# Analysis of the Effects of Kansas School Funding Reform on Standardized Testing Scores

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## Abstract

Kansas public school funding has been a contentious policy matter for several years. Brownback-era tax cuts reduced funding to a point where absolute funding levels were deemed unconstitutional in both adequacy and fairness. A 2014 Kansas state supreme court ruling lead to policy makers implementing a school funding redistribution policy increasing state aid to low income school districts. The purpose of this study is to determine the effects of this 2014 funding redistribution policy on public school district composite ACT Scores. Special attention is paid to school district family income levels when determining the effects of the redistribution.

To measure the effects of the redistribution, a series of difference in differences regression models are employed. Results indicate changes in ACT scores decreased post-2014 at the middle-income level but did not change at the aggregate level due to redistribution.

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## I. Introduction

### *Background*

K-12 school funding has been a matter of fierce debate in the state of Kansas over the past several years. The modern disagreement stems from the results of the 2005 state supreme court case *Montoy vs. State.* The landmark June 3, 2005 court decision ordered the state to appropriate an additional 853 million dollars for public education spending. Under a special session convened by Governor Sibelius, the legislature appropriated 147 million dollars for the 2005 school year. Further special legislative sessions appropriated an additional 289.5 million dollars for the 2006 school year, and 466 million for the following three years for a total of 755 million. This number represented an increase of base budget authority per pupil of $3800 in 2004 to a peak of $4400 in 2008.

In the wake of the Great Recession, the state found itself facing a budgetary shortfall. To reconcile the budget, lawmakers decided to cut some of the funding provided by the ruling of the 2005 *Montoy* case. The state decreased per pupil base budget authority from $4400 in 2008 to $3780 in 2011. The funding issue was further exacerbated by radical tax cuts championed by Governor Brownback. These tax cuts eliminated the income tax for almost 200,000 small businesses and reduced the income tax rates for individuals. Economic growth did not meet the governor's expectations and Kansas quickly found itself facing more budgetary shortfalls. As a short-term budget reconciliation strategy, state government was forced to enact additional public-school funding cuts. These budget cuts were subsequently challenged in court in 2014 in the case *Gannon vs. State*.

The *Gannon* case challenged that the state of Kansas was not fulfilling its obligations in

relation to the increased funding criteria enacted in the *Montoy vs. State* ruling. In addition to challenging the adequacy of the total funding level, plaintiffs argued the current distribution of funding was unconstitutional. Their argument centered around the premise that the block grant distribution of school funding was inherently unfair to certain school districts. Until that point, the school funding formula had been based on poverty incidence rate in the county. This resulted in school districts such as Blue Valley receiving very high levels of state aid due to high numbers of students coming from impoverished home environments. However, this funding formula failed to adequately compensate for the high levels of local tax revenue generated by the higher property taxes of Johnson County which could be transferred to school districts through the use of local-option-budgets (LOBs). The use of LOBs allowed school districts in high wealth areas to dramatically supplement their funding through minor increases in property tax rates due to the high property valuations in the district. This disconnect resulted in certain school districts in wealthy areas receiving significantly more funding relative to other school districts in the state.

The state supreme court sided with the plaintiffs in their decision. The judges ruled that the state was both inadequate and unfair in its provision of funding to Kansas public school districts. The courts ordered the state to provide equitable funding by a June 30 deadline or face a withholding of 4 billion in funding, potentially jeopardizing the opening of schools in the fall. The state was able to comply with the order of the court and avoid the potential shutdown through transitioning to an older school funding formula that did not include block grant distribution

***Research questions***

This study examines the changes in district average composite ACT scores in periods prior and post the 2014 *Gannon vs. State* ruling and subsequent school funding redistribution in

Kansas. The choice of ACT scores as the dependent variable is multifold. The ACT provides a standardized method of measuring student performance across all US school districts. Many states provide student readiness assessments to determine student performance within that state, but these results are not comparable across state lines. GPA is also not a good comparison tool as differences in class structure and curriculum can lead to GPA being non-analogous, even within individual states. The ACT is consistent across all states and has not been subject to significant changes in scoring or question composition. in recent years. Additionally, the ACT has been indicated to have predictive power over student success post high school graduation. Prior research suggests a correlation between higher ACT scores and post-secondary first year GPA (Noble and Sawyer, 2002).

Given the aforementioned importance of ACT scores, the primary purpose of this paper is to examine whether the effects of 2014 school funding redistribution prompted by the ruling in *Gannon vs. State* had a causal effect on public school district student academic achievement as measured by average district level ACT scores.

The secondary purpose of this paper is to determine whether changes in ACT scores due to funding redistribution were influenced by school district income levels. Percentages of students qualifying for the free and reduced-price lunch program can be used as a proxy measure for student population income across districts, as the qualification cut-off point is directly tied to specific income levels.

The primary research questions are as follows:

1. Did the 2014 Kansas school finance reform have an effect on student ACT scores?
2. Did district income affect the magnitude of change in ACT scores due to finance reform?

3. Was the achievement gap in ACT scores between high- and low- closed due to progressive school finance reform?

## II. Literature Review

### Physiological Needs and Academic Performance

The contribution of this paper is to investigate the effects of changes in school district expenditures on student academic achievement, with respect to ACT composite scores. Before presenting related empirical work, this section provides a brief overview of Maslow's hierarchy of needs as well as supporting empirical research to provide a framework and justification for discussion to follow.

Maslow's hierarchy of needs is a theory of psychological motivation posited by Abraham Maslow in 1943 as a method of explaining intrinsic behavioral motivation. The five tiers of the hierarchy of needs are further subcategorized into two groups: deficiency needs and growth needs. The deficiency needs subgroup is the first four tiers of the hierarchy. When these needs are not satisfied the person is left in a state of wanting. Growth needs, however, are needs that when satisfied lead to personal growth. An individual seeks growth needs once the deficiency needs are met (Maslow, 1943). In this research paper, children whose family income levels qualify them for free and reduced-price lunches are seen as having a deficiency need, while academic achievement is regarded as a growth need.

Although Maslow himself based his theory more on philosophy than scientific evidence, empirical evidence suggests student's academic performance does improve when basic physiological needs, particularly adequate nutrition, are met. The socio-economic status of a family has a direct consequence on the fulfillment of physiological needs of students. Children

raised in low income households are at higher risk of malnutrition and poor health which in turn can lead to decreased levels of academic performance. Alaimo et al. demonstrates a negative relationship between family income and incidence of health issues. After controlling for potential confounding effects, the researchers determined school aged children from lower income families experienced a higher prevalence of food insufficiency-related health statuses, including stomachaches, headaches, and iron deficiencies (Alaimo et al, 2001). The researchers determined students from food insufficient households were more likely to miss school and repeat a grade than student from food sufficient households. The researchers also found that food insufficiency was associated with feelings of deprivation, stress and worry.

Ferguson, Bovaird, and Mueller confirms the conclusions of Alaimo et al. with regard to academic achievement. The research demonstrates educational outcomes are directly influenced by family incomes. The authors posit students from low income backgrounds are more likely to start school at a disadvantage than students coming from families with higher incomes, with their claim supported by measures of school readiness (Ferguson, Bovaird, and Mueller, 2007). Other research confirms the findings of Ferguson. Black and Engle determined a negative association exists between academic performance and poverty at all levels of schooling in the United States (Black and Engle, 2008). Further research conducted by the EFA Global Monitoring Report Team determined the relationship between children raised in impoverished family environments and reduced student achievement is nearly universal across countries, age groups, and academic areas of study (UNESCO, 2006).

Other research has indicated the effects of lower income on academic achievement can partially be mitigated by providing funding vehicles which reduce the incidence rate of food insufficiency. Kleinmen et al. explores the effects of a universal free breakfast program on the

academic and psychosocial functioning of students at risk of nutritional insufficiency (Kleinmen et al., 2002). The researchers found students at risk for nutritional insufficiency exhibited significant improvements in attendance, improvements in math grades, and fewer behavioral problems six months after the implementation of the free breakfast program.

