Money for Nothing:
The Failures of Education Reform in Massachusetts

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Executive Summary

Providing a quality education to every public school student is a generally accepted goal of Massachusetts public policy. In the case *Hancock* v. *Driscoll*, Suffolk Superior Court Judge Margot Botsford determined that the Commonwealth is failing in that goal: Only the state's wealthier communities are meeting their responsibility of providing a quality education to their students. The poorer school districts, in her opinion, are failing.

The judge's remedy for this imbalance is for the state to spend more money on the poorer school districts. This new funding might come from higher state taxes or from a reallocation of the money now going to wealthier districts. But, over the period 1994 to 2003, the state spent $24 billion in aid to education under the aegis of the Education Reform Act of 1993. Before the state raises taxes or reallocates school funding, legislators and the judiciary should be certain that increased aid to poorer school districts would lead to better educational results. Is it possible that the state could achieve its goal of providing a quality education without providing additional funds to the poorer districts?

To answer this question, one needs first to determine what factors positively influence students' educational attainment. The Beacon Hill Institute's Education Assessment Model (BEAM) endeavors to identify these factors. This report is an updated application of BEAM to the results of the 2003 Massachusetts Comprehensive Assessment System (MCAS) exam. The Beacon Hill Institute (BHI) has issued two prior reports on BEAM assessments of MCAS exams, in 2001 and 2002.

Under the Massachusetts Comprehensive Assessment System (MCAS), the state tests students in English and Mathematics at the 4th and 10th grade level and classifies test results as "Warning," "Needs Improvement," "Proficient" or "Advanced." BEAM predicts MCAS test scores for each grade, subject and performance category.

Similar to our previous reports, we find that increased education spending in Massachusetts is not resulting in improved school performance, as measured by results on the MCAS. We find:

- Reduced class size worsens or has no effect on school performance.
- Spending more on instruction, whether by raising teachers' salaries or by hiring additional teachers, worsens or has no effect on school performance.

- Socioeconomic factors and prior performance on standardized tests, along with various "intangible" factors, are far more important than increased spending as determinants of performance.

The answer to the question posed above appears to be yes: The problem for poor districts is not that the state is failing to spend enough but that it is not spending wisely enough. The state is getting nothing for the money that it is lavishing on school districts, rich and poor alike.

Assessing Education Spending

BEAM 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, BEAM 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. BEAM 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 increases in:

(1) per-pupil regular day expenditure;
(2) teachers' average salary;
(3) per-pupil expenditures on non-instructional items (including administration, athletics, transportation, maintenance and health);
(4) the student-teacher ratio (where a higher ratio indicates a decrease in spending and a resulting increase in class size).

Applying BEAM, 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 variables, (5)-(6), which represent percentage changes in the socioeconomic character of a district:

(5) the Equalized Valuation Index (EQV), which measures property values in a district, and
(6) the participation rate in the free/reduced price lunch program, which measures poverty.

Finally we include the 1994 Massachusetts Educational Assessment Program (MEAP) scores. We applied the model to 2002-03 (henceforth referred to as 2003 MCAS scores) MCAS test scores for districts reporting data on all explanatory variables. The model shows whether an increase in each variable exerts a significant positive effect, a significant negative effect or no significant effect on performance.

Each finding is a number whose sign, positive or negative, shows whether an increase in the independent variable exerts a positive or negative effect on performance and whose associated "t-statistic" shows whether the effect is statistically significant or not.

In Table E-1, we summarize those findings by showing how an increase in a variable worsens, improves or has no effect on performance in each category. If an increase in the variable is shown to improve (or worsen) performance, then it has a positive (or negative) sign in the model estimation results and is statistically significant. If an increase in the variable is said to have no effect on performance, it is not statistically significant (but can have either sign).

Policy Variables

The most striking result is that increased spending on education, represented by variables (1)-(4), either *worsens* or has *no effect* on student performance. Specifically:

- Increases in regular day expenditures generally have no effect on performance;
- Increases in the student-teacher ratio and therefore in class size in most instances improve performance, which is to say, smaller classes generally worsen performance;
- Increases in teachers' average salary worsen performance for 10th grade;
- Increased expenditures for non-instructional purposes worsen performance for the 8th grade.

Socioeconomic Variables

For the socioeconomic variables (5)-(6), the results prove what conventional wisdom would indicate and what numerous past studies have already shown. In all categories but one, an increase in property values (measured by the Equalized Valuation Index) shows a positive effect on performance. Participation in the free/reduced lunch program has a more limited, negative effect.

Table E-1. Influence of Variables on 2003 MCAS Scores

	Grade 4		Grade 8		Grade 10	
Variable	English	Math	Math	Science	English	Math
(1) Increase in Regular Day Expenditure	No Effect	No Effect	No Effect	No Effect	Worsens	No Effect
(2) Increase in Student-Teacher Ratio	Improves	Improves	Improves	No Effect	No Effect	Improves
(3) Increase in Teachers' Average Salary	No Effect	No Effect	No Effect	No Effect	Worsens	Worsens
(4) Increase in Non-Instructional Expenditure	No Effect	No Effect	Worsens	Worsens	No Effect	No Effect
(5) Increase in Equalized Valuation Index	Improves	No Effect	Improves	Improves	Improves	Improves
(6) Increase in Free/Reduced Lunch Participation Rate	No Effect	No Effect	No Effect	Worsens	Worsens	No Effect
(7) Prior Scores in 1994	Improves	Improves	Improves	Improves	Improves	Improves

Remaining Variable

The one variable that has the strongest effect on current performance is past performance. A strong performance on earlier standardized exams predicts a strong current performance on the MCAS test. These results are consistent across the three grade levels considered here. They are a particularly damning indictment of education reform. After many billions of dollars of increased spending, we know most about how a school district will perform today by knowing how it performed ten years ago. This fact was entirely lost on the *Hancock* court.

Interpreting the Results

As with our prior reports, our results lead to the question: How is it that higher teachers' salaries and smaller classes can worsen performance? The answer could lie partly with the procedures that determine teachers' salaries. Perhaps, in the instance of 10th grade teachers, schools, in their efforts to improve teaching quality, are diverting 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.

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. BEAM 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.

In Table E-2 below, we compare the reported mean performance with that predicted by BEAM, with the predicted performance in parentheses. Because BEAM generally does a good job of predicting school performance, 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 of districts that take into account whether and to what extent their actual performance exceeds their predicted performance. For example, for 4^{th} graders, we ranked Eastham 1^{st} for its performance, even though it ranked 7^{th} according to its reported score.

Table E-2: Reported (Predicted) Mean Performance For Different Grade Levels

	Grade 4		Grade 8		Grade 10	
Performance	English	Math	Math	Science	English	Math
Warning	2.99 (3.65)	6.93 (8.36)	18.38 (19.83)	16.16 (17.31)	3.44 (4.61)	9.97 (11.33)
Needs Improvement	27.94 (27.58)	41.98 (41.49)	32.17 (31.19)	40.33 (38.96)	21.15 (20.90)	26.79 (25.34)
Proficient	54.79 (54.69)	34.83 (33.81)	32.98 (32.04)	37.48 (37.23)	48.14 (46.56)	32.22 (31.16)
Advanced	14.28 (14.07)	16.26 (16.34)	16.47 (16.94)	6.03 (6.50)	27.28 (27.92)	31.01 (32.17)

Further, Sherborn district ranked 3rd according to its reported MCAS score in 2003; however, because it underperforms relative to our model's predictions, the ranking we gave it is 12th (see Appendix, Table A-2).

For grade 8, even though Hadley is ranked 41st according to it reported MCAS scores in 2003, it ranks 2nd under the BEAM criteria because it beats most other school in exceeding the model's predicted performance. For grade 10, even though Harvard ranks 1st on the basis of its reported performance in MCAS 2003, its BEAM rank is 23rd, because it did not do well in exceeding or meeting the model's predicted performance.

Three school districts that have performed consistently well over the past three BHI studies are Hadley, Eastham and Mansfield. Joseph M. McCarthy of the Suffolk University Education Department examined the methods used in these districts and reports his findings.

One further characteristic of the data presented in Table E-2 is worth noting: Although reported and predicted values are generally close, the reported values in the warning and advanced categories are consistently lower than those predicted by the model. The explanation appears to lie in an effort by schools to get students to pass the test at the expense, if necessary, of excellence: Because teachers and students have focused their attention on passing the MCAS test (avoiding a "warning" label), the reduced failure rate is achieved at the cost of reduced excellence.

Conclusion

The new spending that has occurred under the aegis of Massachusetts education reform has not improved school performance. This bodes ill for court-mandated attempts by the legislature to improve the performance of the state's poorest districts.

