in Four Juniors Still Failing MCAS," *Boston Globe*, 26 April 2002.
[6] We focus on the regular day program, which pertains to most students and which provides a general course

Table 3: Per-Pupil Expenditures
1993 - 2000

Program	1993	1994	1995	1996	1997	1998	1999	2000
Total Day	5,035	5,235	5,468	5,750	6,015	6,361	6,692	7,149
Regular Day	4,268	4,369	4,528	4,737	4,933	5,221	5,487	5,876
Special Needs	7,170	7,666	8,241	8,873	9,391	9,873	10,249	11,311
Bilingual	4,824	5,539	5,994	6,380	6,518	7,106	7,495	7,566
Occupational Day	7,355	7,843	8,173	8,468	8,813	9,052	9,404	9,944

Source: Massachusetts Department of Education.

Despite these increases in spending, a substantial proportion of all students who took the MCAS test in 2001 ranked in the Warning or Needs Improvement categories in all grade levels and especially in Mathematics. Has the infusion of billions of dollars helped the public schools? Does more money really translate into better education? These are among the questions that this report seeks to answer.

of instruction. The special-needs program provides for students whose learning needs cannot be met through the regular day program. The bilingual program is for students whose native language is not English. Occupational programs concentrate on students who wish to specialize in a specific trade.

IV. Analyzing Student Performance: Motivation and Scope

There have been numerous attempts to link student performance and expenditures in the literature. In one of his many survey articles, Hanushek (1997) argues that the published empirical literature suggests that there is no clear relationship between school expenditures and student performance.[7] Studies are split over the question of whether money matters.[8]

We find fault with existing and past attempts to determine contemporaneous relationships between school inputs and student performance. A casual glance at a cross section of districts points out the obvious difficulty in relating spending to school performance. Simply looking at expenditure levels across schools creates a murky picture. The fact that the state provides more aid to low-performing schools under Education Reform creates the appearance that higher expenditure levels are associated with low performance. However, high-performing schools in wealthier districts also have higher expenditures on schools, thus suggesting the opposite relationship. As a result, a model that compares spending levels with performance cannot conclusively answer the question whether spending improves performance.

Of the factors considered to affect student performance, there is consensus that socioeconomic factors play a major role. However, schools have no control over these factors. In addition, learning is a cumulative process so that the influence of a school policy becomes visible only after a lag. Students consistently perform better in some districts than in others due to differences in socioeconomic factors and to successful prior school policies. Since schools are often evaluated based on current student performance, schools located in districts with a history of poor student performance tend to be criticized unfairly.

The BHI model seeks to remedy this by offering a better data design and a sound methodology. Our value-added approach bases current student performance on the track record of a school district, measured by its prior student performance. Any change in performance is postulated to be due to percentage changes in school inputs and in socioeconomic factors.

The value-added framework allows us to assess changes in performance that may be attributable to changes in school spending. This is an improvement over models that consider contemporaneous relationships only. We also address the problem of the highly aggregated nature

[7] Eric A. Hanushek, "Assessing the Effects of School Resources on Student Performance: An Update," *Education Evaluation and Policy Analysis*, 19:2 (1997): 141-164.
[8] See, for example, Sanjiv Jaggia and Alison Kelly, "An Analysis of the Factors that Influence Student Performance: A Fresh Approach to an Old Debate," *Contemporary Economic Policy,* 17:2 (1999): 189-198.

of spending, from which previous models have suffered, by considering components of spending rather than spending per se in evaluating performance.

Below, in a preliminary analysis, we report the correlation between the incremental changes in scores and expenditures on students from 1994 to 2001 (see Table 4). Both scores and expenditures are first standardized for the two periods and then differenced.[9] A glance at the table reveals that these correlations are not statistically different from zero for all grades and subjects. In general, changes in per-pupil spending for regular day education are not related to changes in performance at any grade level. There may be some components of spending that improve performance, but as an aggregate measure, spending is unable to pick up such individualized effects.

Table 4: Correlation between Changes in Scores and in Standardized Expenditure 1994-2001

Grade Level	Subject	Pearson Coefficient of Correlation (Test-Statistic)	Spearman Coefficient of Correlation (Test-Statistic)
4	English	0.037 (0.595)	0.091 (1.487)
	Mathematics	0.059 (0.966)	0.092 (1.494)
8	English	0.078 (1.199)	0.022 (0.343)
	Mathematics	0.095 (1.462)	0.088 (1.351)
10	English	-0.020 (-0.293)	-0.077 (-1.135)
	Mathematics	0.014 (0.212)	-0.061 (-0.895)

Although schools have no control over the socioeconomic character of their district or its history of prior performance, they do have some influence over how money is utilized and distributed among competing uses. For instance, schools may choose to hire more teachers in order to reduce the student-teacher ratio. Alternatively, schools may choose to offer lucrative teacher salaries, with the hope of motivating current teachers and of attracting better teachers. Similarly, an argument for the importance of leadership can be used to justify expenditures directed toward

[9] Student performance is defined in terms of total average scores in English and Mathematics. Changes in scores and expenditure are computed as $\frac{x_{98}-\mu(x_{98})}{\sigma(x_{98})}-\frac{x_{94}-\mu(x_{94})}{\sigma(x_{94})}$. Critical values for Pearson as well as Spearman test statistic at 5% level of significance are ±1.96.

management, including salaries for and expenditures by principals, and vice principals. Instead of considering general school spending per se, we consider four policy variables that constitute school inputs, namely the percentage change in (a) teachers' average salary, (b) expenditure on management, (c) non-instructional expenditure and (d) student-teacher ratios.

Another important assumption made in the extant literature that we wish to counter is that all policy factors have the same influence in all districts. In prior studies, while the effects of policy factors are allowed to differ over grade levels, they are assumed equal for a given grade. Jaggia and Kelly (1999) show that smaller class size is important in improving performance of 4th graders, but has no significant influence on the performance of 8th and 10th graders. We believe that a better model specification will also allow the influence on performance to differ within grade levels. In this report, we allow the influence of all school inputs to differ between low, average and high-performing districts.

The model suggests that there is no unique policy measure that will work for all districts. For instance, some districts may benefit from smaller class size while others benefit from raising teachers' salaries.

Finally, we provide rankings of districts in terms of how schools are performing in comparison to what can be expected of them. Schools are increasingly evaluated in terms of their performance on the MCAS test. These rankings are based on raw scores and do not take into account factors that are beyond the school's control. Such rankings tend to penalize schools located in disadvantaged neighborhoods suffering a low socioeconomic status. The problem can be aggravated if school funding is tied to MCAS test achievement. We provide a superior method of rating schools insofar as it shows how well or how poorly a school performs relative to what the model would predict, based on prior performance and changes in policy and socioeconomic variables. A ranking system based on these principles provides insights to the relevant question of what schools are doing right and what they are doing wrong.

V. The BHI Education Assessment Model for Massachusetts

Consider a model that relates student performance (*P*) to the current and past values of school inputs (*S*) and other socioeconomic factors (*F*),[10]

$$(1) \qquad P_{iT} = \alpha_T S_{iT} + \beta_T F_{iT} + \sum_{t=1}^{T-1} \alpha_t S_{it} + \varepsilon_{iT} ,$$

where, $i = 1,2,\ldots,N$ represents the districts, and the αs and the βs are the unknown parameters that capture the influence of the various factors. The linearity in the above function is used for notational simplicity only. An attractive value-added formulation is given by

$$(2) \qquad P_{iT} = \alpha P_{iT-1} + \beta\left(\frac{S_{iT} - S_{iT-1}}{S_{iT-1}}\right) + \delta\left(\frac{F_{iT} - F_{iT-1}}{F_{iT-1}}\right) + \varepsilon_T .$$

Note that there is no need to include past values since their influence is reflected in P_{iT-1}. Any further change in performance is postulated to be due to a percentage change in school inputs socioeconomic and other factors.

The MCAS test results for 2001, which measure performance of students in the 4th, 8th and 10th grades in Massachusetts' districts, is the dependent variable (P_{iT}). MCAS test results are reported according to four performance levels defined by the Board of Education: Warning, Needs Improvement, Proficient and Advanced. We use an ordered logit model that appropriately captures the natural ordering of the dependent variable and analyzes the influence of various factors on the probability of each performance level.

We do not, as is customary, define the dependent variable as the average score in a school district. Average scores suppress useful information and cannot capture movement between different categories of students' scores. For example, if the average goes up, it is not clear if the improvement has been for the students who were previously in the low, middle or top bracket of test scores. We therefore, analyze not just changes in mean scores, but also changes in the proportion of students performing in various categories.

For each school district, we observe the percentage of students falling into four categories: Warning, Needs Improvement, Proficient and Advanced. We then apply a model that allows us to explain the influence of school inputs, as well as socioeconomic variables, on the probability of

[10] Eric A. Hanushek, and L. Taylor, "Alternative Assessments of the Performance of Schools*," Journal of Human Resources,* 25:2 (1990); Ronald Fergusen and Helen Ladd, "How and Why Money Matters: An

students' falling into these categories. It is important to understand that the underlying performance variable (P_T) is continuous but only the discrete responses are observed. Consider the following grid, which puts students in the various categories:

Warning	Needs Improvement	Proficient	Advanced
γ_0	γ_1	γ_2	P_T

Here, P(Warning) = $P\left(P_T < \gamma_0\right)$, P(Needs Improvement) = $P\left(\gamma_0 \le P_T < \gamma_1\right)$, P(Proficient) = $P\left(\gamma_1 \le P_T < \gamma_2\right)$, and P(Advanced) = $P\left(P_T > \gamma_2\right)$. For an ordered logit model,

$$(3) \qquad P(P_T < \gamma_j) = \frac{1}{1 + \exp(\beta' X - \gamma_j)},$$

$$(4) \qquad \beta' X = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \,.$$

The coefficient β_j measures the influence of the factor X_j on the probability of falling into a particular category. The γ_j s are the unknown parameters to be estimated along with the β s. These probabilities are used to specify the following log-likelihood function that is maximized to obtain the parameter estimates:

$$(5) \qquad £ = \sum_{i=1}^{N} n_i \left[\sum_{j=1}^{4} \hat{p}(C = j) \ln P(C = j) \right],$$

where $\hat{p}(C = j)$ refers to the proportion of students in the ith school who scored in the jth category and n_i refers to the number of students in the ith school who took the MCAS test. Further, given a constant term in X, γ_0 is set equal to zero without any loss of generality in the estimation.[11] Keep in mind that the net effect of a particular factor on the above probabilities is always zero.

The Dependent Variable

As mentioned above, the dependent variable represents performance on the Massachusetts Comprehensive Assessment System (MCAS) in 2001. In this study, we consider test results for *regular day* education students only. The Department of Education provides this information on public schools (excluding charter schools). The MCAS test was administered in the spring of 2001 to students in English Language Arts and Mathematics. For each school district, the value of the dependent variable is determined by the percentage of students falling into each of the four performance categories: Warning, Needs Improvement, Proficient and Advanced.

Analysis of Alabama Schools," in *Holding Schools Accountable*, Helen Ladd, ed., (Washington, D.C.: Brookings Institution, 1996), 265-298.

[11] Maximum likelihood estimates are obtained using the MAXLIK module of the GAUSS programming

The Independent Variables

Policy Variables

As stated earlier, instead of considering general school spending per se, we consider policy variables that constitute school inputs. Further, the influence of school inputs is allowed to differ between districts on the basis of past student performance, suggesting that there is not a single policy measure that will work for all districts. Some districts may benefit more from smaller class sizes than others, while some are better off using higher salaries to attract better-qualified teachers.

The Massachusetts Department of Education stipulates the foundation level of spending per pupil based on nineteen different spending classifications. These nineteen components can be further lumped into two main categories - instructional and non-instructional expenditures (which are calculated based on total day costs). Instructional expenditures account for 68% of total spending. This study includes only those components that are considered significant for the purpose of understanding student performance. In addition to prior performance, P_{iT-1}, four variables are used in the calculation of the percentage change in school inputs from 1994 to 2000 $\left(\left(S_{iT} - S_{iT-1}\right)/S_{iT-1}\right)$. These policy variables are as follows:

1. *Percentage change in teachers' average salary*. This variable captures the effect on student performance due to increased spending on teachers, as measured by changes in their average salaries.

2. *Percentage change in non-instructional expenditures*. Non-instructional expenditures include school spending on administration, athletics, transportation, maintenance and health.

3. *Percentage change in expenditure on management*. This variable measures spending on and by principals and vice principals, and is classified under instructional expenditures.

4. *Percentage change in student-teacher ratio*. The student-teacher ratio indicates the number of students per teacher for a given school year and is calculated by dividing total student enrolment by the regular education instructional staff. The staff figure is in full-time equivalents (FTE), and the student figure is a headcount. This variable is used as a proxy measure of class size.[12]

All the above variables are measured as percentage changes from 1994-2000, except for student-teacher ratio, which is the percentage change from 1994-1999 (since 2000 data were not

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language.