**Discussion of Related Empirical Research**

A significant portion of empirical research on student academic achievement is devoted to factors other than school district expenditure. It is widely acknowledged these other factors tend to influence academic achievement more than funding. Specifically, research often cites student's socioeconomic background (Sirin., 2005), class size (Tennessee State Department of Education, 1990), or teacher ability and teacher experience (Sanda., 2013), as being more predictive than total expenditure with regard to student academic achievement. However, the research that does examine the effects of total expenditure on student academic achievement obtain mixed, often contradictory, results. In this section, two studies offering opposing viewpoints on the effects of additional school funding on academic achievement are presented.

In 1986, the Journal of Economic Literature published a meta-analysis of education and student achievement research conducted by Eric Hanushek of the Hoover Institution. In a section of the paper, Hanushek presented the results of a meta-analysis of 147 studies presenting what he dubbed "educational production functions", formulas that attempted to relate various inputs such as expenditures and student-teacher ratios with student academic performances. In this section, Hanushek decomposes school district expenditures into instructional expenditures and non-instructional expenditures. He continues by stating instructional expenditures are determined by two factors: teacher salaries, determined by teacher experience and education levels, and class sizes. Of the 147 studies examined, 65 contained data regarding total expenditures. Results of the

meta-analysis indicated no statistical significance between the production factors of instructional expenditure and student academic achievement. However, the research did indicate a strong positive simple correlation between total expenditure and achievement, indicating the non-instructional portion of expenditure was statistically significant in determining student success. However, this relationship became statistically insignificant when differences in family background were controlled. Hanushek eventually concluded there was "no strong or systemic relationship between school expenditures and student performance." (Hanushek, 1986)

Hanushek is cautious to provide disclaimers to his strong conclusion. He states his conclusion is limited by the conclusions of the studies themselves and is careful to point out that the conclusions of the studies may rely on incomplete data. He continues by mentioning the actions of administrators may provide confounding effects in the studies which are not addressed and in turn may affect the conclusion of the meta-analysis. Hanushek also does not consider the interaction of school district income level and total district expenditure in his meta-analysis.

More recently, Lafortune et al. 2016 conducted an event study across 26 states aimed at measuring the impact of school finance reforms on National Assessment of Educational Progress (NAEP) scores (Lafortune et al, 2016). Their research, consisting of panel data from 1990-2011, indicated clear changes in achievement trends following school finance reforms, particularly when low-income school districts received sharp, immediate, and prolonged increases in funding due to reform. Results of the study indicated on average school finance reforms resulted in an absolute and relative rise in funding for low income districts of approximately $1200 and $700 respectively. These increases were associated with a 20% reduction in the initial relative achievement baseline gap between low income and high-income school districts over the course of ten years. The findings of this study are contradictory to the findings of Hanushek's meta-

analysis.

The researchers point out the results of the study are not appropriate for the determination of optimal allocation of school funding resources. The researchers also are careful to point out that states, like Kansas, which experience multiple school finance reforms over the observation period may lead to flawed conclusions about the effect of changes to school funding on academic achievement.

The purpose of this paper is to follow an approach similar to that of Lafortune et al. but instead examine the results of a single instance of school finance reform at a state level rather than exploring school finance reforms at a country level. Unlike Lafortune et al. this paper will use ACT data as a proxy for student academic achievement as opposed to NAEP scores, due to Kansas NAEP scores not having been published at the time of writing. This paper also explicitly interacts income levels with school district total expenditures, something that is not done in Lafortune et al.

## III. Data

### *Kansas and Missouri Panel Dataset Description*

This section introduces the school district level panel data used in the models and its method of collection. The majority of the data is sourced from Kansas and Missouri Department of Education databases. This data consists of historical school district level observations from Kansas and Missouri and include information on student body demographics, educators, and budgets. A secondary subset of the data is sourced from the American Community Survey 5-year estimates conducted by the US census bureau. This data contains historical county-level demographic data. Together, these data sources are synthesized into panel data containing 580

school district observations over the period 2011-2016. Of the 580 school districts, 280 are located in Kansas and 300 are located in Missouri.

Due to recent education policy changes enacted by the state of Missouri, it was not appropriate to use observations after 2016 in the analysis. Starting in the 2016 academic year a Missouri state mandate was enacted which required the state to pay for all high school juniors to take the ACT. This policy lead to 100 percent participation rate in junior ACT test takers and the mean district average ACT composite score dropping approximately 1.6 points. The large increase in the participation rate of test takers in Missouri caused data in the years post 2016 to be non-comparable.

School district level data from the state departments of education is hosted on the Kansas and Missouri websites. Data from Kansas school districts is broken into reports which are further segmented by years into separate files. Specific data reports used in this paper include District ACT scores, General State Aid/Supplemental State Aid, Students Approved for Free and Reduced Price Lunch Headcount Enrollment, Certified Personnel by Personnel Type, Selected School Statistics - District Totals, and Expenditures per Pupil. District ACT scores contains historical ACT metrics dating from 2009. The data in this file includes building level average ACT composite scores, district average ACT composite scores, state average composite scores, and number of students who took the ACT per building. This file did not provide the decomposition of ACT Score by subject area. The General State Aid/Supplemental State Aid files contain district level yearly records of total expenditure per pupil, state spending per pupil, and local spending per pupil. The Students Approved for Free and Reduced Price Lunch Headcount Enrollment file contains both headcount and district level percentages of students enrolled in free and reduced price lunch (FRPL) programs. Certified Personnel by Personnel

Type contains headcount information on total number of certified personnel within a school district, including the distribution of teaching vs. support employees. Selected School Statistics - District Totals includes information about teacher-pupil ratio. This file also contains district level expenditure data which were used to cross validate information from the other reports. The Expenditures per Pupil contains comprehensive information about district expenditures. This file disaggregates spending activities into spending related to instruction and spending related to support activities.

Missouri school district data was retrieved from the reports and resources section of the Missouri Department of Education website. This database contains several comprehensive reports which unlike Kansas reports span several years in single files. Specific Missouri data reports I used were the District ACT report, District Student Staff Ratios report, Finance Data and Statistics Summary for All Districts, Free and Reduced Lunch Percentage by Building, and District Certification. The District ACT report contained ACT composite scores by building, district, and state for the years 2009-2017. This file also contained the score breakdown by subject area. District Student Staff Ratios contained information about the student to certified staff ratio in school districts. This report included the specific student to teacher ratio for each district. Finance Data and Statistics Summary for All Districts contained information about district finance, including total expenditure per pupil, state funding per pupil, and local funding per pupil. The Free and Reduced Lunch percentage by Building report contains both district level percentage and headcount of students qualifying FRPLs. The District Certification report contained information on district staff certification and the distribution of certified staff in teaching/non-teaching roles.

To control for macro income trends across school districts, county poverty rate is included in the data. This measurement has been shown to have a significant effect on ACT scores as demonstrated in a paper submitted to *Paediatrics Child Health* (Ferguson, Bovaird, and Mueller, 2007). County level poverty data for Kansas and Missouri was obtained from the US Census Bureau and the American Community Survey 5-Year Estimates. This datafile contained the historical poverty incidence rates in Kansas and Missouri counties. This data was combined with the school district level data by applying the county poverty rate with the school district county of residence.

***Descriptive Statistics***

The subset of school districts surveyed includes information on 580 school districts across Kansas and Missouri. School districts with missing values are removed from the dataset. Cursory analysis of the dataset revealed only 14% of the districts contained missing data points for the years 2011-2016 (Table 1). Further analysis of the missing data revealed most missing data was caused by redistricting. In almost all instances, missing cases were sequential, indicating the district was either newly created or redistricted during the observation period.

Table 1: District Counts by State and Data Completeness

| State | Complete Data | Incomplete Data | Total Districts |
|---|---|---|---|
| Kansas | 276 | 5 | 281 |
| Missouri | 304 | 94 | 398 |

School districts are organized into income categories based on the percentage of their student body qualifying for FRPLs. Districts FRPL percentages are averaged over the period 2011-2016, then categorized by averaged quartile as low, medium and high income (Table 2).

