An Evaluation of Illinois's Evidence Based Funding Education Policy on Student Performance and District Financial Health

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Content

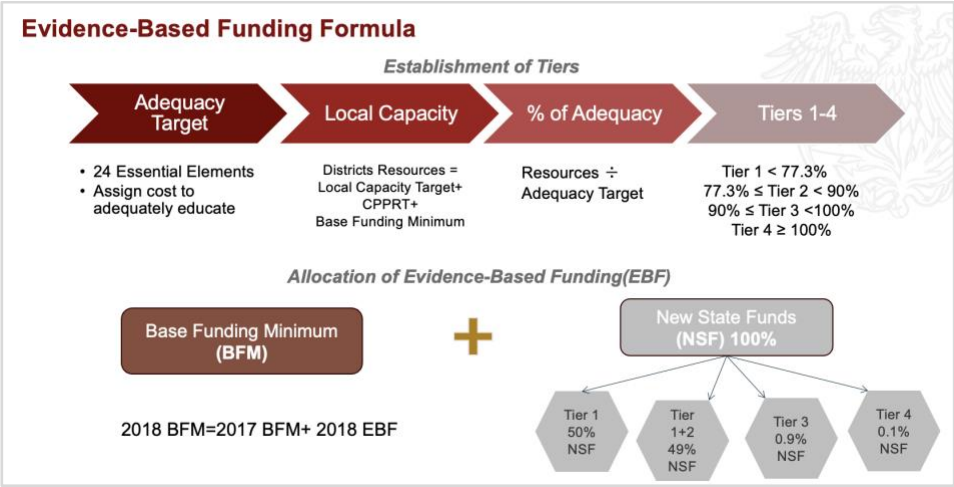
1.Statement of the Research Question

1.1 Importance of Research Question

While the importance of addressing funding inequities of public schools is widely recognized among academic researchers and policymakers, significant disparities persist. Funding levels vary both across states and within individual states, exemplified by the case of Illinois. Despite having per-pupil expenditure near the national average, Illinois ranks poorly in terms of funding fairness, with substantial variation among districts.

In response to these challenges, the State of Illinois enacted the Evidence-Based Funding for Student Success Act (EBF) in 2017. This legislation aimed to rectify the state's underinvestment in K-12 education and promote adequacy and equity in funding allocation across school districts. Under the Illinois EBF model, districts are categorized into four tiers based on their available local resources, with Tier 1 representing districts with the least resources and Tier 4 with the most.

The law mandates that 50% of new funding goes to Tier 1 districts, 49% to Tier 2, and the remainder 1% to Tiers 3 and 4. Each year, the state recalculates funds needed for all districts to reach adequacy, ensuring a systematic approach to addressing funding disparities and promoting statewide educational equity.



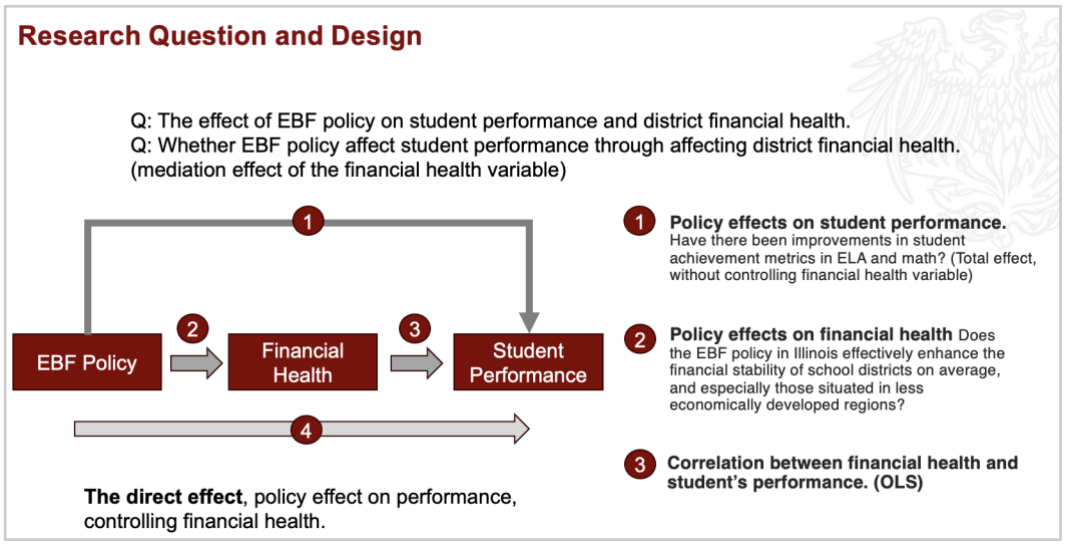
Graph: Evidence-Based Funding Formula Mechanism

1.2 Approach to Addressing the Research Question

Research Question 1: How does the Evidence-Based Funding (EBF) policy in Illinois impact student performance and district financial health?

Research Question 2: Whether EBF policy affects student performance through affecting district financial health?

The time frame selected is 2015 and 2019, two years before and after the implementation of the Evidence-based Funding policy in 2017. We chose this timeframe to avoid the influence of the COVID-19 pandemic in our analysis.



The analysis will be divided into four steps. Firstly, we will evaluate the policy's direct effects on student performance metrics, focusing on improvements in English Language Arts (ELA) and Mathematics achievement. By analyzing pre- and post-implementation data, we aim to determine whether the EBF policy has led to measurable improvement in student academic outcomes. This initial assessment will provide insights into the overall impact of the policy on student achievement without considering the influence of district financial health.

Secondly, we will delve into the effects of the EBF policy on district financial health. Specifically, we will investigate whether the policy has effectively contributed to the financial stability of school districts across Illinois, with a particular focus on districts situated in less economically developed regions. By examining financial indicators such as budgetary allocations and reserve funds, we aim to assess the policy's effectiveness in bolstering the financial well-being of districts, thereby providing critical context for understanding its broader impacts.

Thirdly, we will explore the correlation between district financial health and student performance. Using Ordinary Least Squares (OLS) regression analysis with fixed effects, we will examine the relationship between financial metrics, such as budgetary allocations and reserve funds, and student achievement outcomes. This analysis will help elucidate the extent to which district financial health is associated with student academic success, providing valuable insights into the underlying dynamics at play.

Fourthly, we will assess the direct effect of the EBF policy on student performance while controlling for district financial health variables. By employing mediation analysis techniques, we will determine whether district financial health serves as a mediator in the relationship between the EBF policy and student outcomes. This analysis will enable us to ascertain the extent to which improvements in student performance can be attributed to the district financial health, and whether there are any improvements in education performance unexplained by the financial health.

Apart from the regression analysis, we will also conduct a spatial analysis using Geographic Information System (GIS). The main purpose of this analysis is to first visualize the educational performance and financial condition of school districts in 2015 and 2019, that is two years before and after the EBF policy. The analysis aims to explore whether there are any districts that have low educational performance and also low financial health scores or a decline in state funding. The analysis could have policy implications in identifying districts that are performing lower in education while at the same time being financially disadvantaged.

We will then use spatial autocorrelation and Local Indicators of Spatial Autocorrelation (LISA) methods to analyze the relationship between these variables. A conditional map for education performance on financial condition is further produced. By comparing whether the patterns are aligned with each other, we could further understand whether improved financial conditions would also mean education performance improvement, and whether more fundings is distributed to districts that have worse education performance.

1.3 Hypothesis and Mechanisms

It is hypothesized that the implementation of the Evidence-Based Funding (EBF) policy in Illinois will have a positive effect on both student performance and district financial health. The rationale behind this hypothesis stems from the understanding that equitable and adequate funding is crucial for improving educational outcomes and ensuring the financial stability of school districts.

This research addresses a pressing issue in education policy: the persistent inequities in funding allocation and their implications for student outcomes. The implementation of the EBF model in Illinois represents a significant attempt to address these disparities and improve educational equity. By examining the effects of this policy intervention, we can gain insights into the effectiveness of targeted funding strategies in promoting fairness and enhancing student success.

2. Context

Prior to the implementation of the Evidence-Based Funding (EBF) model, Illinois struggled with a significant issue in its school funding system. The previous model, known as General State Aid (GSA), was widely criticized for being one of the most regressive in the nation. Under GSA, districts with higher levels of poverty consistently received less funding per pupil compared to wealthier districts. This disparity arose due to several factors, including insufficient state investment in education and a heavy reliance on local property tax revenue to fund schools.

The reliance on local property taxes exacerbated funding disparities between districts with differing levels of property wealth. Wealthier districts could generate significant revenue with relatively low tax rates, while less affluent districts struggled to provide essential resources despite higher tax rates. As a result, these disparities widened over time, contributing to socioeconomic inequalities in educational opportunities across the state.

The disparities in school funding had profound environmental implications for Illinois communities. Students in districts with limited financial resources often faced challenges such as inadequate facilities, outdated instructional materials, and a shortage of qualified teachers. Furthermore, the lack of funding hindered districts' ability to offer essential support services, including special education programs and mental health resources. These deficiencies not only compromised the quality of education but also perpetuated cycles of poverty and inequality, hindering students' chances for academic success and upward mobility.