[12]In his 1998 study, “Evidence on Class Size," Eric A. Hanushek argues that student-teacher ratios reflect the total number of teachers and the total number of students at any time, not class size. In most instances, according to Hanushek, class size tends to be much larger than that implied by student-teacher ratios. In the absence of better information on class size, however, we use student-teacher ratio as a proxy.

yet available at the time of this study). Also, we provide separate measures of these variables distinguishing between them according to their performance on the 1994 MEAP tests. Schools that score in the bottom third of all districts are designated as "low-performing," those that fall in the middle are "average-performing," and those in the top third are designated "high-performing."

<u>Socioeconomic Variables</u>

There are also various socioeconomic factors $\left(\left(F_{iT}-F_{iT-1}\right)/F_{iT-1}\right)$ that are postulated to influence student performance. The variables used are percentage changes between 1994-2000 for:

5. *Equalized Valuation Index (EQV).* EQVs present an estimate of fair cash value of all taxable property in each city and town as of January 1 of each year (MGL Ch. 58, Sections 9 & 10C). The EQV is a measure of the relative property wealth in each municipality. It facilitates comparisons of municipal property values at one point in time, adjusting for differences in local assessing practices and revaluation schedules. A municipality's 2000 EQV is the sum of the estimated fair market value for each property class plus an estimate of new growth, resulting in values indicative of January 1, 2000.[13] EQVs are used in the apportionment of local aid to cities and towns, including Chapter 70 education funding. We use the EQV index as a proxy measure of wealth for districts.

6. *Free/reduced price lunch participation rate.* This is an indicator of wealth and is measured by the proportion of students receiving free or reduced-price lunch. It is commonly used in accountability studies. A high rate of students receiving free or reduced price lunch in a particular school district would indicate that the district has a substantial number of students from low-income families.

7. *Proportion of single mothers in the community.* This variable is an indicator of economic and family stability and is believed to have a negative impact on performance.[14] It represents the percentage of households with single-female householder, no husband present, with own children under 18 years old and is reported by the Census Bureau.

<u>Other Variables</u>

Finally we include variables that define school choice and prior test scores:

8. *Proportion of students in public schools.* This variable (which is defined as a percentage change) is used to measure the effectiveness of school choice. If high proportions of students in public schools have a negative impact on student performance, then the ability of students to choose private over public schools may be interpreted as an incentive for the public schools to improve performance.

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[13] The *Division of Local Services* of the Department of Revenue reports the Equalized Valuation Index (EQV) in the *Massachusetts Municipal Profiles Data Bank*. For a more detailed explanation on this measure of wealth refer to http://www.dls.state.ma.us.

[14] According to the Census Bureau, children in married-couple families are much less likely to be living in poverty than children living only with their mothers. In 1999, 8% of children in married-couple families were living in poverty, compared to 42% in female-householder families.

9. *Dropout rate.* In addition to the variables considered in the analyses of the 4th and 8th grades, for 10th grade we incorporate a variable representing the percentage change in the dropout rate.

10. *Prior test scores.* Most studies have found that prior scores exert a significant, positive effect on current and future test scores. This study includes 1994 MEAP scores as a measure of prior school district performance, P_{iT-1}.

These variables are directly available for almost all districts. For the regional academic districts, we use the average of the socioeconomic variables weighted by the population size of the corresponding districts.

VI. A Baseline for School Performance

Average Factor Values

Tables 5, 6 and 7 below provide both mean values of the independent variables for the 4^{th}, 8^{th} and 10^{th} grades and separate measures of these variables, according to school district performance on the 1994 MEAP tests, as "low-performing," "average-performing" or "high-performing." These values provide a performance baseline against which we can compare changes in the independent variables for their effects on school performance.

Table 5 reveals a number of interesting results of Education Reform in the 4^{th} grade. For example, we see that, for 4^{th} grade, the percentage change in teachers' average salary has been greatest for the low-performing districts, 23.07%. Similarly, the percentage decrease in student-teacher ratio has been higher in low-performing districts than in average and high-performing districts. This indicates that class size decreased much faster for districts that performed poorly in the past as compared to those that performed well, which would, at first glance, suggest a correct ordering of priorities.

Table 5 also shows the mean values of the socioeconomic variables. For example, the percentage change in the Equalized Valuation Index for the high-performing (34.42%) districts has been higher than that for the average (21.94%) and low-performing (18.10%) districts in 4^{th} grade. The upward change in property values for high-performing districts could be explained by many factors, one of which might be having schools that perform well. Also we notice that the participation rate for free/reduced price lunch for better performing districts (high and average) has fallen, whereas it has risen in the case of their lesser performing counterparts. Tables 6 and 7 contain similar averages for the 8^{th} and 10^{th} grade levels.

Table 5: Mean of the Variables: 4th Grade

Variable	Prior Average Performance in 1994			
	Low	Average	High	All
Percentage Change in:				
Teachers' average salary	23.07	18.52	15.10	18.90
Non-Instructional Expenditures	40.27	37.37	27.29	34.97
Expenditure on Management	50.80	36.98	39.28	42.37
Student-Teacher Ratio	-9.14	-6.49	-3.32	-6.32
Equalized Valuation Index	18.10	21.94	34.42	24.83
Free / Reduced Lunch Participation Rate	6.91	-5.80	-10.77	-3.21
Proportion of Single Mothers in the Community	10.16	11.79	9.28	10.40
Proportion of Students in Public Schools	3.36	2.39	2.00	2.58
Prior Scores in 1994	1278.03	1356.21	1434.38	1356.21

Table 6: Mean of the Variables: 8th Grade

Variable	Prior Average Performance in 1994			
	Low	Average	High	All
Percentage Change in:				
Teachers' average salary	21.05	17.69	16.88	18.54
Non-Instructional Expenditures	37.80	32.68	24.37	31.62
Expenditure on Management	41.94	34.25	26.27	34.15
Student-Teacher Ratio	-8.83	-4.18	-4.43	-5.81
Equalized Valuation Index	16.10	24.87	35.86	25.61
Free / Reduced Lunch Participation Rate	-0.90	2.36	-12.58	-3.68
Proportion of Single Mothers in the Community	9.85	6.85	12.42	9.70
Proportion of Students in Public Schools	4.20	1.18	2.17	2.51
Prior Scores in 1994	1273.59	1346.77	1426.62	1348.98

Table 7: Mean of the Variables: 10th Grade

Variable	Prior Average Performance in 1994			
	Low	Average	High	All
Percentage Change in:				
Teachers' average salary	21.40	18.37	16.12	18.63
Non-Instructional Expenditures	40.24	30.83	22.11	31.06
Expenditure on Management	47.20	25.52	25.54	32.79
Student-Teacher Ratio	-10.22	-3.36	-2.93	-5.51
Equalized Valuation Index	19.27	22.13	32.50	24.64
Free / Reduced Lunch Participation Rate	2.11	-3.03	-8.83	-3.25
Proportion of Single Mothers in the Community	7.57	9.75	9.63	8.98
Proportion of Students in Public Schools	3.41	-0.27	2.05	1.74
Dropout rate	1.85	4.38	0.58	1.02
Prior Scores in 1994	1263.97	1326.11	1396.85	1328.99

Performance

Table 8 compares the actual average student performance, shown in parentheses, in various categories with that predicted by the model. A comparison of these probabilities to the actual average values indicates that these two values are extremely close to one another. For example, for Mathematics in the 4th grade, the actual average percentages of students in the four categories for all levels of performance (based on prior results) are 9.48%, 46.64%, 30.35% and 13.54% while their predicted values are 10.95%, 45.88%, 29.53%, and 13.64% respectively. Thus, the model has excellent predictive abilities. These predicted values can easily be constructed for individual districts and further used as a benchmark for comparing the actual student performance in these districts.

Table 8: Mean and Predicted Student Performance

Grade Level	Performance	Predicted and (Actual) Mean of Performance at Various Prior Levels (%)							
		English				Math			
		Low	Average	High	All	Low	Average	High	All
4	Warning	8.05 (7.42)	3.79 (2.53)	2.23 (1.27)	4.69 (3.75)	16.89 (14.98)	10.59 (8.99)	5.36 (4.47)	10.95 (9.48)
	Needs Improvement	45.29 (43.76)	31.76 (33.70)	21.85 (22.34)	32.97 (33.27)	53.47 (53.47)	48.61 (48.72)	35.58 (37.73)	45.88 (46.64)
	Proficient	42.33 (44.52)	56.14 (55.46)	62.00 (63.64)	53.48 (54.53)	22.16 (24.12)	29.24 (30.11)	37.19 (36.81)	29.53 (30.35)
	Advanced	4.33 (4.30)	8.31 (8.32)	13.92 (12.74)	8.86 (8.46)	7.47 (7.43)	11.56 (12.18)	21.86 (21.00)	13.64 (13.54)
8	Warning	4.09 (3.51)	2.00 (1.34)	0.98 (0.46)	2.36 (1.77)	29.47 (28.44)	16.97 (14.36)	9.43 (8.25)	18.62 (17.01)
	Needs Improvement	26.69 (25.13)	16.86 (16.76)	9.04 (8.22)	17.53 (16.70)	41.94 (41.73)	39.04 (41.21)	28.70 (30.22)	36.57 (37.73)
	Proficient	64.09 (65.87)	72.75 (73.34)	72.80 (75.01)	69.89 (71.42)	21.30 (22.28)	30.49 (30.70)	36.11 (37.15)	29.31 (30.04)
	Advanced	5.13 (5.49)	8.38 (8.56)	17.18 (16.30)	10.22 (10.11)	7.29 (7.56)	13.50 (13.74)	25.77 (24.38)	15.51 (15.22)
10	Warning	13.19 (11.86)	7.62 (5.80)	3.99 (2.14)	8.27 (6.60)	20.54 (19.31)	10.72 (9.49)	6.26 (4.80)	12.52 (11.21)
	Needs Improvement	35.54 (33.59)	28.25 (30.55)	17.73 (18.97)	27.17 (27.69)	36.83 (37.12)	29.49 (31.05)	20.47 (22.51)	28.93 (30.23)
	Proficient	38.77 (40.42)	45.51 (45.93)	45.57 (48.19)	43.27 (44.84)	28.55 (29.79)	35.80 (35.48)	35.13 (36.71)	33.15 (33.99)
	Advanced	12.50 (14.12)	18.63 (17.73)	32.71 (30.70)	21.29 (20.86)	14.08 (13.79)	24.00 (23.98)	38.13 (35.98)	25.41 (24.59)

This information can be used to provide incentives to even the most disadvantaged schools to attempt to deliver better than expected performance. The performance of a school district relative to what the model predicts offers an objective measure of the effectiveness of that district in delivering results, given various factors, including socioeconomic factors, beyond its immediate control. Also, a key finding in this table that deserves mention is that the model continually over predicts the percentage of students that fall in the Warning category, especially in the 10^{th} grade. This implies that in this category, schools are doing much better than expected.

VII. Results of the Ordered Logit Model

The purpose of the BHI Massachusetts Education Assessment Model is to determine whether a particular independent variable is significant in explaining school performance and, given that the variable is significant, how policy makers can bring about improvements in school performance by bringing about changes in the variable. This information is vital to all stakeholders, including parents, teachers and other administrators in the district. The estimated results are further used to compute predicted values on the basis of a district's prior student performance, changes in school input variables and socioeconomic factors. These predicted values are used to provide rankings of districts. In this analysis, a school that has performed below average for the state as a whole could still have performed above what the model predicted. Such an analysis will identify strengths (or weaknesses) in certain of the weakest (or strongest) schools in the state. This section provides the information needed to make the above determinations.

General Results

We first review the general results of the model, as they pertain to policy, socioeconomic and school choice variables. The model defines the appropriate policy implications on different districts categorized as low, average, and high-performing, based on their 1994 MEAP test scores. The model also looks at the effects of prior performance and percentage changes in school inputs and other factors on student performance levels over a period of time. Results of the model for each grade level are presented in the tables below followed by a brief description and analysis of the results. Note that the interpretation of the coefficients in ordered logit regression is not straightforward. However, in our application, a significantly positive coefficient implies that the variable positively influences the probability of performing in the proficient and advanced categories. We also provide simulation results to shed further light on the impact of the input variables.

The following is a summary of the results of the independent variables that exhibit consistency through all grade levels.

- Teachers' average salary is significant and negative in 14 of the 18 categories. Overall, increases in teachers' average salary have resulted in poorer performance on the MCAS test.
- Non-instructional expenditure is significantly negative for high-performing districts, which means that added expenditure of this kind will do more harm than good in such districts.
- Based on the results, increased expenditure on management proves to be an effective policy for high-performing districts, especially in the 8^{th} and 10^{th} grade.

- When significant, increasing the student-teacher ratio has a positive influence on scores, implying that bigger classes improve performance. Smaller classes actually worsen student performance.

- The wealth of a district, as measured by the Equalized Valuation Index (EQV), has a positive impact on performance for all grade levels, implying that the wealthier a district the more likely it will perform well on standardized tests such as the MCAS.

- Participation rates in the free/reduced price lunch program, a measure of the family backgrounds in the community, is significant and negative in all cases. This result indicates that districts with increased participation rates in the free/reduced price lunch program produce lower performance on the MCAS test.

- An increased number of single mothers in the community worsen performance on the MCAS test.

- In four out of the six cases, increased proportions of students attending public schools worsen performance for the underlying districts. This would mean that, in most instances, a rise in the proportion of all students who are in public schools does more harm than good with regard to performance on the MCAS test.

