Research Report

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Assessing Performance

Spending And Learning In Texas Public Schools

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TABLE OF CONTENTS

ABOUT THE TEXAS PUBLIC POLICY FOUNDATION

The Texas Public Policy Foundation is a 501(c)(3) non-profit, non-partisan research institute guided by the core principles of limited government, free enterprise, private property rights and individual responsibility.

The Foundation's mission is to improve Texas government by generating academically sound research and data on state issues, and by recommending the findings to opinion leaders, policy makers, the media and general public. The work of the Foundation is conducted by academics across Texas and the nation, and is funded by hundreds of individuals, foundations and corporations.

EXECUTIVE SUMMARY

Over the last 25 years, Texas public schools have undergone comprehensive reform, and state funding has increased significantly. Scores on the National Assessment of Educational Progress indicate strong gains for Texas elementary students and modest gains for middle school students. To determine what role funding has played in improving student performance and whether resources really matter, the Texas Public Policy Foundation commissioned the Beacon Hill Institute at Suffolk University (BHI) to provide a model for evaluating spending and achievement, and to use this model for evaluating school districts throughout Texas. The model and results of this study can help guide development of effective education policy and efficient funding decisions.

The BHI Educational Assessment Model was designed to answer the following three questions.

1. How is student performance affected by – prior performance demonstrated by the district, teachers' education, teachers' experience, teachers' pay, student-teacher ratio, percentage of student population that is economically-disadvantaged, and percentage of students enrolled in special education?
2. How is student performance affected by funding and allocation of funds?
3. What school districts are most successful in overcoming the likelihood that student performance will be determined by the economic status of the student population and academic variables including past school performance and the percentage of students requiring special education?

The third question is very important because Texas holds public schools accountable for equipping all student groups with the skills necessary for educational success, and closing the achievement gap between students that is associated with low-income, race and ethnicity. This is also a central requirement of the federal No Child Left Behind Act. The BHI model identifies school districts that are closing the achievement gap, adding educational value to compensate for the academic and economic disadvantages and producing higher levels of student performance beyond what the district has accomplished in the past.

BHI's assessment of the performance of Texas public school districts revealed the following.

- Prior performance of school districts was the strongest determinant of passing rates for state assessments, SAT/ACT scores, graduation rates and dropout rates.
- The economic status of the student population was the second strongest determinant of district performance on all outcomes measured.
- Increasing total district expenditure had no effect on passing rates for state assessments or, in some cases, worsened performance.
- Increasing total district expenditure worsened both SAT and ACT scores.

- Increasing district expenditure on instruction as a share of total expenditure generally improved student performance (except for grade 5 mathematics).
- Increasing district expenditure on leadership, teacher salaries and class size reduction generally did not improve student performance (the one exception was for grade 5 mathematics).
- Increasing teacher experience never improved student performance.

INTRODUCTION

Public education has enjoyed a favored status among policymakers for many decades. Popularly characterized as an "investment," rather than an "expense," public schools have been largely exempt from the need to justify increased outlays of state revenue. Today, this favored status seems to be changing as policymakers face declining state revenues, budget shortfalls and hard decisions about rising health care costs.

Like government spending on roads or private sector spending on fast-food franchises, spending on public education is now being asked to justify costs and illustrate benefits. A growing body of research by economists seeks to determine if an additional dollar of education spending is justified by its production of future social returns at least as great as returns that might be produced by the next best alternative use of that dollar.

Similar to other states, Texas has increased its commitment to education while simultaneously imposing performance standards to which local school districts are accountable (a summary of Texas' move toward school accountability is provided in Appendix C at the end of this report). As part of the cost-benefit calculus applicable to education spending, however, it should be asked whether the increased spending associated with education reform is yielding the promised benefits, measured in terms of improved school performance.

There have been numerous attempts to link student performance and expenditures in the research literature. There is no consensus on how much money matters. In a review of the research on this question, Eric A. Hanushek (1997) argues that the weight of published empirical research demonstrates no clear relationship between school expenditures and student performance.[1]

The major cause for disagreement among researchers on this question stems from the fact that most studies look at expenditure levels rather than changes in spending and thereby consider only contemporaneous relationships. Additionally, simply looking at expenditure levels across schools creates a murky picture. The fact that inner-city, low-performing schools are generally given additional funding by states create 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.

An approach that compares expenditure levels with performance cannot conclusively answer the question whether spending improves performance. To answer this question, the Texas Public Policy Foundation commissioned the Beacon Hill Institute (BHI) to develop a value-added method (model) showing how changes in policy variables and other variables "add value" or improve on school performance. Rather than focusing on contemporary relationships, this model focuses on school characteristics (variables) whose changes over time are most likely to explain and predict changes in performance.

MODELING SCHOOL PERFORMANCE

Of the factors considered to affect school performance, there is consensus that economic factors, such as district wealth, and academic factors, such as prior test performance, play a major role.[2] Although schools have no control over the economic characteristics of their students, public schools are now expected to compensate for the educational deficits commonly associated with economic disadvantage and erase the performance gap between different economic groups (central components of the federal No Child Left Behind Act[3] and Texas' school accountability system).[4]

There is also a consensus that learning is a cumulative process, which results in a lag between school policy changes and the observation of the influences of these changes.[5] Thus, the performance of some school districts is consistently better than others because a large percentage of their student population comes from higher income families and school policies have established successful performance over time. These school characteristics have important implications for evaluating school performance and accountability.

The BHI Education Assessment Model provides a method of examining school performance that considers these important influences on education outcomes and evaluates the evidence that schools add value above and beyond what might be expected given the track record of a school district measured by its prior performance and the percentage of economically disadvantaged students.

The model postulates that any change in performance is due to changes in school inputs: education policy decisions, financial investments, and resource allocations. Or change in performance could be attributed to change in the economic or educational composition of the student population.[6] Only school inputs fall under the control of policymakers. Indeed, individual schools (or school districts) are able best to control those variables, such as individual teaching methods and management styles, that fall outside the purview of this or any model.

The model examines school inputs to determine how different investments affect student performance. This examination can provide school administrators with the information needed to make more effective resource allocations to improve student performance and help state policymakers with decisions about educational funding. Using data published by the Texas Education Agency's 2002-03 AEIS report, the model examines the effectiveness of the following inputs on improving performance:

- Total per-pupil expenditure (a number that is a sum of *Operating Expenditure* (including *Instructional Expenditure*, *Leadership Expenditure* and *Administrative Expenditure*) and *Non-Operating Expenditure*,
- Instructional expenditure,
- Leadership expenditure,
- Administration expenditure,

- Teachers' education (with graduate degree),
- Teachers' experience (more than 5 years),
- Teachers' salary (average base salary), and
- Student-to-teacher ratio (class size).

