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Is dependence on property tax funding stifling academic achievement? Evidence from public high schools in New York

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Abstract

The United States has historically demonstrated a fervent interest in its public education system. Performance concerns have inundated the system for years, prompting overarching policy reforms that have received vast criticisms. This paper aims to highlight the link between these performance deficiencies and the nature in which public education in funded in the United States, and in the process of doing so argues that this system is outdated and needs to be changed. Our results indicate that a strong relationship exists between school districts that rely more heavily on property tax revenue and academic achievement in the form of graduation rates and standardized English Language Arts exam scores.

1. Introduction

This empirical study explores the relationship between the dependency on local property taxes for funding public school districts in New York State and academic achievement. Although the happenstance of drawing from local sources to fund education is present abroad, it is remarkably widespread inside the United States. The efficacy of the system has been challenged time and time again within state court systems, with plaintiffs arguing that it infringes on tax-based fairness and equality of opportunities across districts. Yet, while the extensive usage of local funding has come under heavy scrutiny within education literature and court systems, federal policy regarding it is nonexistent. Hence this paper contends that the focus of federal policy regarding education reform has been misguided and needs to change. While policy implementations by the federal government such as the *No Child Left Behind Act of 2001* and *Race to the Top* have overtly focused on administrative incentives to improve schools, the channels of these focuses are erroneous. The focus should instead be put on means that affect inputs, and how these means can affect incentive schemes of the agents in play, that is students, parents, and taxpayers. Of these means, we argue that the manner in which school districts are funded can be tied to their performance, which has allowed incongruous funding schemes to be a vehicle for creating academic achievement disparities that are evident not only in New York State, but across the country as well.

Utilizing a new panel dataset comprising roughly 650 school districts in New York State for the years 2005 through 2012, this paper aims to empirically estimate a positive relationship between property tax revenue and academic achievement, an aspect of the education production function that we argue is underemphasized by federal policy. We follow the example set by Mensah, Schoderbek, & Sahay (2013), a study which found the percentage of revenues generated by school districts in New Jersey that are derived from property taxes to have a significantly positive effect on student performance. As noted in their publication, "due to the high percentage of school district expenditures funded locally, as well as the variation in local taxes between districts, New Jersey provides an excellent backdrop to test our theory." (p. 2) Statistically, New York State's educational funding system is very similar to New Jersey's, exhibiting strong dependence on property taxes and high variation across districts.

An important distinction to be made is that this paper attempts to expose the effect of property tax revenue on achievement, not income. While it may be a natural assumption that disparities between districts in terms of property tax revenue coincide with the distribution of household income, this is not always the case. In many cases, richer districts do not necessarily have high property values and vice versa (Kenyon, 2007). The effect investigated is more indicative of incentive schemes corresponding to out-of-pocket spending on property taxes that directly contribute to the funding of public schools. We argue that taxpayers of districts with higher property taxes are more concerned with how their money is spent, leading to active engagement in school board meetings and procedures, which benefits the quality of education that students achieve. Conversely, districts that rely more heavily on state and federal revenue contain taxpayers that are either unconcerned or disillusioned with the process, as their out-of-pocket expense has a smaller contribution to the education production function. Although the coincidence of these correlations with the income distribution is relevant to our discussion, it is not a research endeavor of this study.

Our primary results indicate a consistent relationship between property tax revenue and graduation rates and ELA test scores, and a less uniform relationship between the former and Math scores. These results are robust to a time fixed effects model and a random effects model, but not to a time and district fixed effects model. We attribute the latter inconsistency to a lack of within-district variation in funding and achievement over time, and therefore assert and interpret the former results with greater conviction.

The rest of this paper is organized as follows. The next section discusses the conceptual framework of federal policy regarding education, and highlights why it has been considered ineffective. It then goes on to discuss school district finance, touching on how state legislatures and courts have attempted to address issues of fairness and equality in property tax funding. Section 3 outlines the specification of our empirical model. Section 4 discusses our data sources and descriptive statistics. Section 5 summarizes our different modeling approaches and presents detailed results, followed by our conclusions and policy recommendation in Section 6. Section 7 contains works cited, Appendix I presents tables described in the paper, and Appendix II presents graphs.

2. Theory

2. 1. Theoretical Underpinnings of Education Policy

Accountability has been a hallmark feature of policy regarding high school achievement in the United States since the introduction of the Elementary and Secondary Education Act of 1965. Following its inception, it has been adapted and reauthorized several times, culminating in the *No Child Left Behind Act of 2001* which called for more accountability regarding test scores by eliciting hard sanctions or rewards for schools that failed or passed statewide standards. By sanctioning schools that failed to reach a benchmark for achievement within a given school year (labeled Adequate Yearly Progress, or AYP), No Child Left Behind hoped to incentivize gains in academic performance, with a goal of 100 percent proficiency amongst students by 2014. Needless to say this goal has not been reached, resulting in 43 states, the District of Columbia and Puerto Rico being approved for waivers granting flexibility from the sanctions administered for failing to reach AYP (U.S. Department of Education, 2012). The program has received much criticism since its inception, coming under intense scrutiny concerning its effectiveness. Yet, amongst all the qualms, accountability remains prevalent across the country, with Race to the Top, a contest-based program introduced in 2009 currently in effect, and a few states still adhering to the restrictions of No Child Left Behind. So why is it that accountability policies remain at the core of our education agenda, and why are they so ineffective?

