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Achievement Investment Prowess:
Identifying Cost Efficient Higher Performing Maine Public Schools

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Introduction

Throughout the United States the debate has been frequent, intense, and at times adversarial over how to fund education adequately. Maine has been trying to identify higher performing schools in the hope that practices that contribute to success at higher performing schools can be adapted at similar schools throughout the state. The 1997 establishment of Essential Programs and Services, an adequacy based funding model, has a primary goal to ensure success for all of Maine's children based on generating and distributing funds more equitably throughout the state. However, identifying higher performing schools based on achievement misses inclusion of fiscal responsibility within a school. This study proposes to broaden the definition of higher performing by stipulating that a higher performing school should not be defined by academic achievement and "added value" alone but also on cost efficiency.   Maine school administrative units (SAUs) and schools are unique, based on demography, geographic determination, financial resources, and other factors. Keeping in mind that within Maine there is high variation between SAUs and among schools, there still needs to be a means of defining schools that are performing higher than others academically while being cost efficient so that model schools may be identified.

Nationally, Standard & Poor's School Evaluation Services an independent analytic team analyzes educational data for the purpose of providing the public with objective information that may be used to implement school reform. Standard & Poor's reports out their findings on the World Wide Web under the name SchoolMatters. Starting in 2002, Standard & Poor's rolled out various measures and methodological processes used for evaluating and establishing comparisons of school districts and states to identify higher performing cost efficient schools. Two measures that Standard & Poor's have created are a Return on Spending index (RoSI) and a Proficiency Cost index (PCI). Standard & Poor's Return on Spending Index (RoSI) is the average number of proficiency points obtained per $1000 of per pupil expenditure. RoSI, when used simultaneously with other measures such as PCI, helps to identify school districts that achieve better educational proficiency for a given level of spending, while taking into consideration the proportional enrollment of economically disadvantaged students.   Proficiency

Cost Index (PCI) is defined as average per pupil core operating expenditure per achievement proficiency point. It is the inverse of RoSI. PCI is used when comparing districts descriptively in conjunction with RoSI to theoretically get a sense of what per pupil operating expenditure would be for a 100% proficiency rate at the current RoSI.

In general, Standard & Poor's refrains from using RoSI at the school level because expenditure is generally not reported by school. Instead of allocating expenditure to schools, Standard and Poor's reports RoSI on the district level or state level. In Maine expenditure data is not reported by school but by district and by level of education, elementary or secondary. Other than in one school district, Maine has only one public secondary school per district, secondary district expenditure data in Maine is school level data. Based on the similarity of the data and the added advantage of a one to one relationship between districts and secondary schools in Maine, this study will simulate the Standard & Poor's Return on Spending index (RoSI), use the RoSI in defining cost efficiency in Maine public secondary schools, identify and compare cost efficient high performing Maine public secondary schools for the general purpose of identifying the utility of the Standard & Poor's methodology on all Maine public school data.

Methodology

Literature Review & Process

A review was done of the Standard & Poor's evaluation measures and methodological process documents found on the SchoolMatters web site. Standard and Poor's defined RoSI as [(proficiency rate)/ (per pupil expenditure adjusted for region)]*1000. It used the RoSI, a general productivity measure, in conjunction with "Error Band" methodology and a "Risk-Adjusted Proficiency Index" to ascertain school districts that achieve better educational proficiency for a given level of spending, while taking into consideration the proportional enrollment of economically disadvantaged students. For our purpose in Maine, we defined RoSI as: [(3 year average percent that meet or exceed the standard on the 11th grade MEA composite within a school)/ (per pupil operating expenditure adjusted for region, teaching experience & education, and special education)]*1000.

In defining cost efficient higher proficiency schools, three ways of defining higher performing were used:

1) A Standard & Poor's type (S&P type) defined by the analysis of proficiency regressed on percent of economically disadvantaged. Higher performing in this model will be categorized using "Error Band" methodology and is defined as schools performing above one standard deviation above predicted given their proportion of disadvantaged pupils.

2) A modified Standard & Poor's type (modified S&P type) defined by the analysis of proficiency regressed on percent of economically disadvantaged, 3 year average school enrollment, and percent Special Education. Higher performing in this model will be categorized using "Error Band" methodology and is defined as schools performing above one standard deviation above predicted.

3) Maine performance categories reflecting the current Maine definition of higher performing which is based on three years of achievement data, including two years of achievement data on advantaged & disadvantaged students. Higher performing in this model is 1/3 of a standard deviation above the state average and 1/3 standardized residual above predicted.

Two definitions of cost efficient were compared:

1) A Standard & Poor's type (S&P type) defined from the analysis of RoSI regressed on percent of economically disadvantaged. "Error Band" methodology was utilized to define a school as cost efficient if its RoSI is above one standard deviation above their predicted RoSI given their proportion of disadvantaged pupil.

2) A modified Standard & Poor's type (modified S&P type) defined from the analysis of RoSI regressed on percent of economically disadvantaged, 3 year average school enrollment, and percent Special Education. "Error Band" methodology was utilized to define schools as cost efficient if its RoSI is above one standard deviation above their predicted RoSI.

