US Elementary School Funding and Expenditures Analysis

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The study is using data compiled by the United States Census Bureau on finances of public schools/school districts. The data contains yearly summary of revenue and expenditure for the years 1992-2015. The data is organized by States, Year, School Districts or Schools. The schools/districts include Elementary and High Schools (K-12).

Data Source

The original data source -
https://www.census.gov/programs-surveys/school-finances/data/tables.html
The data is compiled by Roy Garrard and published in Kaggle:
https://www.kaggle.com/noriuk/us-educational-finances
CSV file:
https://www.kaggle.com/noriuk/us-educational-finances/downloads/elsect_main.csv/4

Sample Data Fields

NAME,
STATE,
YEAR,
ENROLL,
TOTAL_REVENUE,
FEDERAL_REVENUE,
STATE_REVENUE,
LOCAL_REVENUE,
TOTAL_EXPENDITURE,
INSTRUCTION_EXPENDITURE,
SUPPORT_SERVICES_EXPENDITURE,
OTHER_EXPENDITURE,
CAPITAL_OUTLAY_EXPENDITURE

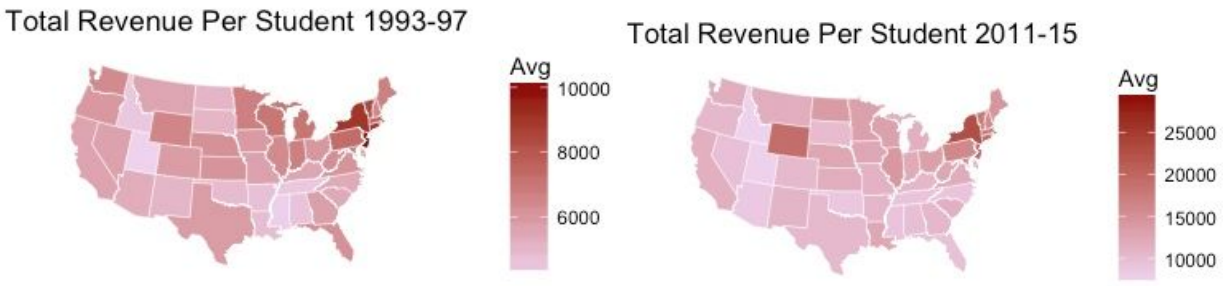
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	STATE	ENROLL	NAME	YRDATA	TOTALREV	TFEDREV	TSTREV	TLOCREV	TOTALEXP	TCURINST	TCURSSVC	TCURONON	TCAPOUT
2	Alabama	7568	AUTAUGA CO SCH DIST	1995	31827	2821	21389	7617	27457	15228	7123	2575	2176
3	Alabama	19961	BALDWIN CO SCH DIST	1995	93379	6655	55108	31616	87973	48750	22961	6927	6795
4	Alabama	2045	BARBOUR CO SCH DIST	1995	9828	1676	7016	1136	9797	5635	2822	1144	35
5	Alabama	2972	EUFAULA CTY SCH DIST	1995	14374	1299	9301	3774	15272	7834	3626	1428	2384
6	Alabama	3539	BIBB CO SCH DIST	1995	14917	1923	11169	1825	14398	8449	3762	1528	529
7	Alabama	6239	BLOUNT CO SCH DIST	1995	25869	2271	19403	4195	23534	14241	6361	2452	394
8	Alabama	1182	ONEONTA CITY SCH DIST	1995	4668	190	3379	1099	4252	2483	1074	470	68
9	Alabama	1972	BULLOCK CO SCH DIST	1995	8712	1655	6127	930	8670	4692	2533	1157	288
10	Alabama	4300	BUTLER CO SCH DIST	1995	18120	2697	13234	2189	17715	10108	4726	2083	568
11	Alabama	3584	ANNISTON CTY SCH DST	1995	19203	2567	11932	4704	18756	10116	5831	2469	280
12	Alabama	10330	CALHOUN CO SCH DIST	1995	40768	3424	30415	6929	41358	21993	10919	4346	4062
13	Alabama	1647	JACKSONVILLE CTY SCH DIST	1995	6173	581	4529	1063	5957	3771	1484	616	81
14	Alabama	1220	PIEDMONT CTY SCH DIST	1995	4471	390	3336	745	4993	2730	1042	501	705
15	Alabama	2838	OXFORD CITY SCH DIST	1995	11360	772	8250	2338	11078	6719	2664	1135	422
16	Alabama	4145	CHAMBERS CO SCH DIST	1995	19766	2062	13150	4554	19739	11608	5389	1945	713
17	Alabama	1605	LANETT CTY SCH DIST	1995	6449	726	4587	1136	6450	4050	1669	613	118
18	Alabama	3714	CHEROKEE CO SCH DIST	1995	16620	1469	11861	3290	16285	9132	4287	1810	868
19	Alabama	6228	CHILTON CO SCH DIST	1995	26068	2258	19454	4356	25624	14812	7104	2515	1181
20	Alabama	2929	CHOCTAW CO SCH DIST	1995	13730	1812	9609	2309	13903	8167	3393	1553	790
21	Alabama	4059	CLARKE CO SCH DIST	1995	17495	2424	13010	2061	17031	9244	5029	2018	549

