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Kentucky School Districts as Educational Bright Spots

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Every year a select group of Kentucky school districts perform better than expected on measures of educational achievement. These measures include things like the percentage of elementary students who achieve proficiency or distinguished in reading, or the proportion of less-advantaged middle school students who show a similar level of competency on the math assessment. Understanding the reasons for better-than-expected performance is fundamentally important. While our analysis does not address the question of *why* students perform better than expected, our results can be used to inform further inquiry on that question. Our work is best viewed as a statistical sieve designed to narrow the list of candidate districts worthy of closer examination. By subjecting a school district to closer scrutiny, one can gain a sense of confidence about identifying the constellation of factors facilitating exceptional performance.

There are wide differences in the learning environments, finances, and student outcomes among and within Kentucky's 173 school districts. This is not surprising given that the largest school district in the state, Jefferson County, has 97,000 students and 165 schools, while the smallest, West Point Independent in Hardin County, has one school with 120 students.[1] Since school districts are likely to reflect the underlying economic conditions of their surrounding communities, the socioeconomic characteristics of Kentucky's school districts are as diverse as the state itself. This is evidenced by the percentages of less-advantaged students in the Oldham and Owsley County School Districts, which are, respectively, 22 and 89 percent. Likewise, the average per pupil expenditures in the top quartile of districts is one-third higher than those in the bottom quartile—$13,380 compared to $10,140.

Student outcomes, of course, are the bottom lines for school districts, and there is a similarly wide distribution of outcomes across the state's 173 districts. For example, the percentage of elementary students in the Anchorage Independent School District achieving a proficient or distinguished score on the 2016-2017 Kentucky Performance Rating for Educational Progress (K-PREP) in mathematics is 84 percent—substantially higher than the 9.4 percent for the Silver Grove Independent School District. While the size of this difference might be surprising—roughly 75 percentage points—its existence is not. Anchorage Independent enjoys advantages over Silver Grove Independent, such as more experienced teachers and fewer less-advantaged students.

From this broad range of student outcomes, family and community backgrounds, and school district characteristics, we identify districts that have performed better than expected—which we refer to as "bright spots." For example, the Jenkins Independent School District in Letcher County and the Russell Independent School District in Greenup County performed similarly on the 2016-2017 K-PREP elementary mathematics assessment, demonstrated by 57.3 and 58.2 percent of their students scoring proficient or distinguished, respectively. Yet, once we consider student, district, and community factors, only one of these districts emerges as a "bright spot"—Jenkins Independent. While Russell Independent performs at a level we expect, Jenkins Independent performs much better than we expect; in fact, it performs 20 percentage points higher than we expect. In the sections that follow, we provide additional information on our method, approach, and results.

METHOD

Using a district-level database that includes, but is not limited to, data from the Kentucky Department of Education (KDE), the Kentucky Center for Statistics (KYstats), and the U.S. Census Bureau, we analyze data covering six years—2012 to 2017.[2] We estimate an expected level of performance using regression analysis—a statistical method for estimating, expressing, and understanding the relationships between variables—and then compare it to the actual performance. The difference between actual performance and model-based expected performance is the residual. If the size of the residual is sufficiently large, we consider it a "bright spot."[3] The development and creation

[1] West Point Independent School District is one of five in the state that does not have a high school. The other four are Anchorage Independent, East Bernstadt Independent, Science Hill Independent, and Southgate Independent.

[2] For the Kentucky Department of Education School Report Card data, these years correspond to the 2011-2012 to the 2016-2017 academic years. The Census data, on the other hand, is based on a calendar year.

[3] The threshold we use for determining whether a positive residual is a "bright spot" is when the studentized residual is 2 or higher.

of our statistical models is informed by Prichard Committee personnel, the scholarly literature on factors affecting student outcomes, data availability, and technical considerations regarding variable selection and model construction.