Ideally, six overall definitions of cost efficient higher performing schools were theorized, based on examination of combinations of the three definitions of higher proficiency with the two definitions of cost efficiency. Using a simultaneous comparative analysis approach of proficiency and RoSI within the above mentioned combinations will allow for identification of cost efficient higher performing schools and a comparison of the varying definitions. The reason for looking first at S&P type definitions of performance and RoSI was to simulate and assess Standard & Poor's methodology with Maine data and to get a sense of higher proficiency and

cost efficiency accounting for only percent disadvantaged. The modified S&P type proficiency and RoSI models were an intermediate step which defined higher proficiency and cost efficiency given not only a certain percent disadvantaged but also accounting for other key factors, such as school size. Lastly, based on prior work done in Maine in defining higher performing, examining Maine's current criteria for higher proficiency in combination with the proposed cost efficiency models allows further thought and comparison on current Maine criteria.

Measurements and Data Sources

A total of 121 secondary schools in the state of Maine were initially included in the study. Twelve secondary schools, private and alternative secondary schools were excluded from the study, due to lack of complete data.   Descriptive statistics are used to describe schools classified as either higher performing, average performing, or lower performing by enrollment size, achievement proficiency rate, percent disadvantaged, percent Special education population, per pupil core operating expenditure (adjusted for region, teacher education and experience and special education), PCI, and RoSI based Standard & Poor's methodology of categorizing schools compared with Maine's methodology for categorizing schools based on proficiency. A disadvantaged student is defined by enrollment in the National School Lunch Program.

Academic proficiency data is from the school years 2002, 2003, and 2004. This data was supplied by Maine Educational Assessment (MEA).   Data on percent special education and percent disadvantaged is also from the MEA, but for only the most recent year of achievement data.   Enrollment and expenditure data was supplied by the Maine State Department of Education for the 2002, 2003, and 2004 school years.

Outcome measures.

There are two outcome measures that will be considered in creating the definition of "Cost efficient higher performing" public secondary schools. Proficiency rate is the three year average percent of pupils by school that meet or exceed the state standard on the 11th grade MEA. This variable is defined as the three year average of the annual average composite percent of pupils that meet or exceed the criteria per the four subject areas (Reading, Writing, Math, and Science) for the 2002, 2003, and 2004 school years.

RoSI is defined as the 3 year average percent that meet or exceed the standard on the 11th grade MEA composite within a school divided by the three year average school per pupil operating expenditure adjusted for region, teaching experience and special education, multiplied by 1000.

Predictor variables included:

Percent eligible for the National School Lunch Program. Percent eligible for the National School Lunch Program is defined as number of secondary school pupils tested that are eligible for either free lunch or reduced lunch for the 2004-2005 school year divided by the total number of students tested within the given year.

Secondary School Enrollment Size. Secondary school enrollment size is the 3 year average of the average attending secondary school (grades 9-12) enrollment measured on October 1 and April 1 for the school years 2002, 2003, and 2004.

Percent Special Education. Percent special education is defined as the number of secondary school pupils tested receiving special education services for the 2004-2005 school year divided by the total number of students tested within the given year.

Simple and multiple linear regression analyses are used to generate the predicted RoSI and the predicted proficiency level of students that meet or exceed the standard, both with standardized residuals. Variables were included in the model that resulted in statistically significant models that are easily interpretable. Scatter plots were initially referenced to interpret if nonlinear relationships or non-normal variable distributions that would invalidate the results of the regression studies. Nothing was noted as aberrant enough to disqualify regression.

Results

Table 1 displays the results of the four regression models performed: two models of S&P type with dependent variable proficiency rate and RoSI and two models from the modified S&P type with dependent variable proficiency rate and RoSI. In the S&P type models the only predictive variable is percent economically disadvantaged. For both S&P type models the constant and percent economically disadvantaged are statistically significant and indicating that as the percentage of disadvantage goes up, on average percent proficiency and RoSI decrease. Interesting results appear for the modified S&P type models. First, for the model of achievement proficiency, neither enrollment size nor percent special education population is significant. The implication is that neither enrollment size nor percent special education influence achievement proficiency on average. This modified S&P type model of achievement proficiency is

equivalent to the S&P type model of achievement proficiency, the above mentioned covariates were not statistically significant. Second, when looking at the modified S&P type model of RoSI, average enrollment size and percent economically disadvantaged are both significant. Enrollment size being significant implies that larger schools have a slight advantage in return on spending. This is not necessarily new information; it relates to the fact that operating small schools seem to cost a bit more but there seems to be an enrollment size where the cost of running schools levels off. In interpreting the S&P type RoSI model and the modified S&P type RoSI model, it is a policy issue as to which efficiency model is most appropriate. The S&P type RoSI model defines efficiency in general, answering the question "Is this a cost efficient school for the level of disadvantaged regardless of size?" The modified S&P type RoSI answers the question "Is this a cost efficient school for the level of disadvantaged given its enrollment size?" The average estimated RoSI for the modified S&P is lower than for the S&P type RoSI model estimates.