3. Literature Review

The literature consistently demonstrates a positive association between equity and adequacy in per-pupil spending and student achievement (Baker, 2018; Rothstein, 2016). Moreover, increasing per-pupil spending has been shown to help narrow the opportunity gap (Atchison,2019; Baker, 2018; Darling-

Hammond, 2019; Rothstein, 2016). Beyond high school graduation, the impact on student achievement has long-term implications. Biasi (2019) examined school finance reform across seven cohorts of students in 20 U.S. states and found that smaller variances in per-pupil expenditures can lead to a reduction in income inequality and an increase in intergenerational mobility, although impacts are often moderate. This increase in mobility occurred through enhancements in educational inputs, such as more teachers, and intermediate outcomes like college enrollment (Biasi, 2019).

Furthermore, Biasi noted that the timing of school finance reform is crucial, with more significant results observed when reforms occur earlier in a child's educational career. Increases in per-pupil spending throughout a child's educational journey result in higher graduation rates, increased lifetime wages, and lower rates of adult poverty (Jackson, 2015). Additionally, research indicates that exogenous spending increases are associated with improvements in school inputs, including higher teacher salaries, longer school years, and reduced student-to-teacher ratios.

In the context of Illinois, Houston (2018) examined school finance reform and found that per-pupil funding significantly influenced educational outcomes for high school students. Per-pupil funding showed a significant and positive relationship with all postsecondary-related outcomes, such as postsecondary enrollment, even after accounting for student- and school-level predictor variables (Houston, 2018). Houston argued that fully funding the current EBF formula was crucial for improving postsecondary outcomes for students, given the strong predictive nature of increased revenues. As the importance of ensuring college and career readiness grows, understanding the role of additional funds in ensuring economic mobility becomes increasingly vital, particularly amid potential budget crises affecting funding distributions.

While there's no set timeline for observing changes after policy implementation, several studies shed light on this aspect. Kreisman and Steinberg (2019) found that in Texas, an extra $1,000 per pupil spending led to improved test scores, lower dropout rates, and increased college enrollment and graduation. These gains were most significant in districts with higher proportions of low-income and Hispanic students. Their research highlighted the importance of sustained investment over time to fully reap the benefits of educational policies.

In Wisconsin, Baron (2019) discovered that even a modest increase of $600 per student, mostly allocated to instructional expenses, resulted in higher test scores, increased college enrollment, and reduced dropout rates. Interestingly, while some indicators like test scores and dropout rates changed relatively quickly, others such as college enrollment took nearly a decade to show tangible improvements. This variability underscores the nuanced nature of the impact of funding increases on educational outcomes.
Research into the implementation of evidence-based funding models in other states, like New Jersey and Massachusetts, has demonstrated potential benefits in reducing funding gaps among school districts and improving student performance, particularly in districts that had been historically underfunded. The Illinois EBF policy is officially evaluated with concrete auditing reports, but more analysis is focusing on the financial and spending side (Johnson, 2023). It is a great complement to existing research by using statistical spatial analytic methods to evaluate the causal inference and geographic distribution of education outcome. This research also provides a potential connection with financial condition and other broader location-specific variables.

4. Research Design

4.1 Data

1. Evidence-Based Funding Data
We use data on evidence-based funding obtained from the Illinois Board of Education. This dataset has information from 3,767 public schools and 325 educational districts, including enrollment data and tier assignments, spanning the years 2015 to 2019.

The evidence-based funding policy is designed to address district needs, student demographics, and available resources to determine the necessary level of funding support for each district to achieve adequacy. Each district's final percentage of adequacy determines its placement into one of four tiers. Tier 1 represents districts farthest from meeting adequacy, requiring greater state assistance, while Tiers 3 and 4 denote districts closer to adequacy, thus needing and receiving less state support.

The dataset serves as a proxy for assessing the impact of evidence-based funding policy on student performance. By examining the distribution of funding across districts and their tier placements, we can gain insights into how different levels of funding affect student outcomes. This nuanced approach allows for a more comprehensive analysis of the relationship between funding allocation and academic achievement.

In terms of temporal and spatial granularity, the dataset allows for analysis from the implementation of the EBF model onwards, spanning multiple years. This longitudinal perspective enables us to track changes in funding allocation and student performance over time, providing valuable insights into the long-term impact of the EBF policy. Spatially, the dataset covers all educational districts and public schools within Illinois, offering a thorough view of the educational landscape in the state.

2. Student Performance Data
The dataset includes the percentage of students proficient in English Language Arts (ELA) and Mathematics, as measured by state standardized tests administered through the Partnership for Assessment of Readiness for College and Careers (PARCC) at the district level.

Data on PARCC proficiency rates for each school and district are sourced from the Illinois Report Card (PARCC). This report card provides detailed proficiency levels for grades 3 through 8, offering insights into student achievement across various districts and schools. As the primary measure for Illinois public school students, PARCC holds schools accountable for academic performance in ELA and Mathematics.

We use changes in the percentage of students proficient in ELA and Math over time as a proxy measurement to assess the effectiveness of the Evidence-Based Funding policy in improving educational outcomes across various districts. The dataset not only shows district-level variations in student proficiency levels but also helps identify disparities in academic performance. With data available from multiple years both before and after the implementation of the EBF model, we can discern trends in student performance, providing insights into the impact of the funding model on educational outcomes. Spatially, the dataset covers all student performance in Illinois at the district level. Temporally, it includes data spanning three years before and two years post-implementation of the EBF model and allows for a thorough assessment of the funding model's effectiveness.

3. School District Financial Profile Scores
This dataset includes information on the financial health of school districts across Illinois, utilizing five weighted indicators to assess their financial status. The indicators include the Fund Balance to Revenue

Ratio, Expenditure to Revenue Ratio, Days Cash on Hand, Percent of Short-Term Borrowing Ability Remaining, and Percent of Long-Term Debt Margin Remaining.

Each indicator is assigned a weight, and the Total Profile Score is calculated as the sum of the weighted scores. Districts receive a score ranging from 1.00 to 4.00, with a higher score indicating stronger financial health. These scores are categorized as follows: Financial Recognition (3.54-4.00), Financial Review (3.08-3.53), Financial Early Warning (2.62-3.07),Financial Watch (1.00-2.61).

By examining changes in the financial profiles of districts over time, we can infer the effectiveness of the EBF model in allocating resources and supporting districts in financial need. By classifying districts into four categories to vary degrees of financial health enables us to identify districts facing financial difficulties and evaluate the impact of the EBF model on improving their financial stability. In terms of temporal and spatial granularity, the dataset covers all school districts across Illinois on their financial profiles. Temporarily, the dataset spans multiple years, allowing for longitudinal analysis of changes in district finances over time. We can assess trends in district financial health before and after the implementation of the policy.

4. Socioeconomic Data

Socioeconomic Status (SES) metrics provide aggregated information about the economic status of students within a district. By examining indicators such as the percentage of students eligible for free or reduced-price lunch or classified as part of the low-income population, we gain insights into the economic backgrounds of students in the district. This data serves as a proxy measure for the number of students living in poverty.

The Free Lunch Count dataset originates from the Common Core of Data (CCD), provided by the National Center for Education Statistics (NCES), and it contains information on students eligible for the National School Lunch Program. Free lunch students are those who qualify for the Free Lunch Program, typically individuals with family incomes below 130 percent of the poverty level or those who are directly certified.as a proxy measure for the number of students living in poverty.

Eligibility for free lunch is typically indicative of lower family income, and thus, a higher count of students eligible for free lunch serves as a proxy for higher levels of poverty within the student population. Including free lunch count as a control variable allows us to control for the potential confounding effects of socioeconomic status when analyzing the impact of educational policies on student outcomes.

5.Educational Inputs and Resources Data

This dataset comes from the 5Essentials®, a research-based system designed to improve schools and student outcomes. It assesses crucial aspects of a school's environment through a survey covering five key factors: Effective Leaders, Collaborative Teachers, Involved Families, Supportive Environment, and Ambitious Instruction. Research derived from the Five Essentials for School Success has proven that schools strong on at least three of the 5Essentials are 10 times more likely to improve student outcomes.

The data from the 5Essentials Survey serves as a proxy for organizational conditions within schools, known to influence student outcomes. The dataset provides insights into a school's overall health and effectiveness, which are crucial for school improvement efforts. Improvements in these areas are expected to correlate with positive changes in student outcomes.

5.Expenditure and Fundings

The dataset originates from the School District Finance Survey conducted by the National Center for Education Statistics (NCES). This survey collects annual finance data from State Education Agencies

(SEAs) in all 50 states and the District of Columbia.

The dataset includes information on various financial aspects, including revenues by source, expenditures by function and object, indebtedness, and assets. These data provide a detailed overview of the financial transactions associated with local education agencies, offering insights into their financial operations and resource management.

4.2 Identification

The identification strategy consists of two parts of analysis: non-spatial and spatial analysis. The non-spatial analysis will focus on using a four-stage panel linear regression analysis to estimate the impact of policy on student performance, and the mediation effect of the financial health variable.

4.2.1 Regression Analysis

Regression I Effect of EBF policy on student performance

This analysis aims to find out the direct effect of the EBF policy on the math and ELA performance, without controlling the financial score variable.