The model also examines the impact of the percentage of economically-disadvantaged students (poor students) and students enrolled in special education on school district performance.

Several measures are used to evaluate school district performance. The model relies on 2003 TAKS scores for English, Mathematics and All Subjects (a category used by the Texas Education Agency to describe combined scores for English, Mathematics plus other subject area assessments) as the basis for determining if school districts performed at or below what could be predicted from assessments of previous years and the economic and educational status of the student population.

SAT scores, ACT scores, graduation rates and dropout rates are additional measures of school district performance. Although some economists do not consider SAT and ACT scores a reliable measure of student performance because scores suffer from selectivity bias (students who choose to take these tests are likely to share characteristics that are different than the total student population) and only reflect the performance of older students, SAT and ACT scores do offer a measure of how well school districts are educating the most highly performing students.

School districts that perform better on all of these measures than the model predicts are districts that add educational value and, it may be presumed, use resources or inputs more effectively.

This report describes the results of the BHI Education Assessment Model analysis. This report also ranks school district performance and identifies the effect of different inputs on student performance (the district ranking is published on the Foundation's website, www.texaspolicy.com, with this report). The analysis identifies highly effective, efficient school districts and some of the inputs that have contributed to their success. The results provide policymakers additional information about the importance of funding, which will be useful as they reform the state system of school finance. The model, itself, provides Texans a new and better way to hold public schools accountable for improving student performance. A detailed description of the statistical construction of the model is provided in Appendix B at the end of this report.

RESULTS: ANALYSIS OF SCHOOL DISTRICT PERFORMANCE

As shown in Table A (page 9), student performance is most strongly affected by previous educational outcomes achieved by the school district. This is noted in the table as *Prior Score*. The better a school district's students did on the 1994 TAAS, the better they did on the 2003 TAKS. A higher *Prior Score* always and substantially predicts a higher score on later assessments.

The finding that school district performance is generally stable over time is unsurprising. High-performing schools generally continue to do well while lower-performing schools generally continue to lag.

Economic status is the second most important influence on student performance in school districts. For the most part, an increase in the percentage of students requiring special education and the percentage of students that are economically disadvantaged (variables 10 *Percent Special Education* and 11 *Percentage Poor* in Table A) are associated with lower student performance. This is true for every grade and subject except grade 5 mathematics (where these variables show no statistical significance – positive or negative). An increase in *Percentage Special Education* results in lower performance for 10^{th} graders but has no statistically significant effect on 5^{th} graders.

The finding that economic and educational status both strongly affect student performance is consonant with the landmark Coleman Report of 1996 and subsequent research showing that family backgrounds exert a strong influence on student achievement.[7] However, research also shows that schools can substantially offset or eliminate educational deficits associated with economic disadvantage.[8] A number of studies show that some Texas schools have been remarkably successful with high populations of economically-disadvantaged students.[9] This finding is not surprising given that the school accountability system is based on the requirement for schools to meet the same passing standards for all student groups.[10]

As for policy variables, increases in *Total Expenditure* show no effect on, or in some cases, result in lower student performance.

However counterintuitive, the findings that overall increased spending have no effect or sometimes lower performance is consistent with both national and international studies that show an increase in funding does not generally lead to an increase in student performance.[11] It is consistent with findings that there are no statistically significant correlations between *Total Expenditure* and TAKS scores for any grade or any subject. (See Appendix A, Table 1 at the end of this report.)

The results change somewhat – and become more intuitively plausible in the process – when *Total Expenditure* is divided into its components. Increases in *Instructional*

Table A. Results of the BHI Education Assessment Model for Texas Based on 2003 TAKS Scores.

	Grade 5			Grade 10		
Parameter	Eng	Math	All	Eng	Math	All
(1) High Prior Score	Improves	Improves	Improves	Improves	Improves	Improves
(2) Total Expenditure	Worsens	NA	Worsens	Worsens	NA	NA
(3) Instructional Expenditure	Improves	NA	Improves	Improves	Improves	Improves
(4) Leadership Expenditure	NA	Improves	NA	NA	NA	NA
(5) Administration Expenditure	Worsens	Worsens	Worsens	NA	Worsens	Worsens
(6) Teachers' Education	NA	NA	NA	NA	NA	NA
(7) Teachers' Experience	NA	NA	NA	NA	NA	NA
(8) Teachers' Salary	NA	Improves	Improves	NA	NA	NA
(9) Student-to-Teacher Ratio	NA	Worsens	NA	NA	NA	NA
(10) Percentage Special Education	NA	NA	NA	Worsens	Worsens	Worsens
(11) Percentage Poor	Worsens	NA	Worsens	Worsens	Worsens	Worsens

This table shows identified statistical relationships between the factors listed on the left and performance on TAKS exams listed across the top. "Worsens" indicates an increase in the value of the associated factor results in reduced performance on the relevant test. "Improves" indicates an increase in the value of the associated factor results in increased performance on the relevant test. "NA" indicates no discernible relationship between the associated factor and performance on the relevant test.

Expenditure improve performance in all categories except grade 5 Math. Further, grade 5 Math represents the only instance in which increases in *Leadership Expenditure* improve performance. Otherwise, increases in *Leadership Expenditure* or *Administration Expenditure* either have no effect on, or result in lower student performance.

The findings regarding *Instructional Expenditure* or the portion of district spending devoted to instruction is consonant with state and national research.[12] Likewise, the findings regarding higher spending on school administration associated with lower student achievement is consonant with the research.[13]

Interestingly, increases in *Teachers' Salary* are shown to improve performance in only two categories: grade 5 Math and grade 5 All Subjects. Increases in *Teachers' Education* or *Teachers' Experience*, however, are shown to never affect student performance.

The finding that increasing teacher salary, teacher education, and teacher experience generally does not improve student achievement is consistent with the review of research conducted by Dr. Eric Hanushek in the landmark study *The Failure of Input-based Schooling Policies*, which finds no clear relationship between school expenditure and student performance.[14]

Increases in *Student-to-Teacher Ratio* (a proxy for increase in class size) are shown to result in lower student performance only for grade 5 Math. The failure of class size reduction to improve performance for any students but those in early grades has been repeatedly demonstrated by national and international research,[15] as well as through prior research by the principal author of this study.[16]

Other Results

The BHI model further evaluates school districts on four additional measures of performance: SAT scores, ACT scores, graduation rates and dropout rates. For SAT and ACT scores, higher *Prior Score* improves performance and increases in *Percentage Special Education* and *Percentage Poor* consistently worsen student performance. Increases in *Total Expenditure* worsen performance for both SAT and ACT scores. For graduation and dropout rates, the only clear relationship is a positive one between *Prior Score* and performance.