From an economic standpoint, the insight behind accountability policies is clear. If the aim were to increase performance and productivity from the educational sector of our economy, then the first lines of thinking would be competition and incentives. It works in the other sectors: by handing out grants and tax breaks for firms that surpass production and efficiency goals, we experience positive responses in both areas. However, the education sector is more complex. "Output" in the education sector is very ambiguous (Fiva & Rønning, 2008; Mensah et al., 2013); we should not expect the same responses to incentives, and increased competition won't necessarily bring out the same results. The primary reason for this is what Dee & Jacob (2010) refer to as a principal-agent problem, in that those who are responsible for enacting and enforcing the policy (legislators and administrators) have interests that are misaligned with the agents at play (students, parents, and taxpayers).Thus, not only is it evident that the agents' response to the policy will be other than expected, but since interests are heterogeneous administrators may also "respond to accountability policies in unintentionally narrow or even counterproductive ways," (Dee & Jacob, 2010, p. 152). This can shift the focus from students to teachers assuming that if we want educational performance to improve, we must first make sure that those who are educating students provide the correct methods and hold the same interests as those of taxpayers, parents, and legislators. The issue of teacher incentives comes to light, of which a large literature exists concerning their effects on academic achievement (Clotfelter, Ladd, & Vigdor, 2006; Fryer, 2011; Goldhaber & Brewer, 2000).

The principal-agent problem is still apparent, as naturally the interests of parents and students are not necessarily aligned with those of teachers, nor are they always conveyed accurately. The only common ground we can be sure of is the most obvious; legislators, administrators, teachers, and parents all want the same outcome: higher educational performance. However only administrators and legislators control the inputs, and as much as we assume parents and students have an interest in the implementation of those inputs, we cannot even be sure how many of them are engaged enough to make their stance visible. The problem becomes more complex. Firstly, how do we obtain an outcome when interests are misaligned and misrepresented? Secondly, from the administrator's perspective, how do we obtain an outcome when interests are misaligned and misrepresented, and the agents in question are potentially disengaged?

The solution to these questions and the problem at hand lies within incentive channels, however the difficulty with the matter resides in how we decide to affect them. The incentives of students, administrators, teachers, parents, and taxpayers all need to be addressed accurately and fairly in order to achieve an optimal result. While students are the primary agents at play here, affecting their incentives can be difficult and impractical. The only direct and well-documented attempt at this was performed by Fryer (2010), who attempted to incentivize educational outcomes by offering monetary rewards to students. His study focused on two different approaches, which were either input or output based. The input approach consisted of incentivizing skills, such as reading, whereas the output approach applied to outcomes of the education production function, i.e. grades and test scores. Fryer's results revealed that techniques incentivizing inputs were superior to that of outputs, as monetary rewards for reading books had greater effects on test scores than direct monetary rewards for test scores did. Although these findings certainly do not warrant paying students to develop reading skills, they can help to identify the correct channel through which incentives can be positively influenced.

The input versus output problem also helps us to better understand the disengagement problem and how students react to policy, and how we can improve the way they become educated. Among other interpretations of Fryer's results, he notes that students "do not understand the educational production function and, thus, lack the know-how to translate their excitement about the incentive structure into measurable output," (Fryer, 2010, p. 7). This implies that students of interest, i.e. failing students or "bubble" students in the grades sampled, lack the ability to improve their grades, even with directly imposed incentives. This implies that input incentives would be more effective, for it suggests a structural problem rather than an engagement problem. This approach is opposite to that of accountability within the framework of No Child Left Behind, which is an output-based policy.

By focusing on test scores, No Child Left Behind influenced the incentives of educators, not students. By design, sanctions have a more pronounced effect on administrators in the form of budget cuts, reorganization requirements, and in some cases closure of schools. In targeting educators rather than students, No Child Left Behind provoked distortions in motivational methods, as proficient test scores became necessary to satiate the needs of administrators and teachers. Concerns over teaching to the test in order to maintain AYP status has been well documented in the literature (Dee & Jacob, 2010; Menken, 2006; Cawelti, 2006) and the presence of administrative cheating in the years following the introduction of No Child Left Behind have also been exposed (Jacob & Levitt, 2003; Amrein-Beardsley, 2009).

Although it is rash to assume that all testing during the NCLB era succumbed to these pernicious techniques and should therefore be disregarded, it is nevertheless clear that incentivizing educators has its drawbacks.

In order to prevent these insular approaches from becoming widespread teacher credentials and techniques should be monitored closely. There have been multiple empirical studies performed on the correlation between teacher credentials and student performance (Clotfelter, Ladd, & Vigdor, 2006; Kane, Rockoff, & Staiger, 2007; Goldhaber & Brewer, 2000) some of which find positive effects, while others find minimal effects on student performance. There is an emphasis on experience; many studies find that while training, credentials, and performance amongst teachers is spuriously correlated with student performance, a learning curve for teaching is present, in that after the first few years teachers experience significant gains in student performance (Kane, Rockoff, & Staiger, 2007), and modest gains thereafter (Harris & Sass, 2011). This can also speak to the incentives of teachers, in that after a probationary period in which their job security may feel threatened, increased job security can improve the quality of their teaching. Reback, Rockoff, and Schwartz (2013) find that decreased job security can lead to teachers expecting to leave the profession soon, which decreases their incentives to teach well. This channel is complicated even further by the existence of tenure, as many argue that once a teacher receives tenure their incentives to teach at a high caliber can decrease (Goldhaber & Hansen, 2010).

The evidence provided from Fryer (2010), numerous studies regarding teacher incentives (Fryer, 2011; Ahn, 2013; Figlio & Kenny, 2007), as well as the occurrence of imprudent practices by administrators tell us how tricky of an issue education is, and why it is so difficult to solve. From a policy standpoint, education reform is not reactive to traditional economic thought, and is unlike any other sector of the economy. Findings on teacher incentives have found the effects on student performance to be both minimal or absent (Fryer, 2011), as well as significant (Ahn, 2013). Heterogeneous students and teachers call for a policy that applies to students and teachers with vastly different needs. The disengagement problem exists in both groups, which calls for incentive-based reform. Innate quality deficiencies exist in both groups, which calls for comprehensive reform in structural and methodical approaches, of which the best route is unknown. This lack of information naturally leads to reform policy that is both insufficient and ineffective. The desire to correct both core problems within one channel of implementation has led policymakers to accountability.

