



The SSFR Technical Report on Resource Allocation and Student Outcomes:

Regression Models Used for Implicit Poverty Weight and Student Achievement Analyses, Along with Descriptive Statistics for LAUSD and TRUSD

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With contributions from

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Dr. Merrill Vargo served as the SSFR Co-Principal Investigator.
James R. Brown served as the Co-Principal Investigator for the first two years of the SSFR project and subsequently served in the role of a senior advisor to the project.
Steve Jubb served as SSFR Project Director for Implementation and Director of the District Redesign Workshop.
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Veronica Ensign served as a task leader on the preparation of the SSFR final report.
Ray Tolleson served as an SSFR project consultant and advisor on behalf of Pivot Learning Partners in Twin Rivers Unified School District.

District Partners

Mahala Archer served as the SSFR project manager in Twin Rivers Unified School District during the course of the project. On February 22, 2013, Ms. Archer joined the SSFR team as an AIR employee.

Matt Hill, who is the Chief Strategy Officer in LAUSD, and served as the SSFR Project Director for the district.

William Bass, who is a Program and Policy Development Advisor in LAUSD, also served during portions of the SSFR project as a project liaison and manager for the district.

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We would especially like to thank Mahala Archer, former Project Manager for SSFR in Twin Rivers, who provided substantial help in implementation as well as research-related activities during her tenure. She subsequently joined AIR (in 2013) to continue her work on related per-pupil budgeting issues.

We would also like to acknowledge the editorial and formatting assistance provided by Phil Esra, AIR.

ABOUT STRATEGIC SCHOOL FUNDING FOR RESULTS (SSFR)

What is the purpose of SSFR?

During the 2009–10 school year, American Institutes for Research (AIR) and Pivot Learning Partners (PLP) formed a partnership with two large California school districts—Los Angeles Unified School District and Twin Rivers Unified School District—to implement and evaluate the impact of a comprehensive approach to local school finance and governance reform that creates the conditions for improved human resource management and a more equitable distribution of both resources and student learning opportunities. The *Strategic School Funding for Results* project (SSFR) was designed to (1) develop and implement more equitable strategies for allocating resources within each district; (2) make budget and resource allocation decisions more transparent; (3) link those strategies to policies and processes designed to encourage autonomy, innovation, and efficiency; and (4) strengthen accountability for improving student outcomes.

What policies underlie SSFR?

The core reform strategy offered by SSFR includes four basic elements: equity, autonomy linked to accountability, transparency, and a culture of innovation and efficiency.

- 1. SSFR achieves equity by implementing a student need-based funding model**, and by developing and implementing policies, processes, and tools (the Targeted Revenue Model, or TRM) that support allocating dollars, rather than staff, to schools based on the needs of the specific students they serve (e.g., low-income students or English language learners).
- 2. SSFR links school autonomy to accountability** by offering schools discretion over how they use the dollars they receive and holding schools accountable for the results (student outcomes). SSFR includes a site budgeting tool (the Planning, Budgeting, and Allocation of Resources tool, or PBAR) that engages school decision makers in a series of activities that includes a needs assessment, goal setting, and the specification of instructional strategies and resource allocation necessary to achieve the goals with available revenues.
- 3. SSFR promotes increased transparency** by simplifying and clarifying the processes by which resources are allocated to schools, increasing the participation of a wide range of stakeholders in the design of these processes, improving stakeholder access to information about the patterns of resource allocation and student outcomes within the revenue allocation and site budgeting tools, and simplifying the structures that support resource allocation decisions.
- 4. SSFR promotes a culture of innovation and efficiency**. As these strategies are successfully implemented, SSFR encourages a culture of school innovation to improve performance and attract students and families; provides a structured, site-based budgeting tool in the context of a fixed revenue constraint; and encourages school leaders to operate efficiently to produce the best possible results.

What were the benefits of participation in the SSFR project?