Outcome Variables

We examine 18 educational outcome measures using two different variations of a regression model. First, we evaluate a measure, such as K-PREP elementary mathematics outcomes, to assess whether there are significant differences in performance *between* districts. Second, to determine whether there are significant differences *within* a district over time, we add a variable to capture the district-effect. The 18 educational outcome variables include:

1. K-PREP proficiency or higher points. This is the average of four K-PREP scores in a district—elementary reading and math along with middle school reading and math (1 outcome measure).[4]
2. K-PREP proficiency or higher points per $1,000 in per pupil expenditures. This is the average of four K-PREP scores in a district—elementary reading and math along with middle school reading and math—normalized on a per $1,000 basis (1 outcome measure).[5]
3. K-PREP Reading, Elementary School (grades 3, 4, and 5 combined) and Middle School (grades 6, 7, 8 combined), percentage reaching proficient/distinguished, all students and less-advantaged students qualifying for free- or reduced-price meals (4 outcome variables).
4. K-PREP Mathematics, Elementary and Middle School, percentage reaching proficient/distinguished, all students and less-advantaged students (4 outcome variables).
5. ACT Grade 11 Average Score (overall composite) as well as percentages reaching college readiness benchmarks for reading and math, all students and less-advantaged students (6 outcome variables).
6. In- and out-of-state college going rates (combined) derived from the KDE Report Card data (i.e., Transition to Adult Life after Graduation) and the in-state college going rate from the Kentucky High School Feedback Reports (2 outcome variables).[6]

Control Variables

We examined several statistical models, which included different combinations of independent or control variables. These variables include socioeconomic factors (e.g., percentage qualifying for free and reduced lunch), demographic characteristics (e.g., race), teacher characteristics (i.e., experience), student population factors (e.g., ELL), geographic measures (e.g., urbanity), and community characteristics (e.g., educational attainment of adults, children living in nonfamily households). Ultimately, our models examining K-PREP and ACT outcome measures include the following variables:

1. Less-advantaged students, specified as the percentage of the students in a district participating in the National School Lunch Program (NSLP). In 2017, the Kentucky average is 60.4 percent (56.4% free, 4.4% reduced).[7]
2. Children under 18 living in single parent or nonfamily households, specified at the county level. Around 34 percent of children in Kentucky had this living arrangement in 2017.
3. Minority children, specified as the percentage of non-White (not Hispanic) children enrolled in the district (i.e., African American, Hispanic, Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiple races). The statewide percentage of non-White (not Hispanic) students was 22.6 percent in 2017.

[4] This measure is only used if all four test scores are available for a given year.

[5] The per pupil expenditure numbers here reflect the per pupil spending totals in the Annual Financial Revenues and Expenditures files (total expenses in items 1000 to 3400); other non-instruction (3900), facility (3900 to 4900), debt service (5100), and fund transfers (5200) are not included here. These data files are available at <https://tinyurl.com/ybbvx6yf>.

[6] The Kentucky High School Feedback Report data on in-state college going rates are only available for 5 years, AY2012 to AY2016.

[7] This is the statewide average, not the average of the 173 school districts.

4. Independent school districts, specified as a dichotomous variable. Of Kentucky's 173 school districts, 53 are independent.
5. District with no high school, specified as a dichotomous variable. Kentucky has five districts without high schools.[8]
6. Teaching experience, specified as the average years of teaching experience in the district. The statewide average in 2017 was 11.9 years.
7. School district student enrollment, specified as the logged (base 10). In 2017, the median sized Kentucky school district was about 2,240 students (log base 10 = 3.35).
8. Year, specified as the year of the panel data, 2012 to 2017.

For the models used to assess the college going rates, we included a subset of the variables listed above (numbers 1, 2, 4, 6, and 8) along with two additional variables:

9. Bachelor's degree or higher, specified as the percentage of the population 25 and over in the county with at least a BA degree. The statewide percentage in 2017 was 24 percent.
10. ACT Composite, specified as the district level overall ACT composite score. The statewide percentage was 19.8 in 2017.