Table 1. Regression Model Results

	Model of Proficiency			Model of RoSI		
Dependent Variable	**Percent Proficiency**			**RoSI**		
S&P Type						
Independent Variables:	Coefficient	t	Sig.	Coefficient	t	Sig.
(Constant)	**40.316**	**24.502**	**0.000**	**5.363**	**22.129**	**0.000**
Variables						
Percent Economically Disadvantaged	**-0.315**	**-8.194**	**0.000**	**-0.045**	**-7.928**	**0.000**
Adjusted R-square	**0.380**			**0.366**		
Modified S&P Type						
Independent Variables:	Coefficient	t	Sig.	Coefficient	t	Sig.
(Constant)	**40.316**	**24.502**	**0.000**	**4.472**	**14.281**	**0.000**
Variables						
Percent Economically Disadvantaged	**-0.315**	**-8.194**	**0.000**	**-0.038**	**-6.879**	**0.000**
Average school enrollment	----	----	**NS**	**0.001**	**4.114**	**0.000**
Percent Special Education	----	----	**NS**	----	----	**NS**
Adjusted R-square	**0.380**			**0.449**		

Displayed in Figure 1 is the S&P type model of proficiency accounting for percent of economically disadvantaged and as a result of the prior analysis done, also represents the modified S&P type proficiency model. The data and model is in keeping with other national models of proficiency showing a decline in average proficiency with increased percentage of economically disadvantaged. Standard & Poor's "Error band" methodology defines higher performing as having a predicted proficiency value of more than one standard deviation on the figure. This group is represented in blue. There are 14 Maine secondary schools using the S&P type model and "Error band" methodology that meet the criteria for higher performing. In comparison to the Maine performance criteria, Maine also has 14 secondary schools that meet the criteria for higher performing. However, only 10 of the schools overlap in the two criteria of higher performing. There are eight schools where specification of higher performing criteria makes the difference between being considered higher performing or average expected performance.

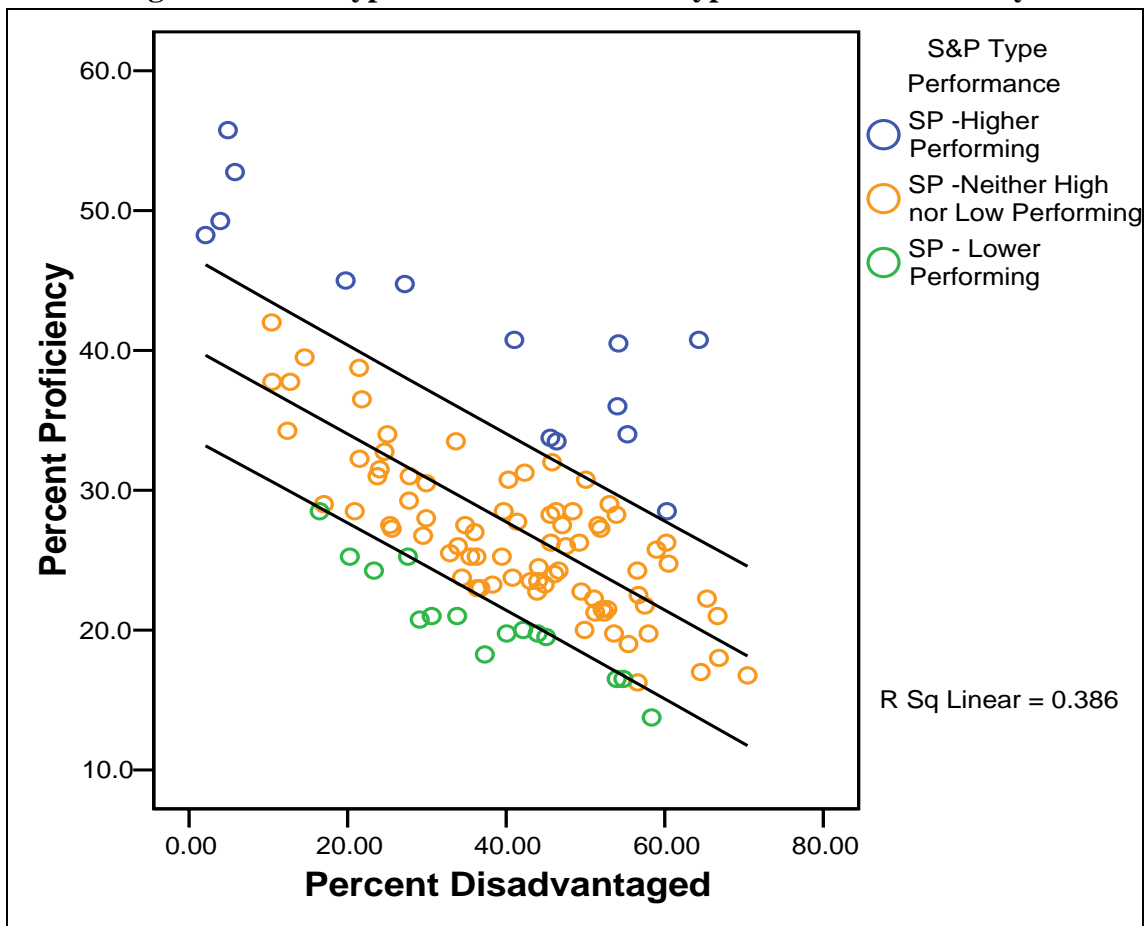**Figure 1. S&P Type and Modified S&P Type model of Proficiency**