Table 2: Distribution of School District Income Groups by State

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| *Kansas School Districts* | | | | | |
| LOW_FRPL | 476 | 31.691 | 7.863 | 7.400 | 51.300 |
| MID_FRPL | 973 | 48.833 | 6.628 | 22.000 | 66.200 |
| HIGH_FRPL | 483 | 66.123 | 6.515 | 50.700 | 89.900 |
| *Missouri School Districts* | | | | | |
| LOW_FRPL | 854 | 40.374 | 9.016 | 13.200 | 57.700 |
| MID_FRPL | 840 | 57.386 | 4.805 | 45.700 | 80.500 |
| HIGH_FRPL | 434 | 69.949 | 5.605 | 55.700 | 95.300 |

Table 3 records the mean averages of selected measurements per school district for the years 2011-2016. This composition check is to confirm that movements in the ACT composite scores can be attributed to the impact of the supreme court ruling rather than other changes in school district makeup. In Kansas, the average total expenditure increased slightly over the years 2015-2016 for the high FRPL group, while average total expenditure decreased slightly for the mid and low FRPL groups. This data is consistent with the 2014 *Gannon vs State* ruling ordering the redistribution of funding to lower income school districts.

Table 3: Descriptive Statistics of Selected Variables

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| *Kansas School Districts* | | | | | |
| ACT_COMPOSITE_SCORE | 1,656 | 21.202 | 1.459 | 14.5 | 27.5 |
| STATE_AID_PER_STUDENT | 1,656 | 5.589 | 1.537 | 0 | 12.32 |
| CERTIFIED_EDUCATORS | 1,656 | 147.503 | 375.934 | 11.6 | 4,388.7 |
| STUDENTS_PER_TEACHER_RATIO | 1,656 | 12.903 | 2.897 | 4 | 32.1 |
| COUNTY_POVERTY_RATE | 1,656 | 12.796 | 4.111 | 4 | 24.7 |
| TOTAL_EXPENDITURE_PER_STUDENT | 1,656 | 13,677.62 | 2,546.261 | 7,812.56 | 51,564.52 |
| FRPL_PERC | 1,656 | 49.002 | 13.937 | 7.4 | 89.9 |
| *Missouri School Districts* | | | | | |
| ACT_COMPOSITE_SCORE | 1,824 | 20.791 | 1.276 | 15.5 | 25.3 |
| STATE_AID_PER_STUDENT | 1,824 | 3.63 | 0.882 | 0 | 7.314 |
| CERTIFIED_EDUCATORS | 1,824 | 118.993 | 171.358 | 14 | 1,283 |
| STUDENTS_PER_TEACHER_RATIO | 1,824 | 12.462 | 4.294 | 6 | 172 |
| COUNTY_POVERTY_RATE | 1,824 | 17.531 | 4.715 | 6.9 | 36.3 |
| TOTAL_EXPENDITURE_PER_STUDENT | 1,824 | 8,718.119 | 1,408.71 | 0 | 18,534.01 |
| FRPL_PERC | 1,824 | 53.001 | 13.23 | 13.2 | 88.5 |

Table 4 shows the correlation between the identified relevant independent variables. There is a moderate correlation between total expenditure per student and county poverty rate. This correlation is not unexpected, as local tax revenue comprises a material portion school funding. Lower median income tends to result in lower amounts of local taxes going to school funding. According to the correlation table, FRPL qualification percentage has the strongest correlation with ACT composite scores in Kansas at -.51. This correlation is consistent with data from XXXX indicating higher FRPL qualification rates in the student body are associated with lower composite ACT scores. Another interesting correlation to note is the strong negative associations between STATE_AID_PER_STUDENT and STUDENTS_PER_TEACHER_RATIO and TOTAL_EXPENDITURE_PER_STUDENT and STUDENTS_PER_TEACHER_RATIO. These correlations are consistent with Hanushek's research and indicate instructional expenditures still make up much of school district expenditures (Hanushek, 1986).

Table 4: Correlation Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. ACT_COMPOSITE_SCORE | 1 | -0.189 | 0.062 | 0.249 | -0.164 | -0.215 | -0.512 |
| 2. STATE_AID_PER_STUDENT | -0.189 | 1 | -0.187 | -0.425 | 0.085 | 0.276 | 0.272 |
| 3. CERTIFIED_EDUCATORS | 0.062 | -0.187 | 1 | 0.297 | 0.037 | -0.095 | 0.048 |
| 4. STUDENTS_PER_TEACHER_RATIO | 0.249 | -0.425 | 0.297 | 1 | 0.057 | -0.591 | -0.254 |
| 5. COUNTY_POVERTY_RATE | -0.164 | 0.085 | 0.037 | 0.057 | 1 | -0.073 | 0.363 |
| 6. TOTAL_EXPENDITURE_PER_STUDENT | -0.215 | 0.276 | -0.095 | -0.591 | -0.073 | 1 | 0.254 |
| 7. FRPL_PERC | -0.512 | 0.272 | 0.048 | -0.254 | 0.363 | 0.254 | 1 |

Table 5 presents the district average ACT composite scores for Kansas and Missouri during the period 2011-2016. Historical ACT data indicates Kansas' overall average ACT score fluctuated around 21.9 from 2011-2016. Average ACT scores per district have fluctuated around 21.2 during the same period. In 2011, Kansas district average ACT scores were about 21.2. Scores follow a negative trend from 2011-2013. In 2014 scores move slightly upward followed by a dramatic increase in 2015, the year after the funding redistribution occurred. However, this increase did not continue the following year. Data from Missouri reflects a similar trend, particularly in 2015 and 2016. Scores decrease from 2011-2012, then start following a positive trend from 2012-2015. From 2014-2015 scores exhibit a significant increase, followed by a decrease from 2015-2016. This data indicates a regional trend from 2014-2016 (Table 5).

Table 5: District Average ACT Scores by State

| STATE | 2010-2011 | 2011-2012 | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 |
|---|---|---|---|---|---|---|---|
| Kansas | 21.223 | 21.243 | 21.158 | 21.172 | 21.297 | 21.190 | 20.982 |
| Missouri | 20.675 | 20.545 | 20.579 | 20.649 | 20.741 | 20.851 | 19.256 |

Figure 1 tracks the district average ACT score district income as measured by percentage of students qualifying for FRPLs. This chart provides graphical evidence that school districts with higher percentages of students qualifying for FRPLs lunches are associated with lower district average ACT scores. In both Kansas and Missouri, ACT scores are lowest in districts

with high FRPL qualification and highest in districts with low FRPL qualification. This data is consistent with other research (Evans, 2015). In Kansas, data indicates a positive trend in ACT scores for high income districts from 2013-2016. Medium income districts indicate a flat trend from 2011-2015 followed by a decrease in 2016. Low income districts indicate a negative trend in ACT scores from 2011-2014, followed by a large increase in 2015.