Accountability targets the incentives of administrators, hoping that in turn the incentives of students and teachers will be positively influenced. In describing the ambiguity in application that arises from this concentration, we have argued that the incentive channels of administrators, teachers, and students are complex and difficult to influence positively via accountability and legislation as a whole. This leaves us with the incentive channels of parents and taxpayers, who at first glance seem exogenous to the education production function, and are not accounted for within the framework of accountability. To affect the incentives of these groups, an input based approach must be taken, where factors outside the realm of those controlled by administrators are considered. Smaller-scaled policies and literature that delves into these factors have considered demographics (Lillydahl, 1990; Glick & White, 2003; Caldas & Bankston, 1997), class size (Nye, Hedges, & Konstantopoulos, 2000), funding, and teacher quality as determinants of quality deficiencies of students. A focus on inputs rather than that of outputs considers variables that are either governed by policy and legislation or endogenous to the make up of the student body as a whole. Statistics such as race, household income level, and gender are variables that while potentially significant, are largely invariant. To find that race is one of the most significant factors in defining academic achievement gaps would be a flaccid discovery for policy implications, and would do little to distinguish important differences of the United States' public education system to that of a more successful education institution.

This leads contributors to the education reform literature to focus on inputs and means that affect inputs that are not only unique to our domestic education production function but that are also potentially mutable. Factors such as teacher qualities, curriculums, and education finance fit this archetype, with the latter being particularly unique to the United States' education system. The domestic approach of drawing immense proportions of funds from locality based tax revenue is largely unparalleled by other countries, especially those which rank significantly higher in terms of education quality than the United States. Averting focus to the incentives of parents and taxpayers makes school finance of particular interest, as it can act as a direct linkage between the interests of legislators (i.e. improving student performance) and the interests of parents and taxpayers (i.e. acknowledgment that their taxes are being utilized efficiently and effectively). This relationship is characterized by monetary incentives influencing inputs to the education production function; taxpayers and parents have budgetary stakes in the actions of administrators, and can take their money elsewhere if they are dissatisfied. It resembles Tiebout's model of the public good (Tiebout, 1956), in which an efficient provision of a public good can exist given certain assumptions, one of which being that consumers (in this case taxpayers) are perfectly mobile. By voting "with their feet", consumers promote efficiency by revealing their preferences and moving to the district that suits their needs the best. If the assumptions of the Tiebout model were satisfied in our finance system, perhaps we could expect similar results.

However, the issue at hand is that most, if not all, parents and taxpayers have the same type of interests, yet some districts have financial leverage to affect administrative decisions and some do not. This problem is exacerbated by zoning laws that have restricted mobility from property tax poor districts to property tax rich districts. These structural deficiencies make "voting with the feet" nonexistent, which means that the provision of the public good (education) is not efficient, nor is it equitable. The results of this are twofold. Firstly, richer districts are able to better fund their schools with lower tax rates than poorer districts. Secondly, the existence of certain districts relying more heavily on property tax revenue than other districts has increased the quality of those schools in comparison with the others. The effect of this disparity is to be empirically investigated later on in this paper.

The focus of this paper hereafter will be education finance vis-à-vis academic performance. The next section will describe the historical underpinnings of the educational finance system in the United States as well as the issues that litigation and policy implementations have attempted to address.

2.2. Education Finance

A lack of federal guidance regarding the funding of public schools, which stems from the neglect of education in the Constitution, has left the parameters of educational finance protocol up to the outcomes of the legislative and judicial processes for each respective state. Most states that have considered a restructuring of education finance have had landmark court cases determining the efficacy of the systems in place. These cases have historically covered multiple areas of finance efficacy, with two typical objectives at stake: promoting fairness to both students and taxpayers. There are approaches that aim to ensure that an education system provides an equal standard of education across districts, an adequate standard of education, and there have been attempts to ensure that increases in tax-rates incur the same impact on per-pupil revenues in every district (Yinger, 2004). The interests of those in favor of fairness to students versus those in favor of tax-payers are sometimes misaligned, and the presence of this misalignment provides not only for heterogeneous funding approaches across states, but also for funding approaches that are not Pareto efficient.

Although schools receive funding from various institutions, and while the composition of these revenues differ state to state, all states utilize local property taxation as a source of revenue for schools (Arocho, 2014). Naturally, this leads to large disparities in per-pupil funding across districts. "This system purportedly maintains local control over education, but as the income gap continues to grow, funding schools with local property taxes has created severe disparities in per-pupil funding between high-property-value school districts and low-property-value school districts." (Arocho, 2014, p. 1481) Taking into account the increasing wealth-gap in the United States sees these disparities accentuated.

Historically speaking, litigation regarding this subject started with the Supreme Court case *Brown vs. Board of Education of Topeka (1954),* which ruled that segregated schools were unconstitutional on the basis that a separate but equal statute discriminated against blacks, and therefore violated the equal protection clause of the Constitution (Kenyon, 2007, p. 8). This case signified the importance of education in the eyes of the government, emphasizing equality among schools. The implications of *Brown* offer more insight than application in education reform however, as attempts to achieve finance equality among schools through federal litigation are often impeded by the lack of language regarding education in the Constitution. Thus litigation within state court systems has been more successful. Beginning in the late 1960's, numerous court cases sprang up that challenged the constitutionality of funding approaches, arguing that by virtue of the system educational needs of students were not being met adequately across districts (*McInis vs. Shapiro 1968*; *Burrus vs. Wilkerson 1969).* These cases were unsuccessful both in local courts and in appeals to the Supreme Court, largely because the court felt that discernment on the distribution of funds that best accommodates students is a value judgment that was better suited for the legislature (Minorini & Sugarman, 1999). A more successful wave of litigation followed *McInis* and *Burrus,* of which the focus was equality. The disparity between per-pupil funding across districts was plainly evident, and the reason for this was the nature of the distribution of property values. John Coons, a trailblazer of this movement, noted the significance of the proportion of tax-rates to per-pupil revenue, which revealed that poverty-stricken districts often have higher tax rates but lower per-pupil revenues in comparison to wealthier districts. Not only does this result in inequality amongst the availability of financial resources to schools, but it also implies that schools are not able to allocate the correct amount of funds that they believe is appropriate for meeting the educational needs of student (Minorini & Sugarman, 1999). Hence, Coons and his colleagues argued that property tax based revenue systems went hand in hand with wealth discrimination, which was unconstitutional. Two cases of note regarding this school of thought are *Serrano vs. Priest* (California Supreme Court, 1971) and *San Antonio Independent School District vs. Rodriguez* (Lower Texas court ruling later appealed to the Supreme Court, 1973). *Rodriguez* set a precedent for federal cases on the subject when the Supreme Court, in a 5-4 decision, ruled that education is not a fundamental right in the Constitution, curtailing any future attempts to contest property tax funding at the federal level. Two years prior, the California Supreme court had ruled that their funding system was unconstitutional by violating equal protection clauses in the California constitution as well as the federal constitution. Since this case was adjudicated at the state level, the ruling in *Rodriguez* did not reverse it.