The finding that performance on tests of college readiness falls as total expenditure rises is unsurprising and consistent with the research correlating spending with performance.

Observations

The following are several relevant observations on the BHI model's findings. Since the model is a value-added model, these observations include some discussion of the statistics of school spending in terms of proportional changes between 1994 and 2003.

Increasing School District Expenditures:
As shown in Appendix A, Table 2 at the end of this report, as 2003 *Total Expenditure* increases, there is a rise in its components (See the rows for *Operating Expenditure* down through *NonOperating Expenditure*), except for *Teachers' Salary*, which seems stable at around $37,000. Further, in the 4th quartile segment, there is less than the proportionate increase between segments in *Instructional Expenditure* as compared to *Total Expenditure* and more than the proportionate increase in *Administration Expenditure*, also as compared to *Total Expenditure*. Also, higher *Total Expenditure* seems to be dictated by the proportion of students who are in special education or students who are poor, as evidenced by the parallel tracking of the *Percentage of Special Ed* increases to the *Total Expenditure* increases. Finally, a large chunk of expenditures – about 28% – is devoted to *Other Expenditure*.

In Appendix A, Table 3 at the end of this report, means for the proportional change from 1994 – 2003 for each variable are reported in quartile segments established on the basis of *Total Expenditure*. It is worth pointing out that although *Total Expenditure* increased by an average of 46% (as noted in the last column labeled 'All'), general price levels rose by only 26%, as measured by the Dallas CPI. Thus, there has been a substantial rise in "real-dollar" spending in Texas public schools.

Relationships between Types of Expenditures:
There is considerable disparity in the rise in spending, from one quartile to another. As shown in Appendix A, Table 3 at the end of this report, *Total Expenditure* rose by only 17% in the lowest quartile (S1) but by 79% in the highest quartile (S4). Overall, the *Instructional Expenditure* component increased by only 42%, perhaps brought down by the less than proportionate increase (66%) of this variable in the 4th quartile segment (S4).

There has been an approximate 38% increase in *Teachers' Salary* at all quartile levels and a varying decrease in the *Student-to-Teacher Ratio* across quartiles. The highest overall proportionate increase is that of 66% shown in *Other Expenditure*. The cross-quartile increase in *Total Expenditure* does not seem to have translated into an increase in *Teachers' Education* (-23%) or *Teachers' Experience* (0%). In general there has been an increase in the proportion of students who are in the special education and economically disadvantaged categories.

Relationship between Spending and Student Performance:
Appendix A, Table 4 reports the regression analysis of all the variables against TAKS scores. The principal finding is that increases in *Total Expenditure* do not improve performance. What is more surprising, however, is the negative and significant relationship that exists between *Total Expenditure* and performance in four of the six tests, including both tests for English. Increases in *Total Expenditure* do not seem to be a good investment for Texas public schools. However, there appear to be components of this aggregated *Total Expenditure* that might justify higher spending.

Assessment scores rise with increases in *Instructional Expenditure*, except for mathematics. And, while *Total Expenditure* does not influence performance in mathematics, increases in both *Teachers' Salary* and in *Student-to-Teacher Ratio* do show improvement in performance for grade 5 Math. Targeted increases in these specific expenditure areas could serve to improve performance.

Impact of Special Education and School District Performance:
As shown in Appendix A, Table 4, the impact of the *Percentage Special Education* is significant and negative. While this variable is insignificant in grade 5, it is highly significant and negative for all subject levels in grade 10. It seems that learning disabilities become an obstacle to school performance as students mature. These documented effects are independent of the level of resources being devoted to students with learning disabilities. A higher percentage of economically disadvantaged students is causing low performance in grade 5 and grade 10, shown through the *Percentage Poor* variable in Appendix A, Table 4.

Importance of Resource Allocation:
Combining the findings shown in Tables 2, 3, and 4 of Appendix A, it appears that a more efficient management of resources is possible. Based on this study, student performance can be increased by implementation of the following measures.

- Shifting resources toward *Instructional Expenditure,* except for grade 5 math, for which higher salaries and smaller classes might be more effective.

- Shifting resources away from *Administrative Expenditure.* Expenditures on school operation and management as measured by *Leadership Expenditure* is positive and significant for 5th graders but has no statistically significant influence in grade 10. *Administration Expenditure* is negative and significant across the board. This variable reflects administrative expenses, and is not directly related to learning. It suggests that the allocation of per-pupil expenditures to such expenditure does more harm than good.[17]

Checking Statistical Reliability:
The robustness of this analysis was tested and is reported in Appendix A, Table 5 at the end of this report. Average 1995 TAAS and 2003 TAKS were divided into four equal quartile segments, and the average prior and actual current scores for each of the four segments are reported in percentage terms.

Expected TAKS scores are estimated using the regression results reported in Appendix A, Table 4 for all subjects. In comparing these expected scores to the prior actual scores, two points are worth mentioning. First, school districts that performed poorly in 1994 continue to do so in 2003. For instance, for 5th graders, the mean TAAS scores (labeled 'Prior' in Appendix A, Table 5) for the 1st and 4th quartile segments are 39.96% and 80.86%. When these school districts are tracked over time, their corresponding mean TAKS scores (labeled 'Current' in Table 5) are 57.93% and 73.67%, respectively, showing consistent relative performance. Second, for each quartile segment the scores predicted by our model are remarkably close to the actual scores. For instance, the expected scores for the 1st and 4th quartiles for grade 5 are 58.21% and 73.57%, very close to the actual "current" results, 57.93% and 73.67%.

Impact of Spending and District Characteristics on Post-Secondary Readiness:
As Appendix A, Table 6 at the end of this report illustrates, the effect of resources on SAT and ACT scores are qualitatively similar to those effects shown for TAKS in Appendix A, Table 4. Although *Total Expenditure* has a negative influence on SAT and ACT scores, one of its components, *Instructional Expenditure,* has a positive influence. *Teachers' Education, Teachers' Salary* and *Teachers' Experience* show no significant effect on SAT and ACT scores. Decreases in *Student-to-Teacher Ratio* do not contribute to improved student performance. Increases in the proportion of students who are in special education (labeled *Percentage Special Education*) and who are poor (*Percentage Poor*) continue to be correlated with overall lower student performance in the district.

Best Predictor for Graduation and Dropout:
The analysis of graduation and dropout rates presented in Appendix A, Table 7 at the end of this report illustrate that the only significant predictor of higher student outcomes is *Prior Score*. It should be noted that the authors did not have the data on graduation rates for 1993-1994, and therefore use (1 - dropout rate) for *Prior Score*. The general lack of predictability may be spurious because of the way the graduation and dropout rates are calculated.