Finally, for each version of the model used to assess K-PREP, ACT, or college attendance, we included a district-level dichotomous variable to identify significant changes within a district over the time period. The summary statistics for the database are presented in Table 1.[9]

TABLE 1 SUMMARY STATISTICS

Variable	Label	Number of	Mean	Minimum	Maximum
PRO_DIS_AVG	K-PREP Proficient/Distinquished, Reading & Math, Elem. & Middle School (%)	985	47.4	18.1	90.1
PPEXPEND	Per Pupil Expenditures ($)	1038	$ 10,173	$ 7,380	$ 20,945
PDKPREP_1000	PRO_DIS_AVG Per $1,000 PPEXPEND	985	4.8	1.3	9.2
PRO_DIS_Math_E	K-PREP Proficient/Distinquished (%), Elementary Mathematics	1028	44.6	9.1	90.2
PRO_DIS_Read_E	K-PREP Proficient/Distinquished (%), Elementary Reading	1027	51.0	12.5	90.8
PRO_DIS_Math_M	K-PREP Proficient/Distinquished (%), Middle School Mathematics	999	42.1	11.4	94.0
PRO_DIS_Read_M	K-PREP Proficient/Distinquished (%), Middle School Reading	1002	52.3	17.5	90.6
PRO_DIS_Math_E_FR	Free and Reduced Lunch Recipients (PRO_DIS_Math_E)	1018	36.4	3.2	74.8
PRO_DIS_Math_M_FR	Free and Reduced Lunch Recipients (PRO_DIS_Math_M)	969	32.7	10.7	64.5
PRO_DIS_Read_E_FR	Free and Reduced Lunch Recipients (PRO_DIS_Read_E)	1015	43.0	11.1	77.7
PRO_DIS_Read_M_FR	Free and Reduced Lunch Recipients (PRO_DIS_Read_M)	967	43.5	12.7	69.0
ACT_COMP	ACT Composite Score	1007	19.1	15.6	25.7
ACT_MATH_PCT	ACT Math, College & Career Ready (%)	1007	37.7	8.2	88.5
ACT_READ_PCT	ACT Reading, College & Career Ready (%)	1006	45.6	16.7	88.1
COMPOSITE_MEAN_SCORE_FR	Free and Reduced Lunch Recipients (ACT_COMP)	972	17.8	15.4	23.2
MATHEMATICS_BNCHMRK_PCT_FR	Free and Reduced Lunch Recipients (ACT_MATH_PCT)	972	27.6	0.0	70.4
READING_BNCHMRK_PCT_FR	Free and Reduced Lunch Recipients (ACT_READ_PCT)	972	36.4	6.9	76.9
TRANSITION_COLLEGE_INOUT_PCT	Students Attending College (In State & Out of State %)	999	53.1	0.4	100.0
INSTATE	Students Attending College (In State %)	840	55.0	9.1	100.0
FRLUNCH_PCT	Free and Reduced Lunch (%)	1038	62.6	0.3	94.4
CHILD_SP_NF	Children Living in Single Parent or non-Family Households, county-level (%)	1038	33.7	14.4	51.2
NONWHIPER	District-level Non-White, not Hispanic Students (%)	1038	12.2	0.7	62.0
INDEPENDENT	Independent District (%)	1038	30.6	0	1
NOHS	No High School in District (%)	1038	2.9	0	1
AVG_YRS_TCH_EXP	Teachers Experience (years)	1038	12.1	5.6	17.8
MEMBERSHIP_TOTAL	District Size (student enrollment)	1038	3,779	110	96,774
DIST_SIZE_LG10	District Size, Logged Base 10	1038	3.33	2.04	4.99
BA	Bachelor's Degree or Higher, 25 or older, county-level (%)	1038	16.4	5.5	41.8

SELECTED RESULTS

The information provided below is illustrative of the overall results. We begin by presenting results for K-PREP proficiency or higher points (PRO_DIS_AVG). This is the average of four K-PREP scores in a district—elementary

[8] This variable was not included in the ACT analysis since these data are available only for districts with high schools. Also, it was not included in the analysis of college going rates.