> “We have determined that this funding scheme invidiously discriminates against the poor because it makes the quality of a child's education a function of the

> wealth of his parents and neighbors. Recognizing as we must that the right to an education in our public schools is a fundamental interest which cannot be conditioned on wealth, we can discern no compelling state purpose necessitating the present method of financing. We have concluded, therefore, that such a system cannot withstand constitutional challenge and must fall before the equal protection clause." (*Serrano v. Priest,* 1971)

Amongst other legislation and public opinions, this decision led to "squeeze formulas" being enacted in California, which attempted to limit district parity by differentiating inflation rates for rich and poor districts, hoping to bridge funding gaps between them over time. Rising property values, along with further legislative attempts to redistribute property tax revenues from rich districts to poor districts led to the passage of Proposition 13, which limited statewide property taxes to one percent of assessed value (Timar, 2006). This necessitated further state involvement in funding public schools, and over time decreased California's dependence on the property tax as a funding mechanism for public school education. Whether or not this has had an effect on academic achievement in California is uncertain, however as Kenyon (2007) claims, "California's test scores, which were equal to the United States' average prior to the late 1970s, are now among the lowest … Although Proposition 13 remains popular with voters, California's centralized system of school funding and governance gets low ratings." (p. 17) Hence, there exists an equity-versus-efficiency problem within education finances; locality based funding approaches appear more efficient, but state funding is more equitable.

Serrano managed to set a precedent for challenging school finance systems in state courts nationwide. Between 1971 and present day 37 states have had the constitutionality of their systems of education funding challenged, with 25 of those states deeming them unconstitutional (Berry, 2007). Although *Serrano* proved successful through many revalidations, in general attempts at restructuring funding systems through litigation on grounds of equality arguments had less success. This gave rise to a reappearance of the adequacy platform of the late 1960s, spearheaded by the case of *Rose vs. Council for Better Education Inc.,* in which the Supreme Court of Kentucky ruled that the State of Kentucky's school system was, "constitutionally deficient," in that the Kentucky General Assembly did not comply with its "constitutional mandate," to "provide an efficient system of common schools throughout the state," (*Rose vs. Council for Better Education Inc.,* 1989). These cases were more successful, for they asserted that the State must provide an adequate education for all students, which fell in line with language of many State Constitutions (Kenyon, 2007, p. 10).

Equality and adequacy suits have littered the litigation history of New York State as well. In 1982, *Levittown vs. Nyquist* addressed the issue of property tax funding inequalities, with the closing statement claiming that the system did not "violate the equal protection clause of either the Federal or the State Constitution nor is it unconstitutional under the education article of our State Constitution," (*Levittown vs. Nyquist, 1982).* This was consistent with the ruling from *Rodriguez,* and set a similar type of precedent for New York State court rulings based on funding equality. The Campaign for Fiscal Equity put forth the adequacy argument in a suit against the State of New York, asserting that the State's financing system was failing to provide "public school students in the City of New York … an opportunity to obtain a sound basic education as required by the State Constitution," (*CFE vs. State of New York,* 1995). This ruling has consequently culminated in a drawn out dialogue between the Court of Appeals and State officials, characterized by court orders to provide additional funding to schools followed by State appeals. Marcou-O'Malley (2014) contends that the common result of this process is the State undercutting the original proposal issued by the court. This has resulted in an estimated 5.9 billion dollars in Foundation Aid and Gap Elimination Adjustment funding being owed to public schools by the State as of August of 2014 (Marcou-O'Malley, 2014).

The observed effects within the literature of these reforms on school funding and academic achievement have mostly been characterized by increases in spending on poor districts and mixed results concerning student performance. As previously mentioned, California's distancing from property tax revenue as a public school funding source has been associated with less local funding and poor academic performance (Kenyon, 2007). Murray, Evans, and Schwab (1998) provided a foundation for these studies by investigating the relationship of court judgments and district spending, noting that school district spending inequalities had reduced by 19 percent between 1972 and 1992, a time period when the volume of school finance litigation suits was high (Berry, 2007). Studies including Murray et al.

(1998) have asserted that the main results of these reforms are increases in spending for poorer schools. Baicker & Gordon (2006) assert that finance reforms have increased state spending on poorer schools at the expense of aid previously devoted to public programs in wealthier areas. Card & Payne (2002) relate similar findings, noting that significant differences in spending are only observed in states where school finance systems were deemed unconstitutional; they also find that following attempts to equalize spending, the distribution of SAT test scores narrows across family background groups. Jackson, Johnson, and Persico (2014) make an empirical claim that these increases in spending have a positive effect on adult outcomes such as years of schooling and earnings.

The structural effects of school finance litigation are characterized by the manifestations of school funding systems with varying dependencies on local, state, and federal sources. Our empirical investigation concerns schools districts of New York State, which rely heavily on local property taxes as a source for funding. State and federal aid is dispersed to all districts in New York, although most non-local assistance is given to districts that have insufficient property tax revenues. While these equalization attempts have curbed funding gaps to an extent, per-pupil total revenues of New York school districts are still not entirely uniform. This is exemplified by the distribution of per-pupil total revenues that is depicted in the histogram in Figure 8 (Appendix II).

