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The Relationship between School Funding and Student Achievement in Kansas Public Schools

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About The Author

Dr. Florence Neymotin graduated from the University of California—Berkeley in 2006. She is now completing her third year at K-State. Florence graduated Summa Cum Laude from the honors program at The Ohio State University, where she earned the Edwin L. Smart Prize, awarded annually to the top economics student at OSU. At Berkeley, Florence was among 3 of the 26 students in her cohort to finish the Ph.D. program in an accelerated fashion.

Florence is responsible for teaching the first semester of graduate level microeconomic theory, as well as teaching courses in intermediate microeconomics and labor economics.

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THE RELATIONSHIP BETWEEN SCHOOL FUNDING AND STUDENT ACHIEVEMENT IN KANSAS PUBLIC SCHOOLS

Recent changes to school funding in Kansas reveal little evidence of improving student outcomes as measured by test scores. But there is (weak) evidence that the changes helped improve graduation rates. These results form the conclusion of the first-ever economic analysis of the most recent amendments to the School District Finance and Quality Performance Act on student outcomes.

During the time period 1997-2006, the state of Kansas witnessed drastic changes in its financial approach to educational reform, as documented in the School District Finance and Quality Performance Act.[1] These changes affected how the state distributes per-student financial support to school districts in Kansas. In particular, the state of Kansas has progressively moved towards a redistributive system of financing education at the school district level. Increasing school funding based on the number of at-risk youth is one example of this sort of change.

This study of the amended Act finds different conclusions from those in an earlier study, which analyzed the Act before its recent amendments. John Deke examined the effect of the School District Finance and Quality Performance Act from the 1989 to the 1995 school years on the student drop out rate.[2] Deke's study focused on the immediate impact of the Act and found that, during the early 1990's in Kansas, a 20 percent increase in spending had the effect of increasing a student's probability of going on to college by 5 percent. The present analysis uses more current data than Deke's study and is, therefore, unique in its ability to analyze the effects of the most recent amendments to the School District Finance and Quality Performance Act on student outcomes.

The annotated figures and tables that follow provide the evidence that drives this study's conclusions.

A BRIEF DISCUSSION OF RESEARCH METHODS

Figures 1-10, which follow, illustrate that Kansas increased total per-student spending from 1997 through 2006. Over this time period, the data record a steady increase in student test scores and graduation rates, as well as a decline in high school dropout rates.

Without any further analysis, it might seem that the increasing per-student spending during this time period caused the improved student outcomes in Kansas school districts. To conclude this without further statistical analysis would be to ignore other explanations for the upward trends.

To illustrate the roots of this economic research problem, imagine that, at a particular point in time, schools with higher per-student funding were also schools that had higher test scores and/or higher graduation rates (or alternatively lower dropout rates). Even a casual observer would be bothered by the automatic assumption that higher per-student revenues *caused* the better student outcomes. Other characteristics of the school districts and the population living in the districts could be simultaneously related to the higher school funding and the better student outcomes.

For example, school districts with a higher fraction of the population who are educated, employed, and wealthier are simultaneously going to have more funding in their public schools and also are more likely to have better student outcomes. The only way to

1 For a list of the amendments to the School District Finance and Quality Performance Act see the following document: Kansas Legislative Research Department, "Amendments to the 1992 School District Finance and Quality Performance Act and the 1992 School District Capital Improvements State Aid Law (Finance Formula Components)," September 2006.

2 John Deke, "A study of the impact of public school spending on postsecondary educational attainment using statewide school district refinancing in Kansas." *Economics of Education Review*. Vol. 22, 2003, pp. 275-284.

determine whether higher school funding caused better student outcomes, therefore, would be to find school-districts that look similar in all respects except for their amount of school funding and student outcomes. They would be school districts that were virtually indistinguishable other than these two characteristics of interest.

A standard statistical technique used in economic analysis (known as ordinary least squares regression) offers researchers a method for implementing this logic.[3] This statistical procedure allows researcher to specify characteristics of school districts (reported in Table 1, below) and evaluate the relationship between school funding and student outcomes as if the researcher had "controlled" for the possible differences among school districts and made them look as (statistically) similar as possible, at a point in time.