- Prior scores (1994 MEAP) are positive and highly significant throughout, implying that a district's current performance is greatly dependant on it past performance.

4th Grade Results

Table 9 details the estimation results for the 4th grade. Generally, in the model, a positive and significant coefficient implies that increases in the policy or socioeconomic variables have a significant and positive impact on scores. Similarly, in the case of student-teacher ratio a positive coefficient suggest that bigger classes are good for better student performance. Or, to interpret it in the present context of decreasing class size, smaller classes hurt performance on the MCAS test.

The percentage change in teachers' average salary – a measure of increased spending on instructional staff – is significant for both English and Math for all districts. The negative sign of the coefficient for both subjects in all districts indicates that as teachers' average salary increases, performance of students in this grade level deteriorates. Several reasons could explain this result. Schools often choose to offer lucrative teacher salaries with the hope that such a measure will help in motivating existing teachers and in hiring more qualified teachers. Hence, as limited resources are targeted at increasing the pay of current teachers or at attracting new highly qualified teachers, other spending areas are left with less. This may take a toll on student performance.

Table 9: Ordered Logit Model Estimation Result for 4th Grade

Variable	English	Mathematics
Constant	-5.8453* (-21.895)	-7.2877* (-27.608)
Percentage Change in Teachers' Average Salary		
Low-Performing Districts	-0.0114* (-10.943)	-0.0103* (-9.232)
Average-Performing Districts	-0.0113* (-6.559)	-0.0127* (-9.763)
High-Performing Districts	-0.0034* (-2.552)	-0.0056* (-4.342)
Percentage Change in Non-Instructional Expenditures		
Low-Performing Districts	-0.0010 (-1.288)	0.0027* (3.340)
Average-Performing Districts	-0.0014 (-1.851)	-0.0008 (-1.072)
High-Performing Districts	-0.0034* (-4.029)	-0.0049* (-6.480)
Percentage Change in Expenditure on Management		
Low-Performing Districts	0.0013* (3.882)	0.0001 (0.450)
Average-Performing Districts	0.0005 (0.833)	-0.0012 (-1.784)
High-Performing Districts	0.0003 (0.667)	0.0014* (3.767)
Percentage Change in the Student-Teacher Ratio		
Low-Performing Districts	0.0149* (8.485)	0.0134* (7.872)
Average-Performing Districts	0.0009 (0.673)	0.0073* (5.296)
High-Performing Districts	0.0035* (2.113)	0.0051* (3.558)
Percentage Change in the Equalized Valuation Index	0.0012* (3.417)	0.0021* (6.228)
Percentage Change in the Free / Reduced Lunch Participation Rate	-0.0014* (-4.840)	-0.0014* (-5.110)
Percentage Change in the Proportion of Single Mothers in the Community	-0.0028* (-4.810)	-0.0024* (-4.362)
Percentage Change in the Proportion of Students in Public Schools	-0.0017* (-2.010)	-0.0053* (-6.672)
Prior Scores in 1994	0.0067* (35.245)	0.0072* (37.873)

Note: numbers reported in parenthesis are the t-statistics and * denote a 5% level of significance.

The negative relationship may also be due to the influence of union bargaining in setting salaries. Most studies have found no connection between learning and salaries. Underperforming teachers get rewarded (salaries) right along with good teachers. Teachers, who have the greatest influence on student learning, are so heavily protected by civil service and union rules that those who are mediocre or even incompetent are almost never removed from their jobs (Lieberman, 1993). This would mean that increased salaries would not be directed to teachers of relatively more skill, thus creating no link between higher paid teachers and more well-educated students. Therefore, in the 4th grade, increasing pay to teachers is not an effective way to improve performance.

The next policy variable is the proportion that goes for non-instructional expenditures, including administration, athletics, transportation, maintenance and health. This variable is significant and negative for high-performing districts, indicating that increased spending of this type hurts performance in such districts. However, in low and average-performing districts, this expenditure is insignificant with the exception of low-performing districts in Math.

Increased expenditure on management consists primarily of increased spending on and by principals. A principal sets policy for a school and thereby exerts an influence on student performance. However, based on the results of the model, this variable is ambiguous both in terms of significance and as to its direction of influence. For example, for low-performing districts it is significant for English but not for Math and has a positive effect on student performance. This variable has no significant effect on the average-performing districts. For high-performing districts however, it is significant for Math and exerts a positive influence. From these results it is hard to identify any real pattern and therefore it is difficult to deduce the effect that this type of expenditure has on student performance in this grade level.

As mentioned above, increased spending on teachers can be captured directly by increases in teachers' average salary or indirectly by changes in class size. We assume that an increase in the student-teacher ratio implies an increase in class size. A negative coefficient would imply, as school advocates commonly argue, that bigger classes hurt student performance. On the other hand, our results show that the percentage change in the student-teacher ratio is significant and *positive* in all but one instance (in average-performing districts for English), which implies that bigger classes have a positive impact (or smaller classes have a negative impact) on scores.

Is this result counter intuitive? Many studies and research suggests otherwise. Once again, quoting Hanushek's paper on class size, "Of the best available studies – single state, value-added studies of individual classroom achievement (similar to the model in this paper) – only one out of twenty-three (4%) shows smaller classes to have a statistically significant positive effect on student performance."[15] On the other hand, 13% of such studies found smaller classes to have a significantly negative effect on student performance. In his paper, Hanushek summarizes the

[15] Eric A. Hanushek, "The Evidence on Class Size", *W. Allen Wallis Institute of Political Economy at the*

results of all major studies that bear on the effects on student outcomes of class size, as measured by student-teacher ratios. Therefore, the outcome of our report is consistent with the results of past studies that use value-added approaches for state-based test results.

Socioeconomic variables exhibit the usual high levels of significance. The results show that performance increases significantly with increases in EQV, a proxy measure of the relative wealth of districts. As another socioeconomic variable, the free/reduced price lunch participation rate among districts provides a measure of family and economic instability. This variable is significant and negative, suggesting that districts with a higher percentage of students coming from poorer families tend to perform worse as compared to their more affluent counterparts. Another indicator of family background is the proportion of single mothers in the community. This variable is significant and negative implying that the higher the number of single mothers in a district, the worse is its performance on the MCAS test.

The school choice variable is significant and negative, suggesting that a rise in the percentage of students in public schools hurts district performance. This result should encourage advocates of school vouchers and educational choice. It strengthens the argument that the state should give low-income parents the opportunity to send their children to private schools or better performing public schools in neighboring districts. This result is in direct contrast to earlier studies of contemporaneous relationships that have generally shown that public school performance improves with the number of students in public schools. However, as indicated in the introduction, a contemporaneous analysis does not truly capture the impact of variables on performance.

As expected, the results of the model suggest that a district's current performance is heavily influenced by its past performance. If the district performed well in the past it will continue to do so, as scores in 1994 have a significant and positive impact on current tests scores.

University of Rochester, Occasional Paper, 98:1 (February 1998).

8^{th} Grade Results

Now we consider the estimation results for the 8^{th} grade

Table 10: Ordered Logit Model Estimation Result for 8^{th} Grade

Variable	English	Mathematics
Constant	-5.1114* (-21.100)	-9.3352* (-40.805)
Percentage Change in Teachers' Average Salary		
Low-Performing Districts	-0.0073* (-5.780)	-0.0078* (-7.178)
Average-Performing Districts	-0.0054* (-3.340)	0.0069* (5.253)
High-Performing Districts	-0.0070* (-4.298)	-0.0047* (-3.358)
Percentage Change in Non-Instructional Expenditures		
Low-Performing Districts	-0.0016* (-2.160)	0.0019* (2.929)
Average-Performing Districts	-0.0044* (-4.517)	-0.0039* (-4.229)
High-Performing Districts	-0.0064* (-6.479)	-0.0081* (-10.676)
Percentage Change in Expenditure on Management		
Low-Performing Districts	0.0003 (0.759)	-0.0001 (-0.167)
Average-Performing Districts	-0.0009 (-0.944)	-0.0047* (-6.141)
High-Performing Districts	0.0042* (6.927)	0.0041* (8.070)
Percentage Change in the Student-Teacher Ratio		
Low-Performing Districts	0.0174* (8.579)	0.0124* (6.949)
Average-Performing Districts	0.0016 (0.918)	-0.0007 (-0.550)
High-Performing Districts	0.0041* (2.435)	0.0025 (1.630)
Percentage Change in the Equalized Valuation Index	0.0050* (11.782)	0.0069* (17.852)
Percentage Change in the Free / Reduced Lunch Participation Rate	-0.0027* (-8.313)	-0.0008* (-3.088)
Percentage Change in the Proportion of Single Mothers in the Community	-0.0042* (-6.267)	-0.0025* (-4.432)
Percentage Change in the Proportion of Students in Public Schools	-0.0065* (-7.297)	-0.0003 (-0.381)
Prior Scores in 1994	0.0066* (38.575)	0.0081* (48.618)

Note: numbers reported in parenthesis are the t-statistics and * denote a 5% level of significance.

Teachers' average salary is significant and negative in five out of the six cases for 8th graders. The exception is Math for average-performing districts, for which it is significant and positive. In all other instances, increased spending on teachers' average salary worsens student performance.

Increases in non-instructional spending worsen performance in both subjects for high and average-performing districts and in English for low-performing districts. However, increases in the same expenditures improve performance in Math for low-performing districts. Increasing expenditure on management improves results for high-performing districts, adversely affects the average-performing districts and has no significant effect on the low-performing districts.

The effects of smaller classes are not as clear in this grade level (8th grade) as in the case of 4th grade in that there are only three statistically significant results. But if significant, smaller classes worsen student performance as is evident from the significant and positive coefficient. For average and high-performing districts however, this variable proves to be insignificant and produces no decipherable information on its effects on student performance (which again is quite a common result in the extant literature on class size and student performance).

The socioeconomic variables reveal almost identical results as in the case of the 4th grade. Concerning choice, for 8th grade, a rise in the percentage of students in public schools improves district performance, similar to what is observed for the other grades and subjects. Prior scores have a positive effect on the district's current performance.

<u>10th Grade Results</u>

In addition to the variables considered in the above analyses of the 4th and 8th grades, for the 10th grade we incorporate a variable representing the percentage change in the dropout rate. While increasing expenditures and falling test scores have characterized public education in the United States in recent decades, graduation rates have also been on the rise.

This has prompted many researchers to argue that secondary schools create two competing outputs, namely standardized test scores and high school graduation rates.[16] Studies have shown that average earnings tend to be higher for workers who have completed more years of education.[17] According to a recent study by the Center for Labor Market Studies at Northeastern University, the inflation adjusted annual income of families headed by a high school drop out fell by $7,000 from 1979 to 1999, whereas, their Bachelor's degree counterparts experienced an $8,000 rise in their annual income over the same period. Furthermore, the 2001 Census reports the civilian

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[16] Jennie Wenger, "What do Schools Produce? Implications of Multiple Outputs in Education," *Contemporary Economic Policy*, 18:1 (2000): 27-36.
[17] David Card and Alan B. Krueger, "Labor Market Effect of School Quality: Theory and Evidence," in *Does Money Matter? The Effect of School Resources on Student Achievement and Adult Success,* Gary Burtless, ed., (Washington, D.C.: Brookings Institution, 1996), 97-140. Also see Alan B. Krueger, "Reassessing the

participation rate in the labor force for high school dropouts fell from 12.2% in 1992 to 9.8% in 2000.

For the aforementioned reasons, some scholars argue that communities in economically disadvantaged areas may actually prefer higher graduation rates to higher test scores, since increased education translates directly into increased earnings. Such a preference for lower dropout rates – for "quantity" over "quality" – would result in lower test scores, since (a) resources are used up in an effort to reduce dropout rates by inducing students to stay in school and (b) students who would have ordinarily dropped out are now bringing the test score average down.[18]

On the other hand, wealthier communities may choose "quality" over "quantity." They may prefer to use their resources in programs for advanced students, in the hope of getting higher test scores. The number of high school dropouts in Boston climbed slightly last year, prompting some opponents of the high-stakes MCAS test to attribute this increase to students abandoning their education out of fear of the statewide test, which is a graduation requirement for the class of 2003.[19] Tables 11 and 12 reveal whether this is observed in the data.

If the use of increased school resources stems from the fact that schools are opting for quantity instead of quality, the data should reveal two things. First, an increased expenditure in a given district should be linked with reduced dropout rates. Second, incremental changes in test scores should be positively linked with incremental changes in dropout rates

Table 11 reports the correlation between these incremental changes from 1994 to 2001.[20] We see that changes in dropout rates (10th graders) are not linked with changes in expenditures. These preliminary findings suggest that increased funding has not succeeded in reducing dropout rates. Further, we find that changes in dropout rates are negatively correlated with scores. It appears that truly good schools are those that exhibit high test scores and also low dropout rates. This result is a sharp contrast to Wenger's paper and to the suggestion that the MCAS test acts as an incentive to drop out.

View that American Schools are Broken," *Economic Policy Review,* 4:1 (1998).

[18] David C. Berliner and Bruce J. Biddle. "The Manufactured Crisis: Myths, Fraud, and the Attack on America's Public Schools,"Addison-Wesley Publishing Company (Reading, Mass., 1995).