[9] The values in Table 1 include 173 districts over six years (2012 to 2017).

reading and math along with middle school reading and math. For example, the percentage of Boyle County elementary and middle school students achieving a proficient or distinguished score on the 2016-2017 Kentucky Performance Rating for Educational Progress (K-PREP) in mathematics and reading is 71.6 percent[10]—over 20 percentage points higher than the district-level state average of 50.8 percent. Boyle County School District, along with eleven others, performed better than expected at least once from 2012 to 2017. The other districts are: Anchorage Independent, Casey County, Cloverport Independent, Floyd County, Hazard Independent, Jenkins Independent, Johnson County, Lyon County, Murray Independent, West Point Independent, and Whitley County.

The parameter estimates are presented in Table 2. All estimates are statistically significant. Economically less-advantaged students, children living in single-parent households, and a higher percentage of minority children are associated with lower performance on this K-PREP outcome measure. On the other hand, independent districts, those with no high schools, higher levels of teacher experience, and larger districts are associated with higher levels of performance on this outcome measure. There is also a statistically significant independent effect for year, as evidenced by the coefficient value of 2.133.[11]

While this model accounts for almost two-thirds of the variation in this student outcome measure (rsq=.61653), there are other factors not accounted for by the model that clearly play an important role. Something is happening in these districts enabling the students to perform better than expected. Whatever those factors are, it is not captured in the regression model, and by identifying these factors one can gain additional insights into the role they play and whether they are transferable to other districts. There could be, for example, specific district-level management practices, leadership approaches, or student support programs that facilitated better-than-expected outcomes in these twelve districts.

TABLE 2 - PRO_DIS_AVG PARAMETER ESTIMATES

TYPE	Intercept	FRLUNCH_PCT	CHILD_SP_NF	NONWHIPER	INDEPENDENT	NOHS	AVG_YRS_TCH_EXP	DIST_SIZE_LG10	YEAR
PARMS	-4250.9	-0.375	-0.076	-0.127	1.905	8.478	0.705	5.776	2.133
STDERR	223.0	0.015	0.032	0.020	0.582	1.215	0.119	0.652	0.111
T	-19.1	-24.9	-2.4	-6.4	3.3	7.0	5.9	8.9	19.3
PVALUE	0.000	0.000	0.018	0.000	0.001	0.000	0.000	0.000	0.000
Note: EDF = 976, RSQ = .61653									

A second model examining this outcome measure, which includes additional variables to control for the district-effect, reveals 15 school districts with a significant *within* district positive residual for at least one of the years studied—that is, a district performed significantly better than its average for at least one of the years from 2012 to 2017 (see "PRO_DIS_AVG SD FE").[12] By examining districts with a significant positive residual in 2017, it is possible to identify districts that experienced steady improvement from 2012 to 2017. There are five school districts with a significant positive residual in 2017, but only one was also a "bright spot" in the first model described above—Floyd County.

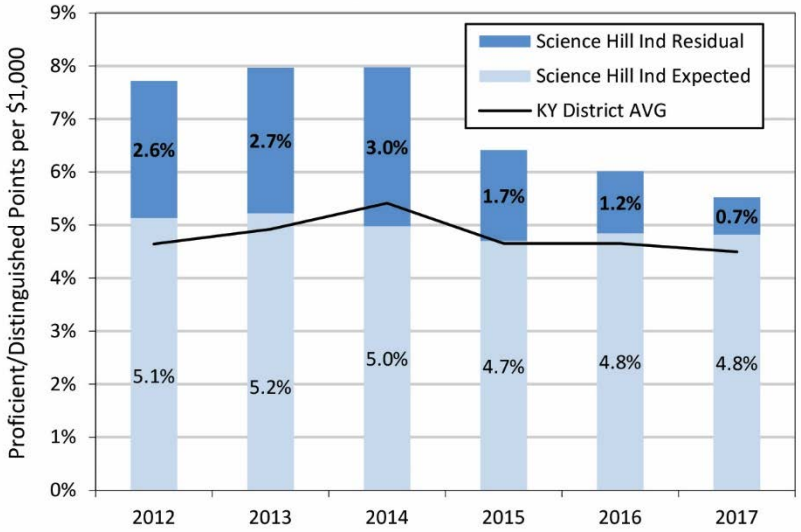
[10] These numbers reflect the average of the four tests and represent all students. The Boyle County district-level scores, for instance, were 68% (elementary school mathematics), 75.5% (elementary reading), 69.6% (middle school mathematics), and 73.4% (middle reading)—an overall average of 71.6% scoring proficient/distinguished.