3. Model Specification

As previously mentioned, a quantitative approach to solving the problem of performance gaps identifies academic achievement as a function of incentives and inputs to the education production function. Inputs in our model will take the form of variables concerning demographics and school district finance, which is of particular interest. There is no deliberate attempt to measure student incentives, however it is expected that some of the demographic variables could indirectly affect them. The inability to quantify incentives coupled with the availability of data at the school district level is the reason for this omission, though considering the ineffectual nature of No Child Left Behind, as well as the results of Fryer (2010), the direct effects of student incentives on academic outcomes could be minimal. Data to be utilized within this model have been organized in a panel format as observations are taken by district and year.

The reliability of test scores as an indicator of student performance is questionable, especially that of standardized tests. Standardized tests are notoriously narrow (Dee & Jacob, 2010). They often test a small number of subjects, of which only certain subsets are focused on. This leads to instances of teaching and learning to the test, which makes test scores an inadequate indicator of student performance as a whole. Additional factors such as test-taking abilities and administrative cheating contribute further to results that can overestimate or underestimate student performance in a given school or district. For these reasons, this model will comprise of two parts, one considering eighth grade English Language Arts and Mathematics test scores and the other considering graduation rates. Graduation rates can be skewed as well; certain district requirements for graduation may be stricter or more lenient than others. However by interpreting separate results with both graduation rates and standardized test scores, this model aims to find a middle ground that minimizes distortion by both variables.

A simple regression in our model concerns student performance on the per-pupil revenue generated from property taxes of a given district. It is commonplace to assume that academic achievement is largely a consequence of the amount of resources available (Hanushek, 1997). This leads to the consideration of household income levels, poverty levels, unemployment, and other variables of the like that may have an effect on performance. Our model focuses on the effect of per-pupil property tax funding, which highlights inequalities in local funding across districts that coincide with performance gaps. Moreover, findings on this front would suggest an agent of local autonomy, in that advanced academic achievement is more tangible for the members of districts with inflated property values via their tax contributions than those with lesser property values. Hoxby (1997) argued that this was due to the presence of higher accountability, in that districts that pay more out of pocket hold their schools to a higher standard, effectively pushing schools to better educate their students. This goes hand in hand with findings from Glaeser (1996) and Fiva & Rønning (2008), who discuss the effects of property taxes on incentives in local governments.

When including other variables, the eliminated bias of omitting them and the changes to the coefficient of per-pupil property tax revenue need to be elucidated. We can refer to the equation below, where b_1 is the original biased coefficient of per-pupil property tax revenue, β_1 is the corrected coefficient, β_2 is the coefficient of the control variable, and δ is the effect that the control variable has on our variable of interest. Hence the composite term $\delta\, \beta_2$ signifies the bias.

$$b_1 = \beta_1 + \delta\beta_2$$

Besides the effects of resource availability, the only clear indicator of student performance, aside from student incentives, is the manner in which an administration uses their revenue, i.e. expenditure. While revenues may in theory affect expenditure, expenditure decisions and divisions do not affect the revenue channel to student performance. Nevertheless, the data may reveal this correlation; hence we expect the value of δ to be positive. The variables that we will be using are the per-pupil amounts of expenditure that are used on instruction and capital outlay, the latter of which includes expenditure on instructional equipment, such as textbooks or other supplemental material that is utilized to better equip students. The value of the coefficients of these expenditure variables are also expected to be positive, assuming that a greater devotion to expenditure on instruction should have a positive effect of student performance. Therefore, we surmise the bias of omitting these expenditure variables to be positive, meaning that the coefficient of per-pupil property tax revenue will decrease upon their inclusion.

Household income may have a direct effect on performance outside the scope of property taxes, in that richer neighborhoods do not always have high property values, and higher incomes may increase educational resources outside of schools, such as in the household. Nevertheless, we presume that the main affect goes through the property tax revenue channel. Quantitatively, this signifies a positive bias, meaning that since household income will have a positive coefficient, including it will decrease the value of the per-pupil property tax revenue coefficient. This variable will be measured as the median household income of a given district.

Poverty levels, Hispanic and Black percentages, and unemployment rates are all anticipated to have negative effects on performance, in that they are the primary indicators of poorer neighborhoods. The poverty of a neighborhood may have to do with the incentive channel in addition to the availability of resources to students both inside and outside schools. Additionally, high poverty levels can coincide with high income-inequality, which overlaps with performance gaps. Traditionally the literature has supposed that the effects of these measures on academic achievement are negative (White, 1982; Sirin, 2005). The bias of these variables being omitted is associated with property values via the historical implications of districts being largely black, Hispanic, or poor, in that districts with historical diversity on this front may have generated white-flight, driving property values down to what they are today. Hence, through this medium some of the effect of racial percentages and poverty levels is funneled through the property tax channel. Furthermore, the bias of these terms is positive, so by including them we expect the per-pupil property tax revenue coefficient to decrease, because their respective coefficients should also be negative.

The assumption for educational attainment of a district is a positive effect as districts with higher percentages of high school and college graduates will experience better academic achievement. This can be attributed to the influence that parents with more education may have on their children, which has been investigated previously in the literature (Davis-Kean, 2005; Magnuson, 2007; Dubow & Huesmann, 2009). There is no theoretical backing for educational attainment to affect the revenue of a district, so it can be added with little discrepancy and no assumptions of bias.