Despite the usefulness of this statistical procedure, however, it is likely that there are many characteristics of school districts that are inherently unobservable but that also influence the school funding-student outcome relationship. Evaluating the relationship over time can help to control for the unobservable characteristics of school districts that are simultaneously driving student outcome measures. In particular, during the time period under evaluation, the state mandated increases over time in per-student funding, with the goal being to distribute more funds to lower-performing schools. Therefore, evaluating the time dimension helps to isolate differences in per-student funding driven by the law versus alternative, but unobservable explanations, like the wealth of a particular school district. If there was a positive relationship between changes in school funds and changes in revenues, then it was likely not due to the fact that wealthier districts were the ones who were increasing their revenues over this time period.[4] In this way, looking at changes in revenues and their effect on changes on student outcomes, it is possible to move away from the problem that unobservable characteristics of school districts are driving the results.

The analysis in Tables 2-4 reports the results of the point-in-time analysis across school districts. The analysis in Tables 5 reports the results of the analysis across time and across school districts.

A DISCUSSION OF THE DATA USED FOR THE ANALYSIS

Data were gathered from the Kansas Board of Education and the National Center for Education Statistics. Information from these two sources was linked by school district.

Test scores are available for math, science, reading and social studies.

"Persistence" in schooling is measured by either the graduation rate, the fraction receiving diplomas, or the dropout rate from high school. The analysis considers different measures of persistence in schooling because of variations in how these measures were defined; employing these several measures of persistence can, therefore, serve as a robustness check in the analysis.

The longest time span for any variable used in this analysis is 1997-2006. Unfortunately, there was some difficulty obtaining information on all of the relevant variables for this entire period of time. During the period 1997-2006, test score data is only available for 2004-2006 since testing before the year 2004 used a different rubric and is, therefore, not comparable to later data. Two of the graduation/dropout measures cover the period 1997-2005, while one measure is only available for 1997-2004.

3 For an introduction to the technique of Ordinary Least Squares, a good source is Stock & Watson's "Introduction to Econometrics," Addison Wesley, Boston. Technical note: All regressions in the current analysis employ robust standard error estimates.

4 The characteristics of the local population which are controlled for in the current analysis are the fraction of the population at each measured level of schooling (1-8 years, 9-12 years, HS grad, some college, at least college), the fraction of local men and women who are in the labor force, median family income and the fraction of local children who are below the poverty line. Characteristics of school districts that are controlled for in the current analysis are the pupil teacher ratio, the number of full-time-equivalent teachers, total enrollment and the fraction on free or reduced price lunch.

Data on school district finances from the F33 survey of finances is only available for as recently as the 2006 school year. It is for this reason that the analysis is not currently extendable to 2007 or 2008 data. It was proposed that the analysis be extended further back to an earlier time frame. However, due to data archiving procedures at the Kansas Department of Education and other restrictive elements this procedure was not feasible. It is also unclear that there would be any value-added in using an analysis that goes further back in time since the goal of the present analysis is to determine the effect of changes to the School District Finance and Quality Performance Act.

Figure 1

Total Per-Student Funding

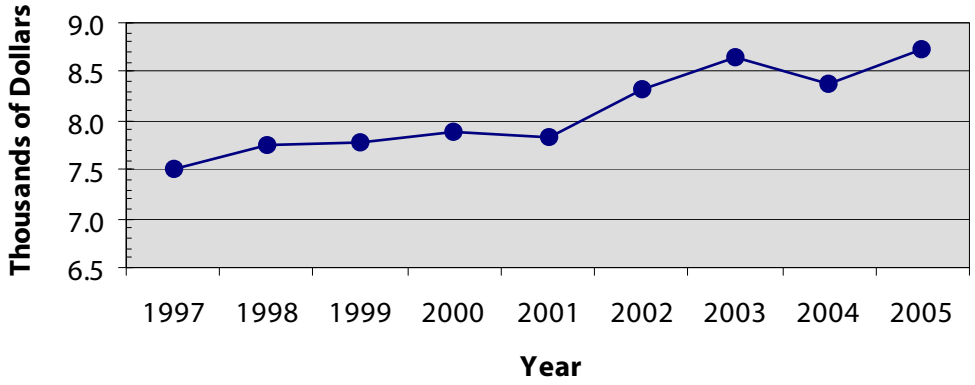
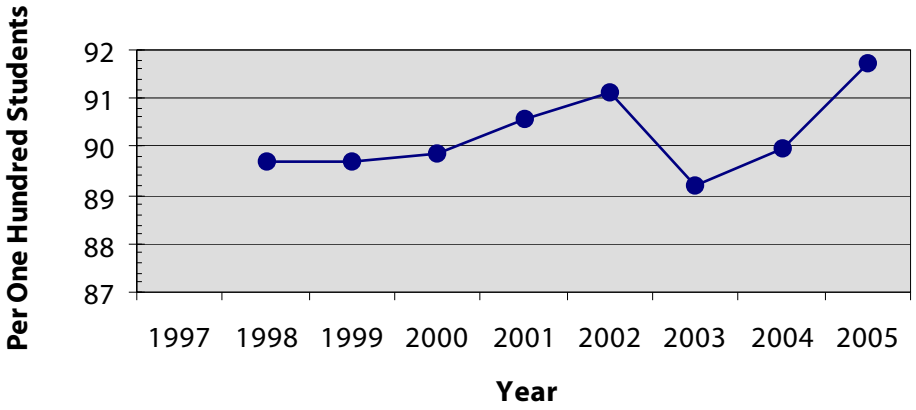