[19] "High School Dropout Rate In Boston Increases Slightly," *Boston Globe*, 27 April 2002.

[20]Changes in dropout rates, scores and expenditure are computed as $\frac{x_{00}-\mu(x_{00})}{\sigma(x_{00})}-\frac{x_{94}-\mu(x_{94})}{\sigma(x_{94})}$. Critical values for Pearson as well as Spearman test statistic at 5% level of significance are ±1.96.

The results of the ordered logit model for 10th grade reported in Table 12, show that lower dropout rates translate to better performance. This result is consistent with the above correlation analysis. Therefore, the quantity v. quality argument, whereby students who are more likely to perform badly tend to quit early, is not supported by the data.

Table 11: Correlations of Changes in Dropout Rates with Changes in Expenditures and Scores

	Variable	Pearson Coefficient of Correlation (Test-Statistics)	Spearman Coefficient of Correlation (Test-Statistics)
	Expenditure	-0.090 (-1.323)	-0.030 (-0.445)
Scores	English	-0.108 (-1.604)	-0.143* (-2.101)
	Mathematics	-0.179* (-2.681)	-0.155* (-2.290)

Note: * denotes a 5% level of significance.

Table 12 below reports the results for 10th grade, with changes in dropout rates incorporated as an independent variable. With regard to the influence of teachers' average salary on scores, the results are close to those obtained for the 4th grade. If significant, increased spending on this policy variable worsens student performance. Additional non-instructional expenditure has no clear influence on the performance of students in low and average-performing districts, whereas it adversely affects the performance of high-performing districts.

As observed in the 8th grade, directing more resources toward management yields better results for high-performing districts. This reinforces the argument that, as districts achieve a high-level of performance, their willingness to hire or pay more to attract and retain better-qualified principals will further improve their students' performance. As for low and average-performing districts, spending more on management (principals and vice principals) does harm rather than good, as is evident from the negative coefficient of this variable.

In the 10th grade, the effects of smaller classes are statistically significant in only 3 of the 6 categories. Similar to the results in the 4th grade, if significant, reducing class size causes a negative effect on student performance.

Table 12: Ordered Logit Model Estimation Results for 10th Grade

Variable	English	Mathematics
Constant	-8.5606* (-28.555)	-10.1723* (-34.443)
Percentage Change in Teachers' Average Salary		
Low-Performing Districts	-0.0043* (-3.734)	-0.0028* (-2.506)
Average-Performing Districts	-0.0108* (-6.683)	-0.0013 (-0.859)
High-Performing Districts	-0.0013 (-0.948)	-0.0007 (-0.482)
Percentage Change in Non-Instructional Expenditures		
Low-Performing Districts	0.0009 (1.119)	-0.0005 (-0.664)
Average-Performing Districts	0.0022* (2.356)	0.0000 (0.022)
High-Performing Districts	-0.0087* (-9.533)	-0.0063* (-7.776)
Percentage Change in Expenditure on Management		
Low-Performing Districts	-0.0027* (-7.299)	-0.0030* (-8.067)
Average-Performing Districts	-0.0033* (-4.310)	-0.0036* (-4.501)
High-Performing Districts	0.0027* (4.613)	0.0019* (3.512)
Percentage Change in the Student-Teacher Ratio		
Low-Performing Districts	0.0044* (2.224)	-0.0030 (-1.515)
Average-Performing Districts	0.0076* (3.903)	-0.0022 (-1.427)
High-Performing Districts	0.0027 (1.946)	0.0033* (2.164)
Percentage Change in the Equalized Valuation Index	0.0022* (6.099)	0.0031* (8.553)
Percentage Change in the Free / Reduced Lunch Participation Rate	-0.0023* (-7.523)	-0.0006* (-2.009)
Percentage Change in the Proportion of Single Mothers in the Community	-0.0011 (-1.680)	-0.0031* (-4.848)
Percentage Change in the Proportion of Students in Public Schools	0.0008 (1.070)	-0.0016* (-2.092)
Percentage Change in the Dropout Rate	-0.0011* (-7.115)	-0.0012* (-7.628)
Prior Scores in 1994	0.0085* (38.187)	0.0093* (42.503)

Note: numbers reported in parenthesis are the t-statistics and * denote a 5% level of significance.

Again, positive changes in EQV are associated with improved performance. An increase in the proportion of students in the district availing themselves of the free/reduced price lunch program worsens performance. An increase in the proportion of mothers who are single worsens performance. Increased enrolment in public schools worsens performance, which reiterates the argument that choice is better in promoting better-educated students through better test result.

Individual Policy Variable Analysis

Here we consider the effects of each of the four policy variables that address expenditure namely, expenditure on teachers' average salary, expenditure on management, non-instructional expenditure, and student-teacher ratios.

Student-Teacher Ratio

Advocates of increased education spending usually stress the importance of reducing student-teacher ratio or class size over other policy variables, particularly over choice. They argue that class size is so important a factor in determining school performance that the state should spend more to reduce class size and, in the process, avoid offering educational choices that would "drain" money from public schools. As seen in Tables 9, 10 and 12, which detail the results of the model, smaller classes do not promise better results; rather they generally worsen performance on the MCAS test. And to further counter the argument offering educational choices to less privileged children will improve their chances of scoring well on the MCAS test, as is evident from the result that increased attendance in public schools has produced negative results on student performance.

Table 13: Effect of a 10-Percentage-Point Change in Student-Teacher Ratio on Good Performance

Grade Level	Student-Teacher Ratio	Percent of Students Registering Good Performance at Various Prior Performance Levels					
		ENGLISH			MATHEMATICS		
		Low	Average	High	Low	Average	High
4	X-10	43.10	NA	75.28	26.98	39.06	57.85
	X	46.66	64.46	75.92	29.64	40.80	59.06
	X+10	50.24	NA	76.55	32.43	42.56	60.26
8	X-10	65.62	NA	89.62	26.19	NA	NA
	X	69.21	81.13	89.98	28.59	43.99	61.88
	X+10	72.59	NA	90.34	31.11	NA	NA
10	X-10	50.23	62.38	NA	NA	NA	72.63
	X	51.27	64.14	78.28	42.63	59.79	73.26
	X+10	52.31	65.86	NA	NA	NA	73.89

Note: The variable X denotes percentage change in Student-Teacher Ratio from 1994 -1999. A change of 10-percentage-point to this variable is computed. All the other variables in the regression are taken at their actual values.
NA denotes that X is insignificant for this grade level.

Table 13 offers further information about the effects on performance of hypothetical changes in student-teacher ratios. It shows the effects of a 10-percentage-point decrease or increase in the student-teacher ratio for low, average and high-performing districts. If, for example, the percentage change in the student-teacher ratio for 4th grade in low-performing districts decreased by ten points (X-10), the fraction of students registering good performance, i.e., falling in the Advanced or Proficient categories, would decrease by 3.56 percentage points (or from 46.66% to 43.10%) in English. A similar decrease in the student-teacher ratio (X-10) would have decreased good performance in high-performing districts from 75.92% to 75.28% in 4th grade for English. Similarly for 8th and 10th grade, a 10-point reduction in this ratio will cause either insignificant or worsened results. On the other hand, a 10-point increase in this ratio in most cases improves results. Overall, as class size decreases performance worsens.

While education experts continue to debate the effects and importance of class size on performance, there are widely held conclusions that support our findings. As stated earlier, fully 58% of existing studies suggest either that more students per teacher are better (i.e., bigger classes are better) or that we can have no confidence in the existence of any relationship at all.[21] Furthermore, among all state, value-added studies, 95% found smaller classes to have either no significant impact or a negative effect on student performance.

Teachers' Average Salary

Table 14 shows that contrary to popular belief, increasing teachers' average salary produces either insignificant results or, even worse, reduces student performance. This result is clearly evident in almost all districts for each of the three grade levels. For example, in 4th grade for the low-performing districts in Math, a 10-percentage-point increase will cause student performance in the Advanced and Proficient categories to fall from 29.64% to 27.59%. Similarly in the 8th and 10th grades among the low-performing districts in Math, increased spending on teachers causes performance in these categories to fall from 28.59% to 27.06% and 42.63% to 41.99% respectively. Overall, increasing teachers' average salary has not resulted in any improvements but, rather, has worsened the percentage of students registering good performance.

Table 14: Effect of a 10-Percentage-Point Change in Teachers' Average Salary on Good Performance

Grade Level	Teacher's Average Salary	Percent of Students Registering Good Performance at Various Prior Performance Levels					
		ENGLISH			MATHEMATICS		
		Low	Average	High	Low	Average	High
4	X-10	49.40	66.98	76.54	31.76	43.85	60.38
	X	46.66	64.46	75.92	29.64	40.80	59.06
	X+10	43.93	61.85	75.29	27.59	37.81	57.73
8	X-10	70.66	81.93	90.58	30.17	42.33	62.90
	X	69.21	81.13	89.98	28.59	43.99	61.88
	X+10	67.73	80.31	89.35	27.06	45.66	60.84
10	X-10	52.29	66.56	NA	43.28	NA	NA
	X	51.27	64.14	78.28	42.63	59.79	73.26
	X+10	50.25	61.64	NA	41.99	NA	NA

Note: The variable X denotes percentage change in Teacher's Salary from 1994-2000. A change of 10 percentage points in this variable is computed. All the other variables in the regression are taken at their actual values.
NA denotes that X is insignificant for this grade level.

[21] See footnote 15.

Non-Instructional Expenditure

The effects of the same 10-percentage-point change on non-instructional expenditure are shown in Table 15. The results of this table are not consistent for all grades and all performance levels. On the contrary, the effect of a decrease or increase in this variable varies across the board. As shown in the table, in Math, for low-performing districts an increase in this type of spending increases good performance in the 4th grade, whereas, it produces either no effect or worsens performance for average and high-performing districts.

Table 15: Effect of a 10-Percentage-Point Change in Non-Instructional Expenditure on Good Performance

Grade Level	Non-Instructional Expenditure	Percent of Students Registering Good Performance at Various Prior Performance Levels					
		ENGLISH			MATHEMATICS		
		Low	Average	High	Low	Average	High
4	X-10	NA	NA	76.53	29.10	NA	60.22
	X	46.66	64.46	75.92	29.64	40.80	59.06
	X+10	NA	NA	75.30	30.18	NA	57.89
8	X-10	69.53	81.80	90.54	28.21	44.93	63.66
	X	69.21	81.13	89.98	28.59	43.99	61.88
	X+10	68.89	80.45	89.47	28.97	43.06	60.07
10	X-10	NA	63.64	79.70	NA	NA	74.44
	X	51.27	64.14	78.28	42.63	59.79	73.26
	X+10	NA	64.63	76.80	NA	NA	72.05

Note: The variable X denotes percentage change in Non-Instructional Expenditures from 1994-2000. A change of 10 percentage points in this variable is computed. All the other variables in the regression are taken at their actual values. NA denotes that X is insignificant for this grade level.

Expenditure on Management

Increased expenditure on management means that the district is increasing the pay of their existing principals or hiring new principals at higher salaries. The results in Table 16 are once again ambiguous for low and average-performing districts. Either the results are insignificant or increases in such spending produce negative results. For the high-performing districts, however, the result is clearer. If the results are significant, increases in expenditures on management increases the percentage of students registering good performance. In high-performing districts, especially with regard to high school, more efficient or better-motivated principals translate to better results on the MCAS test.

Table 16: Effect of a 10-Percentage-Point Change in Expenditure on Management on Good Performance

Grade Level	Expenditure on Management	Percent of Students Registering Good Performance at Various Prior Performance Levels					
		ENGLISH			MATHEMATICS		
		Low	Average	High	Low	Average	High
4	X-10	46.34	NA	NA	NA	NA	58.72
	X	46.66	64.46	75.92	29.64	40.80	59.06
	X+10	46.97	NA	NA	NA	NA	59.39
8	X-10	NA	NA	89.61	NA	45.14	60.96
	X	69.21	81.13	89.98	28.59	43.99	61.88
	X+10	NA	NA	90.35	NA	42.85	62.79
10	X-10	51.92	64.90	77.83	43.33	60.65	72.89
	X	51.27	64.14	78.28	42.63	59.79	73.26
	X+10	50.62	63.37	78.72	41.94	58.93	73.63

Note: The variable X denotes percentage change in Expenditure on Management from 1994-2000. A change of 10 percentage points in this variable is computed. All the other variables in the regression are taken at their actual values. NA denotes that X is insignificant for this grade level.

Accountability

Accountability has played a significant role in influencing performance on the 2001 MCAS test. It appears that the threat of failing has caused schools to concentrate their effort on getting students to pass the test and thereby caused students to apply themselves to learning and taking the exam. As the MCAS test grows closer to becoming a graduation requirement, schools and teachers are under tremendous pressure to make sure their students do well on the test. And in order to achieve this goal, teachers have reconciled their teaching methods to improve results on the MCAS test, which has resulted in this sudden surge in improvement on the MCAS test. This sudden boost in better performance is more pronounced in the case of 10^{th} graders, which proves that when the test matters, student and teachers put in that extra effort to succeed.