Lastly, variables concerning enrollment and non-local revenue are included. The effect of enrollment on performance has been contested within the literature, stemming from a concerted effort by administrators in the 1930's to consolidate schools, believing that as district size increased economies of scale and specialization would improve efficiency and performance (Robertson, 2007). This policy has been criticized after its implementation, with many claiming that smaller district size is more conducive for a learning environment (Fowler & Walberg, 1991; Driscoll, Halcoussis, & Svorny, 2003), and others alluding to an optimal district size, which implies the existence of economies and diseconomies of scale in relation to performance. To appropriately fit the effect of enrollment on achievement we include the square of enrollment in our estimation, expecting a concave characterization of enrollment's relationship with achievement. Hence we expect the coefficient of enrollment squared to be negative, and have no clear expectation for the sign of the coefficient of enrollment.

This paper's hypothesis emphasizes the effect of local revenue, specifically that generated from property taxes. Therefore it follows that we anticipate the effect of per-pupil non-local revenue, which is composed of state and federal revenue, to have a less pronounced effect on academic achievement than local revenue. The effect of non-local revenue on local revenue is theoretically nonexistent, but since we presume there to be a negative correlation between non-local revenues and property tax revenues, the sign of δ in this instance will be negative. There is a possibility for the coefficients of federal and state revenue to be endogenous because the amount of state and federal revenue allocated to districts can be responsive to student performance, either directly or indirectly. Federal revenue, which amounted to approximately five percent of total revenue generated by schools in New York State for the 2011-2012 school year, is mostly allocated on a basis of need. Title 1 aid accounts for roughly 34 percent of all federal revenue, and is given out to poorer districts. A school improvement grant gives funds to schools that are deemed "low-performing", although this grant only accounted for $38 million dollars during the 2011-2012 school year which was a meager 1.2 percent of all federal aid for that year. State aid accounted for roughly 40 percent of total revenue generated for school districts in New York State for 2011-2012; its primary objective is to equalize the funding gaps that are apparent due to the use of property taxes as a source of revenue. Like federal aid, a very small percentage of total state aid is given to schools that are considered low achievers. Hence we do not expect direct endogeneity to be overtly present; upon controlling for poverty levels, as well as utilizing fixed effects, this paper attempts to cut down on the presence of reverse causality as much as possible. Nevertheless, we may still experience a negative coefficient for per-pupil federal and state revenues, signifying a positive bias and therefore decreasing the value of the coefficient of per-pupil property tax revenue upon their inclusion. The negative coefficients of non-local revenues would suggest that when per-pupil property tax revenue is held constant, the districts that have higher per-pupil state and federal revenues have lower achievement levels in comparison to the districts with lower non-local revenues. This would be consistent with the research questions of this paper, as the districts with high per-pupil state and federal revenues are, usually, the ones that also have lower per-pupil property tax revenue and vice versa. Hence, we can expect these coefficients to tell a relationship story rather than one of causality.

In utilizing most components of per-pupil total revenue and some components of per-pupil total expenditure there is a risk of multicollinearity between them, because in most districts total revenue is either equal to or very close to total expenditure. To resolve this we will consider variance-inflation factors (VIF) and include the results of a random effects estimation with the expenditure variables excluded, shown in Table 6 (Appendix I).

4. Data

Data for this paper were collected from both state and national sources, all of which concerns school districts in New York State. Graduation rates and ELA and Math test score data were gathered from the New York State department of education[1], data on school district finance were collected from the United States Census Bureau[2], and data regarding demographics, social characteristics, and economic characteristics were collected from the National Center For Education Statistics[3]. Graduation Rates and school district finance data spans from 2005 to 2012 whereas ELA and Math scores span from 2006 to 2012 since standardized test score data for 2005 were not available. Demographic, social, and economic data concerns the years of 2005 through 2012, and were generated from American Community Survey (ACS) estimates based on the decennial census. It is important to note that this data was expanded from four years to eight years by duplicating estimates for the years 2005-2006, 2007-2008, 2009-2010, and 2011-2012, which came from ACS profiles of years 2005-2009, 2006-2010, 2007-2011, and 2008-2012 respectively. This was done in an effort to improve upon the methodology concerning demographics observed in Mensah et al. (2013), where such data were time invariant observations obtained from the decennial census of 2000. By using estimates that differ every two years, we aim to not only obtain a more accurate representation of demographic and socioeconomic factors, but to also prevent our

[1] http://www.p12.nysed.gov/irs/cohort/archive-grad.html

[2] http://www.census.gov/did/www/schooldistricts/data/finance.html

[3] http://nces.ed.gov/programs/edge/demographic.aspx

fixed effects estimation from essentially omitting these variables. A description of all variables to be used is given in Table I (Appendix I). Figures 1, 2, and 3 show histograms depicting the distribution of our dependent variables (Appendix II). A histogram depicting the distribution of per-pupil property tax revenues is shown in Figure 4 (Appendix II). Scatter plots of graduation rates, mean scaled ELA test scores, and mean scaled Math test scores corresponding to the natural log of our primary independent variable of interest, the per-pupil amount property tax revenue per district, are shown in Figures 5, 6, and 7 respectively (Appendix II).

Descriptive statistics for all variables in question can be seen in Table 2 (Appendix I). The means of our test variables, graduation rates (GRADRATE), mean scaled ELA test scores (MEAN_ELA), and mean scaled Math test scores (MEAN_MATH) are 81.648%, 661.081, and 672.577 respectively. Graduation rates ranged from 28% to 100%, the mean scaled score of ELA examinations ranged from 622.110 and 705.750, and the mean scaled score of Math examinations ranged from 614.093 to 710. The medians were very similar to the means, and Math scores were more varied than ELA scores, exhibited by a variance of 226.493 in comparison to a variance of 110.525 for ELA scores. The distributions of these variables (as shown in Figures 1, 2, and 3) are fairly normal; the distributions of graduation rates and Math scores are slightly skewed left.