Figure 2 models RoSI based on S&P type. This figure also incorporates the "error band" methodology indicating that RoSIs of schools above one standard deviation are efficient given the level of economically disadvantaged serviced and categorizes performance based on the S&P type model. The S&P type higher performing schools are still blue. Notice that nine out of the 14 S&P type higher performing schools are above the upper error band, implying that these nine by S&P type models of proficiency and S&P type RoSI are considered cost efficient higher performing schools.
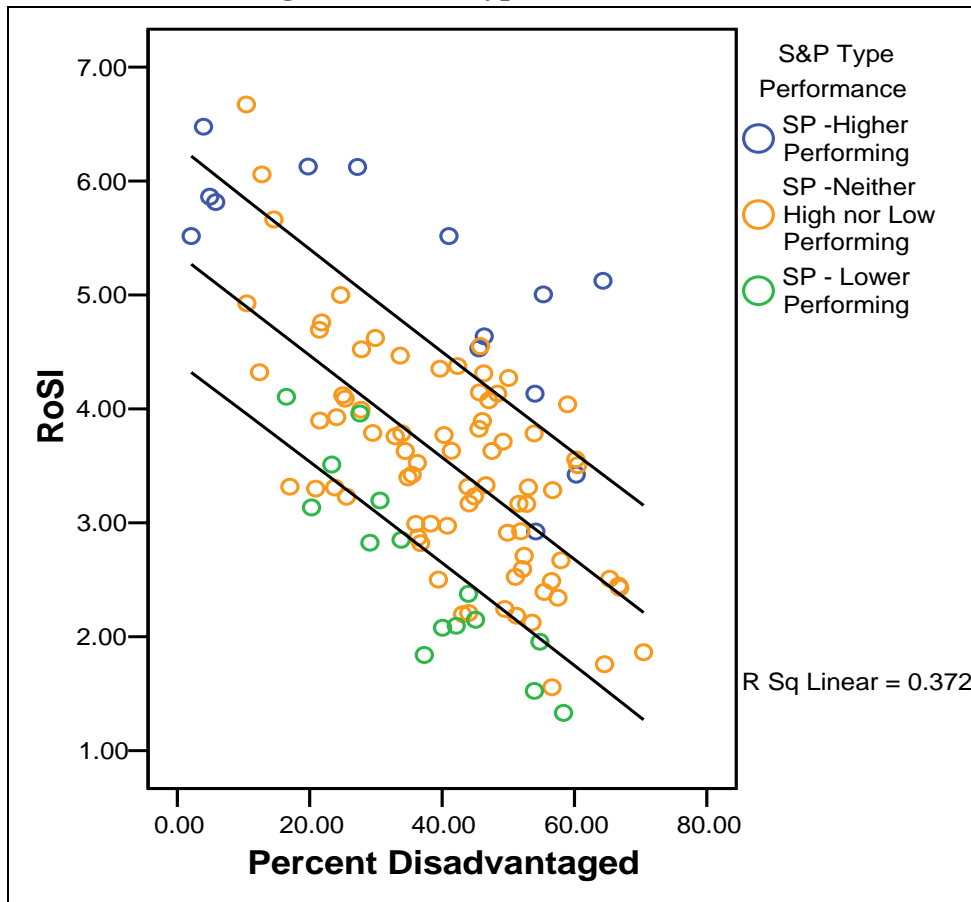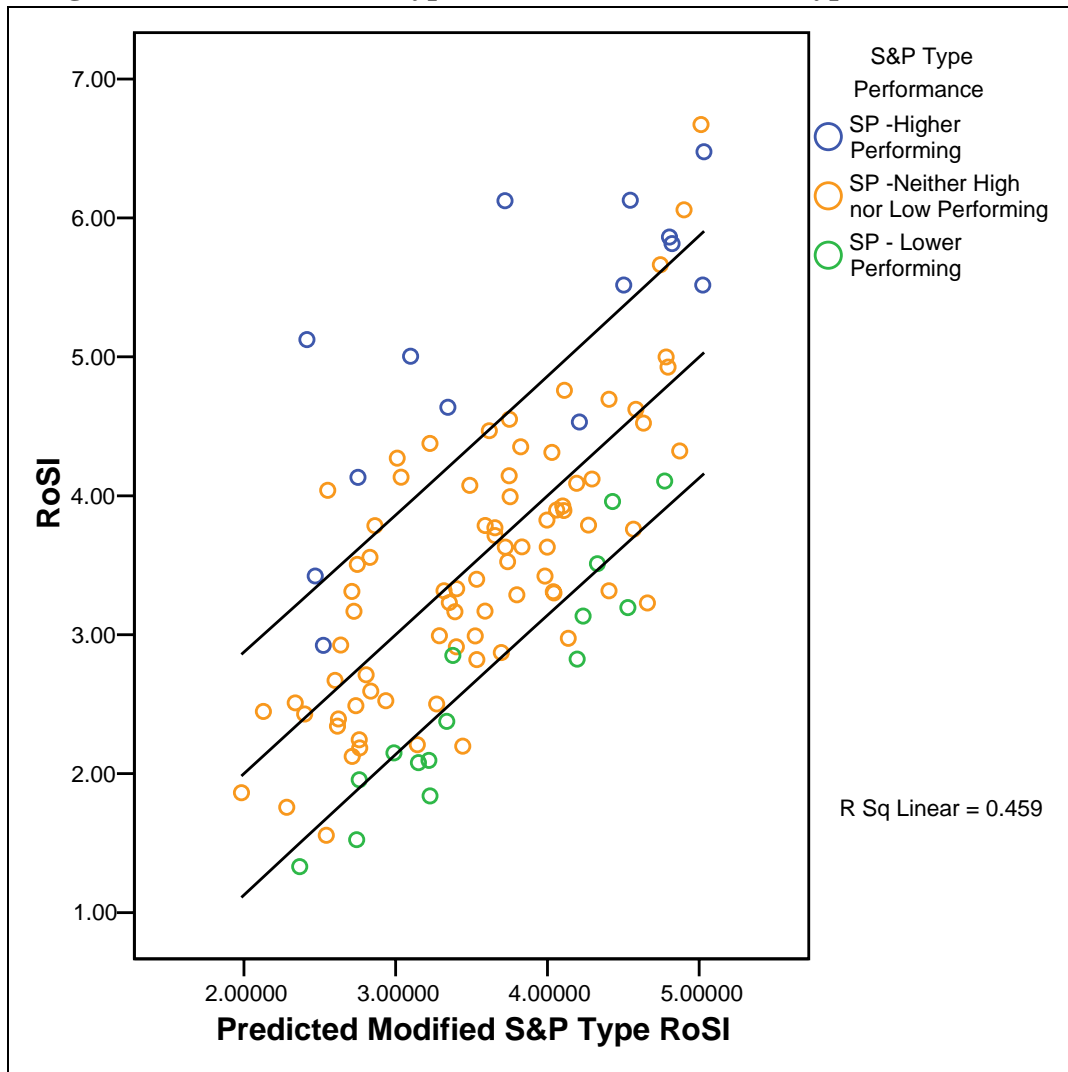
Figure 2. S&P Type model of RoSI