SCHOOL DISTRICT RANKINGS

The Texas accountability system depends mainly on raw test scores and dropout ratings (in previous years, attendance was also used as a standard for performance). But raw performance measures do not give a complete picture of how well school districts have performed. School districts with low scores on state assessments may, in fact, be making dramatic gains in student performance that are not evident when one simply looks at raw scores. What is needed to complete the picture of school district performance is information about how well school districts succeed in overcoming the effect of economic disadvantage on student performance (the “achievement gap”) and the district’s historical performance (“business as usual”).

The BHI model provides a more comprehensive measure of performance – evaluating schools on the basis of how much additional educational value is added annually. The model can be used to identify school districts with low raw scores on state assessments that are actually making significant performance gains as well as districts with high raw scores that are making small or no gains.

The model can be used to identify school districts that raise student performance above the level that they could be expected to reach if the economic status of the student population remained constant and school performance gains or losses remained stable. From these high performing schools, educators and policymakers can learn effective approaches to teaching, administration and resource allocation.

School districts were ranked in three different ways. First, districts were ranked according to raw scores (for comparison purposes only). Second, districts were ranked according to each district’s ability to out-perform its own standard for performance, calculated on the basis of the difference between actual and predicted scores (also for comparison purposes only). Third, the recommended approach to evaluating districts is a ranking of districts that is constructed on the basis of an equal weighted average of the (a) normalized raw scores of a school district, and (b) difference between the actual and the predicted score.

The predicted values for individual districts are easily constructed from the model using the known prior scores and the changes in the policy and economic variables. Districts that perform substantially better (or worse) than predicted by the model are worth studying for the good (or bad) example they provide. A high rank order is awarded when the district scores well on the test and also does better than what the model predicts.

The results of ranking Texas school districts are dramatic and described below. **A full report and listing of the rankings of all Texas school districts is available on the Foundation’s website (www.texaspolicy.com).**

When passing rates on TAKS for grade 5 are examined:

- Walcott ISD heads the list, coming out first on all counts – best for performance on TAKS and for the extent to which it outperforms the model.

- New Home ISD, on the other hand, has the second highest rank even though its raw performance on TAKS would have placed it at 31.
- Rankin ISD scores well on our ranking scheme in spite of a very low TAKS score because of the boost coming from a favorable better than expected performance.
- On the other hand, Cisco ISD's final rank is much lower as compared to what it would have been according to only its TAKS performance.

When passing rates for grade 10 TAKS are examined :

- Patton Springs ISD comes out top. This school district not only did well on TAKS, it also got a boost for performing much better than what the model predicted. It thus gets the highest ranking.
- Knippa ISD, on the other hand, did as well as Patton Springs on TAKS, but did not get as many points for outperforming the model and so is ranked third.
- Similarly, Era ISD and Comstock ISD are ranked at 583 and 551 respectively although their raw TAKS performance would have put them at a substantially higher rank.

When school districts are ranked according to student performance on the SAT:

- Perryton ISD comes out top, but more on account of its TAKS score, since its rank with respect to performing better than the model is two (2).
- Ranger ISD is interesting because, although ranked at 60 for its raw performance, it is awarded a final rank of 13 due to its success in outperforming the model's predictions. Rankings based on ACT scores have similar interesting findings.
- Although Highland Park ISD beats all other districts in its current ACT performance, owing to a very low increment for performing only somewhat better than the model's predictions, its overall rank in our model is only seven (7).

The rankings offer a strong argument against assessing the performance of school districts solely on the basis of raw scores on standardized tests. In many instances, school districts with low raw state assessment scores are ranked very high by the model by outperforming the standard and school districts with very high assessment scores are ranked very low by the model.

CONCLUSIONS AND QUESTIONS

Use of the BHI model to examine public school districts in Texas shows conclusively that increases in per-pupil education spending do nothing to improve student performance but that existing resources could be used more effectively to improve results.

With one small exception, student performance would improve if funds were reallocated away from non-instructional expenditures toward student instruction (with the exception of grade 5 math). There are only a few instances in which an increase in resources might improve student performance – teachers' salaries for grade 5 and class size for grade 5 mathematics.

The burning question that emerges from this analysis is, "Why do increases in total per-pupil expenditure have no effect on, *or sometimes worsen*, performance, while increases in per-pupil expenditure on instruction generally improve performance?"

This question is paradoxical, insofar as instructional expenditure represents only about half (50%) of total district spending. Policymakers cannot infer from this evidence that just any increase in instructional expenditure would improve performance. Increasing the average salary or demanding more experience on the part of teachers will not do the job. Nor, for the most part, will reducing class size. So the answer must lie elsewhere, perhaps, in more generously rewarding qualified teachers who are in short supply or who demonstrate success in the classroom. Further study is needed.

The findings suggest that Texas school districts could improve student performance by reordering educational and financial priorities. Instructional expenditure has increased by only 42% since 1994, while operating expenditure in total has increased by 49%. It would appear advisable, at a minimum, to shift a greater portion of *Operating Expenditure* toward instruction and away from "leadership" and "administration."

The findings also suggest that the pursuit of educational excellence would benefit from greater attention to the schools which, despite unfavorable economic conditions, appear to do well. Schools that are closing the achievement gap, adding educational value to compensate for disadvantages of economic and educational status and producing higher levels of student performance beyond what the district has accomplished in the past are the districts that are most successful in meeting the state's twin goals of equity and excellence. These schools are employing teaching, administrative and financial methods that permit them to overcome obstacles. These schools can be used as models for systemic reform of public education in Texas.

In the end, however, this study suggests that insofar as Texas schools have been improving, the reason lies not in increased spending but in the rising and stronger standards to which Texas schools are held accountable. If Texas schools are going to continue to improve, policymakers will have to delve far more deeply into the question of what kind of spending matters and to strengthen school accountability.

APPENDIX A
TABLES

Table 1: Correlation Between Changes in TAKS Scores and Expenditure (1993-2003).

Grade Level	Subject	Pearson Correlation (Test-Statistic)	Spearman Correlation (Test-Statistic)
Grade 5	English	-0.038 (-1.194)	-0.021 (-0.666)
	Mathematics	-0.008 (-0.242)	-0.012 (-0.384)
	Total	-0.021 (-0.674)	-0.008 (-0.259)
Grade 10	English	-0.024 (-0.742)	-0.032 (-0.972)
	Mathematics	-0.040 (-1.221)	-0.022 (-0.675)
	Total	-0.026 (-0.812)	0.029 (0.899)

- Critical values for both test statistics at 5% level of significance are ±1.96.