Figure 2

Graduation Rate



- Figure 1 shows the trend of increasing per-student school funding in Kansas. The analysis focuses on explaining how much this trend is statistically related to the trends in Figures 2-10: student persistence (graduation rates and dropout rates) and student test scores.
- A general measure of funding—total revenues per student—is used in this analysis due to the difficulty in parsing out exactly how schools were allotted or distributed more specific sub-sections of the funding. This measure captures overall commitment to educational funding.
- During the years 1997-2006, there was an increase in total revenues per student in schools from approximately $7,500 per student in 1997 to $8,700 per student in 2006.
- This time period also displayed a steady increase in the high school graduation rate starting from a graduation rate of approximately 89.7% in 1998 to one of approximately 91.7% in 2005.

Figure 3

Fraction Diplomas

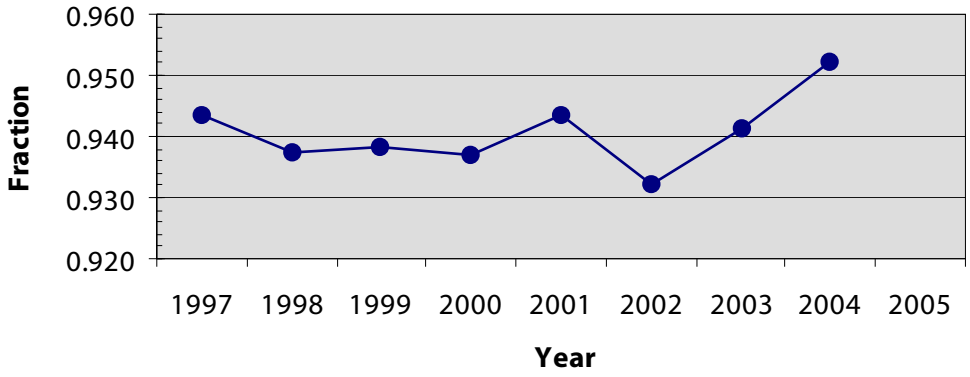
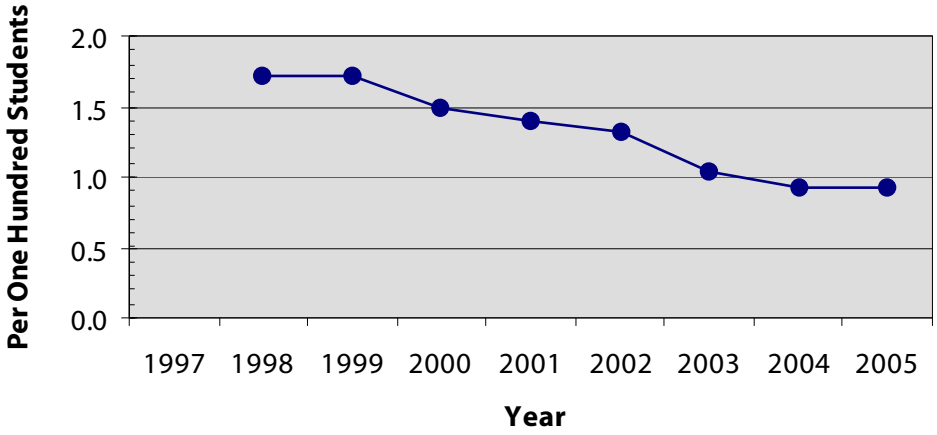


Figure 4

Dropout Rate



- Figure 3 reports the fraction of students receiving diplomas. This measure was used as an alternative measure to the graduation rate because it offers a robustness check.
- The fraction receiving diplomas had an overall increase between 1997 and 2004, with the majority of the increase seen in the last two years of the data. There were two clear decreases in the fraction receiving diplomas in the year 1998 and the year 2002.
- The dropout rate, shown in Figure 4, showed a steady decline over the time period 1998 to 2005. The dropout rate went from a low of 1.71 dropouts per hundred students in 1998 to a low of 0.927 dropouts in 2005.[1]