*Figure 1: ACT Composite Scores by District Income*

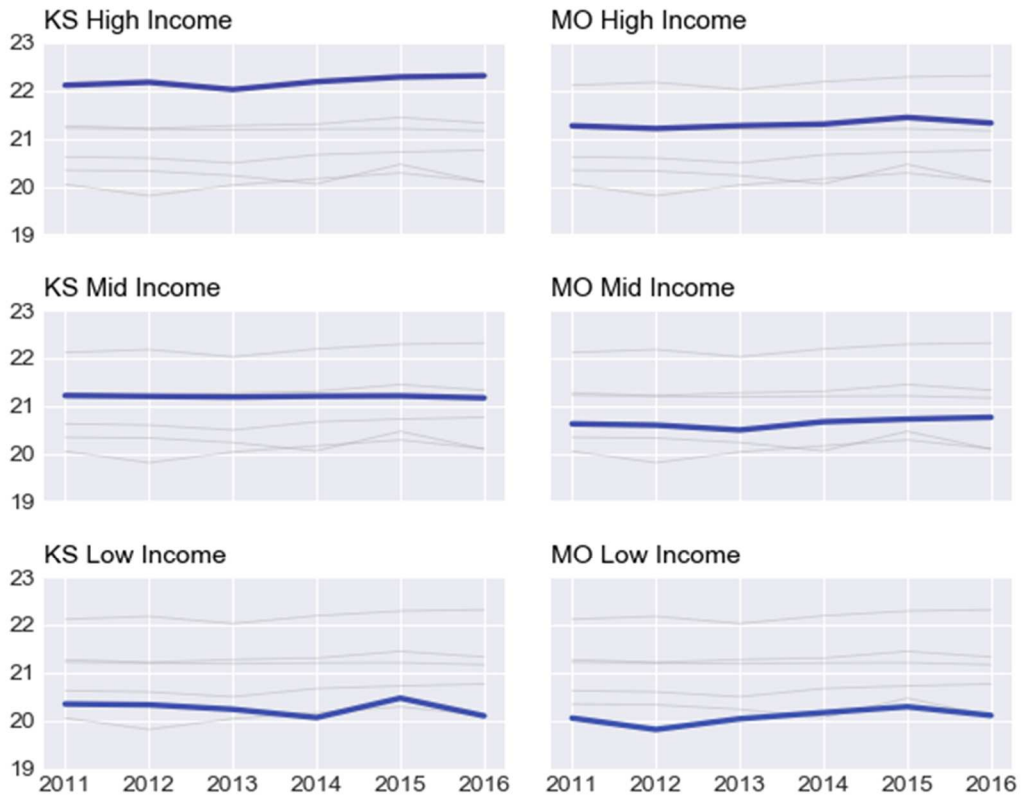



Figure 2 illustrates the total per pupil expenditure in Kansas and Missouri from 2011-2016. Kansas student expenditures reach approximately 13000 per student in 2011 and follow a positive trend until 2016. The data indicates no substantial increase in per pupil expenditure in 2014 despite the ruling in the *Gannon vs. State* case. Missouri student expenditure follows a

similar trend. In 2011, expenditure is approximately 8500 per pupil and proceeds to follow a positive trend until the year 2016. Total amount of expenditure per pupil rises by about 1300 in Kansas and by about 1200 in Missouri from 2011-2016.

*Figure 2: Per Pupil Expenditure by State (Thousands)*

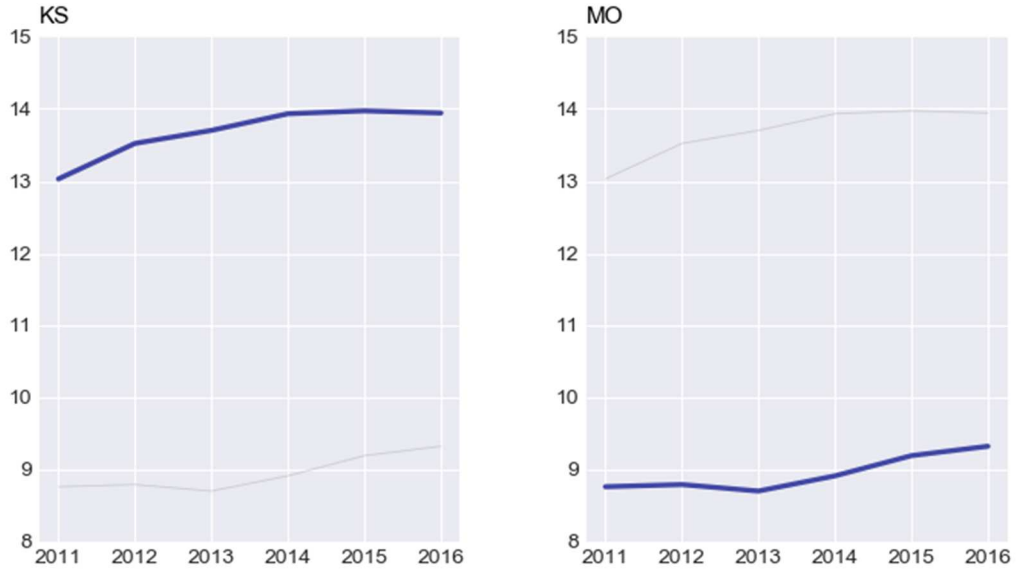



Figure 3 presents the total expenditure per student by school district income group. In this chart, the effects of the *Gannon vs. State* ruling are evident. In Missouri, each income group closely follows the shape of the total district expenditure curve presented in Figure 3. School district expenditure is consistent, regardless of school district income level with differences in expenditures being less than 1000 per student between groups. Kansas has a large expenditure gap between the high-income districts and the other districts. Low- and middle-income districts expenditure per pupil follow one another very closely from 2011-2014. Post-2014 and the Gannon ruling, the two expenditures diverge. The middle-income group expenditure decreases while the low-income group expenditure increases. This data is consistent with the redistribution that was ordered in the court ruling.

*Figure 3: Per Pupil Expenditure by District Income (Thousands)*

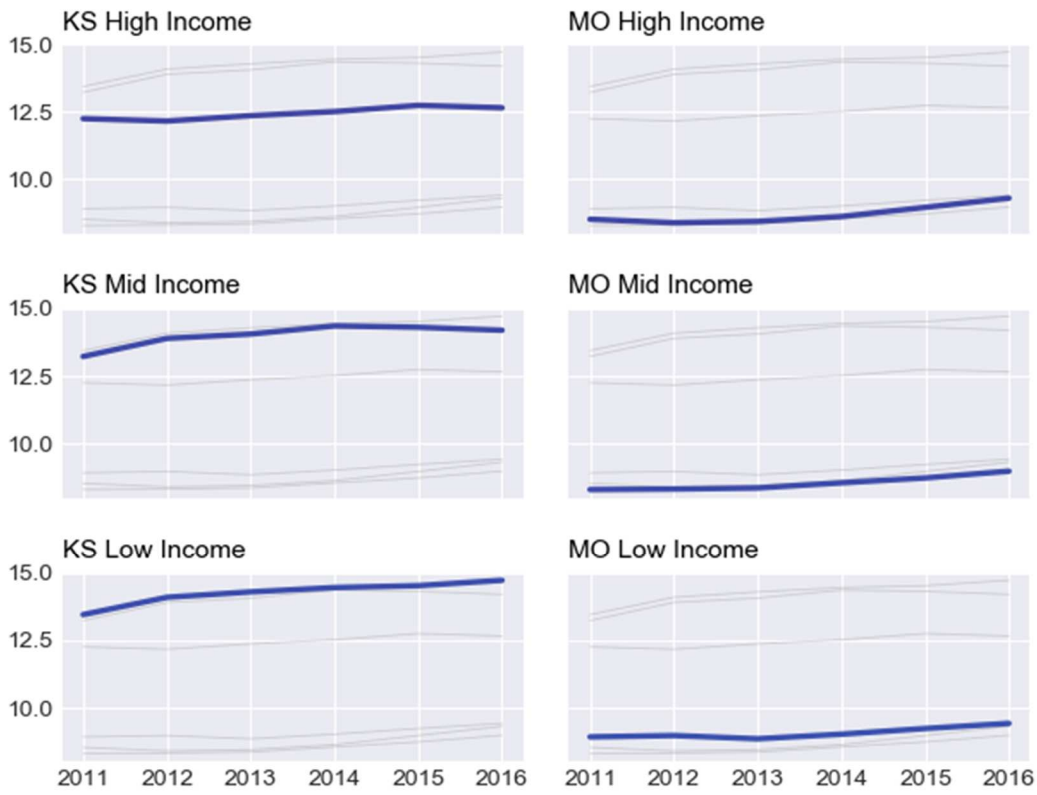



Figure 4 presents the percentage of students qualifying for FRPL in Kansas and Missouri over the observation period. Graph data indicates trends in FRPL qualifications rate are regional, as both Kansas and Missouri began experiencing declines around the same time.

Upon integrating family income data with qualification rates for FRPL, it appears the decrease in percentage of students qualifying for FRPL is endemic of a larger trend in increasing family real median income in the year 2014.