Table 2. Overall and Quartile Segments Means in 2003.

Variable	S1	S2	S3	S4	All
Total Expenditure	6358.60	7073.73	7778.90	10839.50	8044.01
Operating Expenditure	5864.49	6416.39	7126.15	9880.22	7340.65
Instructional Expenditure	3369.10	3631.73	4025.14	5217.53	4072.82
Leadership Expenditure	342.26	377.04	413.99	561.33	425.16
Administration Expenditure	309.53	357.09	494.89	1042.75	553.96
Other Expenditure	1846.39	2054.50	2201.40	3042.58	2288.70
NonOperating Expenditure	494.11	657.34	652.75	959.28	703.35
Teachers' Education	18.86	17.20	16.76	16.13	17.22
Teachers' Experience	30.68	33.49	31.83	29.71	31.40
Teachers' Salary	36920.52	37169.88	36839.17	36990.51	36987.18
Student-teacher ratio	14.12	13.51	12.30	10.03	12.48
Percentage Special Ed	13.35	13.27	13.95	15.24	13.94
Percentage Poor	47.03	48.97	50.37	53.81	50.08

- Data for 2003 are ordered by the Total (Per-Pupil) Expenditure variable and split up into four equal quartile segments. Means for each variable are reported for each quartile segment, S_i as defined according to Total Expenditure. Consequently, we can relate the movements of other variables in relation to Per-Pupil Expenditure. The implications include: a decrease in Student-to-Teacher ratio with an increase in Per-Pupil Expenditure; an increase in NonOperating Expenditure with an increase in Per-Pupil Expenditure; an increase in Administration Expenditure with an increase in Per-Pupil Expenditure; and so on.

Table 3. Overall and Quartile Segments Means for the Proportion Change in 1994-2003.

Variable	S1	S2	S3	S4	All
Total Expenditure	0.17	0.38	0.50	0.79	0.46
Operating Expenditure	0.27	0.43	0.51	0.77	0.49
Instructional Expenditure	0.21	0.37	0.44	0.66	0.42
Leadership Expenditure	0.43	0.54	0.61	0.70	0.57
Administration Expenditure	0.10	0.17	0.25	0.40	0.23
Other Expenditure	0.47	0.61	0.73	0.85	0.66
NonOperating Expenditure	3.97	0.21	1.04	3.29	2.13
Teachers' Education	-0.22	-0.24	-0.20	-0.25	-0.23
Teachers' Experience	-0.02	-0.01	0.01	0.03	0.00
Teachers' Salary	0.37	0.38	0.38	0.39	0.38
Student-teacher Ratio	0.03	-0.07	-0.08	-0.14	-0.06
Percentage Special Ed	0.08	0.10	0.12	0.12	0.11
Percentage Poor	0.11	0.14	0.16	0.17	0.15

- Data for the proportion change between 1994 and 2003 are ordered by the Per-Pupil Expenditure variable and split up into four equal quartile segments. Since data have been ordered according to Per-Pupil Expenditure, we can relate the movements of other variables in relation to Per-Pupil Expenditure. Means for the above variables are calculated for all observations and for each of the four segments, S_j.

Table 4. Regression Analysis of TAKS Scores.

	Grade 5			Grade 10		
Parameter	Eng	Math	All	Eng	Math	All
Constant	-0.31 (-1.58)	0.13 (0.58)	-0.57** (-4.05)	-0.09 (-0.33)	0.06 (0.36)	-0.73** (-5.20)
Prior Score	2.07** (11.40)	1.87** (9.26)	1.69** (11.82)	1.32** (5.25)	1.59** (9.34)	1.46** (9.84)
Total Expenditure	-0.35** (-3.15)	-0.03 (-0.20)	-0.33** (-2.81)	-0.36** (-2.52)	-0.21 (-1.15)	-0.25* (-1.79)
Instructional Expenditure	0.44** (2.92)	-0.03 (-0.14)	0.44** (2.76)	0.62** (3.46)	0.37* (1.67)	0.47** (3.21)
Leadership Expenditure	0.12 (1.48)	0.30** (2.26)	0.11 (1.28)	-0.02 (-0.24)	-0.05 (-0.51)	-0.04 (-0.45)
Administration Expenditure	-0.15** (-2.21)	-0.22** (-2.20)	-0.14* (-1.94)	-0.12 (-1.54)	-0.17** (-2.14)	-0.15** (-2.32)
Teachers' Education	-0.04 (-0.62)	0.05 (0.51)	-0.00 (-0.02)	-0.06 (-0.80)	-0.02 (-0.25)	-0.02 (-0.35)
Teachers' Experience	-0.02 (-0.29)	0.06 (0.69)	0.05 (0.83)	0.04 (0.52)	0.01 (0.18)	0.03 (0.42)
Teachers' Salary	0.09 (0.27)	1.06** (2.72)	0.49** (1.97)	0.06 (0.15)	0.18 (0.51)	0.10 (0.37)
Student-Teacher ratio	-0.11 (-0.41)	-0.77** (-2.19)	-0.02 (-0.09)	-0.10 (-0.34)	-0.21 (-0.66)	-0.24 (-0.97)
Percentage Special Education	0.08 (1.01)	-0.06 (-0.51)	0.00 (0.06)	-0.16* (-1.91)	-0.19** (-2.19)	-0.20** (-2.82)
Percentage Poor	-0.22** (-2.41)	-0.08 (-0.74)	-0.23** (-2.85)	-0.33** (-3.63)	-0.34** (-3.49)	-0.33** (-3.87)

- Coefficient estimates with t-statistics in parentheses; * and ** denote significance at 10% and 5% level respectively. Quasi-maximum likelihood regression is run on fractional data on the performance data on TAKS scores.

Table 5. Actual and Expected 2003 TAKS Scores with Respect to Prior 1994 TAAS Scores.

	Grade 5			Grade 10		
Segment	Prior	Current	Expected	Lagged	Current	Expected
S1	39.96%	57.93%	58.21%	37.40%	44.96%	45.80%
S2	54.75%	63.62%	64.15%	52.30%	50.99%	51.22%
S3	65.43%	68.52%	68.19%	61.97%	55.79%	54.73%
S4	80.86%	73.67%	73.57%	76.32%	59.78%	59.85%

- Data for prior (1994) and current (2003) scores are ordered by the prior score variable and split up into four equal quartile segments. Means for prior and actual current scores are calculated for each of the four segments, S_j. Expected scores are calculated using the regression results in Table 4 for all subjects and evaluated at the various quartile means of the prior score variable, along with the overall means of all other variables. All scores are reported in terms of percentage pass rate.