Data Quality

1. The CSV file contains 359,836 rows and time span is from 1992 to 2015.
2. Data is generally very clean with no unexpected value. There are rows that do not have the number of students. These rows are ignored and filtered out when "dollar value per student" is calculated.

Analysis

1. **Total Revenue Per student for 1993-1997 and 2011-2015**



Total Revenue per Student (Top 10)				
Rank	**1993 - 1997** mean=$6,258		**2011-2015** mean=$12,584	
1	New Jersey	$10,168	District of Columbia	$29,624
2	New York	$9,066	New York	$22,816
3	Connecticut	$9,025	New Jersey	$20,348
4	Alaska	$8,973	Alaska	$19,655
5	District of Columbia	$8,857	Connecticut	$19,274
6	Vermont	$8,489	Wyoming	$19,170
7	Massachusetts	$7,612	Vermont	$17,948
8	Delaware	$7,404	Massachusetts	$17,558
9	Rhode Island	$7,321	Rhode Island	$16,594
10	Pennsylvania	$7,305	Maryland	$16,141

Total Revenue per Student (Bottom 10)				
Rank	**1993 - 1997** mean=$6,258		**2011-2015** mean=$12,584	
42	North Dakota	$4,991	Alabama	$9,805
43	New Mexico	$4,959	Nevada	$9,646
44	Oklahoma	$4,793	Florida	$9,557
45	Louisiana	$4,702	Mississippi	$9,164
46	Arkansas	$4,628	Tennessee	$9,138
47	Alabama	$4,513	North Carolina	$9,134
48	Tennessee	$4,418	Oklahoma	$8,886
49	Idaho	$4,392	Arizona	$8,707
50	Mississippi	$4,146	Utah	$7,759
51	Utah	$4,072	Idaho	$7,594

Observation:

1. The states with the most or least revenue per students are very stable over the 20 years period. We take a 5-year average between 1993-1997 and compare with 2011-2015. For the most revenue, 8 of the 10 States in 1990's maintain the top 10 ranking in 2010's with the exceptions highlighted in yellow.
2. Similar trend is observed with the least revenue per student. 6 of the lowest revenue in 1990's maintain the lowest ranking in 2010's.
3. Observing from the heat map, a lot of the states in Midwest and West are falling into the lower tier of the revenue per student over the 20-year period.
4. Most of the top revenue states are located in East coast and lowest revenue states are located in midwest and southeast of US. East coast states tend to have a higher cost of living. Therefore the revenue through taxes are generally higher. At the same time, midwest and southeast states tend to have a lower cost of living.