1 There is a small increase in dropouts between 2004 and 2005 but these numbers are virtually indistinguishable.

Figure 5
Grade 4 Math Proficiency

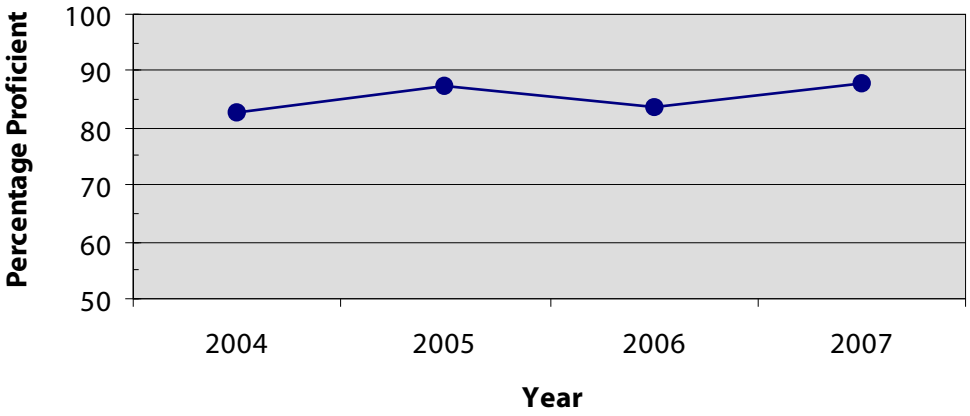


Figure 6
Grade 7 Math Proficiency

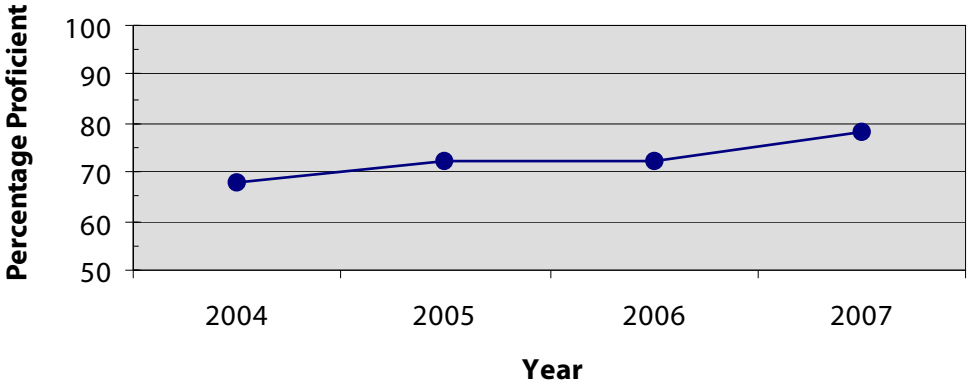
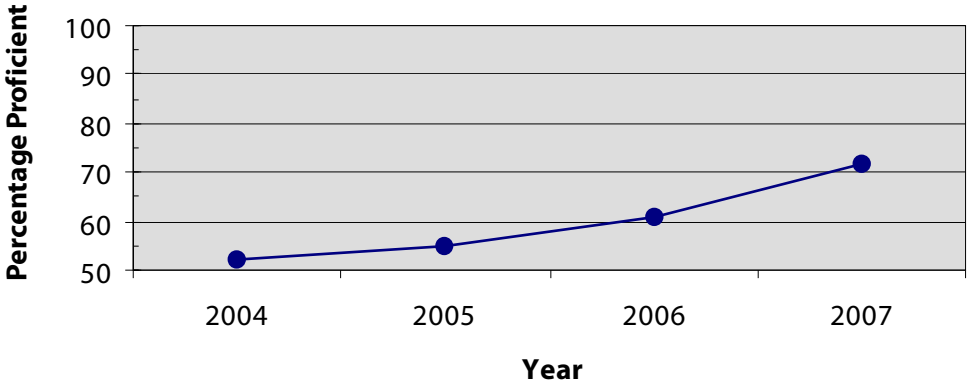


Figure 7
Grade 10 Math Proficiency



- Figures 5-7 show that students in grades 4, 7, and 10 achieved a clear improvement in their math proficiency over the time period 2004-2007. The only aberration was a decrease in scores of 4th graders in the year 2006.