[11] This coefficient is consistent with the district-level means for this outcome measure, which are, from 2012 to 2017, 42.3, 44.3, 48.7, 47.9, 51.2, and 50.8.

[12] We use the same independent variables presented in Table 2 along with a series of dichotomous variables for the school districts. The control district is Barren County School District (DISTRICT_NUM = 021).

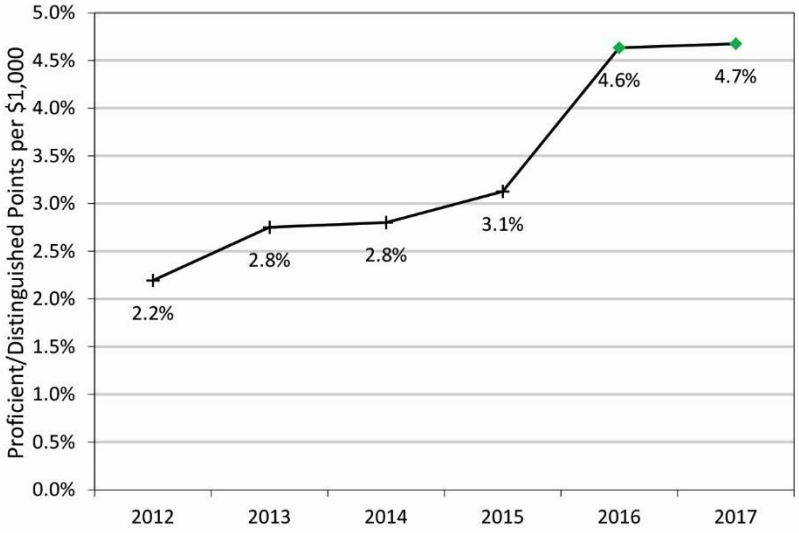
Another interesting outcome measure is the number of K-PREP proficiency or higher points per $1,000 in per pupil expenditures. There are 15 districts that performed better than expected at least once from 2012 to 2017 (see "PDKPREP_1000"). One of these districts distinguishes itself by registering as a "bright spot" in four of the six years analyzed—Science Hill Independent. As shown in Figure 1, Science Hill Independent School District is a bright spot from 2012 to 2015. Our model-generated expected value for this district in 2012, for example, is 5.1 percentage points per $1,000 in per pupil expenditures, but its actual value is 7.7—resulting in a positive residual of 2.6.

FIGURE 1
Science Hill Independent School District, 2012-2017
(K-PREP Math & Reading, Elementary & Middle, per $1,000)



The results shown in Figure 2 show a different facet of this outcome measure. Using a slightly different model by introducing an explanatory variable that captures the district-level effect, we find that the Robertson County School District emerges as a "bright spot" as a district that steadily and significantly improved its performance over this time period. The data in the line chart show its actual performance on this outcome measure, with 2016 and 2017 as "bright spots" for the district (see "PDKREP_1000 SD FE").

FIGURE 2
Robertson County School District, 2012-2017
(K-PREP Math & Reading, Elementary & Middle, per $1,000)



There are many ways to think about and present these results. The illustrations heretofore have focused on a single outcome measure, such as overall performance on K-PREP or the number of K-PREP percentage points per $1,000 in per pupil expenditures. However, combining different outcome measures can be instructive and revealing.

When looking at each of the educational outcome measures described above, there are many candidate school districts worthy of further study because those students performed better than expected given the characteristics of the students, the schools in the district, and the surrounding community. However, if the *overall* elementary student population in a district performs better than expect on, for instance, the K-PREP for mathematics assessment, but the *less-advantaged students* in the district are not, then is the district worthy of being labeled a "bright spot"? Obviously, it depends, but a district that performs well on both is a more interesting candidate for additional study.