The result in Table 8 supports this argument of the effect of accountability. In both subjects and in all grade levels, the model overpredicts the percentage of students that fall in the Warning category compared to what is actually observed. Hence in reality, in this category, on the MCAS 2001 test, schools did better than they were expected to do. This, however, is not the case for the Needs Improvement and Proficient categories. Similarly, in the Advanced category, in 17 of the 24 observations the model overpredicts, meaning that on the 2001 MCAS test, schools had fewer students falling in this category than predicted by the model. A simple explanation for this observation is that as the need to pass the MCAS test becomes a requirement, more schools are aiming to have students pass the test rather than improving the overall performance. Therefore, weaker students are passing the test at the expense of better performing students. This observation indicates that improved performances on the MCAS 2001 test was triggered among other factors by the need to graduate or "accountability."

Another finding to support this argument is that the discrepancy between actual and predicted scores in the Warning category (see Table 8) is most pronounced for 10th graders who are faced with the pressure of passing the test (in order to graduate) within the next year. This effect can be explained only by the accountability factor that is not being captured by the BHI model.

Does Policy Matter?

In order to better understand the relationship between increased spending and test scores in Massachusetts, we conducted a test to explain the influence of policy inputs. Based on the results of the model and through the course of this study we have found that increases in the main policy inputs – teachers' average salary and reduced class size – on which the state has spent the most, have failed to yield the desired result, namely, better student performance. The other less important school spending categories such as non-instructional spending and expenditure on management have produced results that are hard to identify. The overall verdict on the effect of changes (increases) in education expenditure on changes in scores (1994-2001) has been either negative or inconclusive.

As a final test we ran our value-added model as before, but with one major adjustment – without the inclusion of any policy variables. This form of the model (Model II) includes only the socioeconomic and choice variables, and prior test scores. Although the original model (Model I) is superior to the second model in the statistical sense, Model II is still good for its predictive abilities. Table 17 shows the result of the actual versus predictive ability of both models.

Table 17 indicates that the predictive abilities of both the models are equally good. For example, in the 4th grade for English, the average percentage of students falling in the Advanced category was actually 8.46% as compared to the Model I's prediction of 8.86% and Model II's prediction of 8.98%. The similarity in the predictive abilities of both models implies that although policy may have influenced student performance in some way, a concrete and positive effect of increased spending has proven to be non-existent. More importantly, other socioeconomic factors over which education policy makers have very little influence have had significant and pronounced impact on test scores.

Table 17: A Comparison of the Means of Actual and Predicted Student Performance (%)

Grade Level	Performance	ENGLISH			MATHEMATICS		
		Actual	Model I Predicted	Model II Predicted	Actual	Model I Predicted	Model II Predicted
4	Warning	3.75	4.69	4.57	9.48	10.95	10.78
	Needs Improvement	33.27	32.97	32.64	46.64	45.88	45.69
	Proficient	54.53	53.48	53.81	30.35	29.53	29.74
	Advanced	8.46	8.86	8.98	13.54	13.64	13.79
8	Warning	1.77	2.36	2.32	17.01	18.62	18.54
	Needs Improvement	16.70	17.53	17.34	37.73	36.57	36.38
	Proficient	71.42	69.89	69.97	30.04	29.31	29.36
	Advanced	10.11	10.22	10.37	15.22	15.51	15.73
10	Warning	6.60	8.27	8.20	11.21	12.52	12.50
	Needs Improvement	27.69	27.17	26.94	30.23	28.93	28.84
	Proficient	44.84	43.27	43.29	33.99	33.15	33.11
	Advanced	20.86	21.29	21.56	24.59	25.41	25.55

VIII. Learning about Schools from the Model

The Massachusetts newspapers are teeming with stories regarding the performance of public schools on the MCAS test. While these stories are of interest to parents wanting to settle in communities with the best schools (or, to avoid those with the worst schools), they are of little value to policy makers or educators. The MCAS test results by themselves do not give a comprehensible picture of how well districts have performed. The reason lies in the importance of socioeconomic factors over which policy makers and educators can exert little control but that nevertheless are highly important in determining how individual districts perform.

The BHI Education Assessment Model for Massachusetts permits policy makers to determine how well schools perform, given the role of these factors in determining performance. It makes it possible to determine how well teachers and administrators are doing, given that certain important factors are beyond their control. Educators can use the model to identify schools that outperform the model and to discover and identify teaching and administrative methods that make it possible for those schools to outperform the model.

Because the model does a good job at predicting school performance (see Table 8), schools that perform substantially better (or worse) than predicted by the model are worth studying for the good (or bad) example they provide. Hence, we provide a ranking of districts according to whether and to what extent their actual performance exceeds their predicted performance.

This ranking lists schools according to their combined English and Mathematics rankings for each grade level in the "good" (G) category, which is an aggregate of the Advanced and Proficient categories. Schools with lower numbers under this category, i.e. a rank close to "1" outperform schools with higher numbers. If a district is ranked close to "1," then that particular district's actual proportion of students in the "good' (G) category is higher than that predicted by the model. We see, for example, that for 4^{th} graders, the Petersham school district did the best job (with a "1" ranking) and that the Hawlemont district did the worst job (with a "266" ranking) based on what the model predicted. (See Appendix, Table 1A.)

We provide a second ranking ("poor" [P] category), reflecting a district's success in reducing the fraction of students doing poorly, i.e. falling in the Warning category. The closer to "1" that a district is ranked, the more successful it was in keeping the fraction of students who perform badly *below* what the model predicted for that district. Thus, of all districts, the Holyoke district did the best job in reducing poor performance for 4^{th} graders. (See Appendix, Table 2A.)

Finally, we list districts alphabetically, providing the "G" and "P" rankings for each district. Rank G (achieving good performance), and Rank P (reducing poor performance) give the difference between actual and predicted scores. (See Appendix, Table 3A.) For both categories, the closer the rank is to "1" the better the district has performed. From this Table, we examined the Everett school district in its success in "beating" the model. We interviewed school officials and teachers in this district to garner clues for causes of its superior performance.

Everett

Everett is the only district that consistently ranks high in the six ranking categories in both achieving good performance and reducing poor performance. This is especially interesting in that Everett is an urbanized center with a population of 34,773, $14,220 in per capita income, and a school population of 5,377 in seven elementary schools and one secondary school. Frederick Foresteire, the Superintendent and Marie Lee, the Curriculum Director, both noted that they've been contacted and interviewed recently by researchers from Boston College, Boston University, Tufts and the University of Massachusetts, Boston.

The Everett school system appears to be benefiting from long-term standards-based reform across the system. The in-service time devoted to professional development has been augmented by twenty-five hours, and the school year has been extended from 180 days to 186 days for students, 189 days for teachers and 226 days for administrators. This concentration on development has been used to focus on utilizing cooperative learning strategies, addressing differing learning styles, and fostering positive attitudes in teaching and learning.

To assure that all teachers and administrators are speaking the same language and using the same conceptual framework, the system has adopted a uniform approach developed by Research for Better Teaching (RBT) to make the study of teaching an ongoing part of the school culture and to foster collaborative work and shared accountability based on shared goals. All administrators and almost all teachers have had year-long RBT training. In implementing the approach, committees continuously address questions of method and monitor curriculum alignment. Strict accountability and the support necessary for success are central. Assessment is crucial, and teachers produce self-assessments in addition to being evaluated by various administrators. To tie all of this together, the system has mandated uniform plan sheets to replace the old plan books. These sheets provide for more specifics as to aims, goals and methods of individual lessons and relate them to specific standards.

Careful study of MCAS test results that leads to school-by-school design of tutoring programs for students who need assistance and emphasis on coping with open-ended questions has been introduced into the curriculum at all levels. It seems evident, however, that the highly structured focus on system-wide effectiveness is at the root of Everett's success on the MCAS test.

Conclusion

To summarize, the findings of this study are: (1) other factors, beyond the realm of policy makers, have a more pronounced effect on student performance than policy variables; (2) contrary to "conventional wisdom" smaller classes aren't always better; (3) contrary to Massachusetts policy makers' wisdom, increased spending doesn't always mean better-educated students; (4) accountability or the test itself influences better performance in a positive way; and (5) school choice has a positive impact on student performance.

Socioeconomic and demographic characteristics of families within the community and past performance, over which policymakers have little influence, exert a significant impact on current scores. The evidence from the BHI Education Assessment Model shows we can do a better job of rating schools by employing a value-added model such as the one employed here. Until we know how to relate school performance to education policies, we will not be able to make informed judgments about future spending proposals or about the role of the MCAS test in making those judgments.

The study further goes to prove that "choice" is good and parents should be given the option to decide where and how their children are educated, no matter what their social or economic standing. Rather than blatantly pouring money into a weak public school system the government should use scarce taxpayer dollars to provide a good education for its future generations by giving them the choice of a better education – private or public.

APPENDIX

Table 1A: District Rankings for Achieving Good Performance (G)

	Grade 4		Grade 8		Grade 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
1	Petersham	22	Frontier	34	Gill Montague	102
2	Eastham	46	Hadley	29	Northampton	51
3	Conway	1	Provincetown	59	Sutton	50
4	Sunderland	2	Tewksbury	88	Ware	152
5	Foxborough	7	Granby	121	Frontier	33
6	Sutton	94	East Longmeadow	67	Mendon Upton	35
7	Truro	97	Milford	109	Athol Royalston	147
8	Orange	3	Richmond	42	Cohasset	6
9	Orleans	106	Nantucket	99	Mansfield	70
10	Wellfleet	13	Lynnfield	36	Braintree	42
11	Palmer	90	Mansfield	66	Clinton	90
12	Westwood	4	Edgartown	47	Newburyport	28
13	Mansfield	59	Oak Bluffs	17	Westborough	10
14	Brimfield	107	Stoughton	110	Amherst-Pelham	40
15	Lakeville	116	Ipswich	23	Needham	13
16	Cohasset	6	Westford	9	Swampscott	25
17	Williamstown	31	Lunenburg	71	Ashland	54
18	Mattapoisett	65	Needham	16	King Philip	55
19	Pentucket Regional	163	Southern Berkshire	69	Franklin	60
20	Braintree	39	Mashpee	153	Stoneham	45
21	Somerset	83	Cohasset	11	Everett	191
22	Everett	185	Franklin	82	Amesbury	130
23	Tewksbury	81	Chatham	61	Hamilton Wenham	17
24	Arlington	14	Carver	151	Gateway	159
25	Southborough	33	Hatfield	58	Groton Dunstable	19
26	Franklin	35	Groton Dunstable	21	Medford	175
27	Belchertown	153	Milton	60	Milford	137
28	Swampscott	58	Lenox	56	Sharon	9
29	New Salem Wendell	212	Medway	19	Provincetown	141
30	Brewster	50	Marblehead	31	Easton	47
31	Scituate	18	Acton-Boxborough	7	Tyngsborough	79
32	Clinton	136	Ware	158	Chelsea	215
33	Holyoke	261	Hull	149	Acton-Boxborough	2
34	Middleton	72	Burlington	55	East Longmeadow	77
35	Northampton	131	Watertown	84	Malden	184
36	Oak Bluffs	56	Hamilton Wenham	10	Winchester	8
37	Milton	42	Longmeadow	27	Arlington	63
38	Richmond	15	Norton	49	Natick	57
39	Dartmouth	145	Attleboro	165	Southern Berkshire	142
40	Canton	38	Melrose	52	Northborough-Southborough	29
41	Williamsburg	142	Braintree	64	Belmont	16
42	Chelsea	249	Wayland	2	Longmeadow	24
43	Fairhaven	132	Marshfield	100	Hadley	59
44	Spencer East Brookfield	154	Amesbury	102	Silver Lake	119
45	Marshfield	17	Stoneham	57	Hingham	36
46	Belmont	9	Quaboag Regional	87	Canton	65

(Table 1A cont.)