Figure 8
Grade 5 Reading Proficiency

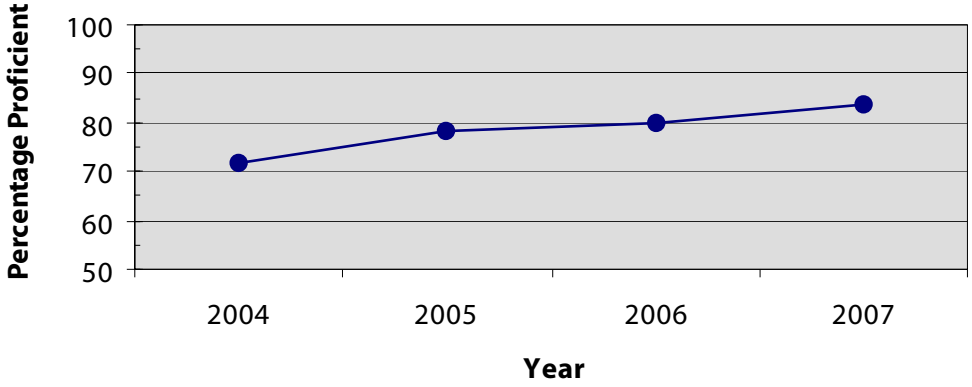


Figure 9
Grade 8 Reading Proficiency

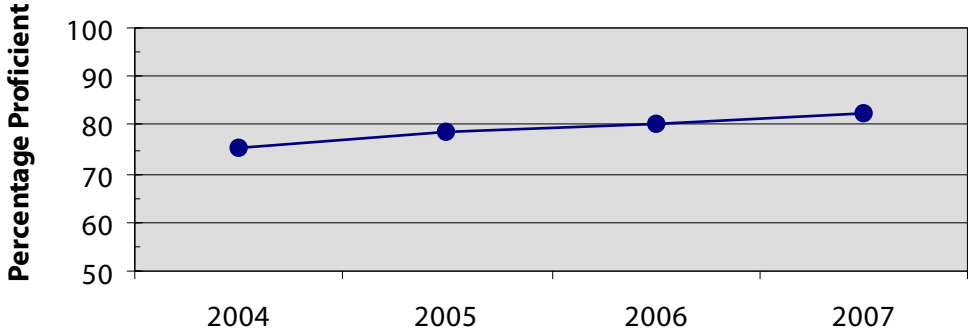
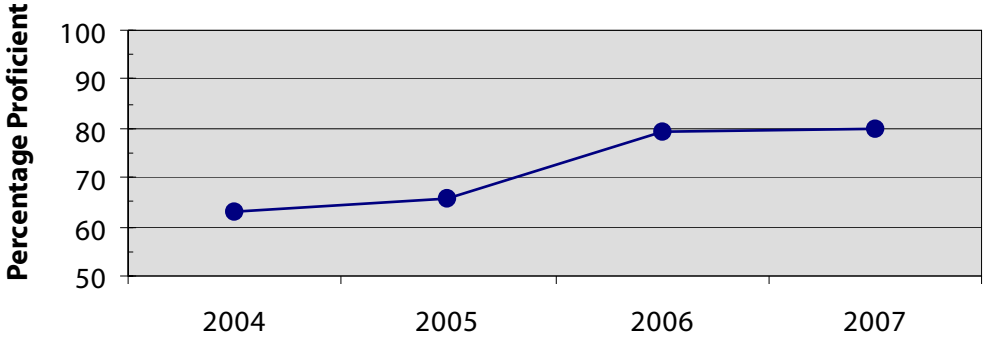


Figure 10
Grade 11 Reading Proficiency



- Figures 8-10 illustrate that students in grades 5,8 and 11 achieved a clear improvement in their reading proficiency over the time period 2004-2007.