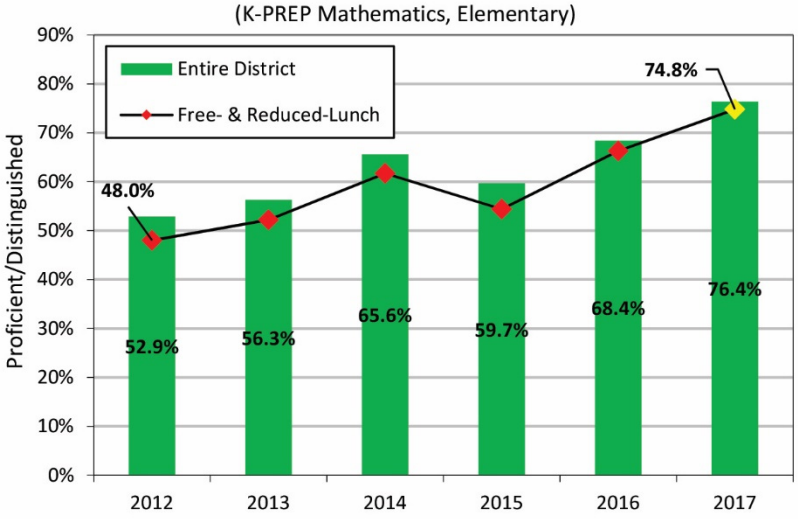
With this holistic approach in mind, we evaluate seven different outcome measures to identify any districts that met two conditions: first, when considering all of the students, the district performed better than expected in at least one of the years using the model *without* the district-level effect; and second, when considering only less-advantaged students, the district performed better than expected in 2017 using the model *with* the district-level effect variable. By using these two conditions, we identify twelve districts where all students (on average) perform better than expected at least once during this period, and less-advantaged students show steady progress over the time period culminating with a better-than-expected outcome in 2017. All twelve districts are listed in Table 3 with Monroe County School District, one of the twelve, shown in Figure 3. This school district performed better than expected in K-PREP Elementary Mathematics in all six years and demonstrated significant progress among less-advantaged students.

TABLE 3 – TWELVE EXEMPLAR SCHOOL DISTRICTS

School District	Educational Outcome Measures
Barbourville Independent	ACT Mathematics College & Career Ready
Fleming County	K-PREP Middle School Mathematics
Grayson County	ACT Mathematics College & Career Ready
Hazard Independent	K-PREP Elementary Reading
Hickman County	K-PREP Middle School Reading
Jenkins Independent	K-PREP Elementary Reading
Monroe County	K-PREP Elementary Mathematics
Paintsville Independent	ACT Reading College & Career Ready
Pineville Independent	ACT Reading College & Career Ready
Robertson County	K-PREP Elementary Reading & Elementary Mathematics
Somerset Independent	K-PREP Middle School Mathematics
Woodford County	ACT Composite and ACT Mathematics College & Career Ready

Note: The seven measures analyzed include four K-PREP assessments, elementary and middle school reading and mathematics, and three ACT measures, the overall composite and percentage achieving college and career readiness for reading and mathematics.

FIGURE 3
Monroe County School District, 2012-2017
(K-PREP Mathematics, Elementary)



Source: Kentucky Department of Education, Data Sets, 2011-2012 to 2016-2017
Note: Dark green bars and/or yellow diamonds indicate presence of a "Bright Spot"

There are many ways to view the results of this analysis. In an effort to acquire a "big picture" perspective, we have sifted through the results and assigned "extra points" to those districts whose bright spots occurred in multiple years or in recent years (i.e., 2016 or 2017). By assigning a value of "1" when there is a bright spot, "1.5" if the bright spot occurs in multiple years or recently, and "2" if it occurs both multiple times and recently, we can assign "performance values" to districts. For example, elementary school students in the Boyle County School District performed better than expected on the K-PREP Reading assessment in 2014, 2016, and 2017. If this had only happened in 2014, we would have awarded them a "1" since it occurred in one year and "not recently." However, it happened in multiple years and recently—therefore Boyle County receives a "2" on this measure.