2. States with the greatest jump or drop in ranking from 1993-1997 to 2011-2015

States with the Greatest Jump/Drop in Ranking			
State	**Rank 1993-1997**	**Rank 2011-20157**	**Difference**
North Dakota	42	17	Up 25
Louisiana	45	24	Up 21
Michigan	12	31	Down 19
Florida	23	44	Down 21

Observation:

1. North Dakota and Louisiana make the greatest jump in ranking from 1990's to 2010's, up 25 spots and 21 spots respectively.
2. On the other hand, Michigan and Florida make the greatest drop, down 19 and 21 spots respectively.
3. Analyzing more on the total revenue breakdown on North Dakota, Louisiana, Michigan, Florida - % from Federal, % from State, % from Local, and number of Students -

	%Federal		%State		%Local		Students	
State	1990's	2010's	1990's	2010's	1990's	2010's	1990's	2010's
North Dakota	9.16%	9.64%	41.3%	53.9%	49.5%	36.5%	119K	101K
Louisiana	11.9%	16.3%	52.5%	41.4%	35.7%	42.2%	799K	666K
Michigan	4.47%	7.89%	54.2%	58.8%	41.3%	33.3%	1,625K	1,393K
Florida	7.25%	13.3%	49.1%	37.7%	43.7%	49%	2,109K	2,685

4. Reviewing the data from these 4 States from 1990's to 2010's, there are no significant increase or decrease from the revenue source, whether it is from Federal, State, or Local.
5. North Dakota and Louisiana has a significant drop in the number of students from 1990's to 2010's. North Dakota has a 15% decrease and Louisiana has a 16% decrease in the average number of students enrolled. If funding source and amount (adjusted for inflation) stay similar, a significant drop of students will bump up the total revenue per student. Same goes to Florida. There is a 27% increase in the average number of students. This can lead to a big drop in total revenue per student.

6. Michigan presents an interesting case. There is a 14% drop of students from 1990's to 2010's. However, total revenue per students does not increase significantly. Financial crisis during 2008 and subsequent housing crisis might pay a big role to explain the situation. Lots of houses in Detroit area got repossessed. This led to substantial drop in property values and subsequent property tax collected.

3. Revenue Correlation

1993-97

	TOtalRevAvg	FedAvg	StateAvg	LocalAvg	Student
TOtalRevAvg	1.00000000	0.13048562	0.23421794	0.74673837	0.03010018
FedAvg	0.13048562	1.00000000	0.16764467	-0.09486183	-0.08443048
StateAvg	0.23421794	0.16764467	1.00000000	-0.46414315	0.02986015
LocalAvg	0.74673837	-0.09486183	-0.46414315	1.00000000	0.01653546
Student	0.03010018	-0.08443048	0.02986015	0.01653546	1.00000000

2011-15

	TOtalRevAvg	FedAvg	StateAvg	LocalAvg	Student
TOtalRevAvg	1.0000000	0.4296798	0.3097040	0.802562884	-0.118950974
FedAvg	0.4296798	1.0000000	-0.1060824	0.410013068	-0.118323127
StateAvg	0.3097040	-0.1060824	1.0000000	-0.311342657	-0.164419797
LocalAvg	0.8025629	0.4100131	-0.3113427	1.000000000	-0.005321352
Student	-0.1189510	-0.1183231	-0.1644198	-0.005321352	1.000000000

Observation:

1. Correlation between all revenue source and number of students was analyzed.
2. Of all revenue source, Local revenue correlates to Total revenue the most. Therefore, Total revenue per student is dependent on Local revenue for school districts across US.
3. Surprisingly, the number of students in a school district does not correlate to the average revenue per student.

4. Total Expenditure Per student for 1993-1997 and 2011-2015

Total Expenditure Per Student 1993-97

Total Expenditure Per Student 2011-15

Total Spending per Student (Top & Bottom 5)				
Rank	**1993 - 1997** mean=$6,325		**2011-2015** mean=$12,577	
1	New Jersey	$10,214	District of Columbia	$28,869
2	New York	$9,543	New York	$23,302
3	Alaska	$9,469	Alaska	$20,292
4	District of Columbia	$8,955	New Jersey	$19,929
5	Connecticut	$8,837	Wyoming	$19,114
47	Alabama	$4,599	Mississippi	$9,048
48	Tennessee	$4,579	Oklahoma	$8,753
49	Idaho	$4,573	Arizona	$8,529
50	Mississippi	$4,196	Utah	$7,853
51	Utah	$4,190	Idaho	$7,257

Observation:

1. The states with the most or least expenditure per students are very stable over the 20 years period. States that are either highest or lowest in 1990's reappear in 2010's.
2. States that have the highest revenue also have the highest expenditures. It makes total sense and good news is these states are not diverting their educational income into other expenditure.