Figure 3 represents the modified S&P type model of RoSI and categorizes proficiency based on the S&P type model. The S&P type higher proficiency schools are blue. Using the modified S&P type RoSI criteria and S&P type proficiency, 11 of the 14 S&P higher proficiency schools are considered cost efficient. Comparing figures 2 and 3, two more schools have classified as cost efficient higher proficiency with the modified RoSI model. This inclusion of the two schools is caused because RoSI now accounts for enrollment size as well as percent disadvantaged, so given the size of the school, it is cost efficient.

Figure 3. Modified S&P Type model of RoSI for S&P Type Performance

In Figure 4, the representation of the S&P type model of RoSI is shown with school performance categorized by current Maine criteria. Out of the 14 schools defined as higher performing by Maine criteria only eight are considered cost efficient, meaning their RoSI is above one standard deviation of predicted given the level of economically disadvantaged serviced. Note also that one of the six remaining Maine higher proficiency schools is below the lower error band and is therefore considered to be not at all cost efficient.

Figure 4. S&P Type model of RoSI for Maine Performance
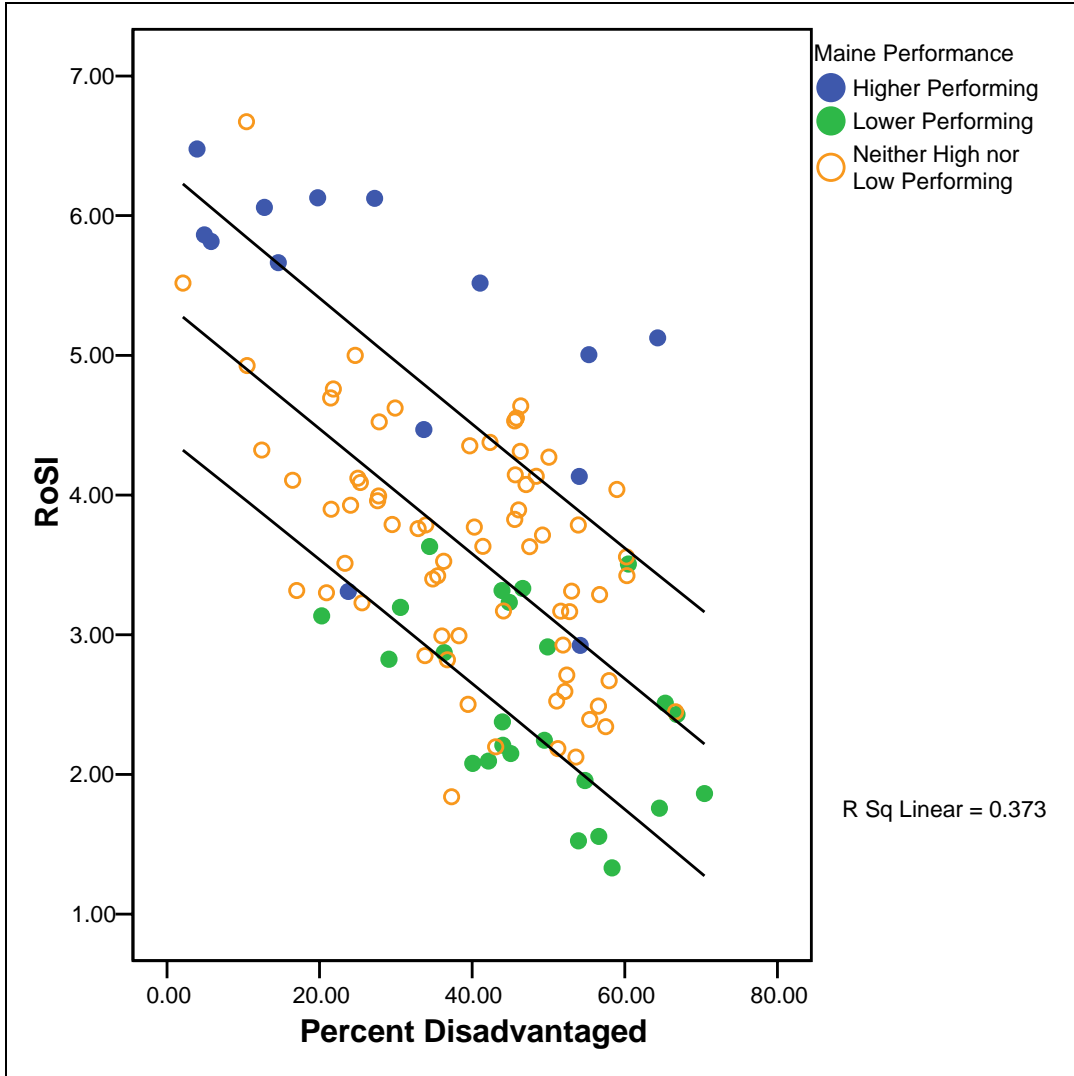
Figure 5 displays results of the modified S&P model of RoSI with school proficiency categorized by current Maine criteria. The modified S&P model accounts for percent economically disadvantaged and average school enrollment. All but four of the 14 Maine defined higher proficiency schools are above the upper error band (one standard deviation above predicted). This implies that this group of schools has higher proficiency and is cost efficient given its enrollment size and the level of economically disadvantaged served.

