Addressing Educational Inequities in Rural and Disadvantaged Areas

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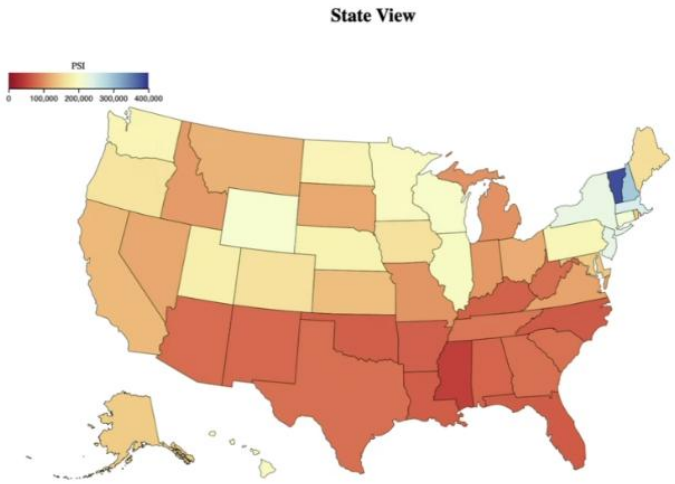

Fig. 1. Overview of the entire US and colored to represent the poverty spending index and relation to spending per child.

Abstract— Educational funding disparities in the United States often go unnoticed due to the complexity of analyzing spending in relation to poverty levels. This study introduces the Poverty Spending Index (PSI) as a tool to normalize and compare per-student spending across districts and states, providing a clearer perspective on resource allocation. Through data visualization, including choropleth maps and scatter plots, this research uncovers patterns of underfunding in rural and disadvantaged areas. These findings emphasize the need for targeted funding reforms to bridge the gap in educational opportunities and support equitable access to resources for all students.

Index Terms - School funding, educational equity, Poverty Spending Index, rural disparities

1. INTRODUCTION

Historically, educational funding tools have relied heavily on local property taxes, resulting in significant disparities between wealthy and impoverished districts. While federal and state policies attempt to minimize these gaps, challenges persist. Understanding the dynamics of school spending and its relationship to poverty is crucial for developing equitable policies that promote long-term social and economic benefits.

Education is a critical determinant of economic mobility and social equity. However, disparities in school spending per child persist, particularly in rural and disadvantaged areas. These inequities often translate to fewer resources, lower graduation rates, and limited college enrollment, perpetuating cycles of poverty. The goal of this project is to analyze and visualize school spending per child, focusing on its relationship with poverty levels. By normalizing spending through the Poverty Spending Index (PSI), we aim to provide actionable insights into the allocation of educational funding and its impact on student outcomes.

This study used publicly available datasets to take a close inspection of funding levels across states and counties. By highlighting these inequities through visualizations, we aim to provide actionable insights for stakeholders, from policymakers to educators.

2. DISTRICT LEVEL ANALYSIS

While state-level disparities in educational funding are often discussed, the inequities within individual states are equally concerning. These district-level disparities reveal how funding allocation varies dramatically between urban centers and rural areas, often exacerbating the challenges faced by economically disadvantaged communities. Using North Carolina as a case study, this analysis explores the relationship between revenue per student and poverty levels across districts, highlighting the uneven distribution of resources and its implications for educational outcomes.

3. KEY OBSERVATIONS

Urban vs. Rural Districts:
Urban districts like Chapel Hill in North Carolina demonstrate significantly higher revenue per student compared to rural counties such as Robeson and Halifax. This discrepancy highlights the uneven distribution of resources within the state.

- *Chapel Hill*: Revenue per student is substantially higher due to robust local property taxes and additional funding from state initiatives.
- *Rural Districts*: Rural counties struggle to match this funding level, often relying on limited state aid and property taxes.

The contrast between these districts underscores how local funding mechanisms, such as property taxes, create a structural advantage for urban areas.

Districts with higher revenue per student, such as Chapel Hill, report better graduation rates, higher college enrollment, and improved standardized test scores compared to underfunded rural districts. This correlation highlights the critical role of adequate funding in achieving favorable student outcomes.

The disparity in funding is not limited to one state but is a national phenomenon. Even in states with high overall education budgets, such as North Carolina, significant gaps exist between well-funded urban districts and underfunded rural areas. These gaps often reflect deeper economic and social inequities within the state.