	Grade 4		Grade 8		Grade 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
47	Millbury	173	Northampton	95	Wayland	3
48	Acushnet	179	Tisbury	90	Lynnfield	38
49	Danvers	60	Nauset	74	East Bridgewater	98
50	Rockland	109	Waltham	111	Triton	82
51	Carver	213	King Philip	86	Beverly	96
52	Easton	71	Hampden Wilbraham	51	North Brookfield	154
53	Clarksburg	186	Berkley	101	Gardner	68
54	Stoneham	79	Central Berkshire	63	Norwood	134
55	Chatham	74	Quabbin	133	Lexington	1
56	Provincetown	218	Methuen	162	Hampden Wilbraham	71
57	Lynnfield	37	Foxborough	68	Greenfield	116
58	Carlisle	10	Everett	178	Masconomet	12
59	Hanover	28	Silver Lake	136	Nantucket	69
60	Grafton	120	Winthrop	97	Danvers	53
61	Lexington	11	Millis	76	Stoughton	100
62	Milford	164	North Andover	77	Ludlow	105
63	Woburn	53	Newburyport	72	Dighton Rehoboth	94
64	Westborough	34	Georgetown	50	Holyoke	216
65	Lenox	77	Lexington	4	North Andover	67
66	Sharon	23	Littleton	91	Milton	110
67	Gateway	188	Wareham	159	Melrose	62
68	Boxborough	27	Florida	5	Reading	72
69	Bridgewater Raynham	100	Nashoba	44	Pentucket Regional	22
70	East Longmeadow	41	Holliston	33	Wellesley	4
71	Holbrook	177	Tantasqua	98	Shrewsbury	20
72	Whately	223	Boston	220	Hatfield	52
73	Weymouth	82	Tyngsborough	80	Hopkinton	26
74	Longmeadow	44	Canton	79	Lowell	204
75	Gardner	209	Triton	137	Nashoba	23
76	Wachusett Regional	48	Holyoke	235	Dennis Yarmouth	95
77	Georgetown	66	Middleborough	140	Walpole	81
78	Norfolk	88	Belchertown	119	Ipswich	88
79	North Attleborough	85	North Adams	205	Berlin-Boylston	15
80	Rochester	130	Sudbury	8	Georgetown	78
81	Chelmsford	43	Wellesley	3	Bridgewater Raynham	93
82	Millis	105	Bedford	22	Rockport	121
83	Shutesbury	175	Westborough	38	Martha's Vineyard	48
84	Avon	126	Uxbridge	126	Falmouth	113
85	Ludlow	189	Pentucket Regional	75	Revere	199
86	Topsfield	52	Narragansett	139	Barnstable	109
87	Seekonk	146	Dudley Charlton Regional	147	Framingham	91
88	Methuen	196	Masconomet	37	Quabbin	89
89	Reading	62	Spencer East Brookfield	143	Dracut	131
90	Brockton	243	Hanover	53	Granby	144
91	Dudley Charlton Regional	140	Chelsea	229	Hudson	126
92	Monson	224	Malden	202	Westford	30
93	Hingham	25	Danvers	85	Boston	208
94	Cambridge	222	Athol Royalston	190	Monson	123

(Table 1A cont.)

	Grade 4			Grade 8		Grade 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
95	Winchester	5	Fitchburg	228	Belchertown	74
96	Winthrop	156	Sutton	114	Winthrop	138
97	Westford	49	Northborough	35	Wachusett Regional	43
98	Sherborn	16	Easton	92	Attleboro	188
99	Barnstable	113	Leominster	171	Newton	5
100	North Brookfield	86	Medford	176	Marblehead	21
101	Walpole	208	Carlisle	1	Brookline	34
102	Lynn	246	Hopkinton	20	Sandwich	46
103	Attleboro	187	Belmont	28	Westfield	164
104	Hampden Wilbraham	63	Gloucester	163	Abington	92
105	Southern Berkshire	167	Agawam	145	Uxbridge	132
106	Whitman Hanson	117	Somerville	154	Bedford	31
107	Watertown	160	Arlington	65	Weymouth	135
108	West Boylston	21	Reading	24	Lunenburg	87
109	Groton Dunstable	45	Abington	122	Concord-Carlisle	11
110	Wrentham	32	Concord	14	Berkshire Hills	108
111	Newton	8	Hingham	39	Springfield	217
112	Bellingham	103	Pioneer Valley Reg.	193	Hull	200
113	Brookline	40	Norwell	41	Gloucester	180
114	Billerica	114	Springfield	232	Tewksbury	106
115	Southbridge	244	Rockport	118	Ashburnham Westminster	86
116	Shrewsbury	68	Cambridge	191	Nauset	27
117	Quaboag Regional	171	Westwood	30	Woburn	101
118	Boston	260	Gardner	185	Burlington	56
119	Harwich	124	Palmer	182	North Adams	165
120	Dighton Rehoboth	119	Greenfield	179	Plymouth	145
121	Agawam	125	Freetown-Lakeville	146	Dartmouth	156
122	Wellesley	12	Newton	15	Mount Greylock	76
123	Leverett	191	South Hadley	161	Foxborough	49
124	Wakefield	96	Hopedale	131	Randolph	149
125	Medford	198	New Bedford	231	Pioneer Valley Regional	194
126	Nahant	55	Plymouth	148	Southbridge	160
127	Deerfield	115	Harwich	168	Holliston	58
128	South Hadley	184	Ludlow	155	Ayer	163
129	Ayer	118	Shrewsbury	46	Dedham	107
130	Lee	217	Beverly	78	Scituate	41
131	Northbridge	161	Harvard	6	North Reading	61
132	Marblehead	78	Lowell	224	Auburn	114
133	Lunenburg	144	Whitman Hanson	138	Freetown-Lakeville	128
134	Athol Royalston	235	Barnstable	117	Leominster	174
135	Needham	29	Natick	93	Blackstone Millville	155
136	Westfield	225	Millbury	188	Somerville	198
137	Triton	147	Wachusett Reg.	45	Old Rochester	99
138	Nashoba	93	Clinton	169	Medway	64
139	Acton	20	Grafton	96	Westwood	18
140	Somerville	227	North Attleborough	106	Winchendon	171
141	Revere	214	Billerica	94	Millis	97
142	Pembroke	67	Dracut	164	West Bridgewater	136
143	North Middlesex	111	Douglas	123	Agawam	168

(Table 1A cont.)

	Grade 4		Grade 8		Grade 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
144	Lowell	258	Dover-Sherborn	13	Maynard	112
145	Boxford	73	Winchester	25	Chatham	103
146	Springfield	253	Blackstone Millville	189	Duxbury	32
147	Greenfield	228	Duxbury	48	Waltham	153
148	Leominster	194	Medfield	12	Lynn	211
149	Andover	47	Southborough	40	Carver	124
150	Natick	57	Swampscott	105	Quaboag Regional	202
151	Medfield	61	Sharon	43	North Middlesex	80
152	Middleborough	202	Revere	204	Lincoln-Sudbury	14
153	Amesbury	170	Bridgewater Raynham	116	Quincy	158
154	Dedham	127	Chelmsford	54	Fitchburg	205
155	Plympton	121	Monson	132	Tantasqua	140
156	Concord	24	Winchendon	214	Harvard	7
157	Wilmington	101	Ashland	115	Adams Cheshire	173
158	Wales	180	Dighton Rehoboth	124	Chicopee	214
159	Waltham	148	East Bridgewater	104	Dudley Charlton Regional	129
160	Granville	178	Granville	200	South Hadley	146
161	West Springfield	215	Salem	201	Lenox	37
162	Hopedale	128	Lynn	227	Hanover	73
163	Mashpee	183	Framingham	134	Hopedale	120
164	Medway	104	Seekonk	177	Fall River	213
165	Falmouth	129	West Bridgewater	127	Salem	203
166	Norton	137	Brookline	26	Methuen	187
167	Sturbridge	112	Holbrook	197	Andover	44
168	Framingham	75	Berkshire Hills	170	Central Berkshire	166
169	Littleton	133	Westfield	187	Lawrence	212
170	Westhampton	172	Walpole	83	Worcester	218
171	Bourne	162	Hudson	174	Marlborough	111
172	Lanesborough	138	Sandwich	70	Wakefield	83
173	Burlington	80	Weston	18	Pittsfield	197
174	West Bridgewater	30	Dennis Yarmouth	141	Leicester	84
175	Weston	181	Shirley	128	West Springfield	189
176	Marlborough	134	North Middlesex	135	Cambridge	183
177	Brookfield	226	Quincy	129	Whitman Hanson	148
178	Haverhill	240	Randolph	216	New Bedford	206
179	Edgartown	159	Falmouth	160	Northbridge	167
180	Melrose	92	Worcester	226	Brockton	201
181	Berkley	205	Peabody	130	Seekonk	169
182	Randolph	233	Brockton	223	Chelmsford	66
183	Chicopee	257	Wilmington	152	North Attleborough	117
184	Granby	197	Mount Greylock	142	Medfield	39
185	Wayland	51	Lawrence	234	Haverhill	177
186	Hopkinton	95	Taunton	206	Narragansett	176
187	Malden	229	Bourne	173	Middleborough	195
188	Newburyport	99	Wakefield	113	Watertown	133
189	Norwood	89	Ashburnham Westminster	103	Bourne	161
190	Plymouth	102	Andover	32	Douglas	172
191	Wareham	201	Avon	203	Harwich	85
192	Central Berkshire	157	Northbridge	166	Grafton	115

(Table 1A cont.)

	Grade 4		Grade 8		Grade 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
193	Peabody	149	Dedham	108	Billerica	143
194	North Reading	36	Amherst-Pelham	81	Wareham	122
195	Fitchburg	255	Scituate	62	Mohawk Trail	125
196	Nantucket	219	Haverhill	209	Marshfield	151
197	Sudbury	26	Mendon Upton	112	Lee	157
198	North Andover	91	Ralph C Mahar	215	Hampshire	104
199	North Adams	259	Acushnet	186	Somerset	127
200	Taunton	206	Maynard	175	Peabody	181
201	Tyngsborough	174	Somerset	183	Ralph C Mahar	179
202	Gill Montague	247	Marlborough	181	Fairhaven	192
203	Quabbin	176	Lincoln	73	Littleton	75
204	Lawrence	262	Adams Cheshire	208	Rockland	185
205	Sandwich	87	Berlin-Boylston	120	Webster	209
206	Kingston	169	Hampshire	125	Saugus	170
207	Dennis Yarmouth	199	Gateway	207	Spencer East Brookfield	186
208	Gloucester	182	Rockland	199	Millbury	162
209	Saugus	139	Chicopee	225	Norton	118
210	Worcester	236	Old Rochester	167	Palmer	210
211	Beverly	108	Lee	195	Holbrook	193
212	Rockport	110	West Springfield	198	Taunton	196
213	Duxbury	54	Weymouth	172	Westport Community	190
214	Pioneer Valley Regional	252	North Reading	89	Avon	182
215	Adams Cheshire	230	Clarksburg	196	Easthampton	150
216	Leicester	165	Saugus	184	Bellingham	178
217	Quincy	155	Leicester	150	Oxford	207
218	Fall River	263	Ayer	219	West Boylston	139
219	Halifax	204	Norwood	107		
220	Norwell	76	North Brookfield	211		
221	Hamilton Wenham	69	Woburn	144		
222	Holland	239	Webster	230		
223	Northborough	64	Pittsfield	210		
224	Abington	123	West Boylston	157		
225	Uxbridge	150	Fall River	233		
226	Plainville	210	Dartmouth	194		
227	Oxford	238	Fairhaven	221		
228	Hull	168	Westport Community	192		
229	Winchendon	254	Mohawk Trail	217		
230	Holliston	135	Oxford	222		
231	Harvard	19	Bellingham	213		
232	Dracut	192	Auburn	156		
233	Maynard	200	Southbridge	218		
234	Webster	231	Gill Montague	212		
235	Salem	195	Easthampton	180		
236	Southampton	207				
237	Stoughton	122				
238	Hadley	232				
239	East Bridgewater	203				
240	Blackstone Millville	141				
241	Westport Community	166				

(Table 1A cont.)

	Grade 4			Grade 8		Grade 10
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
242	Lincoln	84				
243	Hatfield	250				
244	Dover	70				
245	Bedford	98				
246	Ashburnham Westminster	216				
247	Boylston	151				
248	Narragansett	251				
249	Hudson	220				
250	Douglas	221				
251	Auburn	193				
252	Pelham	143				
253	Pittsfield	242				
254	Erving	256				
255	Chesterfield Goshen Reg.	245				
256	Ashland	241				
257	Ware	265				
258	New Bedford	264				
259	Berlin	152				
260	Ipswich	158				
261	Berkshire Hills	248				
262	Mendon Upton	190				
263	Easthampton	237				
264	Shirley	234				
265	Tisbury	211				
266	Hawlemont	266				

*Ranked according to the difference between actual and predicted scores.

Table 2A: District Rankings for Reducing Poor Performance (P)

	GRADE 4		GRADE 8		GRADE 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
1	Holyoke	262	Granby	91	Chelsea	210
2	Chelsea	231	East Longmeadow	42	Ware	119
3	Petersham	1	Nantucket	55	Gill Montague	123
4	Leverett	8	Edgartown	4	Sutton	17
5	Carver	101	Ware	124	Athol Royalston	159
6	Eastham	48	Hatfield	23	Everett	186
7	Truro	78	Lunenburg	24	North Brookfield	110
8	Everett	163	Hadley	35	Hull	160
9	Sutton	65	Tewksbury	103	Northampton	78
10	Acushnet	134	Southern Berkshire	32	Mansfield	58
11	Palmer	66	Milford	118	Frontier	7
12	Orange	118	Frontier	71	Mendon Upton	18
13	Westhampton	9	Lynnfield	28	Medford	176
14	Clarksburg	164	Oak Bluffs	3	Rockport	74
15	Clinton	99	Tisbury	51	Hatfield	2
16	Dartmouth	94	Hull	133	Clinton	117
17	Holbrook	100	Provincetown	92	Hudson	99
18	Mattapoisett	179	Carver	128	Lunenburg	30
19	Brimfield	130	Chelsea	221	Ipswich	53
20	Gateway	135	Everett	179	Georgetown	46
21	Millbury	145	Mansfield	102	King Philip	59
22	Swampscott	22	Stoughton	111	Ashburnham Westminster	31
23	Granville	87	Milton	49	Quaboag Regional	164
24	Gardner	172	Melrose	31	Cohasset	1
25	Rockland	93	Marshfield	83	North Andover	43
26	Wellfleet	5	Granville	184	Easton	40
27	Foxborough	11	Narragansett	101	Hadley	52
28	Mansfield	79	Franklin	86	Dracut	115
29	Agawam	57	South Hadley	106	Ashland	63
30	Somerset	119	Mashpee	183	Southern Berkshire	143
31	Winthrop	105	Norton	41	Silver Lake	125
32	Pentucket Regional	64	Rockport	75	Beverly	83
33	Southampton	68	Cohasset	2	Newburyport	28
34	Milford	144	Lenox	62	Swampscott	19
35	Lakeville	158	Ipswich	26	Dartmouth	120
36	Tewksbury	80	Easton	43	Westborough	4
37	Braintree	31	Amesbury	100	Ludlow	91
38	Easton	37	Hampden Wilbraham	30	Franklin	75
39	Wales	109	Burlington	61	Braintree	68
40	Somerville	195	Attleboro	178	Granby	126
41	Stoneham	51	Ludlow	116	Hopedale	57
42	Williamsburg	181	Quabbin	130	East Longmeadow	81
43	Danvers	36	Millbury	151	Needham	8
44	Plainville	123	Stoneham	47	East Bridgewater	98
45	Millis	70	Methuen	164	Millis	51
46	Granby	127	Needham	18	Canton	64

(Table 2A cont.)