Figure 5. Modified S&P Type model of RoSI for Maine Performance
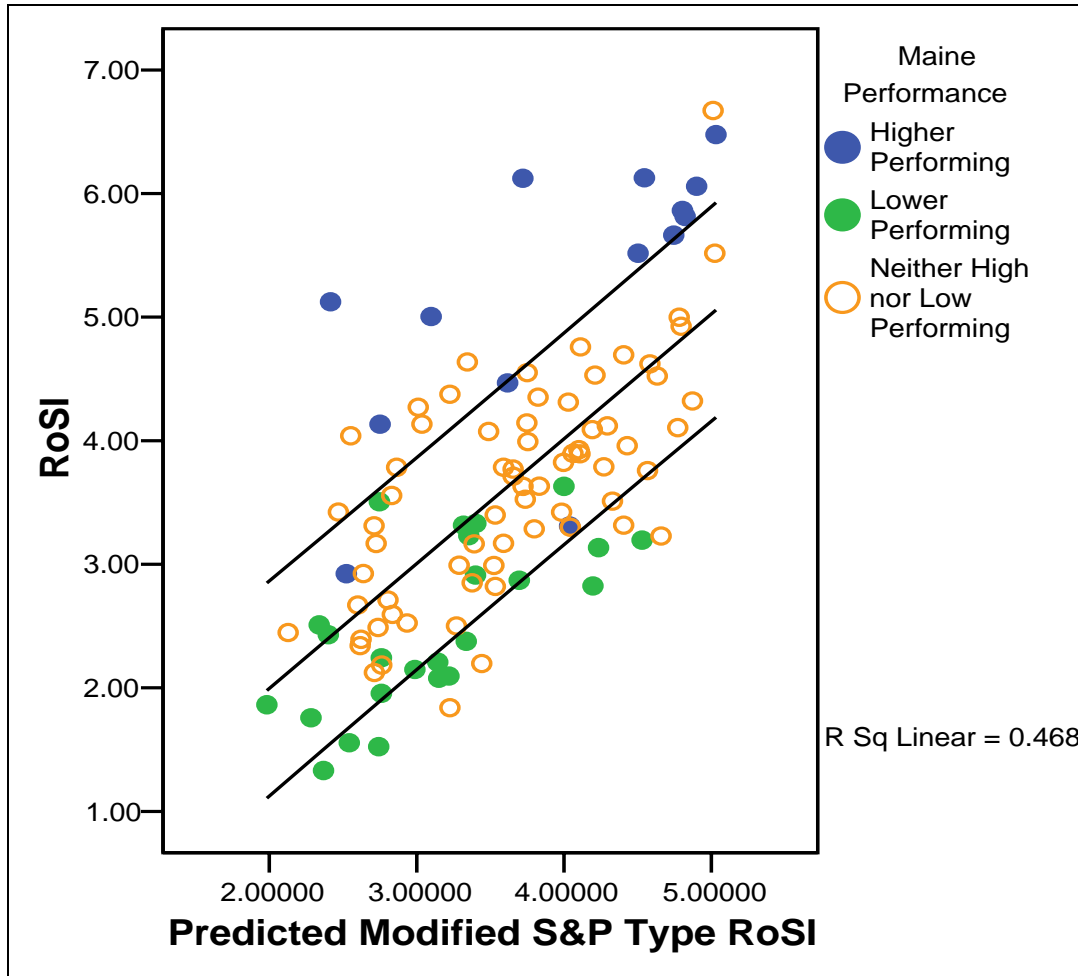
In the appendix Table A1 presents descriptive statistics for S&P type categorization of performance and for the Maine categorization of performance. Overall, the S&P type model of proficiency yields groups that are comparable to Maine's, showing that Standard & Poor's methodology works for Maine data. However, Maine's proficiency categorization criteria have been developed for Maine and not for national comparison and therefore may be more appropriate for Maine currently.

Also in the appendix Table A2 displays the schools classified as higher performing by both S&P type and Maine, or by S&P type and not Maine, or by Maine and not S&P type. It shows the proficiency and cost measures and results of the simultaneous look at performance and cost efficiency. Cost efficiency is defined here in two ways, adjusting for percent economically disadvantaged and another adjusting for economically disadvantaged and enrollment size.

Discussion

The evidence presented above illustrates some of the factors that need to be considered when trying to define Cost Efficient Higher Proficiency Schools. A holistic view at schools may be the most effective way of defining Cost Efficient Higher Proficiency Schools. The above study was a preliminary attempt at adapting a Standard & Poor's, national process methodology. There are several things that need to be considered within this study:

- Maine has more complex definition of Higher Proficiency.
- Currently, especially for the secondary school population, the economically disadvantaged and population receiving special education services are not reported as reliably as would be hoped for and may be under represented.
- In defining RoSI, a 3 year average composite proficiency is used. Other items maybe added and accounted for in the proficiency rate one chooses. An example of a factor that Maine may want to account for in its RoSI is a school's dropout rate. This would in effect not give schools merit for high dropout rates.
- Expenditure data is not reported by school at the elementary level. For Maine to use RoSI at the elementary level prior to individual school data being available would mean the information would have to be allocated.
- The "error band" methodology was only one way to apply the use of RoSI. Another way that Maine may want to consider is finding a state baseline minimum RoSI.

Identifying cost efficient higher proficiency is complex and sensitive work. As a preliminary start in identifying Maine's cost efficient higher proficiency public secondary schools, this study looked at three different definitions of higher proficiency. The simplest definition of proficiency, the S&P type, accounted for percent of economically disadvantaged. This definition is straightforward and useful for comparison within a state to a national level. The current Maine definition of higher proficiency is more complex and was defined for Maine using Maine data and may not be transferable nationally. This study created a RoSI and PCI measure within its data as defined by Standard & Poor's. Both of these measures have been extremely useful in analysis of cost efficiency and in evaluating the over all cost of providing a highly proficient education. There were two models of cost efficiency, RoSI, the return on spending index explored in this study. One definition S&P type RoSI accounted for only the

percent of economically disadvantaged, while the modified S&P type RoSI accounted for the percent of economically disadvantaged and school enrollment size. It is a matter of continued debate over education funding and identifying over all "best practice measures" in education and education management that will mitigate which definitions of higher proficiency and cost efficiency are adopted for use in the simultaneous characterization of model cost efficient higher performing schools in Maine and nationally.