Figure 11

Full-Time-Equivalent Teachers

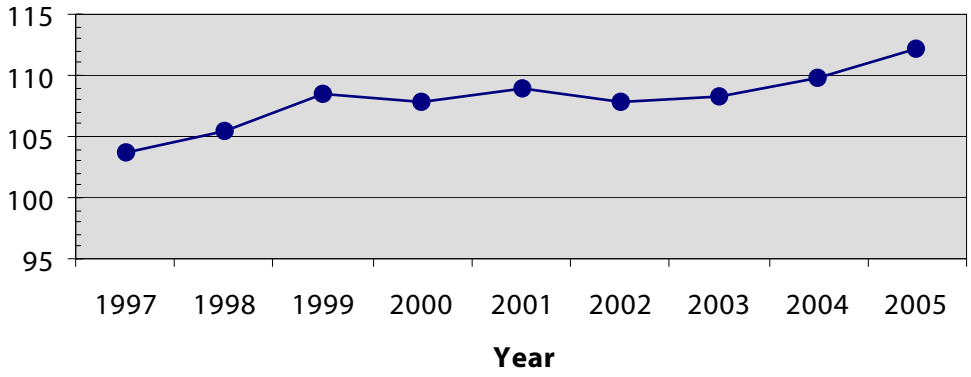
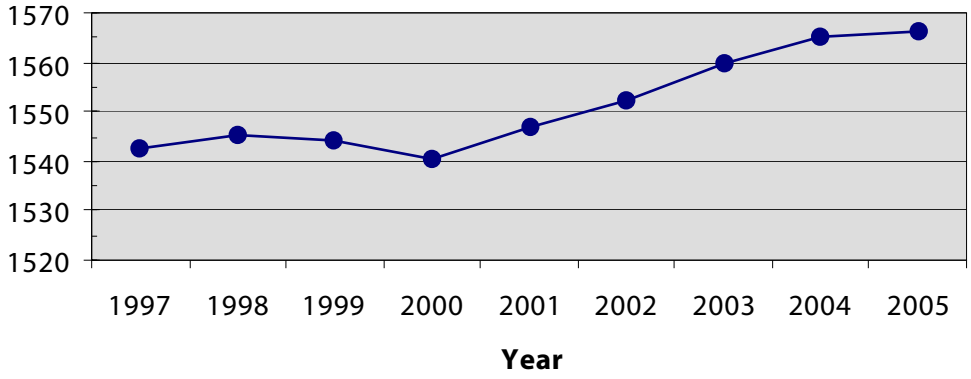


Figure 12

Enrollment



- Figures 11 and 12 report trends in full-time-equivalent teachers and average enrollment per school.
- The average number of full-time-equivalent teachers went from a low of 103.8 in 1997 to a high of 112.2 in 2005.
- The average enrollment per school started out at 1,542.7 students in 1997. It slightly decreased until the year 2000 and then began increasing until reaching a high of 1,566.2 in 2005.

Figure 13

Pupil-Teacher Ratio

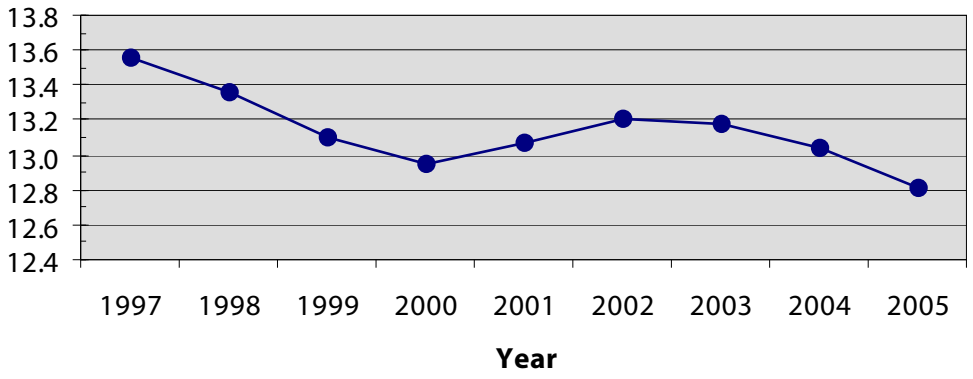
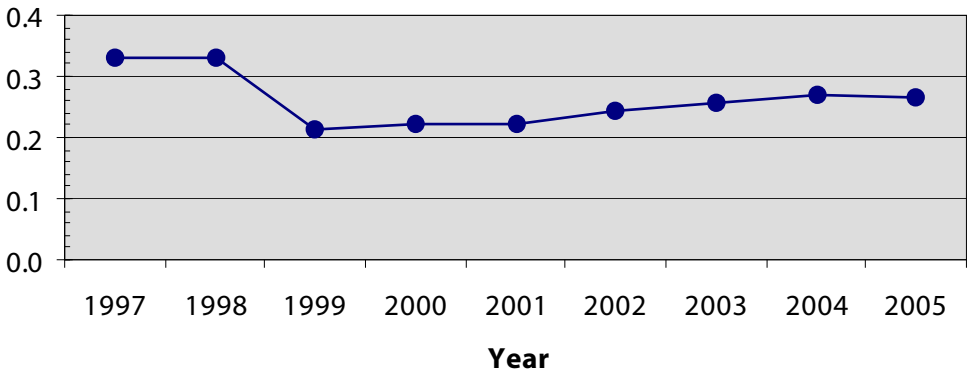


Figure 14

Fraction on Free Lunch



- Figures 13 and 14 report the trend of two variables that researchers often associate with measures of school "quality." Generally, lower measures are interpreted as indicating better quality.
- Figure 13 reports that the pupil-teacher ratio generally declined over the time period under study.
- Figure 14 reports that the fraction of students on free lunch declined between 1997 and 1999 but then maintained a steady or slightly increasing rate through 2005.
- All four of the variables reported in Figures 11-14 are employed as school district control variables in the statistical analysis. By including them, the independent effect of school funding on student outcomes is assessed after controlling for these school factors.