It also presents the state with a dilemma: Having touted the benefits of increased education spending, the state now finds itself arguing in court that, as this study shows, "money doesn't matter" (or doesn't matter as much as the judge would believe). The mistake from the beginning has been to confuse increased spending with improved performance. The *Hancock* ruling simply promises an escalation of the same wasteful spending that has occurred from the beginning: Unless the state is able to increase learning and not merely spending, education reform will continue to operate mainly as a purposeless spending program.

Not all the news from this study is bad: BEAM provides a method for ranking 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.

Assessments based on reported 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 reported data and consider instead the school's ability to perform well despite socioeconomic factors that otherwise hinder their performance. BEAM 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, teachers or additional funding.

We acknowledge the fact that, as passing the MCAS test has become a graduation requirement, schools, teachers and students have focused their attention on passing the test. This report is not, however, intended to debate the worthiness of MCAS or its suitability as a standard for graduation. The purpose of this study, as with the previous two, 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.

I. Introduction

Massachusetts education reform has its origin in *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 are constitutionally entitled.[1] Under this decision, the state was compelled to equalize education across municipalities. The result was the Massachusetts Education Reform Act of 1993.

The Act attempted to bring about 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 Act also mandated 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.[2] In order to accomplish the goal, the state would provide for adequate, equitable and stable financial support for public education.

The program is codified in Chapter 70 of the Massachusetts General Laws and is intended to ensure that every public school system has adequate funding, regardless of its wealth. The most important standard of financial support is related to the determination of "adequate funding." To this end, the Act created a "foundation budget" for each school based on the number and mix of students in that school. The 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.

Education Spending Under Education Reform

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 enrollment 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 enrollment.

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.

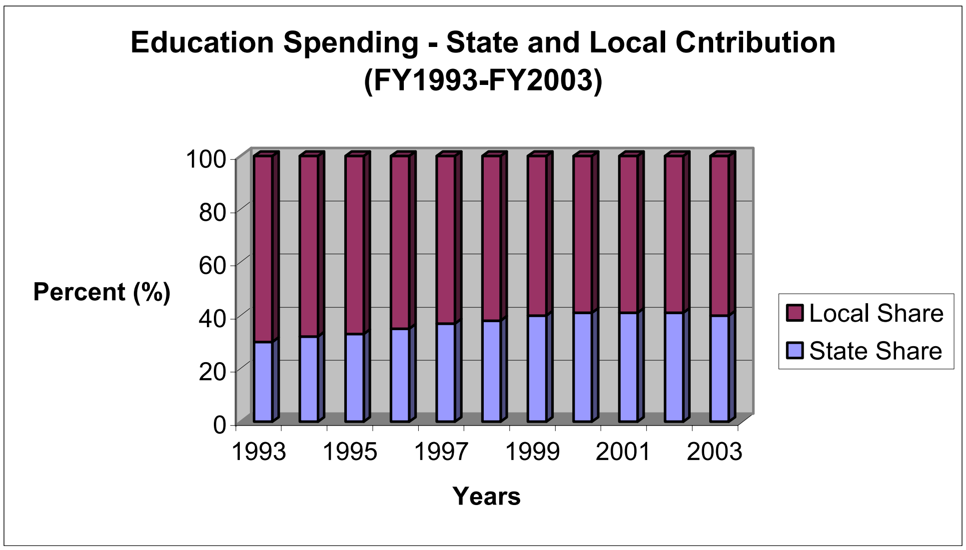
Table 1: Total Education Spending (FY 1984 – FY 2003)

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	6,433,581,288	2,566,134,016	3,867,447,272	40	60
2000	6,892,880,038	2,803,307,931	4,089,572,107	41	59
2001	7,344,378,526	2,989,965,282	4,354,413,244	41	59
2002	7,851,644,737	3,212,701,904	4,638,942,833	41	59
2003	8,152,002,253	3,258,475,120	4,893,527,133	40	60

Source: Massachusetts Department of Education

Table 1 shows that ten years after the passage of education reform, total net school spending for all districts in the state increased from approximately $4.3 billion to $8.1 billion annually. As of fiscal year 2003, 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 1993-2003, local contributions to school funding increased by an average of 5.03% per year while state aid increased by 9.78% 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 30% in FY 1993 to 40% in FY 2003 (see Figure 1).

Figure 1: Education Spending



Hancock v. Driscoll

Now, eleven years later, Suffolk Superior Court Judge Margot Botsford has ruled in *Hancock* v. *Driscoll* that the state was still not meeting its obligations to four Massachusetts school districts, Brockton, Lowell, Springfield and Winchendon. The judge's remedy was to increase funding for the state's poorer school districts.

This increase in funding can be expected to manifest itself in one of two forms. The first would be to reallocate funds from wealthier to poorer communities. The second would allow the wealthier communities to keep their current level of funding, but would raise additional funding through higher taxes raised to augment the budgets of poorer school districts.

The notion that more funding improves learning is a deeply held, but seldom verified, belief. Yet, thanks to standardized educational testing and the availability of spending and socioeconomic data at the district level, it is in fact possible to test the hypothesis that funding improves performance.

The state administers tests under the Massachusetts Comprehensive Assessment System (MCAS) to the 4th, 8th and 10th grade students annually. The MCAS 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; 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. Beginning with the class of 2003, 10th graders are required to pass the MCAS test in order
to graduate.

BEAM

BHI developed its Education Assessment Model (BEAM) 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 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 updated this analysis using 2001 MCAS test scores. This report is a further update using 2003 MCAS scores

II. 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.[3] Studies are split over the question of whether money matters.[4]

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. Our value-added model overcomes this deficiency.

Among the determinants of school performance, there is consensus that socioeconomic factors play a major role. However, public 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.

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

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. Instead of considering general school spending per se, we consider four policy variables that constitute school inputs, namely the percentage change in (a) regular day expenditure, (b) student-teacher ratios (c) teachers' average salary and (d) non-instructional expenditure.

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 reported 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.

III. 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*),[5]

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

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 2003, 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 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 $\qquad$ γ_1 $\qquad$ γ_2 $\qquad$ 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:

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

where $\hat{p}(C=j)$ refers to the proportion of students in the *i*th school who scored in the *j*th category and n_i refers to the number of students in the *i*th 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.[6] 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 2003. In this study, we consider test results for *regular day* education students only. The Department of Education provides this information on public schools (including charter schools). 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.

The Independent Variables

There are three kinds of independent variables in the model: (1) policy variables, which reflect the efforts of state officials to improve performance, (2) socioeconomic variables, which reflect the character of the district in which a school operates and (3) prior test scores, which reflect the status quo prior to education reform.

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 expenditure (which is calculated based on total day costs). 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 2003 $\left(\left(S_{iT}-S_{iT-1}\right)/S_{iT-1}\right)$. These policy variables are as follows:

1. *Percentage increase in per-pupil regular day expenditure*. This variable measures total regular per-pupil expenditure, and includes various categories like instructional, non-instructional, administrative etc.

2. *Percentage increase 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 enrollment 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.[7]

3. *Percentage increase 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.

4. *Percentage increase in non-instructional expenditures*. Per-pupil non-instructional expenditures include school spending on administration, athletics, transportation, maintenance and health.

All the above variables are measured as percentage changes from 1994-2003, except for student-teacher ratio and teacher's salary, which is the percentage change from 1994-2002. Also, we provide separate measures of these variables distinguishing between them according to their performance on the 1994 MEAP tests

Socioeconomic Variables

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 described below:

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 2002 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, 2002.[8] 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. The data used for this variable is from the year 2000.

Other Variable

Finally we include prior test scores:

7. *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.

IV. A Baseline for School Performance

Table 3 (grade 4), Table 4 (grade 8) and Table 5 (grade 10) provide data for the percentage change between 1994 and 2003, which are ordered by the Regular Day Expenditure variable and split up into four equal quartile segments. Means (in percentages) for the given variables are calculated for all observations and for each of the four segments, S_j . The actual values of these variables in 1994 are presented directly below in parentheses. Current score is defined as the percentage of students who performed in Advanced and Proficient categories in 2003.

Table 3 provides an interesting picture. We can see the actual values of prior scores in 1994 (split up into 4 quartiles) as well as per-pupil non-instructional expenditure. From the trend of the movement of these numbers, it is clear that schools that perform the best, get the lowest funding. Quartile S_1 represents the quartile of lowest spending, as seen by the row titled 'non-instructional expenditure'. However, S_1 is also the quartile which represents best performance in terms of both current and prior scores. Similar observations can be made from Tables 4 and 5, for grade 8 and 10 respectively.