For ELA proficiency percentage:

$$ELA_{it} = \beta_0 + \beta_1 \cdot Post_{it} + \beta_2 \cdot Average\_Effective\_leaders_{it} + \beta_3 \cdot Average\_Collaborative\_teachers_{it} + \beta_4 \cdot Average\_Involved\_families_{it} + \beta_5 \cdot Average\_Supportive\_environment_{it} + \beta_6 \cdot Average\_Ambitious\_instruction_{it} + \beta_7 \cdot TEACHER\_COUNT_{it} + \beta_8 \cdot sum\_lunch_{it} + \beta_9 \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

For Math proficiency percentage:

$$Math_{it} = \beta_0 + \beta_1 \cdot Post_{it} + \beta_2 \cdot Average\_Effective\_leaders_{it} + \beta_3 \cdot Average\_Collaborative\_teachers_{it} + \beta_4 \cdot Average\_Involved\_families_{it} + \beta_5 \cdot Average\_Supportive\_environment_{it} + \beta_6 \cdot Average\_Ambitious\_instruction_{it} + \beta_7 \cdot TEACHER\_COUNT_{it} + \beta_8 \cdot sum\_lunch_{it} + \beta_9 \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

•ELA_it and Math_it are the % of students who are proficient at ELA and Math at each school/district, respectively, for school/district i in year t.
•Post_t is a dummy variable that equals 1 for the years considered as the treatment period (2017-2019) and 0 for the control period (2015-2016).
• Average_Effective_leaders_it it is an assessment measure of leadership effectiveness of the school board in a district i in year t

• Average_Collaborative_teachers_it in assessment measure of teacher collaboration in a district i in year t
• Average_Involved_families_it is an assessment measure of family involvement in a district i in year t
• Average_Supportive_environment_it is an assessment measure of the supportive environment in a district i in year t
• Average_Ambitious_instruction_it is an assessment measure of the ambition of instruction in a district i in year t
• TEACHER_COUNT_it is the number of teachers for district i in year t.
• LEP_COUNTit is the number of non-English speaking students in district i in time t
• α_i represents district fixed effects.
• γ_t represents time fixed effects
• ε_it is the error term.

Regression II Policy effects on district financial health, after accounting for district and time fixed effects

$$finance\_score_{it} = \beta_0 + \beta_1 \cdot Post_{it} + \beta_2 \cdot total\_expe_{it} + \beta_3 \cdot fed\_revenue_{it} + \beta_4 \cdot state\_revenue_{it} + \beta_5 \cdot local\_revenue_{it} + \beta_6 \cdot Enrollment_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

• finance_score_it is the financial profile score for school district i in year t.
• Post_t is a dummy variable that equals 0 for years before 2017 and 1 for years after 2017, assuming the analysis includes years after 2017.
• total_expe_it represents the total expenditures for school district i in year t
• fed_revenue_it represents the federal funding for school district i in year t
• state_revenue_it represents the state funding for school district i in year t
• local_revenue_it represents the local funding for school district i in year t
• Enrollment_it represents the total amount of EBF funding attained.
• α_i represents district fixed effects
• γ_t represents time fixed effects
• ε_it is the error term.

Regression III Financial health effects on student performance

$$ELA_{it} = \beta_0 + \beta_1 \cdot finance\_score_{it} + \beta_2 \cdot Average\_Effective\_leaders_{it} + \beta_3 \cdot Average\_Collaborative\_teachers_{it} + \beta_4 \cdot Average\_Involved\_families_{it} + \beta_5 \cdot Average\_Supportive\_environment_{it} + \beta_6 \cdot Average\_Ambitious\_instruction_{it} + \beta_7 \cdot TEACHER\_COUNT_{it} + \beta_8 \cdot sum\_lunch_{it} + \beta_9 \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$Math_{it} = \beta_0 + \beta_1 \cdot finance\_score_{it} + \beta_2 \cdot Average\_Effective\_leaders_{it} + \beta_3 \cdot Average\_Collaborative\_teachers_{it} + \beta_4 \cdot Average\_Involved\_families_{it} + \beta_5 \cdot Average\_Supportive\_environment_{it} + \beta_6 \cdot Average\_Ambitious\_instruction_{it} + \beta_7 \cdot TEACHER\_COUNT_{it} + \beta_8 \cdot sum\_lunch_{it} + \beta_9 \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

If both the results of II and III show significant results, it suggests that financial health may mediate the relationship between the EBF policy and student performance.

Regression IV EBF affects student performance through financial health improvement of the district level (the indirect effect)

$$ELA_{it} = \beta_0 + \beta_1 \cdot Post_{it} + \beta_2 \cdot finance\_score_{it} + \beta_3 \cdot Average\_Effective\_leaders_{it} + \beta_4 \cdot Average\_Collaborative\_teachers_{it} + \beta_5 \cdot Average\_Involved\_families_{it} + \beta_6 \cdot Average\_Supportive\_environment_{it} + \beta_7 \cdot Average\_Ambitious\_instruction_{it} + \beta_8 \cdot TEACHER\_COUNT_{it} + \beta_9 \cdot sum\_lunch_{it} + \beta_{10} \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$Math_{it} = \beta_0 + \beta_1 \cdot Post_{it} + \beta_2 \cdot finance\_score_{it} + \beta_3 \cdot Average\_Effective\_leaders_{it} + \beta_4 \cdot Average\_Collaborative\_teachers_{it} + \beta_5 \cdot Average\_Involved\_families_{it} + \beta_6 \cdot Average\_Supportive\_environment_{it} + \beta_7 \cdot Average\_Ambitious\_instruction_{it} + \beta_8 \cdot TEACHER\_COUNT_{it} + \beta_9 \cdot sum\_lunch_{it} + \beta_{10} \cdot LEP\_COUNT_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

If the coefficient of the EBF policy in IV is less than in I, it means that some of the effect of EBF is being 'explained' or 'mediated' by the financial score. The size of the difference in the coefficient gives an indication of the extent of the mediation effect of financial score.

To quantify the mediation effect, researchers often use the product of coefficients method or the difference in coefficients method, or they conduct a formal statistical test such as the Sobel test. Here we adopt a simple difference in coefficient method.

$$Mediation\ Effect = \beta_{1\ \text{in I}} - \beta_{1\ \text{in IV}}$$

4.2.2 Spatial Analysis

The following two spatial analysis are also conducted as complementary of the regression analysis:

Summary Statistics & Data visualization

We will be using QGIS to visualize the distribution of school district educational performance and financial conditions (financial profile score and newly accessed school funding), respectively, in the years 2015 and 2019.

Step I involves preparing the data for analysis, which begins with loading the shapefile for Illinois state along with educational district geo-data into QGIS. The next task is to clip the education district boundary with the Illinois shapefile, taking note that there are a total of 865 education districts to consider. Concurrently, student performance indicator data and district financial condition variables are downloaded and imported into R for processing. This step includes the detection of missing and outlier values, followed by data cleaning to retain only the relevant variables for the analysis.

To merge the datasets of student performance and district financial health, the 'Dist_name' field is used as a common key. This necessitates aligning the naming conventions across both datasets and establishing joining keys for a successful merge. The resultant dataset is then saved as a CSV file titled "GIS_matched_data."

Once the data preparation in R is completed, the "GIS_matched_data.csv" file is reloaded into QGIS and integrated with the education district geo-data. This integration creates a new layer named “merged_data,” which will be used in subsequent analysis steps.

Step II transitions into data visualization and statistical summaries within QGIS. This phase utilizes the "graduated" feature to summarize student performance in ELA and Math for the years 2019 and 2015. To classify the educational performance of students, the Natural Breaks (Jenks) method is applied, segmenting the performance into eight distinct categories. Additionally, the financial scores are categorized into four groups based on criteria established by the Illinois State Board of Education, enabling a clearer interpretation of financial standings across districts.

Local Indicators of Spatial Autocorrelation (LISA Analysis)

Spatial autocorrelation is an important approach that studies the correlation level in the serial data, and derives spatial correlations. In this analysis we will be using GeoDa to conduct spatial correlation and LISA analysis of education districts in 2015 and 2019, and also producing the clustering map of the education performance and financial conditions.

To calculate local spatial autocorrelation, a weight is first set up based on the district’s polygram-id, and Moran's I Test Statistic is calculated to compare with a random spatial distribution, and reflect the differences in value in a district with its neighbors. The significance level is shown through Permutation Approach.

The process begins with saving the "merged_data" shapefile from QGIS and then importing it into GeoDa. For the spatial weight setup, POLY_ID is created as the identification variable. The queen contiguity method is preferred for setting weights as it takes into account regions that share a common border or vertex, which is deemed more suitable for complex polygon shapes than the rook contiguity approach. The analysis proceeds with the selection of "Univariate Moran’s I" to perform Local Indicators of Spatial Association (LISA) analyses, targeting variables such as "ELA_2019," "Math_2019," "Finance_score_2019," and

"State_log" individually. This generates spatial clustering maps as well as maps indicating statistical significance.

A preliminary visual inspection is conducted to identify any overlapping characteristics—for instance, assessing whether districts with weaker financial scores also exhibit challenges in student performance. To ensure the robustness of the findings, 999 permutations are executed, with significance levels gauged by the p-values generated.

Following the initial analyses, a conditional map is created. This map places the financial score on the vertical axis and the logarithm of state funding on the horizontal axis, while using "ELA_2019" as the variable of interest. Attention is directed toward districts in the bottom 25% quartile of the ELA values, which typically represents low financial scores. This step is crucial to investigate whether poor student performance is correlated with financial conditions across the districts. The aim is to discern whether the association between financial conditions and student performance is consistent, or if there are districts where student performance issues do not appear to be directly linked to financial standings.