The PSI metric provides a normalized view of spending relative to poverty. Districts with high poverty rates, such as Halifax and Hoke Counties in North Carolina, often have some of the lowest PSI scores, indicating that funding is not adequately adjusted for socioeconomic need.

3 .1 CHALLENGES IN RESOURCE ALLOCATION:
Rural districts face unique challenges, including:

- Lower property tax revenues due to lower property values.
- Higher transportation costs, as students are often spread across larger geographic areas.
- Difficulty in attracting and retaining qualified teachers due to lower salaries and fewer resources.

Districts with higher percentages of children living in poverty typically report lower per-student spending. This inverse relationship underscores the systemic challenges faced by economically disadvantaged areas.

4. VISUALIZING THE DISPARITIES

To effectively communicate the district-level disparities in school spending, a series of visualizations were created. These provide an in-depth look at how funding varies across districts and the implications of these differences.

Below is a description of each visualization and its key insights:

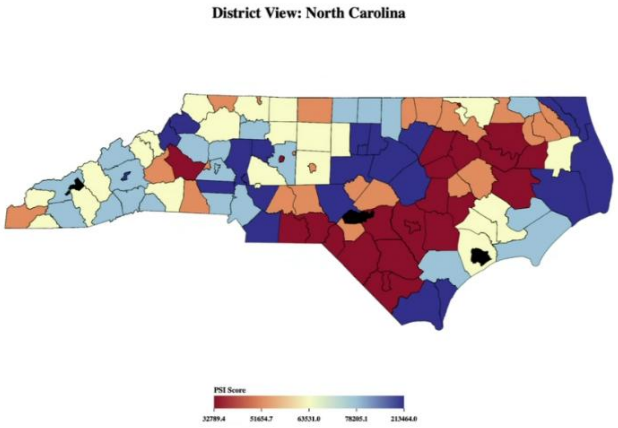

Figure 1 – District Level Heat Map displaying PSI for all North Carolina counties.

A heatmap displays the Poverty Spending Index (PSI) for all counties in North Carolina. The map uses a gradient color scheme, where lighter colors represent higher PSI scores and darker colors indicate lower scores, effectively highlighting areas where funding is insufficient. Counties such as Chapel Hill demonstrate high PSI scores, reflecting robust spending relative to poverty levels, while rural areas like Halifax and Robeson Counties appear significantly darker, indicating insufficient funding in relation to poverty. The stark contrast between urban and rural districts reveals the uneven allocation of resources within the state.

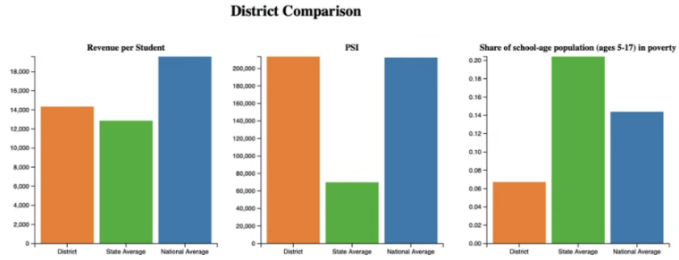

Figure 2 – Bar Chart representing the relationship between the district, state, and national averages.

Bar charts were used to provide a comparative analysis of Chapel Hill's performance against state and national averages across three main metrics: revenue per student, Poverty Spending Index (PSI), and the percentage of school-aged children (ages 5–17) living in poverty. The bar chart reveals that Chapel Hill consistently surpasses both the state and national averages in revenue per student, highlighting its strong funding base. Similarly, its PSI score demonstrates a higher allocation of resources relative to poverty levels compared to broader benchmarks. In contrast, the percentage of children living in poverty in Chapel Hill is significantly lower than both the state and

national averages, reflecting the district's more affluent socioeconomic profile. This visualization underscores the relative advantages Chapel Hill holds within the education system and provides a benchmark for evaluating how resource disparities impact less affluent districts across the state and nation.