Table 3. Overall and Quartile Segment Means for the Percentage Change. Grade 4

Variable	S1	S2	S3	S4	All
Regular Day Expenditure	20.79 (5.036)	36.69 (4.284)	48.93 (4.151)	72.46 (3.808)	44.82 (4.318)
Student-Teacher Ratio	-44.07 (16.65)	-47.79 (17.95)	-52.57 (18.78)	-55.46 (18.98)	-49.99 (18.10)
Teachers' Average Salary	22.99 (40.97)	25.47 (38.20)	25.36 (37.55)	29.99 (35.54)	25.97 (38.06)
Non-Instructional Expenditure	21.38 (1.902)	39.33 (1.620)	54.09 (1.616)	72.70 (1.505)	46.97 (1.660)
Equalized Valuation Index	82.17 (1.385)	64.46 (1.388)	64.81 (1.724)	106.05 (.963)	79.47 (1.363)
Free/Reduced Lunch Participation Rate	-6.10 (8.33)	-5.16 (13.50)	-2.96 (16.44)	1.19 (21.52)	-3.24 (14.97)
Prior Scores in 1994 (Standardized)	0.54	0.19	-0.31	-0.41	-0.00

Current Scores (Standardized)	0.46	0.18	-0.25	-0.37	-0.00

Table 4. Overall and Quartile Segment Means for the Percentage Change. Grade 8.

Variable	S1	S2	S3	S4	All
Regular Day Expenditure	18.36 (5.413)	33.90 (4.494)	44.59 (4.215)	64.71 (4.005)	40.60 (4.527)
Student-Teacher Ratio	-43.01 (16.42)	-46.49 (17.41)	-50.11 (18.66)	-53.99 (18.90)	-48.45 (17.86)
Teachers' Average Salary	21.55 (41.66)	23.48 (38.54)	27.72 (37.61)	28.94 (36.08)	25.45 (38.45)
Non-Instructional Expenditure	18.73 (2.069)	36.59 (1.710)	50.29 (1.565)	65.83 (1.598)	43.05 (1.734)
Equalized Valuation Index	78.51 (1.433)	71.12 (1.513)	66.61 (1.934)	59.92 (1.345)	68.96 (1.554)
Free/Reduced Lunch Participation Rate	-6.01 (7.40)	-9.24 (12.61)	-2.45 (15.53)	2.01 (24.55)	-3.87 (15.10)
Prior Scores in 1994 (Standardized)	0.63	0.15	-0.21	-0.55	0.00
Current Score (Standardized)	0.66	0.22	-0.17	-0.68	-0.00

Table 5. Overall and Quartile Segment Means for the Percentage Change. Grade 10.

Variable	S1	S2	S3	S4	All
Regular Day Expenditure	17.91 (5.630)	33.75 (4.461)	44.41 (4.260)	62.89 (3.982)	39.53 (4.589)
Student-Teacher Ratio	-42.27 (16.28)	-46.20 (17.50)	-50.03 (18.64)	-53.46 (19.12)	-47.94 (17.87)
Teachers' Average Salary	21.19 (41.93)	23.45 (38.38)	26.56 (37.92)	28.55 (36.23)	24.91 (38.64)
Non-Instructional Expenditure	17.03 (2.177)	36.65 (1.700)	50.24 (1.576)	64.33 (1.606)	41.86 (1.766)
Equalized Valuation Index	77.23 (1.402)	68.38 (1.599)	67.10 (2.008)	55.95 (1.449)	67.27 (1.616)
Free/Reduced Lunch Participation Rate	-5.94 (6.31)	-8.57 (13.58)	-1.24 (15.59)	-0.82 (25.96)	-4.17 (15.27)
Prior Scores in 1994 (Standardized)	0.70	0.06	-0.14	-0.64	0.00
Current Score (Standardized)	0.66	0.05	-0.15	-0.58	-0.00

Performance

Table 6 compares the actual average student performance, in various categories with that predicted by the model, shown in parentheses. A comparison of these probabilities to the actual average values indicates that these two values are close to one another. For example, for Mathematics in the 4th grade, the actual average percentages of students in the four categories (based on prior results) are 6.93, 41.98, 34.83, and 16.26, while their predicted values are 8.36, 41.49, 33.81 and 16.34 respectively. A characteristic of the data presented in the Table is worth noting: Although reported and predicted values are generally close, the reported values in the warning and advanced categories are consistently lower than those predicted by the model. The explanation appears to lie in an effort by schools to get students to pass the test at the expense, if necessary, of excellence: Because teachers and students have focused their attention on passing the MCAS test (avoiding a "warning" label), the reduced failure rate is achieved at the cost of reduced excellence.

The predicted values of the model can easily be constructed for individual districts and further used as a benchmark for comparing the actual student performance in these districts.

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.

Table 6: Reported (Predicted) Mean Performance For Different Grade Levels.

	Grade 4		Grade 8		Grade 10	
Performance	English	Math	Math	Science	English	Math
Warning	2.99 (3.65)	6.93 (8.36)	18.38 (19.83)	16.16 (17.31)	3.44 (4.61)	9.97 (11.33)
Needs Improvement	27.94 (27.58)	41.98 (41.49)	32.17 (31.19)	40.33 (38.96)	21.15 (20.90)	26.79 (25.34)
Proficient	54.79 (54.69)	34.83 (33.81)	32.98 (32.04)	37.48 (37.23)	48.14 (46.56)	32.22 (31.16)
Advanced	14.28 (14.07)	16.26 (16.34)	16.47 (16.94)	6.03 (6.50)	27.28 (27.92)	31.01 (32.17)

The estimated ordered logit model is used to derive the probabilities based on the parameter estimates along with the characteristics (factors) of the school districts. Predicted probabilities, averaged across the sample, are compared with the reported probabilities. For each subject and grade level, the actual probabilities appear first with the predicted values directly below in parentheses.

V. Results of the Ordered Logit Model

The purpose of BEAM 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 districts, 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, contained in Table 7 below, of the independent variables that exhibit consistency through all grade levels.

- Regular day expenditure is significant – and negative – only for 10th grade English.
- When significant, increasing the student-teacher ratio has a positive influence on scores, implying that bigger classes improve performance. Smaller classes worsen student performance.
- Non-instructional expenditure is significant but negative only for grade 8, which means that added expenditure of this kind will do more harm than good in this grade.

- The wealth of a district, as measured by the Equalized Valuation Index (EQV), has a positive and significant impact on performance for all subjects and grade levels except 4th grade mathematics, 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 poverty, is significant and negative, but only two instances, in grades 8 and 10. This result reinforces (though just slightly) the results for the Equalized Valuation Index.

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

Table 7. Ordered Logit Model Estimation Results

	Grade 4		Grade 8		Grade 10	
Variable	English	Math	Math	Science	English	Math
Constant	-5.672** (-8.16)	-6.246** (-7.15)	-8.967** (-11.34)	-9.458** (-12.47)	-6.635** (-7.63)	-7.818 (-10.47)
Percentage Increase in Regular Day Expenditure	-0.003 (-1.18)	0.000 (0.08)	-0.003 (-1.18)	0.000 (0.03)	-0.005* (-1.89)	0.000 (0.09)
Percentage Increase in Student-Teacher Ratio	0.012** (3.25)	0.012** (3.12)	0.007** (2.23)	0.006 (1.46)	0.002 (0.45)	0.007** (2.18)
Percentage Increase in Teachers' Average Salary	-0.002 (-0.94)	-0.001 (-0.24)	0.002 (0.62)	0.001 (0.46)	-0.006** (-2.43)	-0.003* (-1.70)
Percentage Increase in Non-Instructional Expenditure	0.001 (0.31)	-0.001 (-0.43)	-0.004** (-2.10)	-0.005** (-2.32)	-0.000 (-0.01)	-0.002 (-1.06)
Percentage Increase in Equalized Valuation Index	0.000** (2.48)	0.000 (1.06)	0.007** (8.38)	0.006** (4.63)	0.005** (3.84)	0.006** (8.61)
Percentage Increase in Free/Reduced Lunch Participation Rate	0.000 (0.10)	-0.000 (-0.07)	-0.001 (-1.58)	-0.002** (-2.82)	-0.002** (-2.49)	-0.000 (-0.06)
Prior Scores in 1994	0.007** (17.19)	0.01** (12.89)	0.007** (15.54)	0.008** (17.47)	0.007** (13.22)	0.008** (15.51)

** and * represent significance at 5 and 10 percent levels, respectively. *t-statistics* are given in parenthesis.

4th Grade Results

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.

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*, 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 BEAM model in this paper] – only one out of twenty-three (4%) shows smaller classes to have a statistically significant positive effect on student performance."[9] 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 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 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.

8th Grade Results

Increases in non-instructional spending worsen performance in both subjects. This is a key result and points out the need for better micro-management of resources, as expenditure on instruction is not directly related to any factor that would improve student performance. Since the resources allocated to this category are worsening performance, there is the need for reallocating them to factors that *will* improve performance.

The effects of smaller classes are only significant for Math. But if significant, smaller classes worsen student performance as is evident from the significant and positive coefficient. The socioeconomic variables reveal almost identical results as in the case of the 4th grade. A higher EQV improves performance, whereas the Free/Reduced Lunch participation rate deteriorates it. Prior scores have a positive effect on the district's current performance.