3. Observing from the heat map, states in the east and northeast have the highest expenditure per student. States in Midwest and Southeast have the lower expenditure per student.
4. East and Northeast has the higher cost of living and it reflects on the expenditure. More money are spent on teacher or staff salary.
5. On the other hand, midwest and southeast states tend to have a lower cost of living and their expenditure per student is lower.

5. States with the greatest jump or drop in ranking from 1993-1997 to 2011-2015

States with the Greatest Difference in Ranking			
State	**Rank 1993-1997**	**Rank 1993-1997**	**Difference**
North Dakota	41	14	Up 27
Louisiana	46	22	Up 24
Michigan	12	29	Down 17
Florida	21	43	Down 22

Observation:

1. The same 2 states (North Dakota and Louisiana) that have the biggest jump in revenue also has the biggest jump in expenditure. The same apply to Michigan and Florida which have the biggest drop in both revenue and expenditure.
2. Analyzing more on the total expenditure breakdown on North Dakota, Louisiana, Michigan, Florida - % for Instruction, % for Support Services, % for Others, % for Capital Outlay, and number of Students -

	%Instruction		%Support Service		%Other		% Capital Outlay		Students	
State	1990's	2010's	1990's	2010's	1990's	2010's	1990's	2010's	1990's	2010's
North Dakota	53%	49%	26%	27%	8%	7%	8%	14%	119K	101K
Louisiana	55%	50%	29%	33%	8%	5%	6%	9%	799K	666K
Michigan	51%	53%	31%	30%	6%	5%	8%	6%	1,624K	1,393K
Florida	46%	54%	31%	30%	7%	7%	14%	7%	2,109K	2,685K

3. Common trend we observe
    a. States spend around 50% on Instruction (teacher salary).
    b. The student drop in North Dakota and Louisiana allow these 2 states to spend less on instruction.
    c. North Dakota and Louisiana increase their percentage spent on capital outlay expenditure over the 20-year period. While Michigan and Florida decrease their percentage spend on capital outlay.

6. Expenditure Correlation

1993-97

	TOtalExpAvg	InstAvg	SServAvg	OtherAvg	CapOutAvg	Student
TOtalExpAvg	1.00000000	0.9424348287	0.895798907	0.15982061	0.2241024927	0.029022561
InstAvg	0.94243483	1.0000000000	0.801784598	0.07599545	0.0003410856	0.014402027
SServAvg	0.89579891	0.8017845982	1.000000000	0.18731056	0.1917623324	-0.001835228
OtherAvg	0.15982061	0.0759954458	0.187310560	1.00000000	0.1007361469	0.150694732
CapOutAvg	0.22410249	0.0003410856	0.191762332	0.10073615	1.0000000000	0.148454042
Student	0.02902256	0.0144020274	-0.001835228	0.15069473	0.1484540418	1.000000000

2011-15

	TOtalExpAvg	InstAvg	SServAvg	OtherAvg	CapOutAvg	Student
TOtalExpAvg	1.0000000	0.95450121	0.9356861	0.4112242	0.6176062	-0.11249221
InstAvg	0.9545012	1.00000000	0.8801324	0.3259124	0.4025054	-0.07678422
SServAvg	0.9356861	0.88013241	1.0000000	0.3488663	0.4969072	-0.17847785
OtherAvg	0.4112242	0.32591243	0.3488663	1.0000000	0.3935953	-0.14774538
CapOutAvg	0.6176062	0.40250544	0.4969072	0.3935953	1.0000000	-0.12280821
Student	-0.1124922	-0.07678422	-0.1784779	-0.1477454	-0.1228082	1.00000000

Observation:

1. Correlation between all expenditure and number of students was analyzed.
2. Total expenditure is highly correlated to Instruction and Support Service. That is expected as money should be spent on teacher and support salary and directly impacting students.
3. Instruction expenditure and Support Service expenditure is correlated too. This make sense too as teacher salary and staff salary should go hand in hand.
4. The correlation between Capital Outlay expenditure to Total expenditure increases during 2010's vs 1990's. That means states are spending more money on capital expense in 2010's. We suspect technology and worn-down infrastructure play an important role in this spending.
5. Number of students does not correlate to the expenditure per student.