	GRADE 4		GRADE 8		GRADE 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
47	Lynnfield	13	Groton Dunstable	15	Blackstone Millville	109
48	Franklin	33	Longmeadow	20	Northborough-Southborough	11
49	Southborough	32	Holyoke	235	Groton Dunstable	20
50	Chatham	52	Tantasqua	70	Milton	111
51	Scituate	23	Watertown	93	Holliston	27
52	Milton	34	Sutton	98	Sandwich	26
53	Avon	120	Richmond	45	Longmeadow	12
54	Westwood	6	Newburyport	68	Agawam	137
55	Norton	89	Uxbridge	115	Dighton Rehoboth	92
56	Middleton	82	Abington	90	Hampden Wilbraham	71
57	East Longmeadow	16	Westford	17	Belchertown	65
58	Halifax	129	Nauset	81	Reading	73
59	Conway	2	Central Berkshire	72	Hopkinton	15
60	Plympton	97	Wareham	158	Amherst-Pelham	69
61	Middleborough	160	Silver Lake	138	Stoneham	76
62	Grafton	146	King Philip	87	Stoughton	105
63	West Bridgewater	137	Chatham	77	Sharon	9
64	Marshfield	12	Dudley Charlton Regional	136	Lynnfield	42
65	Spencer East Brookfield	189	Littleton	95	Martha's Vineyard	54
66	Pelham	10	Gloucester	153	Shrewsbury	14
67	Wakefield	72	Belchertown	110	North Reading	49
68	Orleans	4	Braintree	85	Hanover	37
69	Sunderland	3	Canton	73	Freetown-Lakeville	112
70	Georgetown	54	Middleborough	135	Chatham	66
71	Boxborough	15	Foxborough	64	Burlington	48
72	Hanover	24	Gardner	190	Auburn	85
73	Whitman Hanson	106	Medway	34	Hingham	41
74	Littleton	19	Acton-Boxborough	9	Gardner	153
75	Sturbridge	59	Hamilton Wenham	13	Milford	165
76	Southbridge	230	Agawam	144	Monson	128
77	Canton	50	Berkley	149	Tewksbury	96
78	Rochester	155	Hanover	46	Danvers	72
79	Billerica	121	Holliston	27	Medway	50
80	Edgartown	143	Spencer East Brookfield	148	South Hadley	104
81	Chelmsford	25	Marblehead	57	Woburn	87
82	Reading	42	West Bridgewater	105	Duxbury	3
83	Bridgewater Raynham	115	Pioneer Valley Reg.	180	Berlin-Boylston	16
84	Brewster	81	Masconomet	22	Uxbridge	135
85	Wilmington	75	Westwood	11	Plymouth	136
86	Belchertown	122	Palmer	167	Amesbury	167
87	Ayer	211	Seekonk	141	Tyngsborough	94
88	Andover	18	Freetown-Lakeville	139	Quabbin	127
89	Mashpee	150	Pentucket Regional	66	Westford	23
90	Dudley Charlton Regional	147	Malden	203	Winthrop	142
91	Harwich	125	North Andover	78	Bridgewater Raynham	106
92	Arlington	49	Billerica	79	Belmont	29
93	Topsfield	41	Tyngsborough	89	Walpole	93
94	Wachusett Regional	40	Nashoba	39	Winchester	21

(Table 2A cont.)

	GRADE 4		GRADE 8		GRADE 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
95	Southern Berkshire	176	Winthrop	117	Provincetown	171
96	Carlisle	14	Reading	16	Malden	198
97	Norfolk	103	Florida	1	Weymouth	141
98	North Middlesex	108	Westborough	37	Arlington	89
99	Walpole	83	Medford	175	Southbridge	152
100	Nashoba	86	Harwich	154	Masconomet	22
101	Norwood	61	Waltham	147	Acton-Boxborough	10
102	Woburn	69	Wayland	6	Framingham	107
103	Sherborn	17	Northampton	113	Natick	84
104	Berkley	184	Belmont	21	Norwood	88
105	Medfield	45	Beverly	69	Greenfield	144
106	Barnstable	131	Georgetown	65	Old Rochester	79
107	Tyngsborough	140	Lexington	8	Wachusett Regional	55
108	Medway	88	Norwell	38	Marblehead	25
109	Wrentham	27	Grafton	88	Abington	95
110	Triton	148	Triton	157	Nantucket	90
111	Sharon	39	Quaboag Regional	121	Seekonk	133
112	Belmont	35	East Bridgewater	96	Pentucket Regional	44
113	Bellingham	116	Sudbury	12	Wellesley	6
114	Westford	55	Duxbury	40	Brookline	39
115	Westborough	53	Southborough	29	Lexington	5
116	Seekonk	161	Wakefield	76	Wayland	13
117	Melrose	76	Clinton	170	Revere	204
118	Central Berkshire	139	Dover-Sherborn	10	Methuen	169
119	Weymouth	102	Swampscott	104	Dedham	108
120	Burlington	60	Acushnet	146	Nashoba	45
121	North Attleborough	104	Fitchburg	229	Billerica	101
122	Winchester	7	Wellesley	7	Dennis Yarmouth	124
123	Cohasset	67	Plymouth	152	Dudley Charlton Regional	116
124	North Reading	20	Leominster	188	Triton	130
125	West Boylston	26	Shrewsbury	54	Leicester	67
126	Needham	29	North Middlesex	112	Douglas	147
127	Boylston	92	Berlin-Boylston	80	Lee	114
128	Sandwich	62	Somerville	174	Nauset	32
129	Amesbury	162	Hingham	58	Carver	121
130	Boxford	58	Dracut	169	Melrose	103
131	Natick	74	Medfield	14	Lowell	205
132	Lexington	38	Carlisle	5	Hamilton Wenham	70
133	Hingham	43	Wachusett Reg.	60	Scituate	60
134	Groton Dunstable	56	Walpole	74	Lenox	36
135	Dighton Rehoboth	136	Bedford	52	Central Berkshire	148
136	Ludlow	205	Scituate	50	Bedford	56
137	Marlborough	138	Arlington	82	Maynard	118
138	Westfield	216	Hopkinton	44	Berkshire Hills	131
139	Watertown	177	Sharon	59	Chelmsford	61
140	Blackstone Millville	95	Bridgewater Raynham	114	Newton	24
141	Shrewsbury	71	Dighton Rehoboth	127	Westfield	77
142	Pembroke	73	Greenfield	176	Foxborough	102

(Table 2A cont.)

	GRADE 4		GRADE 8		GRADE 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
143	Lanesborough	151	Chelmsford	63	Mohawk Trail	173
144	Marblehead	85	North Adams	218	Easthampton	80
145	Wayland	47	Hampshire	99	Hampshire	82
146	North Brookfield	206	Danvers	109	Westwood	33
147	Provincetown	239	North Attleborough	122	Whitman Hanson	132
148	Hampden Wilbraham	84	Weston	19	Medfield	38
149	Athol Royalston	227	Sandwich	67	Spencer East Brookfield	150
150	Northampton	204	Concord	33	Concord-Carlisle	47
151	Plymouth	111	Wilmington	140	Barnstable	151
152	Newton	28	Barnstable	126	Littleton	62
153	Fairhaven	30	Bourne	166	Wakefield	86
154	Sudbury	193	Blackstone Millville	193	North Middlesex	97
155	Medford	202	Whitman Hanson	163	Middleborough	175
156	Newburyport	114	Monson	142	Lincoln-Sudbury	34
157	Dedham	149	Winchester	53	Tantasqua	146
158	Saugus	128	Andover	36	Northbridge	157
159	Adams Cheshire	199	Millis	125	Narragansett	161
160	Wellesley	44	Harvard	25	Ayer	172
161	Concord	46	Salem	198	Gloucester	187
162	Erving	201	Ashburnham Westminster	108	Falmouth	156
163	Holliston	117	Newton	48	Attleboro	197
164	Harvard	21	Ashland	132	Watertown	129
165	Waltham	166	Peabody	129	Webster	188
166	Monson	226	Natick	119	Somerville	191
167	Quaboag Regional	190	Northborough	84	Harvard	35
168	Deerfield	157	New Bedford	231	Randolph	168
169	Lunenburg	165	Brookline	56	Quincy	162
170	Lenox	98	Hudson	181	Adams Cheshire	174
171	North Andover	133	Revere	207	Leominster	182
172	Attleboro	194	Winchendon	214	Wareham	134
173	Longmeadow	113	Old Rochester	137	Winchendon	183
174	Duxbury	63	Falmouth	159	North Attleborough	139
175	Beverly	124	Norwood	97	Harwich	113
176	Northbridge	182	Westfield	195	Waltham	170
177	Lynn	248	Framingham	145	Mount Greylock	138
178	Randolph	220	Athol Royalston	210	Millbury	149
179	Hamilton Wenham	77	Berkshire Hills	186	Holyoke	216
180	Bourne	180	Springfield	233	Fall River	209
181	Wareham	196	Lee	182	West Bridgewater	163
182	Peabody	168	North Reading	94	Saugus	158
183	Bedford	91	Saugus	185	Gateway	201
184	Revere	217	Hopedale	177	Andover	100
185	Gloucester	90	Weymouth	168	Marshfield	155
186	Norwell	185	Boston	226	Springfield	217
187	Brookline	96	Quincy	156	Rockland	177
188	Hopedale	167	Rockland	191	New Bedford	203
189	Oak Bluffs	159	Amherst-Pelham	107	West Springfield	190
190	Shutesbury	215	Woburn	123	Grafton	145
191	Cambridge	233	Mendon Upton	131	Lynn	212

(Table 2A cont.)

GRADE 4			GRADE 8		GRADE 10	
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
192	Williamstown	178	Lynn	227	Norton	140
193	South Hadley	210	Douglas	173	Salem	199
194	Methuen	218	Adams Cheshire	201	Marlborough	154
195	Nahant	126	Lowell	228	Haverhill	180
196	Hopkinton	156	Dennis Yarmouth	160	Fairhaven	184
197	West Springfield	219	Gateway	196	Pittsfield	196
198	Abington	153	Northbridge	189	West Boylston	122
199	Falmouth	183	Dartmouth	172	Bourne	178
200	Stoughton	141	Dedham	134	Ralph C Mahar	181
201	Brockton	198	Cambridge	212	Chicopee	213
202	Dennis Yarmouth	249	Fairhaven	206	Peabody	185
203	Ashburnham Westminster	188	Maynard	187	Somerset	166
204	Acton	107	Westport Community	171	Fitchburg	211
205	Pioneer Valley Regional	241	Mount Greylock	165	Holbrook	192
206	Uxbridge	170	Shirley	155	Oxford	189
207	Weston	110	Taunton	211	Pioneer Valley Regional	208
208	Rockport	152	North Brookfield	194	Brockton	206
209	Winchendon	245	Haverhill	213	Taunton	193
210	Dover	112	Ralph C Mahar	205	Bellingham	179
211	Quincy	174	Lincoln	120	Boston	215
212	East Bridgewater	187	West Boylston	162	North Adams	202
213	Mendon Upton	154	Marlborough	192	Worcester	214
214	Hull	186	Leicester	161	Cambridge	200
215	Holland	223	Auburn	150	Westport Community	194
216	Taunton	207	Brockton	222	Palmer	207
217	Shirley	169	Ayer	208	Avon	195
218	Whately	244	Randolph	219	Lawrence	218
219	Ipswich	142	Somerset	200		
220	Westport Community	175	West Springfield	204		
221	Leominster	222	Bellingham	199		
222	Framingham	191	Worcester	230		
223	Oxford	221	Clarksburg	197		
224	Kingston	197	Holbrook	216		
225	Northborough	132	Chicopee	224		
226	Greenfield	238	Lawrence	234		
227	Dracut	200	Pittsfield	209		
228	Brookfield	229	Webster	225		
229	Salem	192	Easthampton	143		
230	Leicester	203	Avon	220		
231	Chesterfield Goshen Reg.	209	Southbridge	215		
232	Richmond	173	Mohawk Trail	217		
233	Quabbin	212	Fall River	232		
234	Maynard	208	Gill Montague	202		
235	Malden	243	Oxford	223		
236	Lee	240				
237	Haverhill	246				
238	Hatfield	234				
239	Narragansett	235				
240	Nantucket	232				
241	Boston	265				

Table 2A cont.)