10th Grade Results

For the 10th grade, an increase in spending for regular day students does not seem to translate into improved performance, as seen from the negative and significant coefficient for English.
Increased spending on teachers' average salary worsens student performance. The effects of smaller classes are statistically significant for Math only. Similar to the results in the 4th and 8th grade, if significant, reducing class size causes a negative effect on student performance.

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. A higher prior score leads to better current performance.

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 have produced results that are hard to identify. The overall verdict on the effect of changes (increases) in education expenditure on changes in scores (1994-2003) has been either negative or inconclusive.

VI. How the schools fared

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, educators or judges. 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 BEAM 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.

We rank schools according to "rank 3" as seen from Tables A-1 to A-4. Rank 1 is simply the rank of the district based on its performance on MCAS 2003. Rank 2 is based on the difference between the district's actual score, and the score for the district, as predicted by the BEAM. Rank 3 is the BEAM rank for the district. Rank 3 is a weighted average of ranks 1 and 2. It is a more comprehensive and meaningful rank, since it encompasses rank 2, which itself takes into account important factors like the socioeconomic character of the district. If the district exceeds the prediction of the model in its actual performance, rank 2 for the district will be higher than rank 1. This also means its overall rank (rank 3) will be higher than rank 1.

Because the model does a good job at predicting school performance (see Table 6), schools that perform substantially better (or worse) than predicted by the model are worth studying for the good (or bad) example they provide. Hence, BEAM ranks districts in part according to whether and to what extent their actual performance exceeds their predicted performance.

We see, for example, that for 4th graders, Eastham school district did the best job based on what the model predicted. So in spite of being ranked 7th based on reported MCAS scores, it topped the overall ranking. On the other hand, even though Winchester ranked 2nd based on its reported MCAS scores, it got a BEAM rank of 19th, simply because it did not perform well, as compared to the model's predictions. (See Appendix, Table A-2.)

In grade 8, even though Longmeadow district ranked 5th according to its reported MCAS scores, it still got a BEAM rank of 1st because it was second best in beating the model's prediction. Equally dramatically, even though Sutton district ranked 60th according to its reported rank, it got a BEAM rank of 16th simply because it gained points by beating our model. On the other hand, Westborough's 8th reported rank left it with a low BEAM rank, because of its low performance (79th) in beating the model's prediction.

For grade 10, Ware district did poorly on the reported MCAS performance (109th) but, since it excelled in beating the model's predictions, it received a BEAM rank of 6th. The rankings over the last 3 years indicate that some schools have been consistently excelling and outperforming BEAM. It may be beneficial for educators and other school districts to be acquainted with what it is that these schools are doing right, to excel again and again.

Learning from the schools: Hadley, Eastham and Mansfield[10]

Reviewing our previous studies, we identified school districts that performed consistently well through the last three years (as it showed up in all three BEAM reports). One such school district is Hadley. Hadley has been among the top three districts for grades 8 and 10 in the last three years. Since the first round of the MCAS tests, Hadley schools have consistently outperformed expectations. In a recent interview, William G. Mahoney, the high school principal, called attention to the same success factors noted four years ago by the then superintendent - community commitment and the work ethic of students, teachers and administrators. The community is small, and various studies have demonstrated that small communities have an edge in school accountability. In the case of Hadley, this shows itself as a sense of ownership and responsibility shared by teachers, students and the community. Indeed, the community has repeatedly opted to forgo the economic advantages of joining larger nearby districts. In this framework of commitment is embedded a tradition of high expectations - parents expect students to do well and students expect to have to work hard and not be entertained.

Hadley school personnel believe there is no magic formula to producing good results. Curriculum frameworks, long-block scheduling and a similarity in teacher sociology throughout the area school districts tend to foster a rough standardization. The difference is in the nature and extent of the work ethic of teachers and students. All secondary teachers, for example, teach six classes per day and a few teach seven, as against the norm of five. Some of those teachers have six preparations per day. This dedication has its counterpart among the students with the result that this small agricultural community sends virtually all its graduates to college.

Another such district is Eastham, which again has been in the top three ranks, from 2001 through 2003, for grade 4. A key factor identified by Dr. Linda Medeiros, Assistant Superintendent of Schools, is the implementation of a system of professional development tightly focused on a standards based agenda. The elementary results in Eastham have also consistently exceeded expectations. Of the 189 days in the teacher contract year, eight are earmarked for professional development. Four of these are devoted to traditional in-service activities during the schools year, four are allotted for flexible use, with teachers undertaking individually approved activities fostering skills in instructional planning, differentiated instruction and assessment. As part of this professional development, the system has required all administrators and teachers to take a three-credit course, *Instruction for All*, in using standards based education. Twenty-four teachers and all administrators took a course together in math curriculum and instruction, combining it with discussion and evaluation of the major approaches and selection of the one most appropriate for the system's needs.

Lastly, Mansfield school district has been consistently excelling for grade 10, from 2001 through 2003. David Farinella, Director of Guidance at Mansfield High School, explains the school's MCAS success in terms of the direct relationship of work in English and Math classes to competencies measured by the MCAS as well as to the time devoted in the curriculum to English and Math. Within the block schedule, ninth and tenth graders have three terms of English and Math in an academic year rather than just two, and in the coming year English and high-risk Math will comprise four terms per year. Continuity is fostered in curricular planning and implementation by the fact that each department chair has a span of control from grade six to grade twelve. In addition, individual success plans are created for all students at the needs improvement and warning levels and all students at the warning level are tutored at an academic learning center.

As noted in previous surveys, successful schools and districts seem to be achieving the results through a clarity of purpose and commitment shared by the major constituent groups, by focus on methods of relating specific strategies to one another in an overall systematic approach and by increasing time in task and individualized diagnosis and prescription for learners.

Conclusion

To summarize, the findings of this study are: (1) the entire effort by the state to increase education spending under the aegis of Education Reform has failed to improve school performance, and (2) school performance continues to be a function mainly of history and of socioeconomic factors beyond the control of policy makers. Furthermore, ten years of experience under Education Reform has failed to make smaller classes or increases in teachers' pay effective for improving performance.

The evidence from the BEAM 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.

Appendix

This table shows how we rank the performance of each district for each grade. The ranking combines both reported performance and reported performance relative to predicted performance. By this measure, the district gets "credit" for performing well and for beating expectations of its performance. The number of districts ranked is

- 269 for fourth grade;
- 234 for eighth grade; and
- 222 for tenth grade.

The BEAM rank of a school district (rank 3 in Tables A-2 through A-4) is constructed as an equally weighted average of (a) the normalized reported score of a school district (rank 1), and (b) the normalized difference between the reported and the predicted score (rank 2). The predicted score is calculated from our model using the prior score and the changes in the policy and the socioeconomic variables of an individual district.

Thus, a school that does well compared to other schools *and* that does well compared to what BEAM predicts for that school will get a high ranking – which is to say a score close to 1. A district that does poorly compared to other schools and compared to what BEAM predicts for that district will get a low ranking – which is to say a score close to 269 for fourth grade, etc.

Table A-1
BEAM Rank

Districts	Grade 4	Grade 8	Grade 10
ABINGTON	142	87	147
ACTON	10	5	8
ACUSHNET	216	141	-
ADAMS CHESHIR	249	155	208
AGAWAM	93	75	97
AMESBURY	175	40	82
AMHERST	115	151	69
ANDOVER	34	80	17
ARLINGTON	30	18	90
ASHBURNHAM WE	248	78	91
ASHLAND	179	131	32
ATHOL ROYALST	192	183	65
ATTLEBORO	210	88	152
AUBURN	234	195	206
AVON	154	191	222
AYER	20	102	110
BARNSTABLE	98	159	123
BEDFORD	131	27	121
BELCHERTOWN	125	67	72
BELLINGHAM	220	179	198
BELMONT	65	31	77
BERKLEY	258	136	-
BERKSHIRE HIL	265	140	130
BERLIN	62	209	149
BEVERLY	174	158	118
BILLERICA	130	134	93
BLACKSTONE MI	160	189	176
BOSTON	240	188	183
BOURNE	235	164	145
BOXBOROUGH	67	-	-
BOXFORD	106	-	-
BOYLSTON	188	-	-
BRAINTREE	32	104	18
BREWSTER	5	-	-
BRIDGEWATER R	102	137	148
BRIMFIELD	39	-	-
BROCKTON	197	218	171
BROOKFIELD	260	-	-
BROOKLINE	86	77	52
BURLINGTON	191	17	120
CAMBRIDGE	201	146	196
CANTON	104	163	36