7. Revenue and Expenditure Correlation

	ENROLL	TotalRevPer	TotalFedRevPer	TotalStateRevPer	TotalLocalRevPer	TotalExpendRevPer
ENROLL	1.0000000000	-0.01775996	-0.002429875	-0.01737123	-0.01792051	-0.01560796
TotalRevPer	-0.0177599615	1.00000000	0.592915985	0.79322893	0.80789861	0.92956491
TotalFedRevPer	-0.0024298746	0.59291598	1.000000000	0.20797139	0.19258245	0.57337463
TotalStateRevPer	-0.0173712324	0.79322893	0.207971387	1.00000000	0.51501291	0.73092356
TotalLocalRevPer	-0.0179205136	0.80789861	0.192582448	0.51501291	1.00000000	0.73884455
TotalExpendRevPer	-0.0156079645	0.92956491	0.573374629	0.73092356	0.73884455	1.00000000
TotalInstruExpPer	-0.0111437159	0.67504104	0.103628759	0.68183623	0.65229817	0.78376502
TotalSupServExpPer	-0.0175475473	0.79130516	0.310817369	0.67702459	0.72269896	0.78648966
TotalOtherExpPer	-0.0047609348	0.29415043	0.108103015	0.23751978	0.28760384	0.29261917
TotalCapOutExpPer	0.0003580373	0.56131315	0.884444616	0.21927142	0.21237569	0.59970678

	TotalInstruExpPer	TotalSupServExpPer	TotalOtherExpPer	TotalCapOutExpPer
ENROLL	-0.01114372	-0.01754755	-0.004760935	0.0003580373
TotalRevPer	0.67504104	0.79130516	0.294150430	0.5613131528
TotalFedRevPer	0.10362876	0.31081737	0.108103015	0.8844446163
TotalStateRevPer	0.68183623	0.67702459	0.237519784	0.2192714205
TotalLocalRevPer	0.65229817	0.72269896	0.287603836	0.2123756915
TotalExpendRevPer	0.78376502	0.78648966	0.292619166	0.5997067777
TotalInstruExpPer	1.00000000	0.55490032	0.162920821	0.1444780915
TotalSupServExpPer	0.55490032	1.00000000	0.320317389	0.2508416549
TotalOtherExpPer	0.16292082	0.32031739	1.000000000	0.0452030403
TotalCapOutExpPer	0.14447809	0.25084165	0.045203040	1.0000000000

Observation:

1. Correlation between all revenue and expenditure was analyzed.
2. Total revenue per student and total expenditure per student is highly correlated.
3. There is a higher correlation on Total revenue to Support Services expenditure (0.79) vs Instruction expenditure (0.675).
4. Federal revenue is correlated to Capital Outlay expenditure (0.884). Perhaps Federal money is tied to big grants for technology and infrastructure improvement.

8. California Top & Bottom 5 School District - Total Revenue per student in 2015

Top 5 school districts in California

YRD ATA <int>	NAME <fctr>	STATE <fctr>	ENR OLL <int>	total_rev_per_student_CA <dbl>

1	2015	TRINITY COUNTY OFFICE OF EDUCATION	California	15	485133.3
2	2015	SAN MATEO CO SPL SCHS OPER BY CO SUPT	California	403	394017.4
3	2015	LAKE COUNTY OFFICE OF EDUCATION	California	45	387111.1
4	2015	SAN FRANCISCO CITY/CNTY SPECIAL SCHOOLS	California	398	386419.6
5	2015	LASSEN CO SPL SCHS OPER BY CO SUPT	California	30	384600.0