Table 1

Kansas School District Characteristics *(Census 2000)*

	Mean	Minimum	Maximum
Fraction of Children in Poverty	0.115	0.000	0.397
Median Family Income	44,005	31,100	102,987
Fraction Males in Labor Force	0.724	0.375	0.915
Fraction Females in Labor Force	0.576	0.442	0.734
Fraction with College Degree	0.240	0.073	0.790
Fraction with Associates Degree	0.080	0.020	0.160
Fraction Who are HS Grads	0.474	0.115	0.674
Fraction 9-12 Years School	0.120	0.016	0.239
Fraction 1-8 Years School	0.078	0.006	0.404

- Census 2000 school district characteristics give us a snapshot of the Kansas population. These characteristics are used to proxy the average "quality" of school districts in later parts of the analysis.
- Approximately 47 percent of Kansans received exactly a high school degree (or some years of college but not college graduation). Looking at the variation over school districts, there are school districts in Kansas with as few as 11 percent high school graduates and others with as many as 67 percent.
- On average, 32 percent of Kansans received a degree beyond the high school level, receiving either an associates or a 4-year college degree.
- The labor force participation rate was much higher for men than for women, which is an expected outcome. On average, 72.4 percent of men in a school district participated in the labor force; as did 57.6 percent of women.
- In terms of income, Kansans were making $44,000 (inflation unadjusted) during the time period under study. The variation had some school districts with a median income as low as $31,000 and others with a median income as high as $100,000.
- Approximately 11.5 percent of the children in any particular school district were living in poverty, with a low of approximately zero percent of children living in poverty and a high of almost 40 percent living in poverty.

Table 2

Effect of Revenues Per Student on Reading and Math Scores *(Cross Sectional Regressions)*

		Math			Reading		
		4th Grade	7th Grade	10th Grade	5th Grade	8th Grade	11th Grade
2004	coefficient	**1.302**	1.137	-0.794	-0.328	**1.068**	0.889
	significant	**YES**	NO	NO	NO	**YES**	NO
2005	coefficient	1.347	0.271	-0.42	0.188	0.945	0.12
	significant	NO	NO	NO	NO	NO	NO
2006	coefficient	0.125	0.654	-0.274	0.508	0.171	-0.471
	significant	NO	NO	NO	NO	NO	NO

- Table 2 reports the results of the statistical regression analysis comparing school districts on a point-in-time basis. By employing Ordinary Least Squares Analysis (OLS), at the school-district level of analysis, it is possible to determine whether school funding shows an independent positive relationship with the test scores of students in school districts after making school districts as similar as possible by controlling for observable school district characteristics: the Census characteristics reported in Table 1 and the school district characteristics reported in Figures 11-14.
- Table 2 shows how total revenues per student independently impacted reading and math scores of students in various grades during each of the years 2004, 2005 and 2006 after controlling for the observable characteristics of school districts. Overall, the table shows 18 separate statistical regressions.
- The "coefficient" measures the magnitude of the effect. The coefficient is interpreted as the average amount that student performance changed as the result of changing a control variable by one unit— holding each of the other control variables constant. For example, in 2004, if school finances increased by $1,000 per student, on average, 1.302% more fourth graders in a grade would have reached math proficiency. First of all, this is a fairly small change, and second of all, as explained in what follows, although this particular effect is statistically significant, only one additional coefficient in this table is significant. This implies that overall funding had little relationship with test scores in the statistical comparison across school districts (i.e., the cross sectional regressions).
- A "YES" in the "significant" category means that the coefficient is statistically significant, meaning it can be trusted as having a true influence. The analysis reports significance at the 5-percent level, meaning that we can be 95 percent sure that the relationship measured by the coefficient holds true. A "NO' in the significant category means that the coefficient is not statistically significant, meaning that we can not say with confidence that the measured effect is any different from a zero relationship between student performance and the per-student funding.
- The regressions results reported in Table 2 show that there is generally a positive relationship between test scores and per-student funding for all grades in math and in reading. However, in only two instances is this relationship statistically significant at conventional levels, i.e. the 5 percent level. We cannot say with confidence that the other 16 relationships in this table are actually true.