CARLISLE	47	13	
CARVER	112	58	160
CENTRAL BERKS	137	112	10
CHATHAM	15	145	159
CHELMSFORD	54	99	103
CHELSEA	60	175	173
CHICOPEE	237	207	158
CLARKSBURG	211	234	-
CLINTON	158	94	181
COHASSET	119	85	129
CONCORD	46	52	64
CONWAY	3	-	-
DANVERS	146	193	104
DARTMOUTH	92	130	155
DEDHAM	163	229	49
DEERFIELD	22	-	-
DENNIS YARMOU	196	116	111
DIGHTON REHOB	133	172	117
DOUGLAS	244	233	210
DOVER	74	73	19
DRACUT	184	208	132
DUDLEY CHARLT	126	100	62
DUXBURY	180	103	107
EAST BRIDGEWA	238	217	133
EAST LONGMEAD	66	38	35
EASTHAM	1	-	-
EASTHAMPTON	178	142	156
EASTON	33	43	24
EDGARTOWN	122	21	-
ERVING	263	-	-
EVERETT	124	178	126
FAIRHAVEN	181	200	131
FALL RIVER	245	222	191
FALMOUTH	173	132	106
FARMINGTON RI	150	-	-
FITCHBURG	182	173	162
FLORIDA	-	232	-
FOXBOROUGH	11	51	29
FRAMINGHAM	165	114	61
FRANKLIN	16	3	85
FREETOWN LAKE	-	184	163
FRONTIER	-	26	14
GARDNER	138	227	76
GATEWAY	198	214	201
GEORGETOWN	148	81	42
GILL MONTAGUE	183	128	146
GLOUCESTER	155	123	161
GRAFTON	141	154	142
GRANBY	75	69	102
GRANVILLE	82	160	-

GREENFIELD	247	122	109
GROTON DUNSTA	56	49	51
HADLEY	121	2	4
HALIFAX	253	-	-
HAMILTON WENH	214	29	34
HAMPDEN WILBR	110	10	37
HAMPSHIRE	-	231	189
HANOVER	49	8	45
HARVARD	100	95	23
HARWICH	129	228	214
HATFIELD	219	190	1
HAVERHILL	215	202	217
HINGHAM	57	50	11
HOLBROOK	200	219	221
HOLLAND	268	-	-
HOLLISTON	143	32	43
HOLYOKE	227	215	194
HOPEDALE	127	25	154
HOPKINTON	42	111	38
HUDSON	254	168	113
HULL	246	133	179
IPSWICH	168	70	7
KING PHILLIP	-	36	21
KINGSTON	73	-	-
LAKEVILLE	241	-	-
LANESBOROUGH	113	-	-
LAWRENCE	262	225	207
LEE	252	91	202
LEICESTER	217	226	187
LENOX	120	101	84
LEOMINSTER	167	106	165
LEVERETT	2	-	-
LEXINGTON	8	14	86
LINCOLN	189	76	57
LITTLETON	79	42	-
LONGMEADOW	76	1	47
LOWELL	236	182	180
LUDLOW	153	180	101
LUNENBURG	140	48	33
LYNN	207	206	182
LYNNFIELD	105	22	9
MALDEN	256	147	168
MANSFIELD	81	65	20
MARBLEHEAD	103	93	75
MARION	147	-	-
MARLBOROUGH	218	177	174
MARSHFIELD	31	34	128
MARTHA'S VINEYARD	-	-	58
MASCOMNET	-	54	48
MASHPEE	58	108	116

MATTAPOISETT	48	-	-
MAYNARD	149	96	170
MEDFIELD	25	86	46
MEDFORD	157	120	137
MEDWAY	185	19	74
MELROSE	177	150	53
METHUEN	172	152	186
MIDDLEBOROUGH	156	153	166
MIDDLETON	186	-	-
MILFORD	161	84	71
MILLBURY	108	176	215
MILLIS	239	44	2
MILTON	109	79	112
MOHAWK TRAIL	213	138	218
MONSON	209	127	105
MOUNT GREYLOCK	-	181	190
NAHANT	95	-	-
NANTUCKET	206	216	59
NARRAGANSETT	195	210	195
NASHOBA	88	45	30
NATICK	68	171	78
NAUSET	-	4	67
NEEDHAM	90	23	15
NEW BEDFORD	266	212	212
NEW SALEM WEN	28	-	-
NEWBURYPORT	229	89	68
NEWTON	35	12	31
NORFOLK	27	-	-
NORTH ADAMS	261	211	127
NORTH ANDOVER	144	47	70
NORTH ATTLEBO	45	46	80
NORTH BROOKFI	264	139	144
NORTH MIDDLES	132	72	153
NORTH READING	64	97	99
NORTHAMPTON	114	20	63
NORTHBOROUGH	176	66	55
NORTHBRIDGE	171	148	135
NORTON	117	204	140
NORWELL	84	9	16
NORWOOD	151	203	141
OAK BLUFFS	14	15	
ORANGE	77	98	175
ORLEANS	29	-	-
OXFORD	80	170	193
PALMER	96	121	138
PEABODY	159	156	192
PELHAM	7	-	-
PEMBROKE	164	-	-
PENTUCKET	52	24	94
PETERSHAM	251	-	-

PIONEER	233	165	100
PITTSFIELD	257	169	157
PLAINVILLE	139	-	-
PLYMOUTH	136	196	169
PLYMPTON	26	-	-
PROVINCETOWN	4	194	92
QUABBIN	228	53	83
QUABOAG	224	213	139
QUINCY	118	118	178
RALPH C MAHAR	-	90	115
RANDOLPH	194	223	150
READING	38	55	3
REVERE	223	174	209
RICHMOND	107	41	-
ROCHESTER	9	-	-
ROCKLAND	97	187	205
ROCKPORT	162	39	66
SALEM	226	113	184
SANDWICH	169	61	73
SAUGUS	232	144	216
SCITUATE	50	115	125
SEEKONK	190	185	177
SHARON	53	62	5
SHERBORN	12	-	-
SHIRLEY	259	68	-
SHREWSBURY	152	74	22
SHUTESBURY	13	-	-
SILVER LAKE	-	63	98
SOMERSET	36	71	164
SOMERVILLE	231	126	95
SOUTH HADLEY	166	220	134
SOUTHAMPTON	193	-	-
SOUTHBOROUGH	43	157	-
SOUTHBRIDGE	255	230	213
SOUTHERN BERK	116	107	12
SOUTHWICK TOL	71	92	185
SPENCER EAST	101	201	199
SPRINGFIELD	243	221	204
STONEHAM	41	60	56
STOUGHTON	208	109	114
STURBRIDGE	205	-	-
SUDBURY	37	37	-
SUNDERLAND	17	-	-
SUTTON	69	16	25
SWAMPSCOTT	23	30	60
SWANSEA	203	110	122
TAUNTON	170	192	203
TEWKSBURY	123	64	27
TISBURY	242	11	-
TOPSFIELD	70	-	-

TRITON	199	124	119
TRURO	187	-	-
TYNGSBOROUGH	61	119	79
UXBRIDGE	221	125	81
WACHUSETT	40	56	50
WAKEFIELD	91	59	108
WALES	85	-	-
WALPOLE	59	105	26
WALTHAM	222	198	88
WARE	72	149	6
WAREHAM	225	224	172
WATERTOWN	44	35	87
WAYLAND	18	7	44
WEBSTER	267	205	200
WELLESLEY	24	57	28
WELLFLEET	145	-	-
WEST BOYLSTON	135	167	211
WEST BRIDGEWA	134	83	151
WEST SPRINGFI	202	143	188
WESTBOROUGH	87	28	39
WESTFIELD	204	166	96
WESTFORD	51	6	13
WESTHAMPTON	269	-	-
WESTON	55	129	40
WESTPORT	99	162	220
WESTWOOD	21	82	54
WEYMOUTH	78	197	136
WHATELY	6	-	-
WHITMAN HANSO	94	-	167
WILLIAMSBURG	83	-	-
WILLIAMSTOWN	128	-	-
WILMINGTON	212	135	89
WINCHENDON	250	117	219
WINCHESTER	19	33	41
WINTHROP	111	161	124
WOBURN	89	186	143
WORCESTER	230	199	197
WRENTHAM	63	-	-