References

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Hampel, Martin, Introducing the SES Risk-Adjusted Performance Index, SES Research Methods Paper, No. 2, New York: Standard & Poor's, March 2005, available at www.schoolmatters.com

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Appendix

Table A1. Descriptive of schools categorized by S&P Performance or Maine Performance

S&P Type Performing	N	3-Year Average School Enrollment		3-Year Average Percent Proficiency			Percent Free/Reduced Lunch (2005)			Percent SPED (2005)		
		Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Higher Performing	14	99	1479	41.68	28.5	55.8	34.63	2.09	64.31	.09	.00	.18
Neither Higher nor Lower	80	126	1377	26.67	16.3	42.0	41.32	10.43	70.45	.13	.01	.34
Lower Performing	15	102	1136	20.67	13.8	28.5	37.12	16.48	58.35	.11	.00	.28
Total	109	99	1479	27.77	13.8	55.8	39.88	2.09	70.45	.12	.00	.34
Maine Performing	**N**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Higher Performing	14	99	1479	41.52	31.0	55.8	29.66	3.95	64.31	.11	.00	.24
Neither Higher nor Lower	70	126	1377	27.58	18.3	48.3	39.13	2.09	66.67	.12	.00	.25
Lower Performing	24	102	1136	20.46	13.8	25.3	48.01	20.28	70.45	.15	.00	.34
Total	108	99	1479	27.81	13.8	55.8	39.87	2.09	70.45	.12	.00	.34

S&P Type Performing	N	3 year average Per pupil Expenditure			PCI			RoSI		
		Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Higher Performing	14	$8,377	$6,794	$13,854	206.68	154.40	342.08	5.05	2.92	6.48
Neither Higher nor Lower	79	$7,837	$6,058	$10,695	309.47	149.88	642.69	3.49	1.56	6.67
Lower Performing	15	$8,367	$6,378	$10,824	428.30	243.57	751.29	2.60	1.33	4.11
Total	108	$7,981	$6,058	$13,854	312.65	149.88	751.29	3.58	1.33	6.67
Maine Performing	**N**	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Higher Performing	14	$8,258	$6,231	$13,854	203.67	154.40	342.08	5.19	2.92	6.48
Neither Higher nor Lower	69	$7,745	$6,058	$10,695	292.89	149.88	543.60	3.63	1.84	6.67
Lower Performing	24	$8,499	$6,541	$10,824	432.07	275.43	751.29	2.50	1.33	3.63
Total	107	$7,981	$6,058	$13,854	312.43	149.88	751.29	3.58	1.33	6.67

Table A2. Schools classified as Higher Proficiency by either S&P type, Maine, or Both

Higher Performing: Maine and S&P type	3 Year Average Enrollment	Percent Economically Disadvantaged	Percent that Meet or Exceed Standard	3 year average Per pupil Expenditure	PCI	RoSI	S&P Proficiency & S&P RoSI	S&P Proficiency & modified S&P RoSI	Maine & S&P type RoSI	Maine & S&P type RoSI
A	662	3.95	49.3	$7,604	154.40	6.48	ABV	ABV	ABV	ABV
B	767	19.76	45.0	$7,344	163.20	6.13	ABV	ABV	ABV	ABV
C	675	55.30	34.0	$6,794	199.83	5.00	ABV	ABV	ABV	ABV
D	308	54.04	36.0	$8,711	241.96	4.13	ABV	ABV	ABV	ABV
E	262	27.22	44.8	$7,308	163.31	6.12	ABV	ABV	ABV	ABV
F	1479	41.04	40.8	$7,386	181.26	5.52	ABV	ABV	ABV	ABV
G	531	5.80	52.8	$9,071	171.97	5.81	Within	ABV	Within	ABV
H	483	4.91	55.8	$9,509	170.57	5.86	Within	ABV	Within	ABV
I	99	54.17	40.5	$13,854	342.08	2.92	Within	Within	Within	Within
J	357	64.31	40.8	$7,953	195.16	5.12	ABV	ABV	ABV	ABV
S&P type Higher Proficiency Schools but not Maine	3 Year Average Enrollment	Percent Economically Disadvantaged	Percent that Meet or Exceed Standard	3 year average Per pupil Expenditure	PCI	RoSI	S&P Proficiency & S&P RoSI	S&P Proficiency & modified S&P RoSI	Maine & S&P type RoSI	Maine & S&P type RoSI
K	265	60.28	28.5	$8,327	292.19	3.42	Within	ABV	NA	NA
L	589	46.37	33.5	$7,224	215.65	4.64	ABV	ABV	NA	NA
M	1368	45.58	33.8	$7,449	220.72	4.53	ABV	Within	NA	NA
N	588	2.09	48.3	$8,746	181.26	5.52	Within	Within	NA	NA

Table A2. continued.

Maine Higher Proficiency Schools but not S&P type	3 Year Average Enrollment	Percent Economically Disadvantaged	Percent that Meet or Exceed Standard	3 year average Per pupil Expenditure	PCI	RoSI	S&P Proficiency & S&P RoSI	S&P Proficiency & modified S&P RoSI	Maine & S&P type RoSI	Maine & S&P type RoSI
KK	437	23.77	31.0	$9,367	302.16	3.31	NA	NA	Below	Within
LL	851	12.77	37.8	$6,231	165.06	6.06	NA	NA	ABV	ABV
MM	770	14.59	39.5	$6,974	176.57	5.66	NA	NA	Within	Within
NN	394	33.67	33.5	$7,498	223.81	4.47	NA	NA	Within	Within