Table 3

Effect of Per-Student Funding on Science and Social Studies Scores *(Cross Sectional Regressions)*

		Science			Social Studies		
		4th Grade	7th Grade	10th Grade	6th Grade	8th Grade	11th Grade
2003	coefficient	1.033	1.201	1.366	1.857	1.173	-0.054
	significant	NO	NO	NO	NO	NO	NO
2005	coefficient	0.811	0.89	-0.075			
	significant	NO	NO	NO			

- Table 3 should be interpreted by the same rules as used for Table 2, above.
- Table 3 reports statistical regression results for test scores related to science and social studies for the years 2003 and 2005. Table 3 displays the results of 9 separate regressions.
- The above regressions show that although there is once again generally a positive relationship between per-student funding and these test scores, the relationships are not significant at the 5 percent level.

Table 4

Effect of Per-Student Funding on Persistence *(Cross Sectional Regressions)*

		Graduation Rate	Fraction Diplomas	Dropout Rate
1997	coefficient	0.137	-0.006	-0.052
	significant	NO	NO	NO
1998	coefficient	0.254	0.003	-0.027
	significant	NO	NO	NO
1999	coefficient	0.218	-0.005	-0.049
	significant	YES	NO	NO
2000	coefficient	-0.114	-0.005	-0.001
	significant	NO	NO	NO
2001	coefficient	0.004	0.009	-0.077
	significant	NO	NO	NO
2002	coefficient	-0.996	**0.011**	-0.119
	significant	NO	**YES**	NO
2003	coefficient	**1.021**	**0.011**	**-0.096**
	significant	**YES**	**YES**	**YES**
2004	coefficient	-0.542	0.018	**-0.08**
	significant	NO	NO	**YES**
2005	coefficient	-2.102	-	**0.836**
	significant	NO	-	**YES**

- Table 4 displays the same structure as Tables 2 and 3; however, the outcome variables are measures of student persistence for all available years of the data.
- The signs of the coefficients go in the expected direction; that is, they show a negative relationship between the dropout rate and per-student revenues and they show a positive relationship between per-student funding and (1) the fraction of students earning diplomas or (2) the graduation rate. However, many of the coefficients are insignificant and we cannot rule out the possibility in those cases that there is no statistically valid relationship between student persistence and per-student funding.

Table 5

Effect of Revenues Per Student on Changes in Student Outcomes *(Longitudinal Regressions)*

Math Test Scores

(2006-2004)

	4th Grade	7th Grade	10th Grade
coefficient	-1.024	2.354	2.04
significant	NO	NO	NO

Reading Test Scores

(2006-2004)

	5th Grade	8th Grade	11th Grade
coefficient	-0.655	-1.643	-0.959
significant	NO	NO	NO

Student Persistence in Schooling

	Graduation Rate (2005-1997)	Fraction Diplomas (2004-1997)	Dropout Rate (2005-1997)
coefficient	-3.382	0.003	0.157
significant	NO	NO	NO

- A point-in-time analysis, such as that employed in the regressions in Tables 2-4 will be biased by parents with higher performing children choosing to locate in better and wealthier school districts. *Looking at changes that occur over time* in school funding and student test scores will rid the analysis of this problem. During the time period in question, mandated increases in per-student funding were to be distributed to lower performing schools. As explained in the introduction, this method will, therefore, partially rid the analysis of the problem of parents selecting into higher quality districts. The regressions in Table 5 control for changes in the school district characteristics employed as control factors in Tables 2-4 as well as their initial levels, although effects of these variables on student outcomes are not shown; our interest is in the results for per-student funding.
- There is no consistent sign pattern for the effect on math scores. The effect on reading test scores seems to generally be negative, indicating the counterintuitive result that an increase in per-student funding would cause a decrease in reading test scores. None of these effects are statistically significant at conventional levels and we, therefore, cannot statistically distinguish them from being simply zeroes.
- There is no significant effect on any of the student persistence variables of changes in per-student funding. It is true, however, that the coefficient for the graduation rate and for the dropout rate (but not for the fraction diplomas) become statistically significant when we add fewer covariates (school district characteristics) to the regression. This would indicate that 2005 was indeed the important year where amendments to the school funding formula had an effect. The reversal of sign on the graduation rate could be due to the fact that funding was targeted to at-risk students during this time period.

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