Table A2

Ranking of Grade 4

Districts	Rank 1	Rank 2	BEAM Rank
ABINGTON	98	197	142
ACTON	4	41	10
ACUSHNET	236	174	216
ADAMS CHESHIR	242	237	249
AGAWAM	94	85	93
AMESBURY	191	141	175
AMHERST	100	134	115
ANDOVER	21	62	34
ARLINGTON	29	42	30
ASHBURNHAM WE	227	253	248
ASHLAND	170	185	179
ATHOL ROYALST	237	104	192
ATTLEBORO	219	190	210
AUBURN	178	249	234
AVON	167	148	154
AYER	49	16	20
BARNSTABLE	104	88	98
BEDFORD	79	199	131
BELCHERTOWN	172	71	125
BELLINGHAM	186	231	220
BELMONT	40	118	65
BERKLEY	253	252	258
BERKSHIRE HIL	255	265	265
BERLIN	41	102	62
BEVERLY	128	207	174
BILLERICA	126	137	130
BLACKSTONE MI	106	208	160
BOSTON	263	109	240
BOURNE	217	229	235
BOXBOROUGH	57	98	67
BOXFORD	82	156	106
BOYLSTON	140	230	188
BRAINTREE	50	34	32
BREWSTER	16	8	5
BRIDGEWATER R	114	86	102
BRIMFIELD	90	14	39
BROCKTON	247	73	197
BROOKFIELD	249	263	260
BROOKLINE	68	123	86
BURLINGTON	118	239	191
CAMBRIDGE	240	112	201
CANTON	73	158	104
CARLISLE	23	83	47
CARVER	201	32	112
CENTRAL BERKS	142	152	137

Districts	Rank 1	Rank 2	BEAM Rank
CHATHAM	17	28	15
CHELMSFORD	42	76	54
CHELSEA	229	7	60
CHICOPEE	250	171	237
CLARKSBURG	207	204	211
CLINTON	206	87	158
COHASSET	75	182	119
CONCORD	13	111	46
CONWAY	1	6	3
DANVERS	110	189	146
DARTMOUTH	145	51	92
DEDHAM	135	191	163
DEERFIELD	44	21	22
DENNIS YARMOU	190	201	196
DIGHTON REHOB	125	147	133
DOUGLAS	203	255	244
DOVER	33	145	74
DRACUT	154	211	184
DUDLEY CHARLT	132	121	126
DUXBURY	91	233	180
EAST BRIDGEWA	211	242	238
EAST LONGMEAD	37	120	66
EASTHAM	7	1	1
EASTHAMPTON	210	130	178
EASTON	47	35	33
EDGARTOWN	129	117	122
ERVING	261	259	263
EVERETT	197	49	124
FAIRHAVEN	208	138	181
FALL RIVER	256	180	245
FALMOUTH	151	187	173
FARMINGTON RI	193	92	150
FITCHBURG	235	81	182
FOXBOROUGH	31	12	11
FRAMINGHAM	130	195	165
FRANKLIN	38	17	16
GARDNER	187	82	138
GATEWAY	222	166	198
GEORGETOWN	120	184	148
GILL MONTAGUE	223	110	183
GLOUCESTER	157	160	155
GRAFTON	133	163	141
GRANBY	137	33	75
GRANVILLE	116	52	82
GREENFIELD	251	213	247
GROTON DUNSTA	34	90	56
HADLEY	141	105	121
HALIFAX	239	254	253
HAMILTON WENH	107	257	214
HAMPDEN WILBR	77	164	110
HANOVER	32	72	49

Districts	Rank 1	Rank 2	BEAM Rank
HARVARD	36	200	100
HARWICH	111	157	129
HATFIELD	216	205	219
HAVERHILL	234	169	215
HINGHAM	25	119	57
HOLBROOK	220	170	200
HOLLAND	268	268	268
HOLLISTON	123	175	143
HOLYOKE	266	43	227
HOPEDALE	124	136	127
HOPKINTON	39	55	42
HUDSON	224	260	254
HULL	226	250	246
IPSWICH	92	218	168
KINGSTON	83	69	73
LAKEVILLE	241	214	241
LANESBOROUGH	101	125	113
LAWRENCE	267	226	262
LEE	248	232	252
LEICESTER	179	234	217
LENOX	117	129	120
LEOMINSTER	205	94	167
LEVERETT	10	3	2
LEXINGTON	6	27	8
LINCOLN	112	240	189
LITTLETON	64	115	79
LONGMEADOW	51	128	76
LOWELL	257	122	236
LUDLOW	188	106	153
LUNENBURG	162	126	140
LYNN	244	101	207
LYNNFIELD	88	144	105
MALDEN	252	243	256
MANSFIELD	89	67	81
MARBLEHEAD	71	167	103
MARION	155	149	147
MARLBOROUGH	198	225	218
MARSHFIELD	20	54	31
MASHPEE	121	19	58
MATTAPOISETT	143	11	48
MAYNARD	160	151	149
MEDFIELD	14	57	25
MEDFORD	195	97	157
MEDWAY	138	223	185
MELROSE	122	215	177
METHUEN	189	132	172
MIDDLEBOROUGH	199	93	156
MIDDLETON	95	244	186
MILFORD	200	95	161
MILLBURY	163	61	108
MILLIS	192	251	239

Districts	Rank 1	Rank 2	BEAM Rank
MILTON	78	162	109
MOHAWK TRAIL	185	222	213
MONSON	225	178	209
NAHANT	80	124	95
NANTUCKET	173	228	206
NARRAGANSETT	213	177	195
NASHOBA	74	107	88
NATICK	52	113	68
NEEDHAM	55	161	90
NEW BEDFORD	260	264	266
NEW SALEM WEN	177	5	28
NEWBURYPORT	181	247	229
NEWTON	12	80	35
NORFOLK	61	20	27
NORTH ADAMS	264	246	261
NORTH ANDOVER	103	192	144
NORTH ATTLEBO	70	36	45
NORTH BROOKFI	262	262	264
NORTH MIDDLES	136	135	132
NORTH READING	24	142	64
NORTHAMPTON	134	91	114
NORTHBOROUGH	85	238	176
NORTHBRIDGE	202	108	171
NORTON	131	96	117
NORWELL	53	155	84
NORWOOD	105	202	151
OAK BLUFFS	48	13	14
ORANGE	156	25	77
ORLEANS	26	46	29
OXFORD	152	31	80
PALMER	165	44	96
PEABODY	148	176	159
PELHAM	5	30	7
PEMBROKE	102	210	164
PENTUCKET	69	50	52
PETERSHAM	228	256	251
PIONEER	245	179	233
PITTSFIELD	243	258	257
PLAINVILLE	166	114	139
PLYMOUTH	108	183	136
PLYMPTON	54	23	26
PROVINCETOWN	18	2	4
QUABBIN	194	236	228
QUABOAG	215	216	224
QUINCY	158	74	118
RANDOLPH	218	159	194
READING	28	59	38
REVERE	232	193	223
RICHMOND	65	186	107
ROCHESTER	62	10	9
ROCKLAND	149	56	97

Districts	Rank 1	Rank 2	BEAM Rank
ROCKPORT	127	196	162
SALEM	214	221	226
SANDWICH	119	203	169
SAUGUS	184	248	232
SCITUATE	59	63	50
SEEKONK	196	188	190
SHARON	30	84	53
SHERBORN	3	45	12
SHIRLEY	230	266	259
SHREWSBURY	113	198	152
SHUTESBURY	81	9	13
SOMERSET	58	37	36
SOMERVILLE	246	165	231
SOUTH HADLEY	176	146	166
SOUTHAMPTON	209	181	193
SOUTHBOROUGH	35	64	43
SOUTHBRIDGE	258	224	255
SOUTHERN BERK	168	66	116
SOUTHWICK TOL	97	53	71
SPENCER EAST	180	38	101
SPRINGFIELD	259	173	243
STONEHAM	60	39	41
STOUGHTON	150	241	208
STURBRIDGE	175	227	205
SUDBURY	8	89	37
SUNDERLAND	22	26	17
SUTTON	161	18	69
SWAMPSCOTT	45	22	23
SWANSEA	183	212	203
TAUNTON	182	140	170
TEWKSBURY	144	103	123
TISBURY	171	261	242
TOPSFIELD	56	116	70
TRITON	174	217	199
TRURO	204	168	187
TYNGSBOROUGH	96	40	61
UXBRIDGE	169	245	221
WACHUSETT	27	65	40
WAKEFIELD	87	99	91
WALES	115	60	85
WALPOLE	66	68	59
WALTHAM	212	219	222
WARE	153	24	72
WAREHAM	221	209	225
WATERTOWN	99	15	44
WAYLAND	9	47	18
WEBSTER	265	267	267
WELLESLEY	11	58	24
WELLFLEET	147	154	145
WEST BOYLSTON	76	206	135
WEST BRIDGEWA	139	143	134

Districts	Rank 1	Rank 2	BEAM Rank
WEST SPRINGFI	231	150	202
WESTBOROUGH	63	139	87
WESTFIELD	233	153	204
WESTFORD	43	70	51
WESTHAMPTON	269	269	269
WESTON	19	131	55
WESTPORT	86	133	99
WESTWOOD	15	48	21
WEYMOUTH	84	78	78
WHATELY	67	4	6
WHITMAN HANSO	109	77	94
WILLIAMSBURG	159	29	83
WILLIAMSTOWN	93	172	128
WILMINGTON	164	235	212
WINCHENDON	254	220	250
WINCHESTER	2	75	19
WINTHROP	146	79	111
WOBURN	72	127	89
WORCESTER	238	194	230
WRENTHAM	46	100	63