Table 6. Analysis of SAT and ACT Scores.

Parameter	SAT Exam	ACT Exam
Constant	499.14** (13.61)	7.75** (9.23)
Prior Score	0.57** (14.74)	0.62** (15.68)
Total Expenditure	-43.93** (-2.95)	-1.28** (-3.83)
Instructional Expenditure	54.49** (2.73)	1.80** (4.02)
Leadership Expenditure	19.60* (1.78)	0.07 (0.27)
Administration Expenditure	-6.04 (-0.67)	-0.28 (-1.37)
Teachers' Education	-3.75 (-0.40)	-0.12 (-0.58)
Teachers' Experience	0.42 (0.05)	-0.08 (-0.38)
Teachers' Salary	-62.47 (-1.57)	-0.69 (-0.78)
Student-Teacher Ratio	0.42 (0.01)	-0.15 (-0.20)
Percentage Special Education	-25.69** (-2.52)	-0.81** (-3.57)
Percentage Poor	-20.69** (-2.03)	-0.44* (-1.93)

- Coefficient estimates with t-statistics in parentheses; * and ** denote significance at 10% and 5% level respectively. A linear regression of SAT and ACT scores is run on the above variables.

Table 7. Analysis of Graduation and Dropout Rates.

Parameter	Graduation Rate	Dropout Rate
Constant	-13.32** (-8.40)	-5.06** (-16.00)
Prior Score	15.54** (9.76)	19.23** (8.19)
Total Expenditure	0.08 (0.20)	0.16 (0.74)
Instructional Expenditure	-0.17 (-0.32)	-0.24 (-0.85)
Leadership Expenditure	-0.17* (-1.81)	0.12 (0.69)
Administration Expenditure	0.13 (1.29)	0.11 (0.76)
Teachers' Education	0.04 (0.46)	0.14 (1.32)
Teachers' Experience	-0.12 (-1.36)	-0.05 (-0.48)
Teachers' Salary	0.67 (0.84)	-1.39* (-1.74)
Student-teacher ratio	-0.12 (-0.26)	0.69 (1.11)
Percentage Special Education	-0.09 (-0.96)	0.03 (0.25)
Percentage Poor	-0.05 (-0.38)	-0.18 (-0.84)

- Coefficient estimates with t-statistics in parentheses; * and ** denote significance at 10% and 5% level respectively. Quasi-maximum likelihood regression is run on fractional data on the graduation and dropout rates.

APPENDIX B
STATISTICAL CONSTRUCTION OF THE BEACON HILL MODEL

The performance on a standardized test in a given school district is a complex product of a number of factors. A crucial factor in the equation is the educational and economic environment in which the school operates. Since this environment is unlikely to exhibit marked variations across years in a short span of time, prior performance is a strong predictor of current performance. Changes in the academic and economic character due to the choice of school policy or the change in the economic mix of the district will also influence current performance.

Consider a model that relates current performance of a school district *i* (P_{iT}) at time period *T* to the current and past values of school inputs (S_{iT}) and other economic factors (F_{iT}),[23]

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

$i = 1, 2, \ldots, N$ represents the *N* school districts into which the state is divided, and the αs and the *ß*s 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. Thus, a model that studies student performance must take into account, at the very least, all of these factors.

Dependent Variables

The Texas Academic Excellence Indicator System (AEIS) publishes annual comprehensive data reports on various aspects of school education. The system reported test scores under the aegis of the Texas Assessment of Academic Skills (TAAS) program from 1990 to 2002. This program was succeeded in 2003 by the Texas Assessment of Knowledge and Skills (TAKS) program.

These reports are produced by the Performance Reporting Division of the Texas Education Agency (TEA). The Division also provides extensive information on staff, finances, programs, and demographics for each school and district. The TEA uses information provided under the AEIS to develop and implement the accountability system for Texas public schools and school districts.

A large portion of our data is obtained from AEIS reports. We investigate the performance of school students in Texas on the basis of following three measures of student performance.

1) TAKS scores: TAKS scores for the academic year 2002-03, for school districts, for grade 5 and grade 10, and for English Language, Mathematics, and All Subjects. These can be interpreted as the ”proportion of students who passed the TAKS standard of 2 SEM [Standard Error Measurements] below panel recommendation for the given school district for the given year and subject.”[24]

2) SAT/ACT scores (2003): Scholastic Assessment Test and American College Testing Assessment Test scores for the academic year 2002-03 for the school district.

3) Graduation Rate and Dropout Rate (2003) – The Performance Reporting Division of the TEA began calculating longitudinal graduation rates for a given school district, using a new method, beginning year 2002-03. The “percent graduated” number is obtained by dividing the number of students who received their high-school diploma by end of the year 2002-03 by the number of students in the 1997-98 cohort. Similarly dropout rate considers the number of students who dropped out during the school year divided by the number of students who were in membership during the school year. Since this method uses a cumulative count of students both in the numerator and denominator, it provides a more reliable measure, especially for schools that have high mobility of students.

It is worth noting that two of the above measures of student performance, namely, TAKS scores and graduation rates, are fractional response variables in that they are bounded in the [0,1] interval. Consider a standard linear regression model formulated in terms of the dependent variable y, and k independent variables (x_j), explained below, as:

(3) $$E(y_i \mid x_i) = \beta_0 + x_{1i}\beta_1 + x_{2i}\beta_2 + \ldots + x_{ki}\beta_k = x_i\beta$$

The above model not only ignores the special feature of the fractional data which leads to inefficiency, the predicted values based on the above model can never be guaranteed to lie in the unit interval. A common alternative to make the dependent variable lie strictly between 0 and 1 is to use the following log-odds ratio:

(4) $$E(\log[y_i/(1-y_i)] \mid x_i) = x_i\beta$$

However, there are two problems with equation (4). This log-odds ratio cannot be defined if the actual y value is 0 or 1 and more importantly, we cannot recover $E(y_i \mid x_i)$ without further assumptions. In this study we use the following logit formulation for a quasi-likelihood estimation of the fractional response model:

(5) $$E(y_i \mid x_i) = G(x_i\beta) = \frac{\exp(x_i\beta)}{1+\exp(x_i\beta)}$$

The estimates are obtained by maximizing the following quasi-likelihood function using the MAXLIK module of the GAUSS programming language.

$$(6) \qquad £ = \sum_{i=1}^{N} y_i \log(G[x_i \beta] + (1 - y_i)\log[1 - G(x_i \beta)]$$