4.3 Results

We start by presenting the results from spatial analysis. By comparing graphs 1.0 to 1.1, and 1.2 to 1.3 in the Appendix 7, we can see that in some districts the ELA and math performance got improved. However, the improvement trajectory is not a jump, but a relatively small and gradual process. From the above graphs we could see that students with relatively worse performance in ELA and math are concentrated in the South most side and the West side of Illinois.

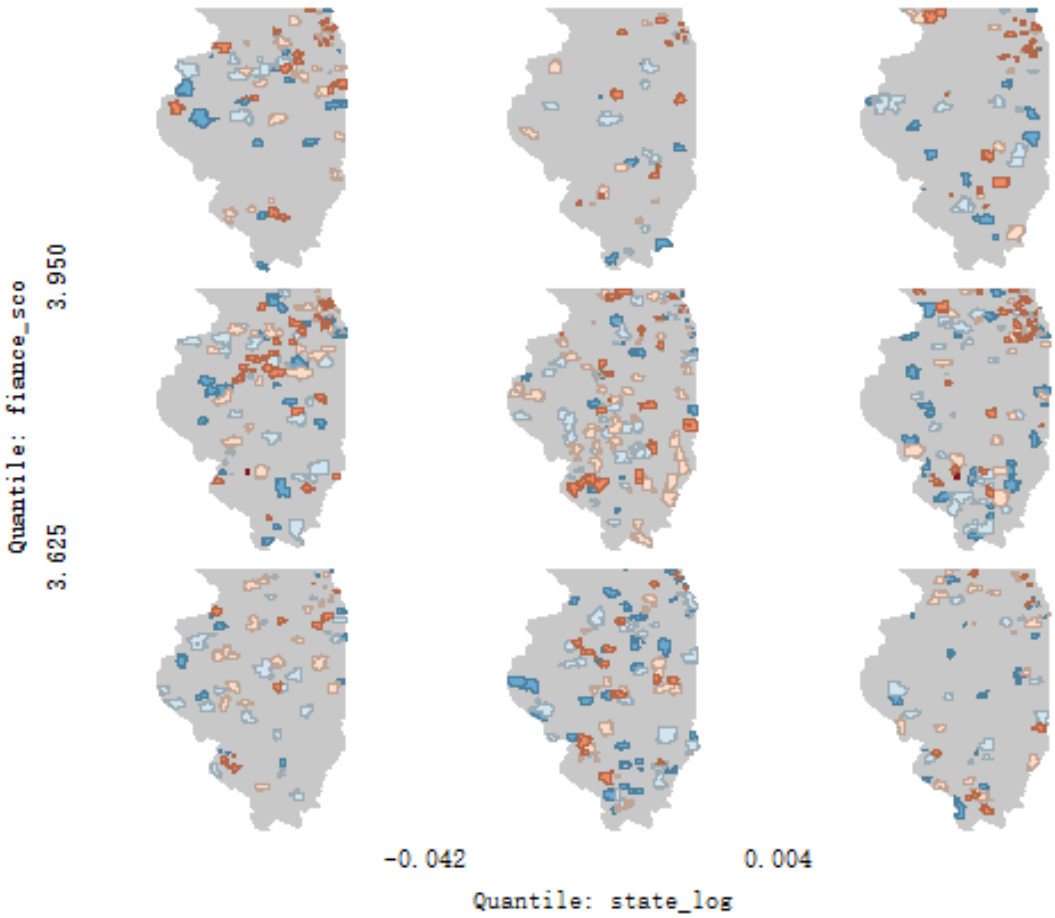
By looking at Graph 1.4 in Appendix 7, we could see the pattern of the increase in state funding distribution in the year 2019. We can see that the funding distribution does not have a very clear geography pattern, and the distribution is scattered. Districts in the northwest side and south side are having an increase in state funding, and districts in the upper middle part of Illinois are having a decline in state funding in 2019. It is very complicated to disentangle whether such a decline in funding is due to the fact the district is already having a very good financial score (shown in Graph 1.6) and the district is already having very good education quality (Graph 1.2 and 1.3), as the situation in each district is very different.

When examining Graphs 2.0 to 2.4 in Appendix 7, we notice that the clustering pattern of educational outcomes across years have certain similarities. Students with relatively worse performance in ELA and math are concentrated in the South most side and the West side of Illinois, and that pattern is the same in 2015 and 2019.

However, such a clustering pattern differs from that of log state funding. Although in some areas in the northeast corner of Illinois, there's a match between increased funding and improved educational levels, and overall, there seems to be a low alignment between the pattern of changes in funding and patterns of educational outcomes.

There are two main explanations. One is that the state funding increase after Evidence-based Funding Policy is less than enough to improve the education qualities in the districts, so that even a high increase in log funding is still insufficient. This is possible under the situation that most districts reply fundings from the federal level and other localized sources (e.g. property taxes).

The other explanation indicates that annual state funding is based on specific regional circumstances, likely more influenced by the current financial status of educational districts and student needs (such as the number of students requiring special education), rather than the average educational performance at present. This is more likely to be the case, according to the evidence presented in this report.



(conditional map of ELA performance in 2019 with log state funding and financial scores. Blue color indicates the district's ELA performance falls at the lower 25% quantile. Deep orange color indicates that the district's ELA performance falls at the upper 25% quartile)

This viewpoint is supported by Graphs 2.5 and 2.6, which are conditional maps of education performance on financial score and log state fundings. These maps show that school districts in the lowest 25% quantile of educational levels are not predominantly situated in segments with low financial scores or low log state funding. Instead, they are more evenly distributed across segments with median financial scores and log state funding. When looking at districts with top 25% education performance, we can also see that they are distributing evenly across the segments. This suggests that financial profile scores and log state funding do not have a strong relationship with educational performance, in scale, economically.

Therefore, we hypothesize that better financial health, although an indicator of a district's potential ability to provide good education, does not necessarily equate to better student performance. A district's financial health more so reflects its ability to balance income and expenses and its capacity to handle short-term debt risks. Student educational performance could be more significantly affected by regional social economic factors, as well as the supply of educational resources (teachers and quality of teaching).

In addition, we further hypothesize that there is a relatively less obvious relationship between the change in state funding and student performance. From the current spatial analysis, we know that most of the funding increases are concentrated in the average standard, since the budgets are relatively fixed at State level each year. The analysis answers a fundamental question on whether there is increased funding to go to schools with lower educational performance, or does it simply go to schools in worse financial conditions or those with other characteristics, like the current resources in an education district. Based on our analysis and further reading on EBF distribution standards, it might be the latter. The Evidence-Based Funding (EBF) policy formula calculates funds based on the resources a district currently has and the resources it needs to provide adequate education. Thus, localized resources and characteristics are important determinants of funding.

To further verify those assumptions in a causal inference approach, we run through a four stage regression analysis.

Regression I Effect of EBF policy on student performance

	Dependent variable:							
	ELA				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	1.356***	1.235***	2.283***	2.660***	2.540***	2.312***	3.175***	3.028***
	(0.186)	(0.235)	(0.335)	(0.411)	(0.170)	(0.225)	(0.291)	(0.371)
sum_lunch		-0.00001		0.0001		0.0003**		0.0003*
		(0.0001)		(0.0002)		(0.0001)		(0.0001)
LEP_COUNT		-0.006**		-0.007***		-0.003		-0.006**
		(0.002)		(0.003)		(0.002)		(0.002)
Average_Effective_leaders			0.031	0.004			0.056**	0.084**
			(0.031)	(0.038)			(0.027)	(0.035)
Average_Collaborative_teachers			-0.026	0.005			-0.122***	-0.132***
			(0.031)	(0.037)			(0.027)	(0.033)
Average_Involved_families			0.017	0.019			0.103***	0.093***
			(0.025)	(0.030)			(0.022)	(0.027)
Average_Supportive_environment			-0.015	-0.035			0.008	-0.009
			(0.018)	(0.022)			(0.016)	(0.020)
Average_Ambitious_instruction			0.057***	0.073***			0.029*	0.037*
			(0.019)	(0.023)			(0.016)	(0.021)
TEACHER_COUNT			-0.006	-0.013			0.005	0.002
			(0.015)	(0.014)			(0.013)	(0.012)
Observations	4,101	2,654	2,354	1,733	4,101	2,654	2,354	1,733
R^2	0.016	0.015	0.035	0.042	0.065	0.065	0.112	0.108
Adjusted R^2	-0.250	-0.309	-0.447	-0.494	-0.189	-0.242	-0.332	-0.391
F Statistic	53.263*** (df = 1; 3226)	10.010*** (df = 3; 1997)	8.238*** (df = 7; 1569)	5.410*** (df = 9; 1111)	222.850*** (df = 1; 3226)	46.417*** (df = 3; 1997)	28.283*** (df = 7; 1569)	14.937*** (df = 9; 1111)
Note:								*p<0.1; **p<0.05; ***p<0.01

After accounting all the district unobservable and time variant variables in a fixed effect model, the regression result shows that post-2017 implementation of the EBF policy demonstrates a positive and robust influence, with percentage of student proficient at the ELA and Math showing an increase of 1.235 to 2.83 and 2.54 to 3.175 percentage points, respectively, indicating the policy's effectiveness across the

districts. This statistical significance shows the policy's potential in enhancing educational achievements of students on average at each district. The mechanism of such an effect, however, remains to be explored in the following analysis.