Within the framework of the SSFR project, the AIR/PLP team provided the districts with data tools and analysis, technical assistance, coaching, and training to implement the funding strategies and evaluate their success. While common themes were promoted across the two

participating districts, each adopted its own focus and is now adapting the SSFR components to fit its unique culture and context. Each of the participating districts committed time on the part of its leadership and staff to participate effectively in this project and acknowledged that the project was a collaborative effort between the AIR/PLP and district leadership teams. The formative nature of the project allowed for a mutual learning experience among the participating districts and the AIR/PLP team and the creation of a strong partnership in successfully implementing SSFR. The SSFR project has resulted in a series of reports and guidebooks that describe the implementation of SSFR, as well as the changes in patterns of resource allocation and student outcomes that coincided with the efforts of the AIR/PLP team to implement SSFR in the two districts. For more information, see the SSFR website at www.schoolfundingforresults.org.

How was SSFR funded?

During the 2009–10 school year, the William and Flora Hewlett Foundation and the Ford Foundation provided grants to the AIR/PLP team to support the first phase of the SSFR work. August 1, 2010, marked the beginning of Phase II of the project, when the Institute of Education Sciences (IES) in the U.S. Department of Education awarded a grant of \$1.67 million to the AIR/PLP team to support the development of the SSFR model for three more years. The Hewlett Foundation awarded an additional three-year grant of \$1.5 million to the AIR/PLP team to extend its support of the project over the same three-year period. The Ford Foundation also contributed \$200,000 to support SSFR work during 2010–11.

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REGRESSION MODELS USED FOR IMPLICIT POVERTY WEIGHT AND STUDENT ACHIEVEMENT ANALYSES

The analyses of implicit poverty weights and student achievement treat the implementation of BSA and SSFR in LAUSD and TRUSD, respectively, as a quasi-experiment, and they make use of a model similar to a *comparative interrupted time series*. The technique involves using a regression model to estimate the relationship between a given outcome variable (in our context, per-pupil expenditure or ELA achievement scores) and student poverty, from before to after an interruption that denotes the point at which treatment started (in this case, when BSA/SSFR was first implemented), for two types of schools: (1) those (treatment) schools that participated in BSA/SSFR; and (2) non-participant (control) schools. The model then estimates the post-implementation difference in the outcome/poverty relationship between the two groups of schools. Below, we provide a technical description of the specific models that were run in each district.

Model Equation Used for LAUSD Implicit Poverty Weight Analysis Regressions

For a per-pupil expenditure measure for school s in year t , we can estimate the following simple model for our analysis:

$$(1) \ln(PPExp_{st}) = \ln(\alpha) + \beta \ln(1 + FRPM_{st}) + \sum_{t=2}^6 \gamma_t + \delta_1 \ln(ENR_{st}) + \delta_2 \ln(ENR_{st})^2 + \epsilon TREAT_{st} + \theta TREAT_{st} * \ln(1 + FRPM_{st}) + \varepsilon_{st}$$

Where:

- $PPExp_{st}$ is per-pupil expenditure for school s at time t
- $FRPM_{st}$ is school-level percent of free and reduced-price lunch-eligible students for school s at time t
- γ_t is an indicator variable for year t (ranging from 2 to 6)
- ENR_{st} denotes student enrollment for school s at time t
- $TREAT_{st}$ is a dummy indicator for school s participating in BSA in year t (equal to 1 if participant and 0, otherwise)
- $TREAT_{st} * FRPM_{st}$ is an interaction variable for school s at time t between $TREAT_{st}$ and percent free and reduced-price lunch
- ε_{st} is an error term assumed to be correlated across school-specific observations over time.

The intercept of the model above [$\ln(\alpha)$] simply denotes the natural logarithm of the base per-pupil expenditure, which represents the general level of per-pupil expenditure in the reference year. We have defined the reference year as the year just prior to initial BSA/SSFR implementation (i.e., the expected per-pupil expenditure for every school in the year before implementation, regardless of their level of poverty or enrollment).