Table A3

Ranking of Grade 8

Districts	Rank 1	Rank 2	BEAM Rank
ABINGTON	110	68	87
ACTON BOXBORO	4	22	5
ACUSHNET	135	143	141
ADAMS CHESHIR	144	159	155
AGAWAM	118	42	75
AMESBURY	89	13	40
AMHERST PELHA	84	214	151
ANDOVER	23	189	80
ARLINGTON	39	15	18
ASHBURNHAM WE	76	97	78
ASHLAND	111	167	131
ATHOL ROYALST	214	104	183
ATTLEBORO	159	34	88
AUBURN	103	221	195
AVON	211	138	191
AYER	183	30	102
BARNSTABLE	125	186	159
BEDFORD	16	61	27
BELCHERTOWN	95	57	67
BELLINGHAM	165	175	179
BELMONT	10	70	31
BERKLEY	154	119	136
BERKSHIRE HIL	145	135	140
BERLIN BOYLST	116	226	209
BEVERLY	108	193	158
BILLERICA	97	183	134
BLACKSTONE MI	176	182	189
BOSTON	219	100	188
BOURNE	175	137	164
BRAINTREE	101	107	104
BRIDGEWATER R	112	171	137
BROCKTON	229	160	218
BROOKLINE	26	178	77
BURLINGTON	34	14	17
CAMBRIDGE	188	91	146
CANTON	105	203	163
CARLISLE	1	85	13
CARVER	132	20	58
CENTRAL BERKS	92	152	112
CHATHAM	73	215	145
CHELMSFORD	61	172	99
CHELSEA	226	65	175
CHICOPEE	217	157	207
CLARKSBURG	227	234	234
CLINTON	140	56	94
COHASSET	50	163	85
CONCORD	12	144	52

Districts	Rank 1	Rank 2	BEAM Rank
DANVERS	147	208	193
DARTMOUTH	119	151	130
DEDHAM	197	230	229
DENNIS YARMOU	117	130	116
DIGHTON REHOB	129	192	172
DOUGLAS	195	233	233
DOVER SHERBOR	22	184	73
DRACUT	189	204	208
DUDLEY CHARLT	133	71	100
DUXBURY	59	181	103
EAST BRIDGEWA	172	219	217
EAST LONGMEAD	82	16	38
EASTHAMPTON	182	90	142
EASTON	66	37	43
EDGARTOWN	21	38	21
EVERETT	205	125	178
FAIRHAVEN	212	146	200
FALL RIVER	230	164	222
FALMOUTH	121	154	132
FITCHBURG	223	66	173
FLORIDA	194	232	232
FOXBOROUGH	63	55	51
FRAMINGHAM	115	122	114
FRANKLIN	33	3	3
FREETOWN LAKE	161	188	184
FRONTIER	94	6	26
GARDNER	225	211	227
GATEWAY	207	205	214
GEORGETOWN	75	101	81
GILL MONTAGUE	142	124	128
GLOUCESTER	148	105	123
GRAFTON	99	197	154
GRANBY	155	19	69
GRANVILLE	210	87	160
GREENFIELD	181	73	122
GROTON DUNSTA	32	95	49
HADLEY	41	1	2
HAMILTON WENH	17	60	29
HAMPDEN WILBR	28	9	10
HAMPSHIRE	204	231	231
HANOVER	18	11	8
HARVARD	45	187	95
HARWICH	192	227	228
HATFIELD	153	199	190
HAVERHILL	200	177	202
HINGHAM	24	106	50
HOLBROOK	215	198	219
HOLLISTON	29	43	32
HOLYOKE	234	109	215
HOPEDALE	46	24	25
HOPKINTON	42	213	111

Districts	Rank 1	Rank 2	BEAM Rank
HUDSON	156	170	168
HULL	202	67	133
IPSWICH	86	72	70
KING PHILIP	64	25	36
LAWRENCE	233	142	225
LEE	149	45	91
LEICESTER	139	229	226
LENOX	100	102	101
LEOMINSTER	168	53	106
LEXINGTON	3	52	14
LINCOLN	51	136	76
LITTLETON	67	33	42
LONGMEADOW	5	2	1
LOWELL	218	88	182
LUDLOW	184	147	180
LUNENBURG	74	35	48
LYNN	222	139	206
LYNNFIELD	56	17	22
MALDEN	209	74	147
MANSFIELD	90	59	65
MARBLEHEAD	65	150	93
MARLBOROUGH	166	174	177
MARSHFIELD	81	10	34
MASCONOMET	31	115	54
MASHPEE	160	63	108
MAYNARD	113	84	96
MEDFIELD	20	206	86
MEDFORD	173	78	120
MEDWAY	14	40	19
MELROSE	131	169	150
METHUEN	190	99	152
MIDDLEBOROUGH	177	117	153
MILFORD	138	39	84
MILLBURY	170	168	176
MILLIS	58	50	44
MILTON	85	86	79
MOHAWK TRAIL	124	153	138
MONSON	136	127	127
MOUNT GREYLOC	120	210	181
NANTUCKET	141	228	216
NARRAGANSETT	163	217	210
NASHOBA	48	62	45
NATICK	102	212	171
NAUSET	27	4	4
NEEDHAM	36	28	23
NEW BEDFORD	231	128	212
NEWBURYPORT	83	110	89
NEWTON	6	32	12
NORTH ADAMS	224	156	211
NORTH ANDOVER	68	46	47
NORTH ATTLEBO	62	48	46

Districts	Rank 1	Rank 2	BEAM Rank
NORTH BROOKFI	151	129	139
NORTH MIDDLES	80	81	72
NORTH READING	40	196	97
NORTHAMPTON	78	5	20
NORTHBOROUGH	43	132	66
NORTHBRIDGE	143	141	148
NORTON	146	216	204
NORWELL	7	21	9
NORWOOD	107	222	203
OAK BLUFFS	13	29	15
OLD ROCHESTER	91	120	98
OXFORD	199	121	170
PALMER	178	76	121
PEABODY	122	185	156
PENTUCKET	44	23	24
PIONEER	201	103	165
PITTSFIELD	203	108	169
PLYMOUTH	164	200	196
PROVINCETOWN	171	191	194
QUABBIN	88	36	53
QUABOAG	157	220	213
QUINCY	130	113	118
RALPH C MAHAR	128	58	90
RANDOLPH	220	194	223
READING	25	126	55
REVERE	206	114	174
RICHMOND	53	44	41
ROCKLAND	193	148	187
ROCKPORT	69	27	39
SALEM	179	54	113
SANDWICH	37	134	61
SAUGUS	127	161	144
SCITUATE	55	207	115
SEEKONK	187	158	185
SHARON	49	111	62
SHIRLEY	70	89	68
SHREWSBURY	54	133	74
SILVER LAKE	96	47	63
SOMERSET	104	51	71
SOMERVILLE	169	93	126
SOUTH HADLEY	185	218	220
SOUTHBOROUGH	57	223	157
SOUTHBRIDGE	228	225	230
SOUTHERN BERK	123	96	107
SOUTHWICK TOL	87	112	92
SPENCER EAST	174	195	201
SPRINGFIELD	232	140	221
STONEHAM	77	64	60
STOUGHTON	150	80	109
SUDBURY	19	82	37
SUTTON	60	7	16

Districts	Rank 1	Rank 2	BEAM Rank
SWAMPSCOTT	47	26	30
SWANSEA	109	123	110
TAUNTON	198	165	192
TEWKSBURY	106	41	64
TISBURY	38	8	11
TRITON	137	118	124
TYNGSBOROUGH	98	149	119
UXBRIDGE	167	92	125
WACHUSETT	52	94	56
WAKEFIELD	71	69	59
WALPOLE	72	166	105
WALTHAM	191	180	198
WARE	208	77	149
WAREHAM	216	209	224
WATERTOWN	79	12	35
WAYLAND	2	31	7
WEBSTER	213	162	205
WELLESLEY	15	173	57
WEST BOYLSTON	114	201	167
WEST BRIDGEWA	93	83	83
WEST SPRINGFI	180	98	143
WESTBOROUGH	8	79	28
WESTFIELD	186	131	166
WESTFORD	9	18	6
WESTON	30	224	129
WESTPORT	134	179	162
WESTWOOD	35	176	82
WEYMOUTH	162	202	197
WILMINGTON	126	145	135
WINCHENDON	196	49	117
WINCHESTER	11	75	33
WINTHROP	158	155	161
WOBURN	152	190	186
WORCESTER	221	116	199

Table A4

Ranking of Grade 10

.