The results also reveal that an increase in the count of non-English speakers is associated with lower ELA and math performance, which is not surprising given the students are facing more challenges in understanding the subjects. In addition, we find students' social-economic characteristics in a district could be affecting student's math performance. Interestingly, the negative relationship between collaborative teaching scores and student performance in both ELA and Math, particularly the latter, prompts questions about the measurement scale of the indicator, and also problems of missing data in a non-random way. It could also be interpreted in a way that the average evaluation score of the entire district does not signal within- district heterogeneity across schools.

In contrast, family involvement and instruction quality emerge as a critical positive contributor to student performance, reaffirming the role of engaged families in supporting academic success. Conversely, the quantity of teachers, represented by TEACHER_COUNT, appears to have no significant correlation with performance in either subject, suggesting that the mere increase in teacher numbers does not translate into higher achievement. This points to the importance of investigating the quality of educational delivery and the interactions between teachers and students.

Regression II Policy effects on district financial health, after accounting for district and time fixed effects

	Dependent variable:			
	finance_score			
	(1)	(2)	(3)	(4)
Post	0.097***	0.104***	0.074***	0.075***
	(0.008)	(0.008)	(0.008)	(0.008)
total_expe		-0.000***		-0.000***
		(0.000)		(0.000)
fed_revenue			0.00000***	0.00000***
			(0.000)	(0.000)
state_revenue			-0.000	0.000***
			(0.000)	(0.000)
local_revenue			0.00000***	0.00000***
			(0.000)	(0.000)
Enrollment				0.00000
				(0.00000)
Observations	3,736	3,734	3,734	3,710
R^2	0.049	0.052	0.071	0.107
Adjusted R^2	-0.204	-0.201	-0.178	-0.135
F Statistic	152.169*** (df = 1; 2949)	81.593*** (df = 2; 2946)	56.427*** (df = 4; 2944)	58.431*** (df = 6; 2918)
Note:				*p<0.1; **p<0.05; ***p<0.01

The result shows that after the year 2017, the financial profile score of the school district has increased for around 0.075 to 0.1 points on average, which is relatively small in economic significance. This means that the EBF policy, by providing a tier-based funding to the school districts, did help improve the overall financial score of the districts.

Other variables in terms of expenditure and total fundings from state, local and federal level all have a significant effect on the financial profile score, but the effect in economic significance is almost negligible. State funding, the source that is most affected by the EBF policy, has a higher magnitude of effect on the financial scores. However, in general, the district's financial scores on average stay in the same recognition level, in the time frame we choose, despite the fact that after 2017 X% of the districts are having an improvement in their financial score. Spatial analysis in the appendix also supports this observation, that there are almost no changes in school district financial health recognition level two years before and after the EBF policy.

This observation could be intuitive in a sense that there is large heterogeneity and imbalance in the district's resources, and thus the effect of EBF policy gets averaged. EBF could lead to a higher improvement on those regions that are weaker in financial profile scores, compared with districts that are financially healthier. The policy's intent is aimed at preventing the financial condition of worse-performing school districts from deteriorating but lacks the thorough ability to turn around a school district's financial health in a relatively short period of time. For those districts already having good financial capabilities, the goal for the policy is simply to maintain the status quo.

A complementary explanation is the distribution of finance score is less balanced, and example is that most of the districts are having a Financial Recognition rating level, so that the potential for financial score improvement is minor.

Regression III Financial health effects on student performance

	Dependent variable:							
	ELA				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
finance_score	1.112**	1.500***	0.599	1.477**	2.222***	2.260***	1.145**	1.692***
	(0.443)	(0.535)	(0.597)	(0.702)	(0.413)	(0.522)	(0.529)	(0.640)
sum_lunch		0.0001		0.0001		0.001***		0.0003*
		(0.0001)		(0.0002)		(0.0001)		(0.0001)
LEP_COUNT		-0.003		-0.004		0.001		-0.002
		(0.002)		(0.003)		(0.002)		(0.002)
Average_Effective_leaders			0.048	0.027			0.071**	0.110***
			(0.032)	(0.039)			(0.028)	(0.036)
Average_Collaborative_teachers			-0.019	0.018			-0.108***	-0.120***
			(0.031)	(0.038)			(0.028)	(0.035)
Average_Involved_families			-0.025	-0.023			0.045**	0.045
			(0.025)	(0.030)			(0.022)	(0.028)
Average_Supportive_environment			0.039**	0.024			0.081***	0.055***
			(0.017)	(0.020)			(0.015)	(0.018)
Average_Ambitious_instruction			-0.017	-0.014			-0.072***	-0.060***
			(0.015)	(0.018)			(0.014)	(0.017)
TEACHER_COUNT			0.0004	-0.003			0.015	0.014
			(0.015)	(0.014)			(0.013)	(0.013)
Observations	3,736	2,633	2,331	1,719	3,736	2,633	2,331	1,719
R^2	0.002	0.005	0.008	0.010	0.010	0.025	0.044	0.058
Adjusted R^2	-0.264	-0.323	-0.492	-0.546	-0.254	-0.296	-0.437	-0.472
F Statistic	6.317** (df = 1; 2949)	3.376** (df = 3; 1980)	1.691 (df = 7; 1550)	1.255 (df = 9; 1100)	28.900*** (df = 1; 2949)	16.700*** (df = 3; 1980)	10.249*** (df = 7; 1550)	7.494*** (df = 9; 1100)
Note:								*p<0.1; **p<0.05; ***p<0.01

The analysis shows that financial score still has a positive and significant influence on ELA and Math grades in almost all regressions. This suggests that the mediation effect of the financial score could be positive, that the EBF policy improves student's performance through improving the financial profile of the district. Improving financial scores of a district could allow the school to recruit more teachers, investing more on student instruction, and therefore improving the performance of the students. However, similar to regression II, we find that the economic level significance of financial_score on student performance is relatively small, with a marginal effect less than 2 percentage points when there is 1 unit of financial score improvement.

Regression IV EBF affects student performance through financial health improvement of the district level (the direct effect)

	Dependent variable:			
	ELA		Math	
	(1)	(2)	(3)	(4)
Post	2.638***	2.660***	2.934***	3.028***
	(0.417)	(0.411)	(0.377)	(0.371)
finance_score	0.931		1.086*	
	(0.695)		(0.628)	
Average_Effective_leaders	-0.003	0.004	0.075**	0.084**
	(0.039)	(0.038)	(0.035)	(0.035)
Average_Collaborative_teachers	0.015	0.005	-0.123***	-0.132***
	(0.037)	(0.037)	(0.034)	(0.033)
Average_Involved_families	0.020	0.019	0.093***	0.093***
	(0.030)	(0.030)	(0.028)	(0.027)
Average_Supportive_environment	-0.036*	-0.035	-0.011	-0.009
	(0.022)	(0.022)	(0.020)	(0.020)
Average_Ambitious_instruction	0.074***	0.073***	0.038*	0.037*
	(0.023)	(0.023)	(0.021)	(0.021)
TEACHER_COUNT	-0.011	-0.013	0.005	0.002
	(0.014)	(0.014)	(0.013)	(0.012)
sum_lunch	0.0001	0.0001	0.0003*	0.0003*
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
LEP_COUNT	-0.007***	-0.007***	-0.006**	-0.006**
	(0.003)	(0.003)	(0.002)	(0.002)
Observations	1,719	1,733	1,719	1,733
R^2	0.045	0.042	0.107	0.108
Adjusted R^2	-0.493	-0.494	-0.396	-0.391
F Statistic	5.172*** (df = 10; 1099)	5.410*** (df = 9; 1111)	13.171*** (df = 10; 1099)	14.937*** (df = 9; 1111)
Note:				*p<0.1; **p<0.05; ***p<0.01

The effect of the independent variable on the dependent variable is less in Model (1) (3) than in Model (2) (4), which is the direct effect estimated from regression I. This is indicating that some of the effect of EBF policy on the student performance is being 'explained' or 'mediated' by the financial profile score, which suggests a positive mediation effect of the finance score variable. However, we can see that the mediation effect of financial score (around 0.04 in ELA and 0.1 in math) is relatively small compared to the magnitude of the EBF policy's effect in total, indicating that the policy could affect student performance through other more important channels.

Our hypothesis is that the policy, instead of only focusing on improving the average financial score and education performance, also provides extensive support in districts where financial condition is worse, or more students that are non-English speakers and those who require special education. The EBF policy recognizes the unique needs of English learning students, students with disabilities, and low-income students by allocating additional funding based on the number of students in each of these groups. This targeted funding, which is not fully captured by our existing data, enables education districts to implement specialized programs and services tailored to the specific needs of these student populations. For ELLs, districts can use the funds to hire bilingual teachers, provide language acquisition curricula, and offer dual language or newcomer programs. For students with disabilities, the funding supports hiring special education staff, purchasing assistive technologies, and implementing inclusive practices like co-teaching. Meanwhile, for low-income students, districts can invest in academic interventions, wraparound services, early childhood education, and extended learning opportunities. When accounting for those

dedicated resources to address the diverse needs of these student groups, we could further understand what the most essential part of the EBF policy is in improving the academic outcomes.

4.4 Limitations & Further Research

There are a couple of limitations for the existing study. The first limitation is the discussion of heterogeneous treatment effects of the EBF policy across districts since the regression analysis only focuses on the average effects. In the EBF formula, the target for "adequate education" is determined by the specifics of each school district, which might lack the potential for horizontal comparison across different districts. Therefore, the magnitude of the increase in percentage of students who pass the exam could mean differently for schools in different districts.