A consistent estimate of the variance-covariance matrix of the parameters is derived as: $\hat{H}^{-1}(\hat{G}^T \hat{G})\hat{H}^{-1}$

where $\hat{H}$ and $\hat{G}$ denote the hessian and the gradient evaluated at the maximum likelihood estimates of the parameters, respectively.[25]

The predicted values used later to derive district rankings are easily obtained as:

$$(7) \qquad \hat{y}_i = \frac{\exp(x_i \hat{\beta})}{1 + \exp(x_i \hat{\beta})}$$

Independent Variables

The model analyzes the above measures of school performance (based on TAKS, SAT scores, ACT scores, graduation rates and dropout rates) as a function of prior performance, changes in the school policy inputs and changes in the socioeconomic character of the district. School policy inputs include the total per-pupil expenditure; and its various components consisting of (a) instruction, (b) leadership, and (c) administration; teachers' education, experience and salary; and student-to-teacher ratio. It is noteworthy that, although the above variables may be correlated contemporaneously, there is no concern of serious multicollinearity in the model since the variables are defined in percentage change terms. The economic factors that we consider are the percentage of students who (a) fall in the special education category, and (b) are economically disadvantaged. A brief thought given to each of these factors gives a fair idea of how it might have an impact on student performance.

It is worth noting that *Total Per-Pupil Expenditure* is divided into *Operating Expenditure* and *NonOperating Expenditure*. *Operating Expenditure* is further divided into (a) *Instructional Expenditure* (including expenditure on instructional leadership*)*, (b) *Leadership Expenditure*, (d) *Administration Expenditure* and (e) *Other Operating Expenditure*. *Other Operating Expenditure* includes media and library materials, counseling, promotion of attendance, and health services. It also includes physical plant maintenance and operation and pupil transportation, food services, and co-curricular activities. For data purposes, the instruction and instructional administration expenses are combined into one variable. *NonOperating Expenditure* includes debt service, capital outlays and community services.

Regarding the specification of independent variables, the model categorizes all our explanatory variables, other than *Prior Score*, as proportionate change from 1994 to 2003. For example, the proportion change in teachers' salary variable is measured as ($Salary_{2003}$ – $Salary_{1994}$)/$Salary_{1994}$.

1. *Prior Score*: This variable consists of TAAS scores for the academic year 1993-1994 for the school district, for grades 5 and 10, for Reading, Math, and for all subjects. These can be interpreted as "percent students who passed the TAAS for the given school district for the given year and subject."[26] Similarly, we use SAT and ACT scores for 1993-1994 for analyzing the current SAT and ACT scores. Since we do not have data on graduation rates for 1993-1994, we use (1 - dropout rate) for the period as prior score.
2. *Total Expenditure*: This variable measures the total per-pupil expenditure, defined as Operating Expenditure plus NonOperating Expenditure. Operating Expenditure consists of *Instructional Expenditure* plus *Leadership Expenditure* plus *Administration Expenditure*.
3. *Instructional Expenditure*: This variable includes per-pupil expenditures on instruction and instructional administration. Instruction contains budgeted expenditure for activities directly related to instruction of pupils, including instruction using computers and instructional administration includes budgeted expenditures for the management and improvement of the quality of instruction and the curriculum. This variable is justified if a higher expenditure leads to a better performance.
4. *Leadership Expenditure*: This includes budgeted per-pupil expenditures for the operation and management of a school. As before, this variable is justified if a higher expenditure leads to a better performance.
5. *Administration Expenditure*: This variable measures the central administration per-pupil expenditure, which includes the general administration activities of the district, the development of personnel and curriculum, and data processing services. As before, this variable is justified if a higher expenditure leads to a better performance.
6. *Teachers' Education*: This measures the percentage of teachers in a school district with a graduate degree.
7. *Teachers' Experience:* This variable is defined as the proportion change in the percent of teachers in a school district who have more than 5 years of teaching experience.
8. *Teachers' Salary*: This is the dollar measure of the average base salary of teachers in a school district. The impact this would have on performance would essentially follow the same argument as that of expenditure.
9. *Student-to-Teacher Ratio*: This is calculated by dividing total student enrollment by the regular education instructional staff. This variable is used as a proxy measure of class size.[27]
10. *Percentage Special Education*: This is defined as the percentage change in total number of special education students as a percent of total number of students in a district
11. *Percentage Poor*: This variable measures the percentage change in economically disadvantaged students and serves as a measure of poverty in a school district.

APPENDIX C
HISTORY OF THE TEXAS PUBLIC EDUCATION SYSTEM

This study of the Texas school education system concerns itself with the main objective of examining the relationship between current student test scores and factors that might have an impact on these scores. It is helpful to acquaint ourselves, in brief, with the history of the education system in Texas. This will enhance our understanding of why and how the testing methods have been changing through the years.

The first public school law in Texas was enacted in 1840 and provided for surveying and setting aside four leagues (17,712 acres) of land in each county to support public schools. Later, the state constitution of 1845 provided that one-tenth of the annual state tax revenue be set aside as a perpetual fund to support free public schools. A new school law set aside as a permanent school fund $2 million of the $10 million in 5% U.S. Indemnity bonds received in settlement of Texas' boundary claims against the United States. A system of accreditation was created in 1885 when high schools sent selected test papers for examination by the faculty of the University of Texas. If the test papers were found satisfactory, the school became affiliated with the university and its graduates were admitted without examination.

By 1900 there were 526 such districts in which the high school replaced the earlier academy. Today, there are some 1,100 independent school districts in Texas. In 1911, a rural high school law was passed which established county boards of education and permitted creation of rural high schools and the consolidation of common school districts. This effort to make common or rural schools equal with those in the independent or urban districts took another step forward with passage of a law in 1917 authorizing state purchase of textbooks. Expansion of rural aid to schools, including state support for teacher salaries, gradually helped improve the education provided to children on the state's farms and ranches.

The drive for improved public education gained further momentum in 1949 with passage of the Gilmer-Aikin laws, which created the Foundation School Program to apportion state funds to local school districts. The new legislation also reorganized the administration of public education, created an elected State Board of Education that appointed a commissioner of education, and reorganized the administration of state public school policy through the Texas Education Agency. In 1984, the Texas Legislature passed what is commonly known as House Bill 72, enacting sweeping reforms of the public school system. House Bill 72 provided a pay raise for teachers, revamped the system of public school finance to funnel more money to property-poor school districts, and took many other steps aimed at improving the academic achievement of students.

Texas has an interesting time-line with respect to the tests it has administered in schools. Each time, the change in the test administered was with the objective of making the testing standard more rigorous than the previous one.