*Figure 4: Percentage of Students Qualifying for FRPL by State*

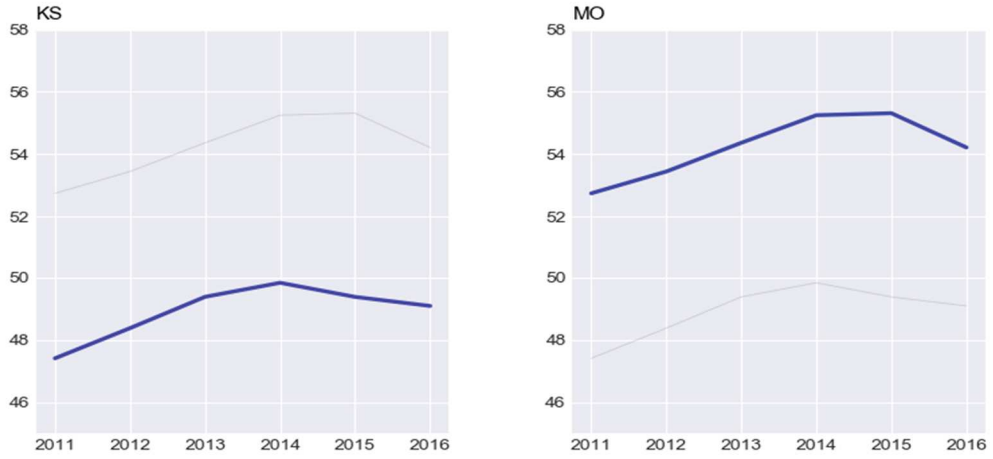
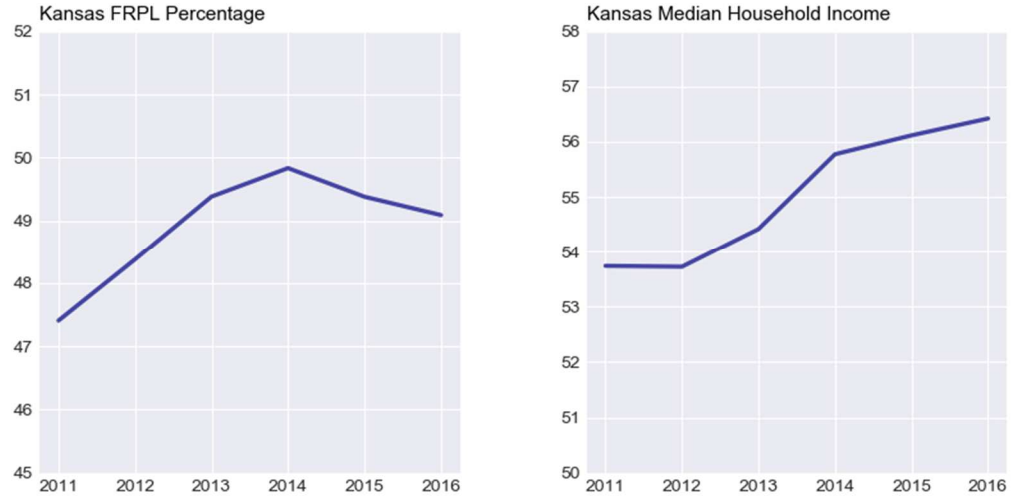



Figure 5 plots the yearly average FRPL qualification rate in Kansas alongside family real median income over the course of the observation period. The chart indicates the decrease in FRPL qualification percentage in Kansas is correlated with a rise in family real income levels. It does appear changes in FRPL qualification rates lag changes in real income by about two years. This lag is likely the result of policy makers being conservative when changing qualification standards. Family real income levels are sourced from American Community Surveys conducted by the United States Census Bureau.

*Figure 5: FRPL Percentage by Household Median Income (Thousands) in Kansas*



## IV. Methodology

This section introduces a series of regression models which are applied to five different continuous variables in order to present a comprehensive examination of how school funding redistribution in the state of Kansas affected composite ACT scores.

A series of fixed effects regression models determine the behavior of district average composite ACT scores from 2011 to 2016. The benefit of using a fixed effects model is it allows the intercepts of each district to vary, thereby mitigating bias arising from omitting variables. In variant (i), all effects that are not recorded in the equation are captured in the intercept term. Models I and II present explanatory details of district average composite scores with emphasis on the percentage of students qualifying for FRPLs. Model II is differentiated from Model I by treating the FRPL percentage as a categorical variable rather than continuous. Model III attempts to draw a causal conclusion about changes in ACT composite scores through use of a series of difference in differences (DID) regressions.

### *Explanation of Variables*

CERTIFIED_EDUCATORS is a continuous variable representing the average number of state certified educators present within a particular school district during an academic year. A positive value for the coefficient of this variable indicates a higher number of certified educators in a school district is correlated with a higher district average ACT composite score. This variable is included to serve as a proxy for total school district size as the number of certified educators tends to vary less year over year than student enrollment.

STUDENTS_PER_TEACHER_RATIO is a continuous variable indicating the average amount of certified teachers within a district divided by the average attendance within that school

district. Should the coefficient be negative, it would indicate smaller class sizes are associated with increased ACT scores. Prior research has indicated this variable should be expected to have a negative coefficient (Tennessee Department of Education, 1990).

COUNTY_POVERTY_RATE is a continuous variable representing the poverty rate within the county in which a school district resides. A positive coefficient for this variable indicates increased county poverty rates are associated with increased ACT scores. Prior research has indicated this variable should be expected to have a negative coefficient as higher county poverty rates have been shown to have a negative correlation with ACT scores (Qiu and Wu, 2011). It is important to note that although this variable has a moderate correlation with percentage of students qualifying for FRPLs, it should be included in the equation as it reflects the localized income trends of communities that are not captured by other explanatory variables. FRPL_PERC is a continuous variable indicating the percentage of students qualifying for FRPL programs.

***Presentation of the regression models***

The first set of regressions examine whether changes in school district FRPL percentages are associated with corresponding changes in district average ACT composite scores.

Model 1 examines the behavior of ACT composite scores as the percentage of students qualifying for FRPL status changes. In Models I-III (i)-(iii), TREAT_TIME is a categorical variable equaling zero for years 2011-2014 and one for years 2015-2016. In each model, should the variable exhibit a statistically significant positive value, ACT composite scores increased post 2014 funding redistribution.

**Model I**

$$(i) ACT\_COMPOSITE\_SCORES_{it} = \alpha_i + \beta_1 \text{FRPL\_PERC}_{it}$$

$$\begin{aligned}(ii) ACT\_COMPOSITE\_SCORES_{it} = \alpha_i &+ \beta_1 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_2 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_3 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_4 \text{FRPL\_PERC}_{it} \\ &+ \beta_5 \text{TOTAL\_EXPENDITURE\_PER\_STUDENT}_{it} \\ &+ \beta_6 \text{TREAT\_TIME}_{it} + \epsilon\end{aligned}$$

$$\begin{aligned}(iii) ACT\_COMPOSITE\_SCORES_{it} = \alpha_i &+ \beta_1 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_2 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_3 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_4 \text{FRPL\_PERC}_{it} \\ &+ \beta_5 \text{TOTAL\_EXPENDITURE\_PER\_STUDENT}_{it} \\ &+ \beta_5 \text{TREAT\_TIME}_{it} \\ &+ \beta_6 \text{TREAT\_TIME} : \text{FRPL\_PERC}_{it} + \epsilon\end{aligned}$$

Variant (ii) builds on variant (i) by introducing several new variables into the regression equation. By introducing these variables into the equation, they are allowed to vary within each fixed effects group instead of being part of the total group fixed effects. This variation causes the model to be more precise and explain more of the total variation of ACT scores across school districts.

Variant (iii) continues to build on the prior variants by introducing the interaction term TREAT_TIME*FRPL_PERC. Interacting TREAT_TIME and FRPL_PERC results in a continuous variable with all observations pre-2014 taking a value of zero and all observations post-2015 taking the original value of FRPL_PERC. When considered in relation to the dependent variable ACT_COMPOSITE_SCORE, TREAT_TIME*FRPL_PERC is the expected difference between the coefficient of FRPL_PERC for observations coded as a zero in

TREAT_TIME and observations coded as a one in TREAT_TIME. A positive statistically significant value of the coefficient would indicate the percentage of FRPL students has a larger impact on ACT composite scores post 2014 funding redistribution in Kansas.