The second coefficient (β) represents the marginal (slope) effect of poverty (where poverty is measured as the natural logarithm of a poverty index equal to 1 plus the school percent of students eligible for free or reduced-price meals). This is a key estimate of interest that measures

the *responsiveness* of per-pupil expenditure to student poverty prior to BSA/SSFR implementation and serves as our equity metric, which is assumed to be identical in the pre-implementation years for participant and non-participant schools.

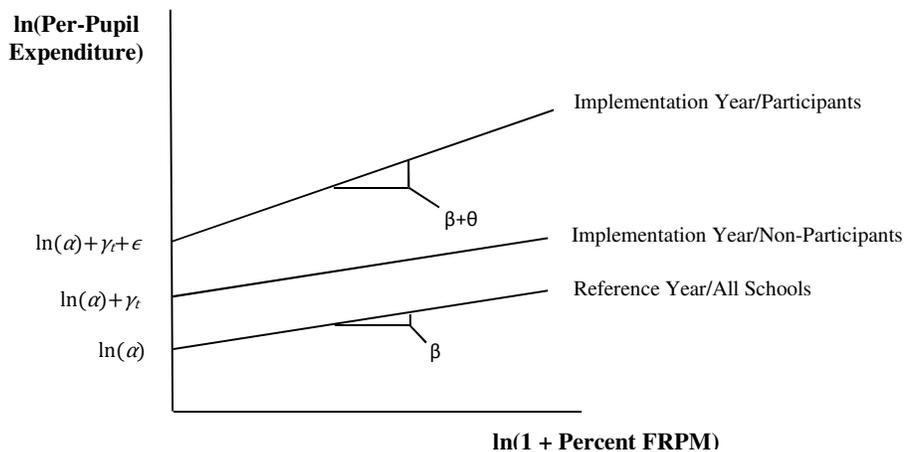
This is followed by a series of coefficients (γ_t) for year-specific dummy (0/1) indicators that show deviations in the general spending level from that of the reference year, which are graphically represented by “shifts” up or down in the spending/poverty profile.

The next two coefficients (δ_1 and δ_2) control for scale of operations by including the natural logarithm of school size and the square of this value (the latter to control for any curvilinear relationship between spending and scale).

The coefficient corresponding to the treatment indicator (ϵ) shows how the general spending level for schools participating in BSA/SSFR may have deviated in the post-implementation years from that experienced by non-participating schools. This coefficient shows whether the general spending level of participant schools differed from non-participant schools in the post-implementation years. Similar to the coefficients for the year-specific indicators, these are represented graphically as vertical shifts in the spending/poverty profile.

The coefficient for the interaction between the treatment indicator and our measure of poverty (θ) is also a key measure that represents the difference in the responsiveness of spending to poverty between participant and non-participant schools in the post-implementation period. In turn, the magnitude and significance of this estimate tells us whether participation in BSA/SSFR is associated with a significant increase or decline in equity. Graphically speaking, this change in slope is shown as a “pivot” in the spending/poverty profile for participating schools in the post-implementation years.

To better interpret the results, it is helpful to show them graphically by charting examples of estimated spending/poverty profiles.



The graphic contains three hypothetical spending/poverty profiles. The lowest profile represents the relationship between the natural logarithms of per-pupil expenditure and poverty (1 + percent FRPM) for both participant and non-participant schools in the reference year and is defined by the intercept $\ln(\alpha)$ and slope β . The middle profile is an example of what the estimated profile might look like for non-participants in year t after BSA/SSFR was implemented. Note that this

profile is parallel to the one for the reference year so that the responsiveness of per-pupil spending, as measured by the estimated slope, is assumed to be equal over the full study period for non-participant schools. However, in this example, the general level of spending has increased by γ_t so that the intercept of the profile is $\ln(\alpha) + \gamma_t$. The third profile shows an example of the estimated profile for schools participating in BSA/SSFR in the same implementation period, where participation was associated with both a general increase in per-pupil spending denoted by ϵ , as well as an increase in the responsiveness of spending to poverty represented by θ (i.e., the intercept and slope of this profile is now $\ln(\alpha) + \gamma_t + \epsilon$ and $\beta + \theta$, respectively).