In addition, a discussion of within-district variation could also be added in the future. An analysis based on the school level could be more specific, as different schools could have different student characteristics and education resources. The 5E evaluation, originally based on the school level, could miss a lot of heterogeneity information if aggregated into district average. It is a pity that at this stage we lack further data to analyze the relationship between school level financial situations and the educational outcomes produced. Moreover, it is interesting to see whether the spending structure of the school and districts are changing, resulting in a change in the educational outcome. Further exploration could be focused on how the education districts spend the education funding in instruction.

Meanwhile, as the Illinois Board of Education has stated, the policy has been in place for a relatively short period of time, and the impact of the pandemic has also been a factor. Therefore, it is not yet the time to conduct a systematic regression analysis. Indeed, the data we have adopted covers only five years, which is a relatively short span of time, making it difficult to discern the effects of the policy.

In terms of the estimation strategy, we could adopt a synthetic control method to simulate a control group situation where the EBF policy is not in place. The challenge for this method is that a large enough panel data is needed from both Illinois and other states in order to simulate a reliable synthetic control. A more practical approach is to build up synthetic control fully based on the historical data at Illinois.

A spatial analysis perspective could probe the mobility of students and educational resources between districts, uncovering patterns of migration and resource distribution. This could be pursued by tracking student movement data, analyzing school choice dynamics, using GIS to visualize and analyze these spatial-temporal trends. Through such multifaceted research, policymakers could gain actionable insights to foster educational equity across Illinois.

5 Conclusion

In summary, this paper applies spatial and regression analysis, shedding light on the effects of the EBF policy on Illinois educational districts' financial health and student performance. While the implementation of the EBF policy post-2017 shows a statistically significant, positive impact on students' ELA and Math proficiency, the mediation effect of improved financial scores on educational outcomes is relatively small in economic scale. This suggests that while financial health is a crucial aspect of a district's capacity to enhance educational quality, it is not the sole determinant of student performance, as

it is affected by a complex interplay of factors, including socioeconomic characteristics and the availability of educational resources, rather than financial metrics alone. We believed in EBF policy's role in addressing more targeted needs such as support for non-English speakers and students requiring special education. Although the study is constrained by a relatively short post-policy timeframe and lacks granular school-level spending data, it points to future research directions including synthetic control methods for a deeper understanding of the EBF policy's impact.

6 References

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7 Appendix

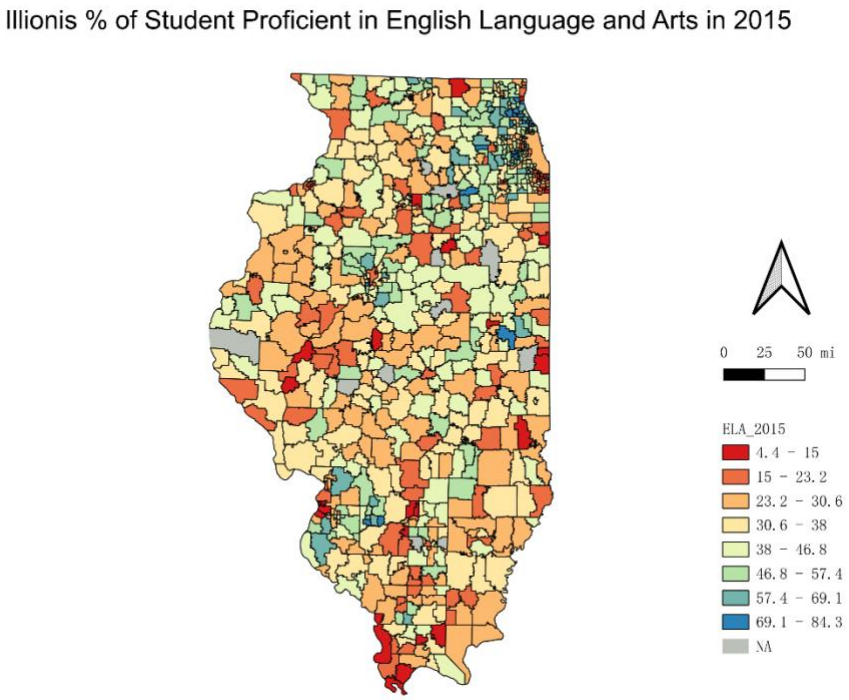
7.1 A list of all the variables

Category	Variable Name	Description
Identifiers	LEAID	Unique identifier for school districts
Identifiers	Year	The year the data was collected
Identifiers	Dist_name	Name of the school district
Identifiers	County	The county in which the district is located
Identifiers	RCDTS	Another unique identifier for school districts
Identifiers	Dist	Short form of district identification
Identifiers	City	The city where the district is located

Dependent Variables	ELA	Percentage of students who passed the PARCC English Language Arts assessment in a particular year
Dependent Variables	Math	Percentage of students who passed the PARCC Math assessment in a particular year
Independent Variable	Post	Whether the data is from after the year 2017, the implementation of EBF policy
Student Characteristics	LEP_COUNT	Number of students who are non-native English speakers
Student Characteristics	Sum_lunch	Number of students in the free lunch program (indicator of poverty and social-economic status of students)
Student Characteristics	Enrollment	Number of students enrolled in the district
Educational Resources	Average_Effective_leaders	An assessment measure of leadership effectiveness of the school
Educational Resources	Average_Collaborative_teachers	An assessment measure of teacher collaboration in a district
Educational Resources	Average_Involved_families	An assessment measure of family involvement in a district
Educational Resources	Average_Supportive_environment	An assessment measure of the supportive environment in a district
Educational Resources	Average_Ambitious_instruction	An assessment measure of the ambition of instruction in a district
Educational Resources	TEACHER_COUNT	The number of teachers in the district
Funding & Expenditure	state_revenue	Funding received from the state
Funding & Expenditure	fed_revenue	Funding received from the federal government
Funding & Expenditure	total_expe	Total expenses of the district
Funding & Expenditure	total_edu_expe	Total educational expenses of the district
Funding & Expenditure	local_revenue	Local funds (e.g., property taxes, parent fundraising)
Funding & Expenditure	log_diff_state_revenue	Change in state funding compared to the previous year, in log
Funding & Expenditure	log_diff_total_expe	Change in total expenses compared to the previous year, in log
Funding & Expenditure	log_diff_total_edu_expe	Change in educational expenses compared to the previous year, in log
Funding & Expenditure	log_diff_fed_revenue	Change in federal funding compared to the previous year, in log
Funding & Expenditure	log_diff_local_revenue	Change in local revenue compared to the previous year, in log

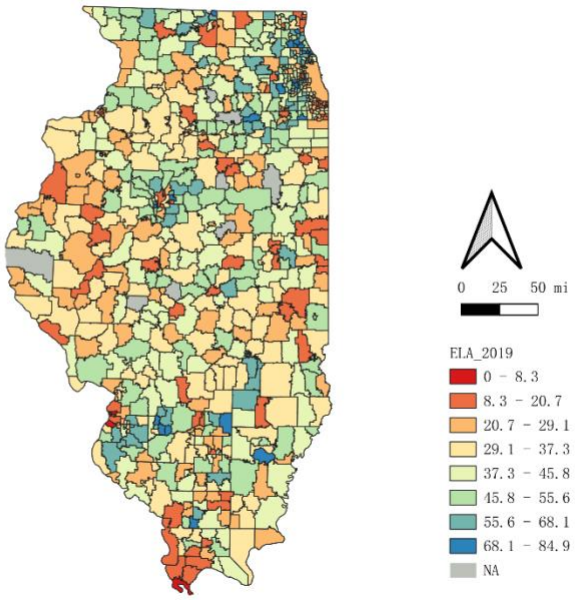
Financial Capability	FBRR	A ratio comparing fund balance to revenue
Financial Capability	ERR	A ratio of expenses to revenue
Financial Capability	DCOH	A liquidity indicator showing the number of days the district can operate with available cash
Financial Capability	STB	The percentage of short-term borrowing capacity that is unused
Financial Capability	LTD	The amount of long-term debt to be repaid
Financial Capability	finance_score	A comprehensive score of overall financial health
Financial Capability	Designation	The financial rating assigned to the district

7.2 Spatial Analysis Results



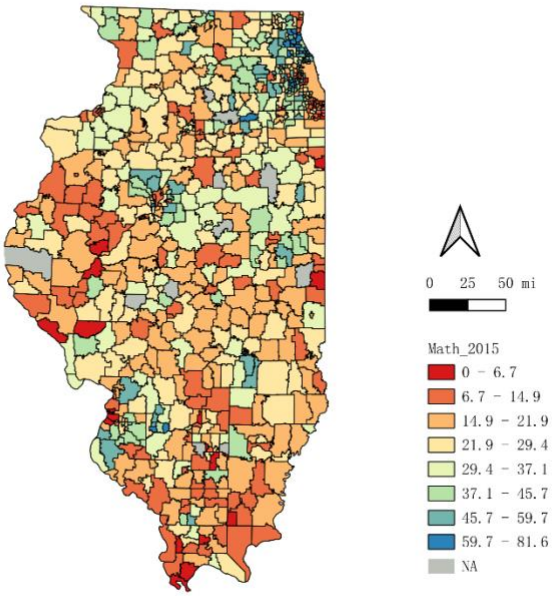
Graph 1.0

Illinois % of Student Proficient in PARCC English Language Arts (2019)