Model II introduces school district income levels as categorical variables. In this model, school districts are classified as high, medium, and low income based on the average percentage of students qualifying for FRPL. Cutoff thresholds are obtained by averaging FRPL percentages over the period 2011-2016. Districts are then assigned the categorical variables LOW_INC, MID_INC, and HIGH_INC. Values of these categorical variables are determined by the 2011-2016 district average FRPL percentages. A district with an average FRPL percentage falling in the bottom quartile of state FRPL average is assigned a value one for HIGH_INC. A district with a FRPL falling within the middle two quartiles of state average is assigned a value of one for MID_INC. Districts with FRPL percentage in the state top quartile are assigned a value of one for LOW_INC.

**Model II**

$$\begin{aligned}\text{ACT\_COMPOSITE\_SCORES}_{it} = \alpha_i &+ \beta_1 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_2 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_3 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_4 \text{FRPL\_PERC}_{it} \\ &+ \beta_5 \text{TREAT\_TIME}_{it} \\ &+ \beta_6 \text{TREAT\_TIME} : \text{LOW\_FRPL}_{it} \\ &+ \beta_7 \text{TREAT\_TIME} : \text{HIGH\_FRPL}_{it} + \epsilon_i\end{aligned}$$

In Model II, the interaction variables TREAT_TIME*LOW_INCOME, TREAT_TIME*MID_INCOME, and TREAT_TIME*HIGH_INCOME determine the impact of

an observation being post-treatment and in one of the categorical income groups. A statistically significant positive value of TREAT_TIME*ANY_INCOME_GROUP would indicate an observation belonging to the income group post-2014 would have a positive association with higher ACT scores. In this model, it is important to note the variables LOW_INCOME, MID_INCOME, and HIGH_INCOME are excluded from the regression. These values are time-invariant properties of observations, meaning they do not vary in the observational window. When performing the fixed effects regression, the variables for each time observation across an individual district are demeaned, meaning all time-invariant variables take a value of zero in the final regression equation. However, the effects of these variables are still captured in the fixed effects portion of the regression analysis.

The 2014 school funding redistribution policy change prompted by the *Gannon vs State* ruling can be modeled as changes in total expenditure across school district income groups. Model III introduces a difference in differences approach in order to determine whether total expenditure per student has a causal effect on ACT composite scores. Kansas school district data post-2014 represent the treatment group in the analysis while school district level data from Missouri is used as the control group. Note that in order to establish causality, four assumptions must hold true: allocation of intervention was not determined by outcome, treatment and control groups have parallel trends in outcome, composition of intervention and comparison groups is stable, and no spillover effects are present.

In the case of Model III, assumption one is true because the treatment group is selected based on geographic criteria rather than specific outcomes. The entire school system of Kansas is subject to the redistribution of funding, while Missouri schools experience no significant redistribution within the observation period. Assumption two is more difficult to establish as no

statistical method exists to test for parallel trends. In the case of this paper, simple visual inspection of the data is used to establish parallel trends. Although not quite parallel, data appears to be suitably parallel for the purposes of this study as presented in the data overview section. Assumption three is valid for the data observational period. Although further court rulings have been made in Kansas regarding funding levels in public school districts, they were not made within the observational period. Finally, spillover is minimal between the treatment and control groups. There is certainly some migration of teachers and students that occurs between Kansas and Missouri school districts, but this migration is likely isolated to schools close to the border of the two states. Having met these assumptions, a difference in differences analysis is performed.

Variants (i) and (ii) of Model III represent regression equations controlling for overall state changes in total expenditure per pupil and FRPL percentages. These two variants are included as robustness checks for variant (iii), which is the primary equation of interest. Like Models I and II, Model III (i)-(iii) employs fixed effects models to determine the effects of the independent variables on district average ACT scores. Like Model II, it is important to note TREATMENT_GROUP is excluded from Model III (i)-(iii) as it is a time-invariant variable whose effects are captured in the fixed effects of the mode. LOW_INCOME, MID_INCOME, and HIGH_INCOME are excluded from Model III (iii) for similar reasons.

**Model III**

$$\begin{aligned}\text{ACT\_COMPOSITE\_SCORES}_{it} = \alpha_i &+ \beta_1 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_2 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_3 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_4 \text{FRPL\_PERC}_{it} \\ &+ \beta_5 \text{TREAT\_TIME}_{it} \\ &+ \beta_6 \text{TREAT\_TIME} : \text{TREAT\_GROUP}_{it} + \epsilon_i\end{aligned}$$

$$\begin{aligned}\text{ACT\_COMPOSITE\_SCORES}_{it} = \alpha_i &+ \beta_1 \text{TOTAL\_EXPENDITURE\_PER\_STUDENT}_{it} \\ &+ \beta_2 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_3 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_4 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_5 \text{TREAT\_TIME}_{it} \\ &+ \beta_6 \text{TREAT\_TIME} : \text{TREAT\_GROUP}_{it} + \epsilon_i\end{aligned}$$

$$\begin{aligned}\text{ACT\_COMPOSITE\_SCORES}_{it} = \alpha_i &+ \beta_1 \text{CERTIFIED\_EDUCATORS}_{it} \\ &+ \beta_2 \text{STUDENTS\_PER\_TEACHER\_RATIO}_{it} \\ &+ \beta_3 \text{COUNTY\_POVERTY\_RATE}_{it} \\ &+ \beta_4 \text{FRPL\_PERC}_{it} \\ &+ \beta_5 \text{TREAT\_TIME}_{it} \\ &+ \beta_6 \text{TREAT\_TIME} : \text{TREAT\_GROUP}_{it} \\ &+ \beta_7 \text{TREAT\_TIME} : \text{TREAT\_GROUP} : \text{LOW\_FRPL}_{it} \\ &+ \beta_8 \text{TREAT\_TIME} : \text{TREAT\_GROUP} : \text{LOW\_FRPL}_{it} + \epsilon_i\end{aligned}$$

Model III (i) represents a difference in differences analysis exploring whether changes in TOTAL_EXPENDITURE_PER_STUDENT in Kansas post-2014 had a causal effect on ACT scores. TOTAL_EXPENDITURE_PER_STUDENT is intentionally omitted from the equation in the expectation its effects will be captured in the interaction variable INTRCT_STATE_TIME. This variable takes a value of one if an observation took place in Kansas after the year 2014, and zero for all other cases. If the coefficient for this variable has a statistically significant value, it indicates there is a statistically significant difference in ACT scores for observations meeting the non-zero interaction variable condition.

Model III (ii) is quite similar to (i). Model III (ii) tests whether changes in FRPL percentage rates in Kansas had a causal effect on ACT composite scores. This variant is necessary due to potential policy changes to the FRPL qualification standards that took place in Kansas in 2014. Changes to base qualifications levels impact students across all school districts equally and statistical significance can be determined through capturing effects through an interaction variable.

Model III (ii) attempts to control for this change by intentionally omitting FRPL_PERC from the regression equation. By omitting this variable, its effects are captured in the variable INTRCT_STATE_TIME, similar to the process described in Model III (i). Like (i), this variable takes a value of one if an observation is taken in Kansas after the year 2014 and zero for all other cases. If the coefficient does not have a statistically significant value, it indicates the qualification standards increase had no significant effect on composite ACT scores.

Model III (iii) is the most complex of the models. This model represents a combination of Models II and III(i-ii). In this model, the categorical variables LOW_INC, MID_INC, and HIGH_INC are allowed to interact with the previously created interaction variable INTRC_STATE_TIME, creating the three new three-way interaction variables INTRCT_STATE_TIME_LOW, INTRCT_STATE_TIME_MID, and INTRCT_STATE_TIME_HIGH. These three interaction variables represent whether an observation was taken in Kansas after 2014 and whether it is a member of the high, medium, or low-income group. Statistically significant coefficients for these variables indicate whether the funding redistribution policy in 2014 had a causal effect on ACT scores within the associated school district income group in Kansas.