	Grade 4			Grade 8		Grade 10
Rank based on the model*	District	Rank based on actual scores	District	Rank based on actual scores	District	Rank based on actual scores
242	Lincoln	171				
243	Springfield	257				
244	Lowell	261				
245	Hudson	213				
246	Fitchburg	255				
247	Gill Montague	253				
248	Fall River	259				
249	Chicopee	260				
250	Douglas	225				
251	Pittsfield	242				
252	Ashland	236				
253	Worcester	250				
254	Auburn	224				
255	Berlin	214				
256	Ware	252				
257	Easthampton	237				
258	Hadley	247				
259	New Salem Wendell	264				
260	North Adams	263				
261	Tisbury	228				
262	Lawrence	266				
263	Webster	251				
264	Berkshire Hills	254				
265	New Bedford	258				
266	Hawlemont	256				

*Ranked according to the difference between predicted and actual scores.

Table 3A: Districts Listed Alphabetically According to Good and Poor Performance

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
Abington	224	198	109	56	104	109
Acton	139	204				
Acushnet	48	10	199	120		
Agawam	121	29	105	76	143	54
Amesbury	153	129	44	37	22	86
Amherst						
Andover	149	88	190	158	167	184
Arlington	24	92	107	137	37	98
Ashland	256	252	157	164	17	29
Attleboro	103	172	39	40	98	163
Auburn	251	254	232	215	132	72
Avon	84	53	191	230	214	217
Ayer	129	87	218	217	128	160
Barnstable	99	106	134	152	86	151
Bedford	245	183	82	135	106	136
Belchertown	27	86	78	67	95	57
Bellingham	112	113	231	221	216	210
Belmont	46	112	103	104	41	92
Berkley	181	104	53	77		
Berlin	259	255				
Beverly	211	175	130	105	51	32
Billerica	114	79	141	92	193	121
Boston	118	241	72	186	93	211
Bourne	171	180	187	153	189	199
Boxborough	68	71				
Boxford	145	130				
Boylston	247	127				
Braintree	20	37	41	68	10	39
Brewster	30	84				
Brimfield	14	19				
Brockton	90	201	182	216	180	208
Brookfield	177	228				
Brookline	113	187	166	169	101	114
Burlington	173	120	34	39	118	71
Cambridge	94	191	116	201	176	214
Canton	40	77	74	69	46	46
Carlisle	58	96	101	132		
Carver	51	5	24	18	149	129
Chatham	55	50	23	63	145	70
Chelmsford	81	81	154	143	182	139
Chelsea	42	2	91	19	32	1
Chicopee	183	249	209	225	158	201
Clarksburg	53	14	215	223		
Clinton	32	15	138	117	11	16
Cohasset	16	123	21	33	8	24
Concord	156	161	110	150		
Conway	3	59				
Danvers	49	43	93	146	60	78

(Table 3A cont.)

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
Dartmouth	39	16	226	199	121	35
Dedham	154	157	193	200	129	119
Deerfield	127	168				
Douglas	250	250	143	193	190	126
Dover	244	210				
Dracut	232	227	142	130	89	28
Duxbury	213	174	147	114	146	82
East Bridgewater	239	212	159	112	49	44
Eastham	2	6				
Easthampton	263	257	235	229	215	144
East Longmeadow	70	57	6	2	34	42
Easton	52	38	98	36	30	26
Edgartown	179	80	12	4		
Erving	254	162				
Essex						
Everett	22	8	58	20	21	6
Fairhaven	43	153	227	202	202	196
Fall River	218	248	225	233	164	180
Falmouth	165	199	179	174	84	162
Fitchburg	195	246	95	121	154	204
Florida			68	97		
Foxborough	5	27	57	71	123	142
Framingham	168	222	163	177	87	102
Franklin	26	48	22	28	19	38
Freetown						
Gardner	75	24	118	72	53	74
Georgetown	77	70	64	106	80	20
Gloucester	208	185	104	66	113	161
Gosnold						
Grafton	60	62	139	109	192	190
Granby	184	46	5	1	90	40
Granville	160	23	160	26		
Greenfield	147	226	120	142	57	105
Hadley	238	258	2	8	43	27
Halifax	219	58				
Hancock						
Hanover	59	72	90	78	162	68
Harvard	231	164	131	160	156	167
Harwich	119	91	127	100	191	175
Hatfield	243	238	25	6	72	15
Haverhill	178	237	196	209	185	195
Hingham	93	133	111	129	45	73
Holbrook	71	17	167	224	211	205
Holland	222	215				
Holliston	230	163	70	79	127	51
Holyoke	33	1	76	49	64	179
Hopedale	162	188	124	184	163	41
Hopkinton	186	196	102	138	73	59
Hudson	249	245	171	170	91	17
Hull	228	214	33	16	112	8
Ipswich	260	219	15	35	78	19

(Table 3A cont.)

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
Kingston	206	224				
Lakeville	15	35				
Lanesborough	172	143				
Lawrence	204	262	185	226	169	218
Lee	130	236	211	181	197	127
Leicester	216	230	217	214	174	125
Lenox	65	170	28	34	161	134
Leominster	148	221	99	124	134	171
Leverett	123	4				
Lexington	61	132	65	107	55	115
Lincoln	242	242	203	211		
Littleton	169	74	66	65	203	152
Longmeadow	74	173	37	48	42	53
Lowell	144	244	132	195	74	131
Ludlow	85	136	128	41	62	37
Lunenburg	133	169	17	7	108	18
Lynn	102	177	162	192	148	191
Lynnfield	57	47	10	13	48	64
Malden	187	235	92	90	35	96
Manchester						
Mansfield	13	28	11	21	9	10
Marblehead	132	144	30	81	100	108
Marion						
Marlborough	176	137	202	213	171	194
Marshfield	45	64	43	25	196	185
Mashpee	163	89	20	30		
Mattapoisett	18	18				
Maynard	233	234	200	203	144	137
Medfield	151	105	148	131	184	148
Medford	125	155	100	99	26	13
Medway	164	108	29	73	138	79
Melrose	180	117	40	24	67	130
Methuen	88	194	56	45	166	118
Middleborough	152	61	77	70	187	155
Middleton	34	56				
Milford	62	34	7	11	27	75
Millbury	47	21	136	43	208	178
Millis	82	45	61	159	141	45
Milton	37	52	27	23	66	50
Monson	92	166	155	156	94	76
Nahant	126	195				
Nantucket	196	240	9	3	59	110
Natick	150	131	135	166	38	103
Needham	135	126	18	46	15	43
New Bedford	258	265	125	168	178	188
Newburyport	188	156	63	54	12	33
Newton	111	152	122	163	99	140
Norfolk	78	97				
North Adams	199	260	79	144	119	212
Northampton	35	150	47	103	2	9
North Andover	198	171	62	91	65	25

(Table 3A cont.)

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
North Attleborough	79	121	140	147	183	174
Northborough	223	225	97	167		
Northbridge	131	176	192	198	179	158
North Brookfield	100	146	220	208	52	7
North Reading	194	124	214	182	131	67
Norton	166	55	38	31	209	192
Norwell	220	186	113	108		
Norwood	189	101	219	175	54	104
Oak Bluffs	36	189	13	14		
Orange	8	12				
Orleans	9	68				
Oxford	227	223	230	235	217	206
Palmer	11	11	119	86	210	216
Peabody	193	182	181	165	200	202
Pelham	252	66				
Pembroke	142	142				
Petersham	1	3				
Pittsfield	253	251	223	227	173	197
Plainville	226	44				
Plymouth	190	151	126	123	120	85
Plympton	155	60				
Provincetown	56	147	3	17	29	95
Quincy	217	211	177	187	153	169
Randolph	182	178	178	218	124	168
Reading	89	82	108	96	68	58
Revere	141	184	152	171	85	117
Richmond	38	232	8	53		
Rochester	80	78				
Rockland	50	25	208	188	204	187
Rockport	212	208	115	32	82	14
Rowe						
Salem	235	229	161	161	165	193
Sandwich	205	128	172	149	102	52
Saugus	209	158	216	183	206	182
Savoy						
Scituate	31	51	195	136	130	133
Seekonk	87	116	164	87	181	111
Sharon	66	111	151	139	28	63
Sherborn	98	103				
Shirley	264	217	175	206		
Shrewsbury	116	141	129	125	71	66
Shutesbury	83	190				
Somerset	21	30	201	219	199	203
Somerville	140	40	106	128	136	166
Southampton	236	33				
Southborough	25	49	149	115		
Southbridge	115	76	233	231	126	99
South Hadley	128	193	123	29	160	80
Springfield	146	243	114	180	111	186
Stoneham	54	41	45	44	20	61
Stoughton	237	200	14	22	61	62

(Table 3A cont.)

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
Sturbridge	167	75				
Sudbury	197	154	80	113		
Sunderland	4	69				
Sutton	6	9	96	52	3	4
Swampscott	28	22	150	119	16	34
Swansea						
Taunton	200	216	186	207	212	209
Tewksbury	23	36	4	9	114	77
Tisbury	265	261	48	15		
Topsfield	86	93				
Truro	7	7				
Tyngsborough	201	107	73	93	31	87
Uxbridge	225	206	84	55	105	84
Wakefield	124	67	188	116	172	153
Wales	158	39				
Walpole	101	99	170	134	77	93
Waltham	159	165	50	101	147	176
Ware	257	256	32	5	4	2
Wareham	191	181	67	60	194	172
Watertown	107	139	35	51	188	164
Wayland	185	145	42	102	47	116
Webster	234	263	222	228	205	165
Wellesley	122	160	81	122	70	113
Wellfleet	10	26				
Westborough	64	115	83	98	13	36
West Boylston	108	125	224	212	218	198
West Bridgewater	174	63	165	82	142	181
Westfield	136	138	169	176	103	141
Westford	97	114	16	57	92	89
Westhampton	170	13				
Weston	175	207	173	148		
Westport Community	241	220	228	204	213	215
West Springfield	161	197	212	220	175	189
Westwood	12	54	117	85	139	146
Weymouth	73	119	213	185	107	97
Whately	72	218				
Williamsburg	41	42				
Williamstown	17	192				
Wilmington	157	85	183	151		
Winchendon	229	209	156	172	140	173
Winchester	95	122	145	157	36	94
Winthrop	96	31	60	95	96	90
Woburn	63	102	221	190	117	81
Worcester	210	253	180	222	170	213
Wrentham	110	109				
Northampton-Smith						
Worcester Trade Complex						
Acton-Boxborough			31	74	33	101
Adams Cheshire	215	159	204	194	157	170
Amherst-Pelham			194	189	14	60
Ashburnham Westminster	246	203	189	162	115	22

(Table 3A cont.)

Name	Grade 4		Grade 8		Grade 10	
	Rank - G	Rank - P	Rank - G	Rank - P	Rank - G	Rank - P
Athol Royalston	134	149	94	178	7	5
Berkshire Hills	261	264	168	179	110	138
Berlin-Boylston			205	127	79	83
Blackstone Millville	240	140	146	154	135	47
Bridgewater Raynham	69	83	153	140	81	91
Chesterfield Goshen Regional	255	231				
Central Berkshire	192	118	54	59	168	135
Concord-Carlisle					109	150
Dennis Yarmouth	207	202	174	196	76	122
Dighton Rehoboth	120	135	158	141	63	55
Dover-Sherborn			144	118		
Dudley Charlton Regional	91	90	87	64	159	123
Nauset			49	58	116	128
Farmington River Regional						
Freetown-Lakeville			121	88	133	69
Frontier			1	12	5	11
Gateway	67	20	207	197	24	183
Groton Dunstable	109	134	26	47	25	49
Gill Montague	202	247	234	234	1	3
Hamilton Wenham	221	179	36	75	23	132
Hampden Wilbraham	104	148	52	38	56	56
Hampshire			206	145	198	145
Hawlemont	266	266				
King Philip			51	62	18	21
Lincoln-Sudbury					152	156
Martha's Vineyard					83	65
Masconomet			88	84	58	100
Mendon Upton	262	213	197	191	6	12
Mount Greylock			184	205	122	177
Mohawk Trail			229	232	195	143
Narragansett	248	239	86	27	186	159
Nashoba	138	100	69	94	75	120
New Salem Wendell	29	259				
Northborough-Southboroygh					40	48
North Middlesex	143	98	176	126	151	154
Old Rochester			210	173	137	106
Pentucket Regional	19	32	85	89	69	112
Pioneer Valley Regional	214	205	112	83	125	207
Quabbin	203	233	55	42	88	88
Ralph C Mahar			198	210	201	200
Silver Lake			59	61	44	31
Southern Berkshire	105	95	19	10	39	30
Southwick Tolland						
Spencer East Brookfield	44	65	89	80	207	149
Tantasqua			71	50	155	157
Triton	137	110	75	110	50	124
Up Island Regional						
Wachusett Regional	76	94	137	133	97	107
Quaboag Regional	117	167	46	111	150	23
Whitman Hanson	106	73	133	155	177	147

Note: Regional Schools are listed alphabetically at the end.