Of key importance to our analysis is the magnitude and statistical significance of θ , as this will help to address our main research question of whether participation in BSA/SSFR is associated with an improvement in equity, as measured by the responsiveness of spending to poverty. It is important to note that the example put forth above assumed that the estimated coefficients were all positive, although there is no a priori reason to expect this to be the case.

The graphics in the main text are similar to the example put forth above. However, in order to make them easier to understand, we charted the profiles in terms of absolute per-pupil expenditure and percent FRPM, rather than using the logged versions of these measures that were used to estimate the regression equations.

The other models in this appendix are structured in a similar fashion and can be interpreted in the same way. Below, we provide the detailed equations used for the implicit poverty weight analysis in TRUSD, as well as those used in the student achievement analyses in both districts.

Model Equation Used for TRUSD Implicit Poverty Weight Analysis Regressions

For a per-pupil expenditure measure for school s in year t , we can estimate the following simple model for our analysis:

$$(2) \ln(PPExp_{st}) = \ln(\alpha) + \beta \ln(1 + FRPM_{st}) + \sum_{t=2}^4 \gamma_t + \delta_1 \ln(ENR_{st}) + \delta_2 \ln(ENR_{st})^2 + \vartheta \ln(ENSHR68_{st}) + \epsilon TREAT_{st} + \theta TREAT_{st} * \ln(1 + FRPM_{st}) + \varepsilon_{st}$$

Where:

- $PPExp_{st}$ is per-pupil expenditure for school s at time t
- $FRPM_{st}$ is school-level percent of free and reduced-price lunch-eligible students for school s at time t
- γ_t is an indicator variable for year t (ranging from 2 to 4)
- ENR_{st} denotes student enrollment for school s at time t
- $ENSHR68_{st}$ is the share of enrollment in grades 6 through 8 for school s at time t
- $TREAT_{st}$ is a dummy indicator for school s participating in SSFR in year t (equal to 1 if participant and 0, otherwise)
- $TREAT_{st} * FRPM_{st}$ is an interaction variable for school s at time t between $TREAT_{st}$ and percent free and reduced-price lunch
- ε_{st} is an error term assumed to be correlated across school-specific observations over time.

Model Equation Used for LAUSD Achievement Analysis Regressions

For a student achievement measure for school s in year t , we can estimate the following simple model for our analysis:

$$(3) \quad \ln(CST_{st}) = \ln(\alpha) + \beta_1 \ln(1 + FRPM_{st}) + \beta_2 \ln(1 + ELL_{st}) + \sum_{t=2}^6 \gamma_t + \epsilon TREAT_{st} + \theta TREAT_{st} * \ln(1 + FRPM_{st}) + \varepsilon_{st}$$

Where:

- CST_{st} is a school-level pupil weighted average CST scale score in English Language Arts for school s at time t
- $FRPM_{st}$ is school-level percent of free and reduced-price lunch-eligible students for school s at time t
- ELL_{st} is school-level percent of English language learners for school s at time t
- γ_t is an indicator variable for year t (ranging from 2 to 6)
- $TREAT_{st}$ is a dummy indicator for school s participating in BSA in year t (equal to 1 if participant and 0, otherwise)
- $TREAT_{st} * FRPM_{st}$ is an interaction variable for school s at time t between $TREAT_{st}$ and percent free and reduced-price lunch
- ε_{st} is an error term assumed to be correlated across school-specific observations over time.