The primary objective of this regression equation is to determine whether 2014 changes in TOTAL_EXPENDITURE_PER_STUDENT per district income quartile had a causal effect on respective income quartile ACT scores. TOTAL_EXPENDITURE_PER_STUDENT, FRPL_PERC, LOW_INC, MID_INC, and HIGH_INC are all omitted from the regression equation. Like Model III (i) and (ii), the reasoning for omitting these variables is to capture their effects in the interaction terms. Statistically significant values in the interaction terms indicate statistically significant differences in ACT scores for non-zero group members.

## V. Results

This section presents a discussion of the regression analyses results and offers plausible explanations for the results. Interpretations of the outcomes of the regression Models I-III offer conclusions relevant to the primary research questions.

The following regression model answers the first research question by examining whether changes in school district FRPL are associated with corresponding changes in district average ACT composite scores

Table 1 presents the results from Model I (i)-(iii) and measures the impact of the FRPL_PERC on district composite ACT scores. Model I (i) omits all variables other than FRPL_PERC from the equation. In absolute terms, Model I (i) reveals that an increase of one percent in FRPL_PERC is associated with a .01-point decrease in district average ACT score over the observation period. This result is consistent with the findings presented in existing research (Evans, 2015). However, this result is only significant to the .1 level, indicating weak statistical significance.

Table 6: Model I Regression Results

| | *Dependent variable:* | | |
|---|---|---|---|
| | ACT_COMPOSITE_SCORE | | |
| | (i) | (ii) | (iii) |
| CERTIFIED_EDUCATORS | | −0.0002 | −0.0002 |
| | | (0.001) | (0.001) |
| STUDENTS_PER_TEACHER_RATIO | | −0.014** | −0.014** |
| | | (0.006) | (0.006) |
| COUNTY_POVERTY_RATE | | −0.003 | −0.004 |
| | | (0.012) | (0.012) |
| TOTAL_EXPENDITURE_PER_STUDENT | | 0.00000 | −0.00001 |
| | | (0.00002) | (0.00002) |
| FRPL_PERC | −0.010* | −0.011* | −0.013** |
| | (0.006) | (0.006) | (0.006) |
| TREAT_TIME | | | 0.172 |
| | | | (0.132) |
| FRPL_PERC:TREAT_TIME | | | −0.001 |
| | | | (0.002) |
| Observations | 3,480 | 3,480 | 3,480 |
| $R^2$ | 0.001 | 0.003 | 0.007 |
| Adjusted $R^2$ | 0.001 | 0.003 | 0.006 |
| F Statistic | 3.379* (df = 1; 2899) | 1.782 (df = 5; 2895) | 2.771*** (df = 7; 2893) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

Like Model I (i), Model I (ii) indicates that an increase in FRPL_PERC is associated with a decreased district average ACT score. While controlling for number of certified educators, students per teacher ratio, county poverty rate, and total student expenditure, the coefficient of FRPL_PERC only increases very slightly. FRPL_PERC remains statistically significant at the .1 percent. The only other variable having statistical significance in the analysis is STUDENTS_PER_TEACHER_RATIO. The coefficient value of .014 is statistically significant to the .05 level. This level of significance indicates a strong negative relationship between ACT composite scores and student-teacher ratio. This result is consistent with the Tennessee Student

Teacher Achievement Ratio (STAR) study, which demonstrated that smaller class sizes are associated with higher student achievement (Tennessee Department of Education, 1990).

The interacted model specification, Model I (iii), indicates consistency with Model 1 (i) and (ii). The model reveals that a one percent increase in FRPL_PERC is associated with a .013 decrease in ACT score. The coefficient of the variable is both larger in magnitude than Model I (i)-(ii) and a higher statistical significance. In Model I (iii), FRPL_PERC is statistically significant to the .05 level. Student to teacher ratio is also statistically significant to the .05 level with a coefficient of -.014. Like the prior variants of Model I, these results are consistent with the Tennessee STAR study (Tennessee Department of Education, 1990)

The percentage of students qualifying for FRPLs within a school district is associated with a decrease in district average ACT scores. A possible explanation for this phenomenon is students from low income backgrounds face additional challenges connected to their families, neighborhoods, and schools that students from high income backgrounds do not face, which leads to a lower emphasis on college preparation. Meta-analysis of research examining the link between socioeconomic status and academic achievement between 1990 and 200 indicate a medium to strong relationship between the two variables (Sirin, 2005).

Model II introduces relative school district income levels as categorical variables quantified by the percentage of students qualifying for FRPLs. FRPL qualification rate is often used as a proxy for poverty rate in research as Census poverty data is not disaggregated at the school district level. FRPL qualification provides a useful method of approximating poverty rates in school districts. In this model, relative income levels are determined by FRPL_PERC quartiles. The following regression model attempts to determine whether significant changes in

ACT composite scores in Kansas occur post-2014 school funding redistribution across varying levels of relative income.

Table 7: Model II Regression Results

| | *Dependent variable:* |
|---|---|
| | ACT_COMPOSITE_SCORE |
| CERTIFIED_EDUCATORS | −0.0002 |
| | (0.001) |
| STUDENTS_PER_TEACHER_RATIO | −0.014** |
| | (0.006) |
| COUNTY_POVERTY_RATE | −0.004 |
| | (0.012) |
| TOTAL_EXPENDITURE_PER_STUDENT | −0.00001 |
| | (0.00002) |
| FRPL_PERC | −0.014** |
| | (0.006) |
| TREAT_TIME | 0.072 |
| | (0.051) |
| TREAT_TIME:LOW_FRPL | 0.085 |
| | (0.078) |
| TREAT_TIME:HIGH_FRPL | 0.055 |
| | (0.087) |
| Observations | 3,480 |
| $R^2$ | 0.007 |
| Adjusted $R^2$ | 0.006 |
| F Statistic | 2.554*** (df = 8; 2892) |
| *Note:* | *p<0.1; **p<0.05; ***p<0.01 |

Results from Model II further support the negative association between FRPL_PERC and ACT composite scores and STUDENTS_PER_TEACHER_RATIO and ACT composite scores.

In Model II, a one percent increase in students qualifying for FRPLs is associated with a .013-point decrease in composite ACT score. This coefficient is statistically significant at the .05 level. Likewise, an average increase of one student per classroom is associated with a .014 decrease in composite ACT score. This coefficient is also statistically significant at the .05 level.

The interaction variables TREAT_TIME*LOW_INCOME, TREAT_TIME*MEDIUM_INCOME, and TREAT_TIME*HIGH_INCOME are not statistically significant in determining composite ACT scores. This statistical insignificance of the coefficients indicates that there is no statistical difference between an observation being in any of the income groups post-2014 and ACT scores.

Model III builds on the ideas presented in Models I and II by examining the effects of district expenditure per student on districts grouped by income level. Model III attempts to draw causal conclusions between changes in district expenditure and ACT Scores by implementing a difference in differences approach. Model III regression results are presented in the following table.

Table 3 presents the results of Model III. Model III consists of three separate difference in differences regression analyses. Model III (i) and (ii) both serve as robustness checks for Model III (iii).

Model III (i) serves as a robustness check against Model III (iii) by determining whether changes in Kansas ACT scores were due to changes in total state expenditures after the 2014 Gannon vs. State ruling. Model III (i) is a difference in differences analysis of ACT scores in Kansas and Missouri that attempts to capture the causal effects of changes in total state expenditures in the interaction term.

In Model III (i) further confirmation is obtained of the negative association between the variables FRPL_PERC and STUDENTS_PER_TEACHER_RATIO and ACT composite scores. Both have statistically significant negative coefficients indicating a negative relationship between their values and ACT composite scores. Model III (i) indicates the variable TREAT_TIME is also highly statistically significant. The coefficient of .159 indicates ACT scores were .159 points higher in the period 2015-2016 compared to the period 2011-2014. None of the other variables in the analysis were statistically significant in their association with ACT scores, including the interaction variable INTRCT_TREAT_TIME.