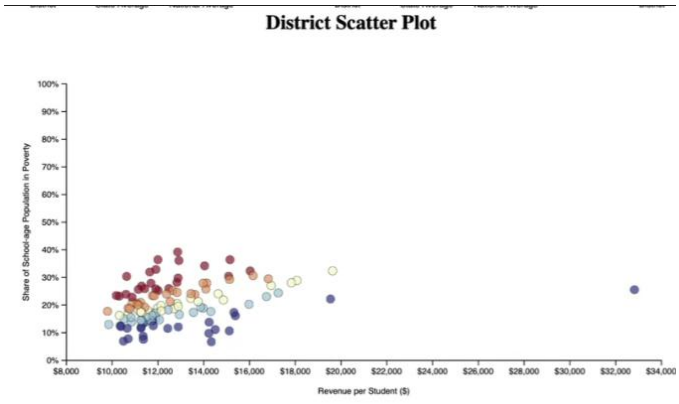

Figure 3 – Scatter plot of all districts in NC based on children in poverty

Displayed in the scatter plot, the relationship between revenue per student and the percentage of school-age children (ages 5–17) living in poverty across various districts within a single state. A negative correlation emerges, where districts with higher poverty levels tend to have lower revenue per student. Most districts cluster in the lower-left quadrant, highlighting significant equity gaps in resource allocation. However, a few outliers indicate districts with both high revenue per student and higher poverty levels, likely due to targeted funding initiatives. This visualization underscores the systemic challenges faced by impoverished districts in securing adequate funding and emphasizes the need for equitable funding models that prioritize higher-need areas.

5. DESIGN ELEMENTS

The visualizations used in this study were carefully chosen to effectively communicate the disparities in school spending and their implications. Each visualization serves a specific purpose in highlighting key aspects of the data, enabling stakeholders to better understand the systemic inequities in educational funding. To further facilitate data-driven decision-making, interactive features that allow users to dynamically explore educational funding data across states and districts

5.1 INTERACTIVE ELEMENTS

The main choropleth map of the United States allows users to hover over any state to view essential metrics, including:

- **Revenue per Student**: Displays the average amount spent per student in the selected state.
- **State PSI Score**: Highlights the Poverty Spending Index for the state, reflecting its spending relative to poverty levels.
- **State Poverty Rate**: Shows the percentage of school-aged children (ages 5–17) living in poverty for the selected state.

This feature provides a quick, intuitive way to assess high-level disparities across states. It helps users identify states with relatively high or low spending per student and evaluate their performance in addressing poverty-related challenges.

Further enhancing data-driven decision-making, by selecting a specific state, such as North Carolina, transitions the visualization to display district-level data for that state. This drill-down functionality allows users to explore disparities within states, offering a localized perspective based on each school district within inter-state borders.

5.2 VISUAL ELEMENTS

Choropleth Map:
The choropleth map was selected to provide a clear, intuitive representation of state-level spending disparities. By using a gradient color scheme, this visualization allows viewers to quickly identify states with higher spending per child (lighter shades) and those with lower spending (darker shades). This approach helps emphasize regional patterns and the stark differences between well-funded and underfunded states.

Bar Chart:
The bar chart compares district-level revenue per student to state and national averages. This visualization is particularly useful for analyzing where a specific district, such as Chapel Hill, stands in relation to broader benchmarks. By juxtaposing district-level data with aggregated state and national figures, the bar chart highlights local advantages or deficits and provides a context for understanding how a district’s funding compares to broader trends.

Scatter Plot:
The scatter plot was designed to showcase intra-state differences in school spending, focusing on the relationship between revenue per student and the share of school-age children living in poverty. This visualization effectively reveals systemic inequities within a single state, highlighting clusters of underfunded, high-poverty districts and identifying outliers that break these trends. The scatter plot also provides a deeper understanding of how poverty correlates with resource allocation across districts within the same state.

6. RELATED WORK

Previous research on educational funding disparities has highlighted the systemic challenges faced by underfunded districts and the broader implications of inequities in resource allocation. Below are a few studies that also

focused on this pressing issue surrounding school spending, including their data sources and findings:

6.1 **"A Decade of Research on Education Inequality in America"** by The Hechinger Report that focused on the growing funding gap between affluent and impoverished school districts over a ten-year period. The data used included sources from the National Center for Education Statistics (NCES) datasets as well as property tax revenues and their role in determining district funding levels.