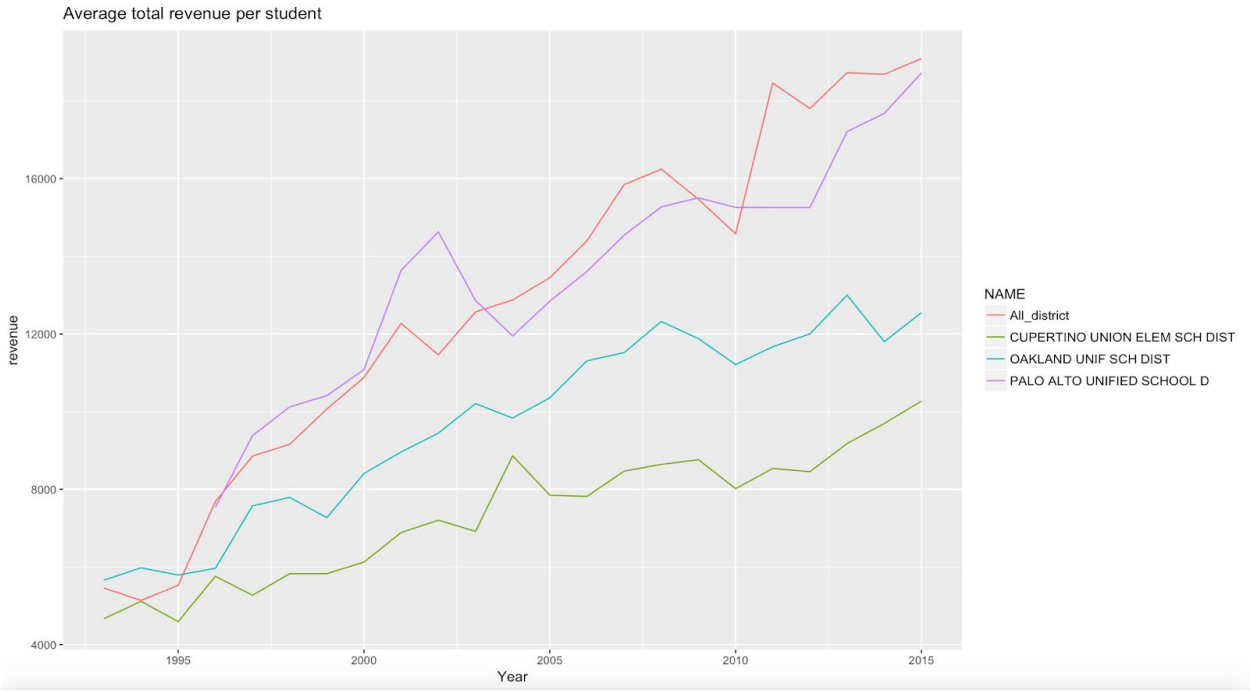
Bottom 5 school districts in California

	YRDATA <int>	NAME <fctr>	STATE <fctr>	ENROLL <int>	total_rev_per_student_CA <dbl>
1	2015	GORMAN ELEMENTARY SCHOOL DISTRICT	California	2050	686.8293
2	2015	RAVENDALE-TERMO ELEMENTARY SCHOOL DISTRICT	California	665	939.8496
3	2015	SPENCER VAL ELEM SCH DIST	California	3205	1313.8846
4	2015	MERIDIAN ELEM SCH DIST	California	978	1491.8200
5	2015	MARCUM ILLINOIS UNION ELEM SCHOOL DIST	California	2283	1612.7902

Observation:

1. School Districts with very high Total Revenue per student have these characteristics -
    a. Small number of students - Lower number of students can skew the average revenue per student because of the fixed revenue and cost of running a school.
    b. Special education school - Special education schools also require more revenue and expenditure per student to operate.
2. Schools with very low Total Revenue per student have these characteristics -
    a. Rural area - Research on the web indicates these schools are in rural area.
    b. School district facing closure - Research on the web indicate these school districts are facing closure or merger because of low student counts.
    c. Susceptible enroll number (Data inconsistency) - Research on the web indicate a lower enrollment number than the data from source.