Table 8: Model III Regression Results

| | *Dependent variable:* | | |
|---|---|---|---|
| | ACT_COMPOSITE_SCORE | | |
| | (i) | (ii) | (iii) |
| TOTAL_EXPENDITURE_PER_STUDENT | | −0.00001 | |
| | | (0.00002) | |
| CERTIFIED_EDUCATORS | −0.0002 | −0.0001 | −0.0003 |
| | (0.001) | (0.001) | (0.001) |
| STUDENTS_PER_TEACHER_RATIO | −0.014** | −0.014** | −0.014** |
| | (0.006) | (0.006) | (0.006) |
| COUNTY_POVERTY_RATE | 0.001 | −0.003 | −0.003 |
| | (0.013) | (0.013) | (0.012) |
| FRPL_PERC | −0.014** | | −0.014** |
| | (0.006) | | (0.006) |
| TREAT_TIME | 0.159*** | 0.143*** | 0.105*** |
| | (0.048) | (0.048) | (0.039) |
| TREAT_TIME:TREAT_GROUP | −0.105 | −0.090 | |
| | (0.069) | (0.069) | |
| INTRCT_STATE_TIME_LOW | | | 0.082 |
| | | | (0.107) |
| INTRCT_STATE_TIME_HIGH | | | −0.056 |
| | | | (0.107) |
| Observations | 3,480 | 3,480 | 3,480 |
| $R^2$ | 0.007 | 0.005 | 0.007 |
| Adjusted $R^2$ | 0.006 | 0.004 | 0.006 |
| F Statistic | 3.539*** (df = 6; 2894) | 2.570** (df = 6; 2894) | 2.845*** (df = 7; 2893) |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 |

INTRCT_TREAT_TIME serves as a robustness check for Model III (iii). By omitting the variable TOTAL_EXPENDITURE_PER_STUDENT from the regression equation in Model III (i), its effects are captured in the interaction term. The non-statistical significance of the interaction term indicates there was no significant causal effect in ACT score changes due to changes in school district expenditure post-2014 in Kansas.

This finding is consistent with the actions of the Kansas state government in the wake of the *Gannon vs. State* ruling. Despite being ordered to increase school funding to an acceptable level, total expenditure per student averaged across all school districts increased only slightly. By excluding the possibility of structural change to total state expenditures, the effects of redistribution on ACT scores are captured.

Model III (ii) is similar to Model III (i) in that it serves as a robustness check against Model III (iii). Model III (ii) attempts to determine whether qualification standard changes for FRPLs in 2014 led to changes in ACT scores. Model III (ii) is a difference in differences analysis of ACT scores in Kansas and Missouri that attempts to capture the causal effects of changes in percentages of students qualifying for FRPLs in the interaction term.

As before, STUDENTS_PER_TEACHER_RATIO and TREAT_TIME are statistically significant. STUDENTS_PER_TEACHER_RATIO again has a negative coefficient, indicating larger class sizes are associated with lower ACT scores. TREAT_TIME provides additional confirmation to the findings in Model III (i), that there is a significant difference in ACT scores between the periods 2011-2014 and 2015-2016. None of the other variables in the equation are statistically significant.

In Model III (ii) the coefficient of the interaction variable INTRCT_STATE_TIME is not significant. As in Model III (i), the interaction variable serves as a robustness check for Model III (iii). Unlike Model III (i), the effects captured in the interaction term are the effects of the changes in the qualification income rates for FRPLs in the state of Kansas. These effects are captured through excluding FRPL_PERC from the regression equation. A non-statistically significant value of this interaction term indicates the change in percentages of students qualifying for FRPLs under the new qualification incomes did not have a causal effect on composite ACT scores.

Model III (iii) examines whether funding redistribution had a causal effect on district composite ACT scores. In this model, schools are separated by income level. By separating schools by income level, the funding redistribution policy can be reinterpreted as total expenditure changes in the different income populations. Model III (iii) implements a series of three-way interaction variables in a difference in differences equation to determine whether the income changes within the different school income groups had a causal effect on composite ACT scores.

Like the other models presented in Model III, FRPL_PERC and STUDENT_PER_TEACHER_RATIO had significant, negative coefficients. In Model III (iii), the categorical variable TREAT_TIME also had a highly significant positive coefficient, indicating ACT scores were higher in the treatment period. In attempting to determine the causality effects of redistribution the significance and coefficients of the three interaction variables, INTRCT_STATE_TIME_LOW, INTRCT_STATE_TIME_MID, and INTRCT_STATE_TIME_HIGH are examined.

Of the three interaction variables, the only one with significance is INTRCT_STATE_TIME_MID, with a significance level of .05. This indicates the changes in total expenditure for the middle-income group had an effect on the group ACT scores. The coefficient value of -.16 indicates ACT scores in the middle-income group would have been .16 points higher had redistribution not occurred. The variables for the other interaction variables did not have statistically significant coefficients indicating the redistribution policy did not have a causal effect on ACT scores in these income groups.

The achievement gap between income groups in Kansas was not closed due to the progressive school finance reform. In all cases, the gap became wider from the years 2011-2014. On average, the ACT score difference between high income district and medium income districts increased by .087 points. This change was even more pronounced in the difference between high- and low- income groups where it increased by .358 points. The difference between low- and medium-income scores was smaller, but still present with a difference of .271. In the years immediately following the finance reform, the achievement gap continued to increase between high- and low-income districts as well as medium- and low- income districts, but at a lesser rate than the prior years. The achievement gap between high and low districts only grew by .089 points while the gap between medium- and low-income districts only grew by .022 points. However, the income gap between high- and medium- income districts grew by .162 points, outpacing the growth prior to the finance reform.

## VI. Discussion

The redistribution of school funding that occurred in Kansas in 2014 was progressive in nature. Funding was increased for low-income school districts and decreased for middle and high-income school districts.

This redistribution is consistent with the *Gannon* ruling. As a result of the policy change, middle income school districts in Kansas experienced an average decrease in funding of 160 dollars per student. This funding was dispersed to low income school districts. These school districts saw their expenditures increase by 260 dollars per student.

Regression results demonstrate the impacts of the 2014 Kansas school funding redistribution on ACT scores. Evidence suggests that ACT scores in middle income school districts were exclusively impacted by the redistribution. Model III (iii) suggests ACT scores from schools in the lowest and highest income quartiles were not affected by the redistribution. Regression results were weakly predictive in determining district average ACT scores when controlling for fixed effects across school districts. This indicates factors other than those controlled for in the regression models are influencing average ACT scores.

In all regression models, the percentage of students qualifying for FRPLs was significant. On average, a single percent increase in qualification rate was associated with a .01-.014-point decrease in average ACT scores. Qualification FRPLs is indicative of low-income households. As shown in other literature, students from low income households are more likely to experience decreased academic performance.

One of the primary limitations of this study is not introducing lag periods into the regression models. Lafortune et al has shown that the impacts of funding changes are often fully recognized several years in the future, opposed to immediately. Due to the recency of the policy changes, the imminence of broader funding changes in Kansas, and changes to ACT testing

policies in Missouri, it was impractical to introduce lag periods in the regressions.

Despite determining that state funding does have an impact on ACT scores, more research needs to be done to determine the optimal amount of funding in order to maximize student academic achievement. In 2017, the Kansas state supreme court again mandated the state to increase total state funding to school districts. As part of its defense in the 2017 court case, the state presented a statistical analysis of various measures of student success regressed on percentage of students qualifying for FRPLs in a 4-page document known as the Penner memo which was used to determine the funding redistribution changes in 2014.

In the memo, researchers identified 41 school districts across the state using four specific measurements of student success: percent of students at college or career ready level on state math and English assessments, percent of students at grade level on state math and English assessments, four-year graduation rate, and average composite ACT score. Each dimension was regressed on percentage of students qualifying for FRPLs. Districts were then selected based on two criteria: whether a district exceeded expected regression results on all four measures, and districts with average scaled differences on each measure was greater than one standard deviation away from the average scaled difference of all districts. The optimum base amount of school funding was then determined to be the per pupil average of the identified districts. Funding changes determined by the Penner memo offer an opportunity in the near future to determine whether the changes in budget again have a positive effect on student academic success and allow state policy makers to come closer to determining optimal school district funding levels which maximize student academic success.

Further opportunities for expanding this research include exploring the relationship between inter-district budgeting and student academic success. Optimization of funding levels

across grade levels as well as proportion of funding for non-instructional related activities is arguably as important as total funding levels in determining student academic success.

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