With 18 different outcome measures used in two different models, we have 36 separate measures to combine into a single point value. Also, we have combined outcome measures around specific categories, such as post-secondary education, middle school, elementary school, mathematics, reading, and ACT. Since there are many ways to prioritize, weight, or combine measures, our ranking should be viewed as suggestive or illustrative—not definitive. With that caveat, selected candidate bright spot school districts are presented below in Table 4. The measures can be combined to tailor different inquires (see "Convergence, Large Table").

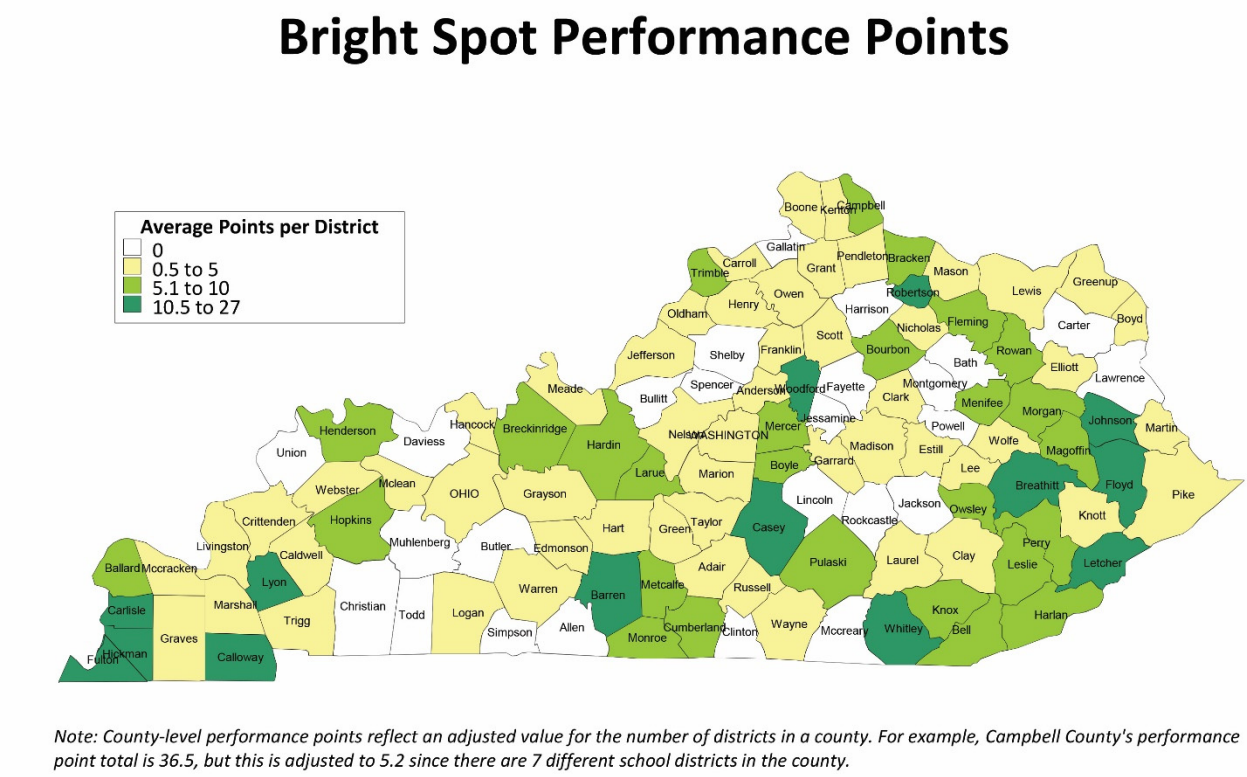
TABLE 4 – SELECTED BRIGHT SPOTS

OVERALL (36 measures)		K-PREP per $1,000 (2)		K-PREP, Mathematics (8)	
District	**Points**	**District**	**Points**	**District**	**Points**
Robertson County	27	Science Hill Independent	3	Robertson County	9
Jenkins Independent	26.5	Beechwood Independent	2.5	Breckinridge County	8
Jackson Independent	25.5	Lyon County	2.5	Murray Independent	8
Paintsville Independent	25	Boyle County	2	Floyd County	7
Murray Independent	23	Laurel County	2	Fleming County	6.5
Carlisle County	21.5	Pulaski County	2	Jenkins Independent	6
Floyd County	21.5	Robertson County	2	Burgin Independent	5.5
Fulton Independent	20.5	Somerset Independent	2	Jackson Independent	5.5
Caverna Independent	20	East Bernstadt Independent	1.5	Monroe County	5.5
Williamsburg Independent	19.5	Paintsville Independent	1.5	Lyon County	5
ACT (12)		**Less-Advantaged, K-PREP & ACT (14)**		**Attending College (4)**	
District	**Points**	**District**	**Points**	**District**	**Points**
Williamsburg Independent	17.5	Paintsville Independent	12	Jackson Independent	5.5
Barbourville Independent	13	Caverna Independent	12	Carlisle County	4.5
Carlisle County	11.5	Murray Independent	11	Fulton Independent	4.5
Jackson Independent	11	Jackson Independent	11	Fulton County	4
Caverna Independent	11	Robertson County	10	Hazard Independent	4
Burgin Independent	11	Jenkins Independent	9.5	Paintsville Independent	3.5
Glasgow Independent	10.5	Floyd County	9	Jenkins Independent	3.5
Beechwood Independent	10.5	Lyon County	9	Fairview Independent	3.5
Augusta Independent	10.5	Carlisle County	9	Rowan County	3.5
Woodford County	10.5	Harlan Independent	9	—	—
—	—	Pikeville Independent	9	—	—

Hints for interpreting this table: K-PREP, Mathematics includes 8 measures: elementary and middle school, all students as well as those receiving free and reduced lunches, using both types of models. ACT includes 12 measures: Composite, Math, and Reading x both types of models x all students as well as less-advantaged.

CONCLUSIONS