Districts	Rank 1	Rank 2	BEAM Rank
ABINGTON	130	162	147
ACTON BOXBORO	4	28	8
ADAMS CHESHIR	187	208	208
AGAWAM	143	42	97
AMESBURY	119	31	82
AMHERST PELHA	78	68	69
ANDOVER	6	46	17
ARLINGTON	83	94	90
ASHBURNHAM WE	87	95	91
ASHLAND	38	35	32
ATHOL ROYALST	156	7	65
ATTLEBORO	188	115	152
AUBURN	177	212	206
AVON	215	222	222
AYER	138	59	110
BARNSTABLE	111	133	123
BEDFORD	74	170	121
BELCHERTOWN	91	50	72
BELLINGHAM	165	207	198
BELMONT	45	127	77
BERKSHIRE HIL	115	143	130
BERLIN BOYLST	92	196	149
BEVERLY	110	128	118
BILLERICA	88	100	93
BLACKSTONE MI	160	191	176
BOSTON	208	147	183
BOURNE	136	156	145
BRAINTREE	50	12	18
BRIDGEWATER R	129	164	148
BROCKTON	196	144	171
BROOKLINE	34	92	52
BURLINGTON	86	158	120
CAMBRIDGE	167	203	196
CANTON	60	30	36
CARVER	152	171	160
CENTRAL BERKS	43	10	10
CHATHAM	108	195	159
CHELMSFORD	56	153	103
CHELSEA	219	45	173
CHICOPEE	207	75	158
CLINTON	194	169	181
COHASSET	81	176	129
CONCORD CARLI	25	131	64
DANVERS	95	110	104

Districts	Rank 1	Rank 2	BEAM Rank
DARTMOUTH	162	160	155
DEDHAM	72	40	49
DENNIS YARMOU	104	108	111
DIGHTON REHOB	106	125	117
DOUGLAS	185	213	210
DOVER SHERBOR	2	55	19
DRACUT	133	129	132
DUDLEY CHARLT	77	56	62
DUXBURY	54	159	107
EAST BRIDGEWA	126	135	133
EAST LONGMEAD	80	16	35
EASTHAMPTON	179	138	156
EASTON	47	18	24
EVERETT	189	33	126
FAIRHAVEN	157	102	131
FALL RIVER	217	124	191
FALMOUTH	102	97	106
FITCHBURG	200	105	162
FOXBOROUGH	29	41	29
FRAMINGHAM	67	64	61
FRANKLIN	84	87	85
FREETOWN LAKE	150	175	163
FRONTIER	58	8	14
GARDNER	123	25	76
GATEWAY	202	190	201
GEORGETOWN	70	32	42
GILL MONTAGUE	191	89	146
GLOUCESTER	174	149	161
GRAFTON	100	179	142
GRANBY	146	48	102
GREENFIELD	158	47	109
GROTON DUNSTA	36	86	51
HADLEY	27	6	4
HAMILTON WENH	21	62	34
HAMPDEN WILBR	65	29	37
HAMPSHIRE	141	209	189
HANOVER	42	57	45
HARVARD	1	76	23
HARWICH	159	220	214
HATFIELD	3	2	1
HAVERHILL	199	215	217
HINGHAM	14	24	11
HOLBROOK	214	221	221
HOLLISTON	46	52	43
HOLYOKE	221	70	194
HOPEDALE	140	173	154
HOPKINTON	15	93	38
HUDSON	112	103	113
HULL	193	166	179
IPSWICH	28	9	7
KING PHILIP	40	19	21

Districts	Rank 1	Rank 2	BEAM Rank
LAWRENCE	220	137	207
LEE	172	205	202
LEICESTER	147	206	187
LENOX	39	145	84
LEOMINSTER	184	140	165
LEXINGTON	32	150	86
LINCOLN SUDBU	17	130	57
LONGMEADOW	41	66	47
LOWELL	212	126	180
LUDLOW	120	67	101
LUNENBURG	61	21	33
LYNN	210	139	182
LYNNFIELD	20	20	9
MALDEN	205	111	168
MANSFIELD	53	13	20
MARBLEHEAD	44	121	75
MARLBOROUGH	145	193	174
MARSHFIELD	103	151	128
MARTHAS VINEY	64	60	58
MASCONOMET	35	81	48
MASHPEE	131	85	116
MAYNARD	148	187	170
MEDFIELD	11	117	46
MEDFORD	182	78	137
MEDWAY	55	106	74
MELROSE	75	44	53
METHUEN	198	174	186
MIDDLEBOROUGH	173	155	166
MILFORD	121	22	71
MILLBURY	195	214	215
MILLIS	13	3	2
MILTON	105	112	112
MOHAWK TRAIL	175	219	218
MONSON	118	79	105
MOUNT GREYLOC	139	211	190
NANTUCKET	26	120	59
NARRAGANSETT	170	201	195
NASHOBA	30	38	30
NATICK	73	88	78
NAUSET	37	119	67
NEEDHAM	23	26	15
NEW BEDFORD	216	185	212
NEWBURYPORT	62	83	68
NEWTON	12	74	31
NORTH ADAMS	168	72	127
NORTH ANDOVER	71	80	70
NORTH ATTLEBO	79	84	80
NORTH BROOKFI	178	109	144
NORTH MIDDLES	114	186	153
NORTH READING	63	142	99
NORTHAMPTON	125	14	63

Districts	Rank 1	Rank 2	BEAM Rank
NORTHBORO SOU	33	96	55
NORTHBRIDGE	134	148	135
NORTON	97	180	140
NORWELL	10	39	16
NORWOOD	124	163	141
OLD ROCHESTER	135	197	175
OXFORD	186	192	193
PALMER	176	98	138
PEABODY	180	194	192
PENTUCKET	59	136	94
PIONEER	142	49	100
PITTSFIELD	197	107	157
PLYMOUTH	153	181	169
PROVINCETOWN	122	43	92
QUABBIN	90	71	83
QUABOAG	164	122	139
QUINCY	166	184	178
RALPH C MAHAR	107	118	115
RANDOLPH	163	141	150
READING	22	4	3
REVERE	204	198	209
ROCKLAND	192	202	205
ROCKPORT	85	51	66
SALEM	201	168	184
SANDWICH	57	104	73
SAUGUS	183	217	216
SCITUATE	76	172	125
SEEKONK	169	177	177
SHARON	5	15	5
SHREWSBURY	24	36	22
SILVER LAKE	117	69	98
SOMERSET	127	183	164
SOMERVILLE	154	27	95
SOUTH HADLEY	113	165	134
SOUTHBRIDGE	211	199	213
SOUTHERN BERK	69	5	12
SOUTHWICK TOL	181	188	185
SPENCER EAST	171	204	199
SPRINGFIELD	222	116	204
STONEHAM	66	54	56
STOUGHTON	116	101	114
SUTTON	68	11	25
SWAMPSCOTT	52	82	60
SWANSEA	98	152	122
TAUNTON	190	200	203
TEWKSBURY	48	23	27
TRITON	101	134	119
TYNGSBOROUGH	94	58	79
UXBRIDGE	96	53	81
WACHUSETT	51	63	50
WAKEFIELD	89	132	108

Districts	Rank 1	Rank 2	BEAM Rank
WALPOLE	49	17	26
WALTHAM	99	61	88
WARE	109	1	6
WAREHAM	151	189	172
WATERTOWN	82	91	87
WAYLAND	18	99	44
WEBSTER	206	178	200
WELLESLEY	8	73	28
WEST BOYLSTON	161	218	211
WEST BRIDGEWA	155	161	151
WEST SPRINGFI	203	167	188
WESTBOROUGH	31	65	39
WESTFIELD	149	34	96
WESTFORD	9	37	13
WESTON	7	114	40
WESTPORT	209	216	220
WESTWOOD	16	123	54
WEYMOUTH	137	146	136
WHITMAN HANSO	144	182	167
WILMINGTON	93	77	89
WINCHENDON	218	210	219
WINCHESTER	19	90	41
WINTHROP	128	113	124
WOBURN	132	157	143
WORCESTER	213	154	197

Endnotes

1. McDuffy v. Robertson, 615 N.E.2d 516 (Massachusetts 1993).
2. Massachusetts Taxpayers Foundation, *The State Investment in Education: School Finance Reform 1993-1996,* (Boston: June 1996).
3. Eric A. Hanushek, "Assessing the Effects of School Resources on Student Performance: An Update," *Education Evaluation and Policy Analysis*, 19:2 (1997): 141-164.
4. 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.
5. 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 Analysis of Alabama Schools," in *Holding Schools Accountable*, Helen Ladd, ed., (Washington, D.C.: Brookings Institution, 1996), 265-298.
6. Maximum likelihood estimates are obtained using the MAXLIK module of the GAUSS programming language.
7. 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.
8. 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.
9. Eric A. Hanushek, "The Evidence on Class Size", *W. Allen Wallis Institute of Political Economy at the University of Rochester*, Occasional Paper, 98:1 (February 1998).
10. Professor Joseph M. McCarthy provided this section.

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