The study revealed that school districts in wealthier areas often received significantly more funding per student compared to districts in economically disadvantaged regions. This disparity was further exacerbated by the reliance on local property taxes, which perpetuated funding gaps over time. The report also found that higher funding levels correlated with improved student outcomes, such as increased graduation rates and higher college enrollment rates. This highlighted the need for alternative funding mechanisms to bridge these gaps.

6.2 "Closing America's Education Funding Gap" by the Century Foundation. This study identified that many states failed to allocate sufficient resources to high-poverty districts, despite federal interventions like Title I. The report recommended implementing weighted funding formulas that direct more resources to underfunded districts. Additionally, it found that states with progressive funding models, such as Massachusetts, were better equipped to reduce funding inequities, leading to measurable improvements in student performance. Data used in these findings came from state-level education budgets, Federal Title I allocations that are targeted at lower-income districts, and census poverty data.

6.3 "Unequal School Funding in the United States" by The Association for Supervision and Curriculum (ASCD) synthesized data from state education departments and national datasets like the Common Core of Data (CCD) and NCES. The analysis explored both historical and current trends in educational funding disparities.

The study found that funding disparities were deeply rooted in structural issues, such as reliance on local property taxes and uneven state-level funding policies. Districts with lower property values consistently lagged in per-student spending. It also highlighted that these disparities disproportionately affected minority and rural students, leading to persistent gaps in academic achievement and long-term economic mobility. The study called for federal oversight to enforce equitable funding standards across states

6.4 "Public Education Funding in the U.S. Needs an Overhaul" by the Economic Policy Institute (EPI) examines how the reliance on local property taxes for public school funding perpetuates systemic inequities in educational resources. The study found that districts with higher property values generate significantly more revenue, resulting in per-student spending that often doubles or triples that of poorer districts. These inequalities directly impact educational outcomes of these students, with underfunded districts reporting lower graduation rates and fewer advanced placement course offerings. The report suggested that a federal overhaul of funding mechanisms is needed to ensure equitable resource distribution, recommending a shift toward state or federal-level funding to reduce dependence on local tax revenues. Sources for the data used include; State and Local education revenues, Property Tax data, and student performance metrics.

6.5 "Think Again: Is Education Funding in America Still Unequal?" by Thomas B. Fordham Institute's that analyzed the state of educational funding inequities in the United States over the past two decades. It was discovered in the study that although federal and state-level efforts, funding inequities remain prevalent, particularly in districts made up of primarily low-income and minority students. Wealthier districts continue to outperform those that are poorer.

Such as in 6.2, this study also found that many state funding formulas failed to effectively address the spending inequalities and recommended that there should be weighted funding models. These models would effectively allocate additional resources to the districts that have a higher need of financial assistance, as well as stressing the importance that transparency plays in the allocation process to ensure equity amongst students.

These studies collectively underscore the systemic nature of educational funding disparities in the U.S. By analyzing various data sources and outcomes, they provide compelling evidence for the need to reform funding mechanisms and prioritize equity in resource allocation.

REFRENCES:

[1] J. Barshay, "A decade of research on education inequality in America," *The Hechinger Report*, Jun. 29, 2020. [Online]. Available: https://hechingerreport.org/a-decade-of-research-on-the-rich-poor-divide-in-education/. [Accessed: Nov. 21, 2024].

[2] E. Baker, M. Di Carlo, and S. Weber, "Closing America's education funding gaps," *The Century Foundation*, Mar. 11, 2023. [Online]. Available: https://tcf.org/content/report/closing-americas-education-funding-gaps/. [Accessed: Nov. 21, 2024].

[3] B. J. Biddle and D. C. Berliner, "Unequal school funding in the United States," *Educational Leadership*, vol. 59, no. 8, pp. 48–59, May 2002. [Online]. Available: https://www.ascd.org/el/articles/unequal-school-funding-in-the-united-states. [Accessed: Nov. 21, 2024].

[4] Economic Policy Institute, *Public Education Funding in the U.S. Needs an Overhaul*, Aug. 2021. [Online]. Available: https://www.epi.org/publication/public-education-funding-in-the-us-needs-an-overhaul/. [Accessed: Nov. 21, 2024].

[5] Thomas B. Fordham Institute, *Think Again: Is Education Funding in America Still Unequal?*, May 2018. [Online]. Available: https://fordhaminstitute.org/national/research/think-again-education-funding-america-still-unequal. [Accessed: Nov. 21, 2024].