Kentucky school districts that perform better than expected are located in all regions of the state, as illustrated in the county-level map below. The points portrayed on the map represent the total number of "performance points" garnered at the county level adjusted by the number of districts in the county. For example, Campbell County has a total of 36.5 performance points, but we have adjusted the total by considering that there are 7 school districts in Campbell County—resulting in an adjusted bright spot performance point county value of 5.2. The main point is to illustrate the wide geographical distribution of bright spots across the Commonwealth.



Note: County-level performance points reflect an adjusted value for the number of districts in a county. For example, Campbell County's performance point total is 36.5, but this is adjusted to 5.2 since there are 7 different school districts in the county.

Topics for Additional Study

First, while our analysis to date has been conducted at the district level, a *school-level analysis* could offer additional clarity about potential bright spots. Our district-level focus, while instructive, unfortunately limits our understanding of school-level differences. This is especially problematic for larger school districts with many schools that are heterogeneous. The Jefferson County School District is the best example of this limitation. There is wide variation among its 165 schools with respect to student characteristics and academic performance, which likely limits our ability to uncover district-level factors leading to better-than-expected academic outcomes. A school-level analysis using district-level fixed effects could reveal new insights about educational bright spots.

Second, educational expenditures are currently presented only at the district level. However, this will soon change as the Kentucky Department of Education is planning to release funding data at the school level. Discussions about nearly every important educational public policy issue eventually come around to funding. Performing a school-level analysis that includes *school-level per student funding levels* could reveal new insights about the relationship between educational funding and academic performance in Kentucky.

Third, understanding the reasons for better-than-expected performance is fundamentally important. Given the wide geographic distribution of educational bright spots, there are many candidates available across the Commonwealth for further study and examination—urban-rural, east-west, and in distressed areas as well as in prosperous

areas. These results can be sorted, selected, and combined with other pieces of information, if desired, to identify educational bright spots worthy of closer examination. With closer *qualitative* examination, it is possible to identify the critical factors leading to better-than-expected educational outcomes.

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