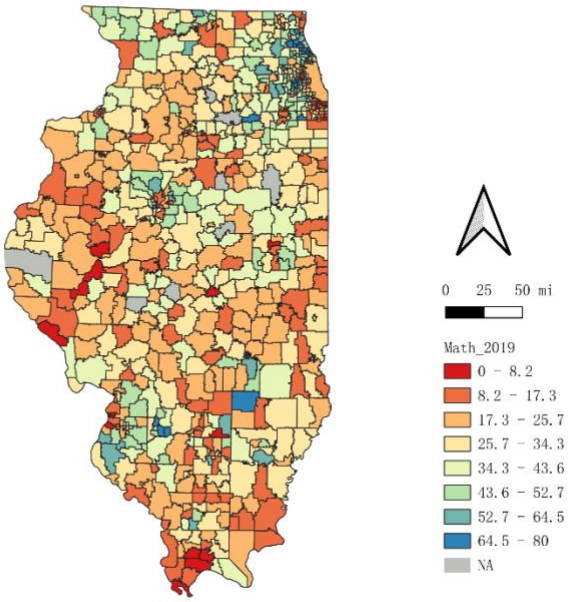
Graph 1.1

Illinois % of Student Proficient in PARCC Math Test (2015)



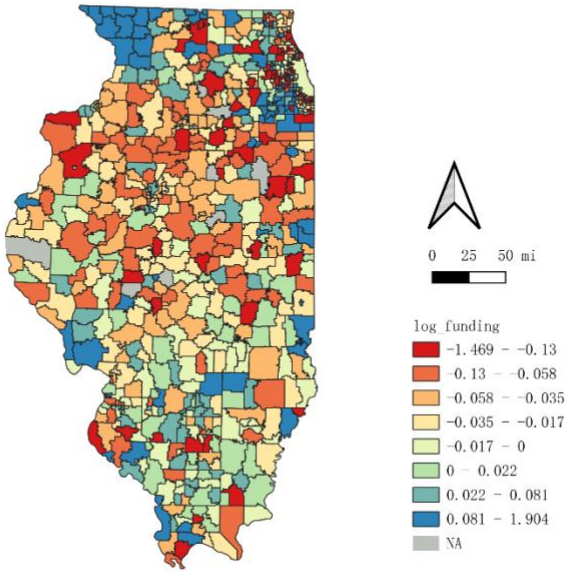
Graph 1.2

Illinois % of Student Proficient in PARCC Math Test (2019)



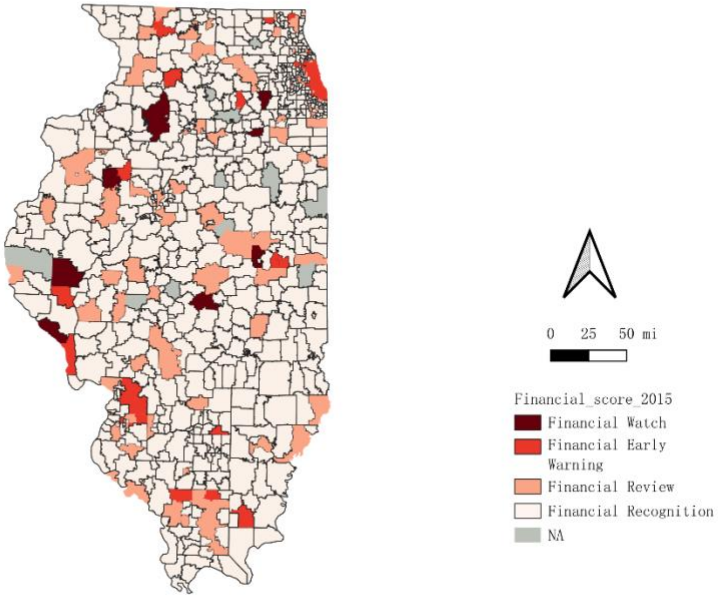
Graph 1.3

Changes in State Funding, 2018-2019



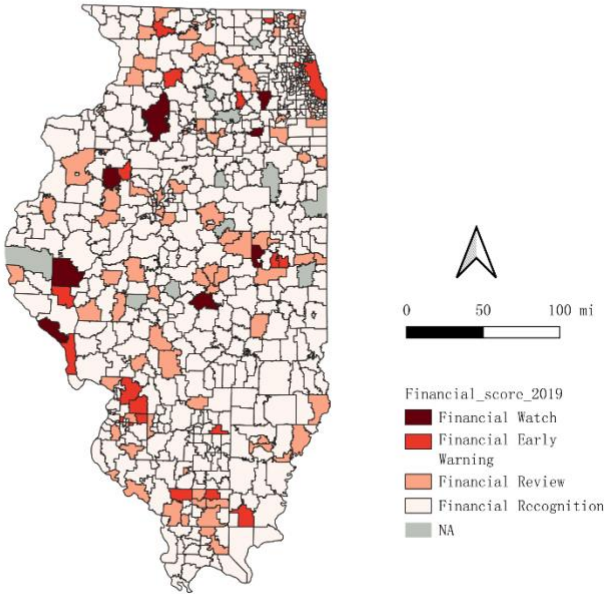
Graph 1.4

Financial Profile Scores of Illinois Education Districts, 2015

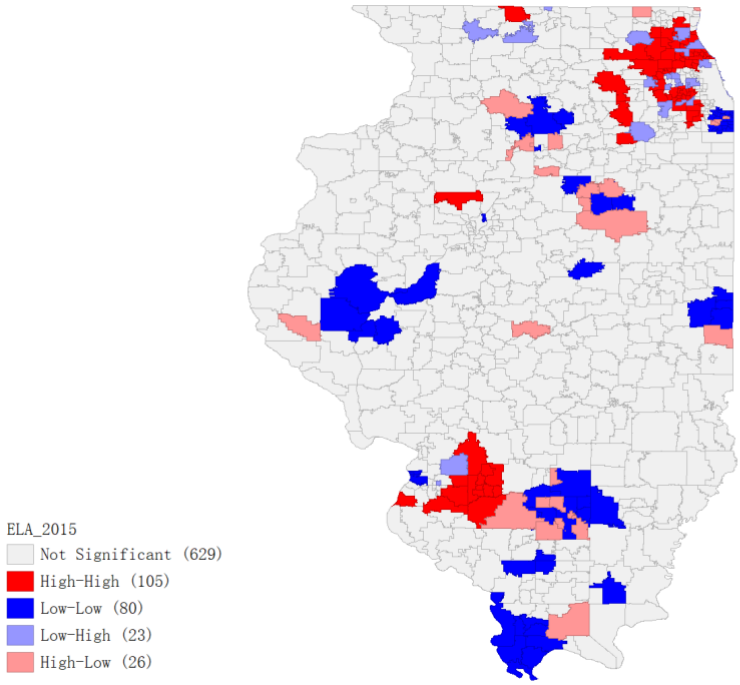


Graph 1.5

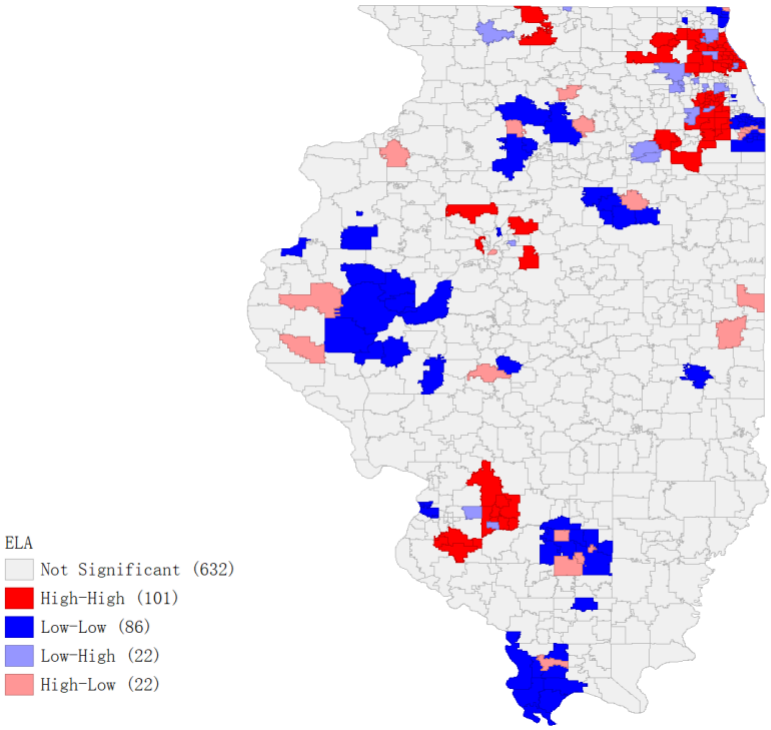
Financial Profile Score of Illinois's Education Districts, 2019