Model Equation Used for TRUSD Achievement Analysis Regressions

For a given outcome measure (per-pupil expenditure or student achievement) for school s in year t , we can estimate the following simple model for our analysis:

$$(4) \quad \ln(CST_{st}) = \ln(\alpha) + \beta_1 \ln(1 + FRPM_{st}) + \beta_2 \ln(1 + ELL_{st}) + \sum_{t=2}^4 \gamma_t + \vartheta \ln(ENSHR68_{st}) + \epsilon TREAT_{st} + \theta TREAT_{st} * \ln(1 + FRPM_{st}) + \varepsilon_{st}$$

Where:

- CST_{st} is a school-level pupil weighted average CST scale score in English Language Arts for school s at time t
- $FRPM_{st}$ is school-level percent of free and reduced-price lunch-eligible students for school s at time t ;
- ELL_{st} is school-level percent of English language learners for school s at time t
- γ_t is an indicator variable for year t (ranging from 2 to 4)
- $ENSHR68_{st}$ is the share of enrollment in grades 6 through 8 for school s at time t
- $TREAT_{st}$ is a dummy indicator for school s participating in SSFR in year t (equal to 1 if participant and 0, otherwise)
- $TREAT_{st} * FRPM_{st}$ is an interaction variable for school s at time t between $TREAT_{st}$ and percent free and reduced-price lunch
- ε_{st} is an error term assumed to be correlated across school-specific observations over time.