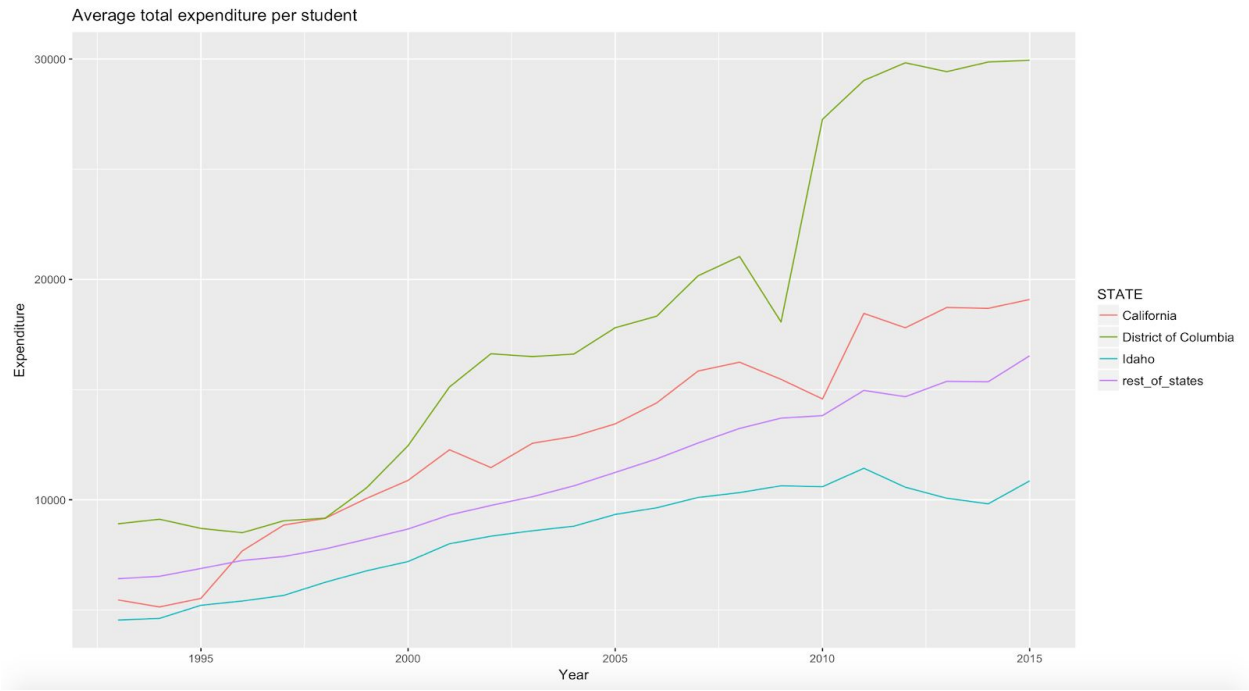
9. Average Total Revenue per students of Cupertino, Palo Alto, Oakland from 1991 to 2015 (Compared to average of CA)



Observation:

1. Generally the average total revenue per student is trending up over the 20-year period. This may due to inflation and cost of living adjustment.
2. There is a significant dip in revenue in 2010 due to US financial crisis and reduce government spending and tax revenue - it takes a couple year from 2008 Financial Crisis to cascade down the government budget and spending.
3. Cupertino, Palo Alto, and Oakland School Districts are mostly below California average over the years. In early 1990's these 3 school districts are close to average but the discrepancies have increased over the years.
4. Only Palo Alto Unified School District are close to California average.
5. Surprisingly, Cupertino has the lowest average of the 3. Cupertino is in a more affluent area than Oakland and should be able to collect my property tax revenue.

10. Average Total Expenditure per students of California from 1991 to 2015 (Compared to High, Low, Average State)



Observation:

1. Average Total Expenditure per student of California is plotted from 1991 to 2015.
2. Top expenditure state (District of Columbia) and lowest state (Idaho) are plotted.
3. California is slightly above all states average.
4. However, because of higher cost of living in California, California students are probably getting less compared with students from other states.
5. In 2008, President Obama, who had been emphasizing the importance of education was elected. With the majority in congress, as you can see there is a dramatic soar of the expenditure for each student in District of Columbia.

Future Analysis

1. Relate cost of living index into Revenue & expense. Dollar amount might not truly reflect the investment made. Higher cost states generate more revenue thru taxes but have to pay more to teacher salaries.
2. Relate test scores with District - Is funding and instruction expenditure related to test scores? This will tell us if the money is well spent and if students actually improve with more money. This may also answer the question on if money can solve American education problem. However, lack of standardized test scores and if test scores truly reflect the academic performance may hinder the answer.