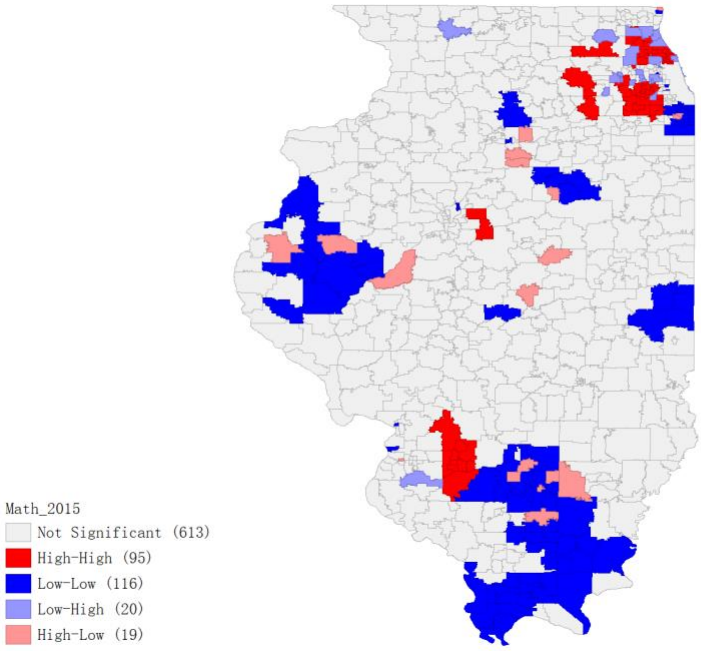
Graph 1.6



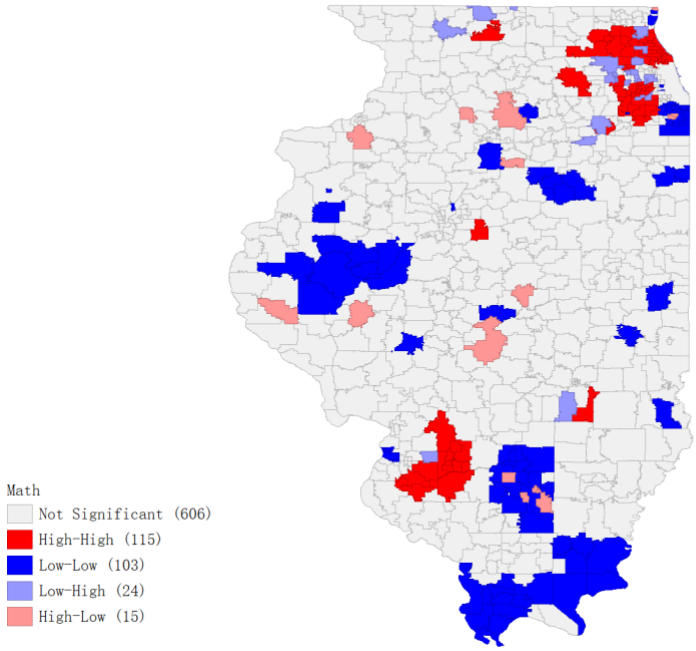
Graph 2.0 LISA Analysis of ELA Grades in 2015



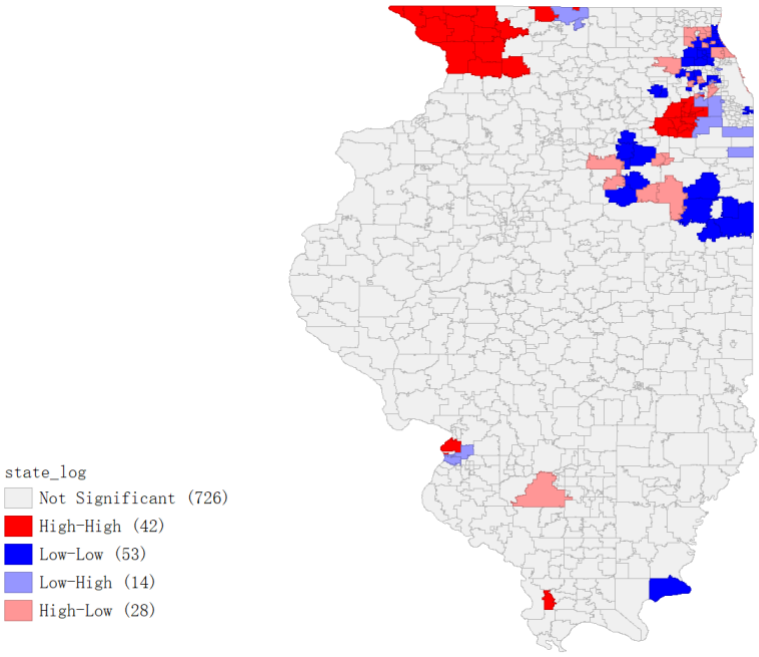
Graph 2.1 LISA Analysis of ELA Grades in 2019



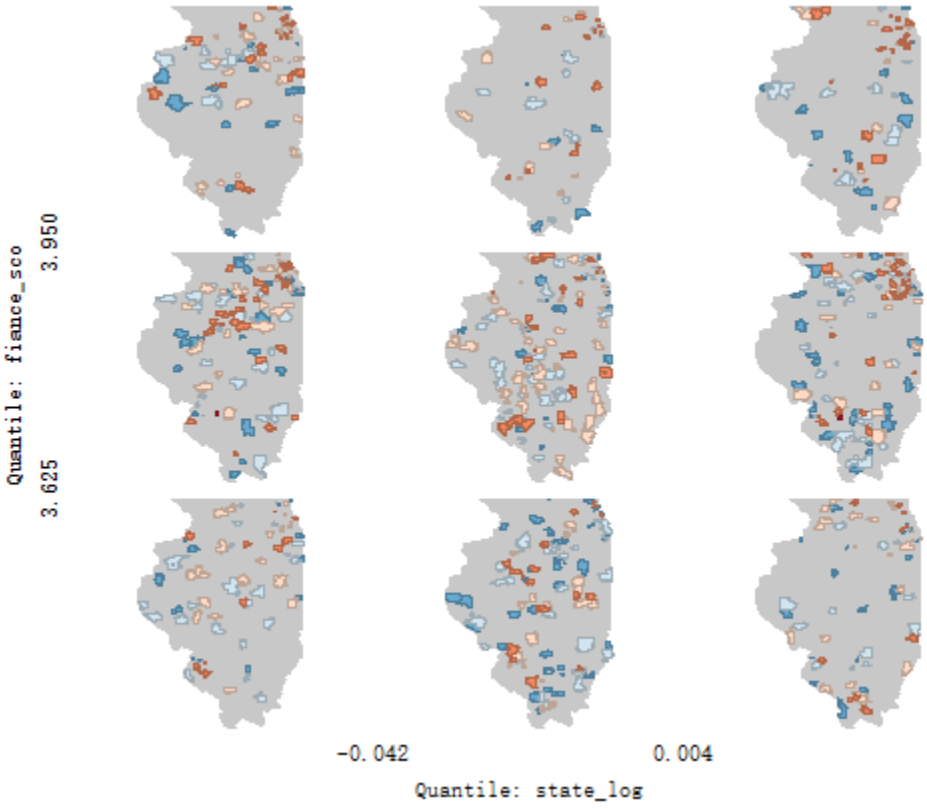
Graph 2.2 LISA Analysis of Math Grades in 2019



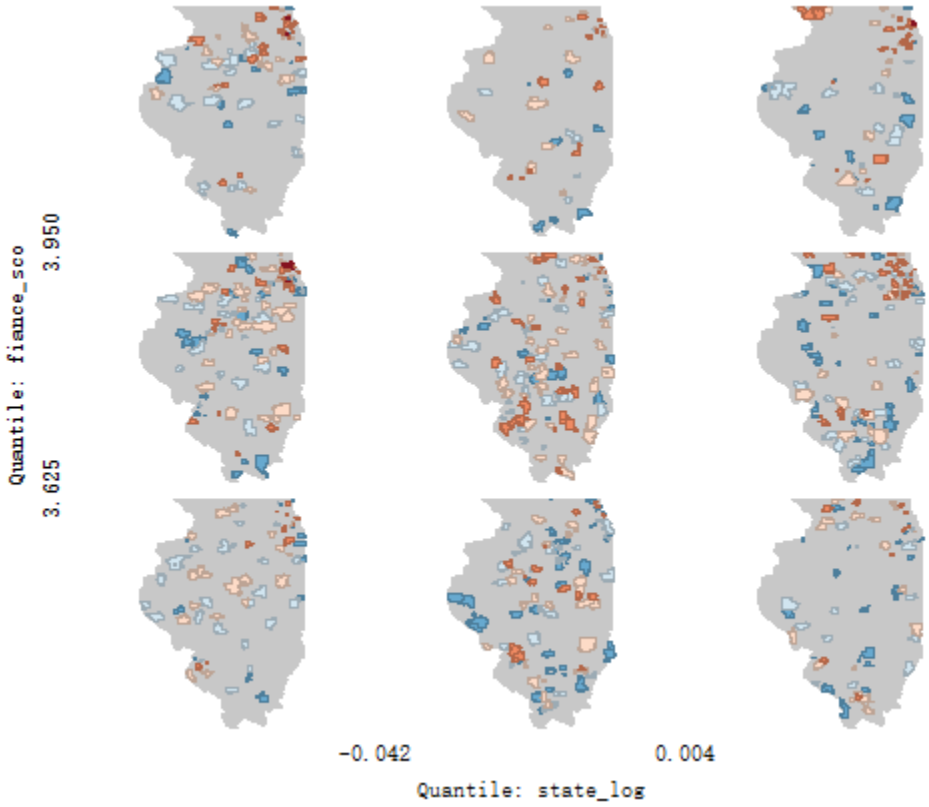
Graph 2.3 LISA Analysis of Math Grades in 2019



Graph 2.4 LISA Analysis of log State Funding in 2019



Graph 2.5 ELA Performance in 2019 Conditioned on Log State Funding and District Financial Score



Graph 2.6 Math Performance in 2019 Conditioned on Log State Funding and District Financial Score