Appendix A.1—Descriptive Statistics for LAUSD Analysis Variables

Variable	Year	Elementary Schools				Middle Schools				High Schools			
		Average	Min	Max	Count	Average	Min	Max	Count	Average	Min	Max	Count
FRPM Percentage	2006-07	79.21%	2.46%	99.53%	460	77.30%	27.39%	96.29%	78	70.74%	22.30%	92.13%	59
	2007-08	72.36%	2.63%	99.48%	460	73.43%	27.05%	96.62%	79	66.93%	21.60%	93.29%	60
	2008-09	78.54%	2.39%	99.47%	462	76.62%	26.72%	96.63%	79	70.89%	22.25%	94.06%	69
	2009-10	78.94%	1.32%	99.86%	466	77.95%	30.62%	96.16%	79	74.31%	23.50%	94.96%	74
	2010-11	78.99%	3.22%	99.86%	464	77.62%	44.06%	96.58%	82	76.15%	43.20%	95.08%	85
	2011-12	79.09%	3.49%	99.85%	464	78.56%	43.81%	96.57%	84	79.22%	44.73%	100.00%	99
ELL Percentage	2006-07	45.36%	0.20%	90.20%	460	32.49%	6.40%	55.10%	78	27.06%	0.00%	54.20%	59
	2007-08	43.17%	0.50%	96.90%	460	28.36%	3.80%	51.90%	79	24.73%	0.30%	49.30%	60
	2008-09	40.79%	1.10%	94.20%	462	25.53%	3.20%	48.60%	79	25.29%	0.00%	79.50%	69
	2009-10	39.79%	0.90%	100.00%	466	24.44%	3.20%	48.90%	79	25.39%	0.30%	76.00%	74
	2010-11	37.54%	0.55%	84.74%	464	22.58%	2.70%	55.16%	82	27.20%	0.26%	79.10%	85
	2011-12	38.34%	0.60%	98.72%	464	18.89%	2.16%	40.22%	84	22.49%	0.26%	70.73%	99
Total Enrollment	2006-07	663	108	1968	460	1940	548	3501	78	2700	165	4647	59
	2007-08	641	77	1907	460	1856	697	3410	79	2647	220	4648	60
	2008-09	628	59	1925	462	1755	817	3216	79	2322	225	4576	69
	2009-10	619	97	2485	466	1603	420	2939	79	2130	238	4503	74
	2010-11	602	132	1674	464	1397	398	2709	82	1706	244	4341	85
	2011-12	576	103	1519	464	1307	366	2619	84	1395	205	4109	99
Overall Expenditure Per Pupil	2006-07	\$9,061	\$6,543	\$17,429	460	\$7,152	\$5,909	\$9,029	78	\$7,571	\$5,463	\$9,651	59
	2007-08	\$9,503	\$6,218	\$19,778	460	\$7,699	\$5,897	\$10,686	79	\$7,824	\$5,859	\$10,714	60
	2008-09	\$9,243	\$5,996	\$21,430	462	\$7,892	\$6,125	\$10,963	79	\$7,698	\$5,248	\$11,826	69
	2009-10	\$8,576	\$303	\$18,773	466	\$7,843	\$5,836	\$11,498	79	\$7,439	\$120	\$11,631	74
	2010-11	\$8,478	\$5,978	\$19,359	464	\$8,219	\$5,640	\$13,344	82	\$7,912	\$125	\$16,542	85
	2011-12	\$8,806	\$6,358	\$19,261	464	\$7,957	\$5,619	\$11,601	84	\$8,268	\$5,411	\$13,258	99
Unrestricted Expenditure Per Pupil	2006-07	\$5,223	\$2,311	\$9,788	460	\$3,980	\$3,426	\$5,092	78	\$4,643	\$3,703	\$6,061	59
	2007-08	\$5,367	\$3,900	\$10,725	460	\$4,145	\$3,208	\$5,471	79	\$4,603	\$3,973	\$5,829	60
	2008-09	\$5,457	\$4,070	\$16,521	462	\$4,168	\$3,569	\$5,383	79	\$4,474	\$3,467	\$6,170	69
	2009-10	\$4,341	\$82	\$9,099	466	\$3,575	\$2,830	\$5,207	79	\$3,571	\$57	\$5,407	74
	2010-11	\$4,460	\$3,493	\$6,875	464	\$3,919	\$2,749	\$6,285	82	\$4,006	\$2	\$7,741	85
	2011-12	\$5,443	\$4,331	\$9,712	464	\$4,419	\$3,289	\$5,668	84	\$4,820	\$3,469	\$8,276	99
Restricted Expenditure Per Pupil	2006-07	\$3,838	\$1,361	\$13,255	460	\$3,173	\$1,875	\$4,616	78	\$2,928	\$1,020	\$4,984	59
	2007-08	\$4,137	\$1,255	\$14,435	460	\$3,553	\$2,240	\$5,694	79	\$3,221	\$1,236	\$5,831	60
	2008-09	\$3,786	\$937	\$13,475	462	\$3,724	\$2,219	\$5,691	79	\$3,224	\$1,268	\$5,999	69
	2009-10	\$4,235	\$221	\$15,098	466	\$4,268	\$2,584	\$6,503	79	\$3,868	\$63	\$7,221	74
	2010-11	\$4,019	\$1,406	\$15,431	464	\$4,300	\$2,036	\$8,051	82	\$3,906	\$124	\$8,800	85
	2011-12	\$3,363	\$1,107	\$14,824	464	\$3,538	\$1,467	\$6,650	84	\$3,448	\$1,132	\$7,463	99
ELA CST Mean Scale Score	2006-07	333	295	413	439	317	290	366	78	317	280	378	59
	2007-08	337	299	412	439	323	292	370	79	322	292	394	60
	2008-09	343	301	426	441	327	293	372	79	322	289	396	69
	2009-10	347	304	421	445	331	298	379	79	326	292	405	73
	2010-11	349	304	421	451	336	302	384	82	328	291	407	84
	2011-12	354	313	431	451	341	304	390	84	329	289	405	99