The means of our main independent variables, per-pupil property tax revenue (PROP_PP), per-pupil state revenue (STATE_PP), and per-pupil federal revenue (FED_PP) are $8,492, $8,928 and $860 respectively. The variances of per-pupil property tax revenue (PROP_PP), per-pupil state revenue (STATE_PP), and per-pupil federal revenue (FED_PP) are 37.337, 12,344, and 0.281 respectively, which exposes a more varied distribution of property tax revenue than that of state and federal revenues, and a more varied distribution of state revenues than that of federal revenues. A histogram depicting the distribution of per-pupil property tax revenue (PROP_PP) is shown in Figure 4 (Appendix II), which relates a normal distribution that is skewed right. The mean enrollment is 2,654, whereas the median is 1,641. Enrollments range from 55 to 38,686 students, with a variance of 10.187.

Variance-inflation factors (labeled VIF in Table 2) are all under 7, which indicate that multicollinearity is not a problem.

5. Approaches and Results

As previously mentioned, all data to be tested has been organized in panel format. Let Y_{it} = [$Y_{1it},...,Y_{nit}$] represent *n* dependent variables of interest. Hence, a general panel specification is given by:

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \epsilon_i + \epsilon_t + \epsilon_{it}$$

where subscript *i* refers to a specific district and subscript *t* refers to a specific year. In our model, there is only one type of independent variable, X1, which varies over districts and time. Tables 3, 4, and 5 (Appendix I) shows results from three different estimations, corresponding to time fixed effects, time and district fixed effects, and random effects estimations respectively. Regressions within estimation type are labeled by their dependent variable of graduation rates (GRADRATE), mean scaled ELA test scores (MEAN_ELA), and mean scaled Math test scores (MEAN_MATH), respectively. We disregard the results of an ordinary-least squares regression without any fixed effects due to the issue of correlation between the residuals and our independent variables. We discuss the outcomes of a Hausman test to determine whether to trust the fixed effects or random effects estimation, but reject its suggestion to interpret the district and time fixed effects estimation on the grounds that the districts within our sample do not possess significant variation through time which leads to noisy results in the time and district fixed effects estimation. This notion is supported by the fact that overall R-squares for all district and time fixed effects estimations are below 0.07. Therefore, we use our random effects estimation as our means of empirically interpreting the relationship between per-pupil property tax revenue and student performance.

5. 1. Time Fixed Effects

Our first estimations are performed with ordinary-least squares (OLS), where the data is pooled and dummy variables are added for each year. This approach is not as precise as also including district dummy variables, but it is more efficient. Results of this estimation can be found in Table 3 (Appendix I). All monetary variables have been measured with a natural log. These estimations have panel-corrected standard errors and assume heteroskedasticity, as a plot of residuals against fitted values show a non-constant variance and a formal test asserts the presence of heteroskedasticity.

For all regressions year 2012 was omitted. It is important to note that since data for standardized test scores in New York for the year 2005 was not available, the dataset does not include observations for test scores in the year of 2005, hence the absence of coefficients and standard errors. Graduation rates exhibited relatively consistent improvement through the years of 2005 to 2009, and smoothed out to similar levels for 2010, 2011, and 2012, as the coefficients of the dummy variables for 2010 and 2011 were insignificant. Mean scaled ELA scores were lower in 2006 and 2011 in comparison to 2012, and higher in 2008, 2009, and 2010. There was no significant difference to 2012 for ELA scores in 2007. Math scores consistently improved for the years 2006 to 2010, and were similar in 2011 and 2012. This is consistent with findings that standardized Math scores improved within the confines of No Child Left Behind (Dee & Jacob, 2010).

For the moment we will forgo an interpretation of most of the control variables, seeing as we will prefer to analyze and trust the results of the random effects model. However it is interesting to acknowledge the coefficients of per-pupil property tax revenue (PROP_PP), per-pupil state revenue (STATE_PP), and per-pupil federal revenue (FED_PP). Per-pupil property tax revenue (PROP_PP), our main independent variable of interest, is highly significant when tested against graduation rates (GRADRATE) and mean scaled Math test scores (MEAN_MATH), and weakly significant when tested against mean scaled ELA test scores (MEAN_ELA). Per-pupil property tax revenue (PROP_PP) has a positive coefficient associated with graduation rates (GRADRATE) and (MEAN_ELA), suggesting that a one percent increase in the mean of per-pupil property tax revenue (PROP_PP) ($8,492) would invoke an increase of 1.59 percentage points in the average graduation rate (81.648%), and a 0.758 increase in the average mean scaled ELA score (661.081). Per-pupil property tax revenue (PROP_PP) has a significantly negative coefficient when tested against Math scores, which is unexpected and lacks an explanation. This could speak to the idiosyncrasy of mathematical skill sets, or to pernicious techniques employed by educators in property tax poor districts in order to maintain AYP status.

The coefficient for per-pupil federal revenue (FED_PP) is significantly negative for all regressions, which affirms our assumption that when holding per-pupil property tax revenue constant, districts with higher federal revenues experience lower academic achievement. The coefficient of per-pupil state revenue (STATE_PP) is also consistently negative across regressions, but is not significant when tested against graduation rates, suggesting no difference in graduation rates at the varied levels of per-pupil state revenue when per-pupil federal and property tax revenues are held constant. As previously mentioned, the signs of the coefficients of non-local revenues may be partly due to reverse causality.

As we progress to the fixed effects and random effects methods we recall that the results of the ordinary-least squares estimations with time fixed effects are merely suggestive; this paper makes no assumptions based on them, but rather uses them as a starting point.

5. 2. District and Time Fixed Effects and Random Effects

We then utilize the time and district fixed effects method, which generates a dummy variable for each district in addition to the dummy variables for each year, as well as random effects. Using time and district fixed effects changes our equation to as follows:

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \alpha_i + \alpha_t + \epsilon_{it}$$

where α_i and α_t are the unknown intercepts for each district and year respectively. Hence ϵ_i and ϵ_t have been replaced, and ϵ_{it} is now a classical error term.

When utilizing random effects, we essentially operate a GLS estimation that corrects for errors that are correlated over time within districts such that the new error term is classical.