1. Texas Assessment of Basic Skills (TABS) Test:

   In 1979, the legislature passed a bill requiring basic skills competencies in math, reading and writing for grades 3, 5 and 9. Since there was no state-mandated curriculum at that time, the learning objectives for TABS were created by the committee of Texas educators. In 1983, the Texas Legislature began requiring retesting. Ninth grade students who did not pass the test were required to retake the exam each year thereafter while in school. Since results were reported, the TABS test was the beginning of "high stakes" accountability for school districts.

2. Texas Educational Assessment of Minimum Skills (TEAMS) Test:

   In 1984, the legislation changed the wording of the Texas Education Code, requiring the assessment program to measure "minimum skills" rather than "basic skills competencies." The TEAMS test began in the 1985-86 school year, replacing the TABS. It sought to increase the rigor of the state assessment and added individual student sanctions for performance at the exit level. TEAMS tested mathematics, reading and writing, and were administered to students in grades 1, 3, 5, 7, 9 and 11, with the 11th grade testing being the "exit level" assessment. The class of 1987 became the first class in which students were required to pass the exit level exam in order to receive a diploma.

3. Texas Assessment of Academic Skills (TAAS) Test:

   Changes in state law required the implementation of a new criterion-referenced program in 1990. The TAAS test shifted the focus from minimum skills to academic skills, which represented a more comprehensive assessment of the state-mandated curriculum, the Essential Elements. TAAS assessed higher-order thinking skills and problem-solving in math, reading and writing for grades 3, 5, 7, 9 and 11 exit level. The board considered the following factors when establishing the levels of satisfactory performance. First, the TAAS assessed a broader range of the Essential Elements than TEAMS. Second, in comparison to TEAMS, the TAAS test items were more difficult. Third, the TAAS served multiple purposes by providing scores and consequences at the student level, school level, and the district level. Due to these factors, the board set a one-year interim standard for satisfactory performance.

   In 1992-93, the TAAS transitioned from a fall to a spring testing program, and in 1993-94, assessment was expanded to include grades 3-8 in reading and math. The writing test was moved to grades 4 and 8, and the exit level test was moved from grade 11 to 10. In 1993, the legislature enacted the creation of a new statewide, integrated accountability system that includes the rating of campuses and districts. The inclusion of TAAS in the accountability system, the public release of performance results, and the exit-level requirement for graduation makes TAAS the most "high-stakes" assessment in Texas history. In 1994, the board voted to align the passing standards at grades 3-8, with the standard being established at the exit level. This new standard, the TLI (Texas Learning Index) allowed comparisons of achievement across grades while maintaining the same passing standards for exit level students. The TLI helped districts determine whether each student was making the yearly progress necessary to maintain minimum expectations on the exit level reading and math test in grade 10. In 1995, science and social studies were added to the eighth grade TAAS test.

4. Texas Assessment of Knowledge and Skills (TAKS) Test:
   The development of the TAKS test began in 1999. The legislature passed bills ending social promotions and creating a more rigorous testing program. As mandated by the 76th Texas Legislature, the Texas Education Agency (TEA) began to develop a new assessment program, the TAKS, to be aligned with the state-mandated curriculum, the Texas Essential Knowledge and Skills (TEKS). Under the new law, students in grade 3 (reading), 5 and 8 (reading and math), will be required to demonstrate proficiency on a state assessment test, and achieve passing grades in order to advance to the next grade level. At the 11th grade (reading, writing, math, science, social studies) students must pass the TAKS test, in addition to receiving the required number of credits, in order to receive their high school diploma. The Texas Education Code (TEC) charges the State Board of Education with establishing the passing standards (performance standards) on the new TAKS test.

The last administration of the TAAS test took place in spring 2002. Exit level students who fail any subject will continue to retest. Further, TAKS was field-tested across the state of Texas and became the new statewide assessment program to be administered beginning in the 2003 school year. In February-May 2002, statewide field-testing for grades 3-11 was conducted in order to collect student performance data on test items. Spring 2003 was the first live administration of the TAKS test, which generated scores that counted for students.

Thus, the TAKS is said to exceed the cognitive rigor of prior statewide assessments. The objectives of developing TAKS are to reflect in a better way good instructional practice and measure student learning more accurately. The items in TAKS are written by educators, reviewed and edited by contractors, by the TEA and by the educator committees. There are three categories for performance in TAKS: (1) Commended, (2) Met standards, (3) Did not meet standards. In principle, for each grade of each school district, there is information on the proportion of students who fall in each of the above categories. However, the Texas Education Agency reports information only on the proportion of students who pass (the top two categories) for a given grade.

The TAKS has a phase-in for ‘Met Standard’ for Grade 11 Exit Level. For the tenth-graders, it is 2 Standard Error Measurements (SEM) below Panel Recommendation for the year 2003, 1 SEM below Panel Recommendation for 2004, Panel Recommendation for the years 2005 and 2006. For eleventh-graders, it is 2 SEM below Panel Recommendation for the year 2004, 1 SEM below Panel Recommendation for 2005 and Panel Recommendation for 2005. There is no exit-level requirement for eleventh-graders for the year 2003.

It is important to mention that grade 10 tests have been built to be predictors of performance on grade 11 tests. Therefore, the standards in place when students take grade 10 TAKS must be extended to grade 11 so that for both years those students are required to meet the same passing standard. For example, eleventh graders who take the exit level test in spring 2004 will be subject to the 2 SEMs below the panel's recommendations to meet the standard. This is the same standard that was in effect when these students were tenth-graders.

The standard in place for each class when they begin grade 10 is the standard that will be maintained throughout those students' high school careers. For example, seniors in 2005 who must take one or more exit level retests will be subject to the TAKS passing standard that was in place at the time they started grade 10 in 2003.

Based on this time-line, we are interested in studying the determinants of the performance of students in the current TAKS, which was administered in 2002-2003 academic year. In trying to do so, we also investigate whether the expenditure on education is justified by the performance of the students, which really is the central question of this study.

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[17] We tried alternative specifications with one or more of the variables removed but the results seemed robust to alternative specifications.

[23] 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; Jaggia, Kurian, and Tuerck, "Assessing the Education Reform in Massachusetts: A Value-added Approach."

[24] See Appendix for details.

[25] See Papke L.E. and J.M. Wooldridge, "Econometrics methods for fractional response variables with an application to 401(k) plan participation rates (1996), Journal of Applied Econometrics, 11, 619-632.

[26] It is worth noting that the TAAS and TAKS scores include the scores of special education students. In Texas, special education students are given the option of taking either the regular assessment (TAAS, TAKS) or an alternative SDAA (State-Developed Alternative Assessment). If they choose to take the former, their scores are included in those that are reported for all students in the AEIS report.

[27] 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.

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