Appendix A.2—Descriptive Statistics for TRUSD Analysis Variables

Variable	Year	Elementary Schools				Middle Schools				High Schools			
		Average	Min	Max	Count	Average	Min	Max	Count	Average	Min	Max	Count
FRPM Percentage	2008-09	80.65%	51.95%	95.14%	32	74.93%	69.45%	83.66%	5	63.83%	53.48%	69.69%	4
	2009-10	86.30%	56.91%	97.96%	32	88.31%	77.90%	96.66%	5	73.18%	62.82%	88.76%	4
	2010-11	85.45%	58.07%	97.08%	29	89.97%	83.87%	98.06%	5	75.45%	67.38%	86.00%	4
	2011-12	87.44%	59.12%	98.20%	28	88.85%	82.98%	94.36%	5	79.68%	73.94%	89.05%	4
ELL Percentage	2008-09	31.53%	14.60%	60.80%	32	27.58%	18.40%	35.20%	5	19.78%	14.70%	30.10%	4
	2009-10	34.49%	16.10%	64.50%	32	27.62%	16.80%	38.10%	5	18.98%	14.70%	29.70%	4
	2010-11	32.75%	14.70%	65.90%	29	23.46%	15.70%	32.50%	5	15.95%	12.90%	24.80%	4
	2011-12	29.79%	12.65%	60.08%	28	19.38%	14.07%	23.77%	5	14.47%	10.52%	22.17%	4
Total Enrollment	2008-09	450	302	768	32	584	473	721	5	1762	1363	2098	4
	2009-10	449	289	875	32	566	456	723	5	1668	1346	2009	4
	2010-11	530	289	849	29	572	403	755	5	1519	809	2086	4
	2011-12	517	361	844	28	575	408	752	5	1427	818	1955	4
Overall Expenditure Per Pupil	2008-09	\$6,621	\$4,947	\$9,123	32	\$7,119	\$5,971	\$8,397	5	\$6,312	\$5,567	\$7,019	4
	2009-10	\$6,039	\$4,403	\$8,250	32	\$6,802	\$6,045	\$7,882	5	\$6,422	\$5,742	\$7,298	4
	2010-11	\$5,331	\$3,885	\$8,229	29	\$6,931	\$5,182	\$8,692	5	\$7,138	\$5,933	\$10,028	4
	2011-12	\$5,657	\$4,349	\$7,567	28	\$6,896	\$6,011	\$8,060	5	\$7,570	\$6,480	\$9,271	4
Unrestricted Expenditure Per Pupil	2008-09	\$4,812	\$3,853	\$5,994	32	\$4,673	\$4,054	\$5,213	5	\$4,580	\$4,143	\$5,038	4
	2009-10	\$4,468	\$3,510	\$5,901	32	\$5,056	\$4,471	\$5,605	5	\$5,017	\$4,711	\$5,609	4
	2010-11	\$3,604	\$2,111	\$5,080	29	\$4,772	\$3,768	\$6,473	5	\$4,746	\$3,965	\$6,176	4
	2011-12	\$4,130	\$3,555	\$4,726	28	\$4,801	\$4,522	\$5,229	5	\$5,303	\$4,782	\$5,696	4
Restricted Expenditure Per Pupil	2008-09	\$1,809	\$696	\$3,129	32	\$2,446	\$1,411	\$3,348	5	\$1,733	\$1,424	\$1,982	4
	2009-10	\$1,571	\$646	\$2,734	32	\$1,745	\$1,279	\$2,277	5	\$1,404	\$1,031	\$1,689	4
	2010-11	\$1,727	\$658	\$3,899	29	\$2,159	\$1,414	\$3,055	5	\$2,392	\$1,661	\$3,852	4
	2011-12	\$1,528	\$539	\$3,049	28	\$2,096	\$1,488	\$2,831	5	\$2,267	\$1,514	\$4,022	4
ELA CST Mean Scale Score	2008-09	337	318	359	32	324	317	339	5	328	315	339	4
	2009-10	341	325	360	32	327	314	340	5	329	323	338	4
	2010-11	339	315	356	29	331	323	339	5	336	321	347	4
	2011-12	337	319	359	28	333	312	344	5	337	329	342	4