Results of the time and district fixed effects and random effects estimations are shown in Tables 4 and 5 (Appendix I) respectively. As previously mentioned, the results of Hausman tests for deciding which method is more appropriate are considered; for all three regressions Hausman tests determine a significant systematic difference in coefficients, indicating that time and district fixed effects is a more appropriate estimator than random effects. However, we do not abide by its recommendation as the results of our time and district fixed effects estimations are somewhat noisy, and the fit of the models are poor. Time and district fixed effects regressions for test variables graduation rate (GRADRATE), mean scaled ELA test score (MEAN_ELA), and mean scaled Math test score (MEAN_MATH) have respective overall R-squares of 0.0007, 0.0028, and 0.0678. By choosing to hold to our random effect estimations we aim to utilize a more efficient and accurate estimator, but sacrifice precision. Time and district fixed effects correct for omitted variable biases that occur due to the presence of unobserved time invariant differences across districts; random effects estimates may not fully account for these differences, so it is possible that the coefficients will be biased and therefore less precise.

Coupling results of the Hausman test with the R-squares for each time and district fixed effects model, as well as acknowledging a lack of significant district variation through time within the demographic and socioeconomic controls, we deem random effects estimations more appropriate for our model. The results of the random effects estimations are shown in Table 5 (Appendix I). These results have robust standard errors and have been corrected for heteroskedasticity, as a likelihood ratio test significantly indicated the presence of residuals with a non-constant variance. All independent variables that are measured in monetary units have been estimated with a natural log.

5. 3. Results

Firstly, results of our main independent variables of interest are considered. The coefficients of the natural logs of per-pupil state revenue (STATE_PP) and per-pupil federal revenue (FED_PP) are significantly negative for all three regressions; this is consistent with our expectations and also suggests the possibility of reverse causality. Regardless, the sign of the coefficient implies that when holding per-pupil property tax revenue constant, districts that have a higher reliance on state and federal funding have worse graduation rates and test scores than the ones that generate fewer per-pupil state and federal dollars. The coefficient of per-pupil property tax revenue (PROP_PP) is significantly positive when tested against graduation rates (GRADRATE) and mean scaled ELA test scores (MEAN_ELA), but is insignificant when tested against mean scaled Math test scores (MEAN_MATH). This relates our initial assumptions that when holding non-local funding constant, districts that rely heavier on per-pupil property tax revenue perform better on ELA standardized tests and have higher graduation rates. Our initial assumption does not hold true in regards to Math scores; as mentioned in the time fixed effects section, this could speak to the idiosyncrasy of mathematical skill sets, or to pernicious techniques employed by educators in property tax poor districts in order to maintain AYP status. These results are robust to our time fixed effects model, with the exception that the coefficient of per-pupil property tax revenue (PROP_PP) was significantly negative when tested against mean scaled Math test scores (MEAN_MATH) in the time fixed effects model.

When tested against graduation rates (GRADRATE) and mean scaled ELA test scores (MEAN_ELA), the coefficients of per-pupil property tax revenue (PROP_PP) relate the predicted effect of a one percent increase in the mean of per-pupil property tax revenue (from $8,492 to $8,577) to increase the mean graduation rate by 2.003 percentage points (from 81.648% to 83.651%), and to increase the average mean scaled ELA score by 2.390 points (from 661.081 to 663.471). The effect on graduation rates seems to be more pronounced, although comparing the two is somewhat shortsighted as they are measured on different scales.

Year 2012 is suppressed for all three regressions. Graduation rates exhibit consistent improvement for the years 2005 to 2010, and are not significantly different in the years 2011 and 2012. ELA test scores seemed to suffer in 2006 and 2011, but were higher than 2012 for the years 2007 to 2010. Math scores consistently improved up to 2011, and were similar in the years 2011 and 2012. These results are robust to the time fixed effects estimation.

The coefficient of per-pupil expenditure on instruction (INST_PP) is significantly negative when tested against graduation rates (GRADRATE) and insignificant when tested against mean scaled ELA test scores (MEAN_ELA) and mean scaled Math test scores (MEAN_MATH). The significant negative coefficient is unexpected, and suggests that when holding revenues constant, districts that spend more on instruction have lower graduation rates. The coefficient of per-pupil capital outlay expenditure (CAP_PP) is insignificant when tested against graduation rates (GRADRATE) but significantly positive when tested against test scores. This can support the theory of teaching to the test; more spending on specialized capital can improve test scores but not graduation rates. These results are robust to the time fixed effects model. Amidst concerns over multicollinearity between expenditure controls and our revenue variables, we have included the results of a random effects estimation without the inclusion of the expenditure variables in Table 6 (Appendix I). The changes in the coefficients of our revenue variables in this estimation are explained by the expected biases of omitting the expenditure variables, and the variance-inflation factors (VIFs) of per-pupil instruction expenditure (INST_PP) and per-pupil capital outlay expenditure (CAP_PP) are 4.060 and 1.090 respectively. The inclusion of these expenditure variables does not affect the significance of our revenue variables. Hence, we can assert that multicollinearity is not an issue.

Enrollment coefficients are consistent with our expectations when tested against test scores but not when tested against graduation rates (GRADRATE). When tested against mean scaled ELA test scores (MEAN_ELA) and mean scaled Math test scores (MEAN_MATH), the effect of enrollment on achievement is characterized by a concave relationship. The coefficients of enrollment are insignificant and significantly positive when tested against mean scaled ELA test scores (MEAN_ELA) and mean scaled Math test scores (MEAN_MATH) respectively, and the coefficients of enrollment-squared are both significantly negative. This implies that schools receive positive returns of achievement (test scores) as they increase enrollment, reach an optimal level of enrollment, and then experience decreasing returns of achievement as they increase enrollment past that optimal point. The relationship is opposite in regards to graduation rates however; as districts increase enrollment they first approach a minimum achievement level (graduation rate), and then experience increasing returns to achievement past that minimum level. These results are robust to the time fixed effects model with the exception that the coefficient of enrollment-squared is insignificant when only utilizing time fixed effects.

The coefficients of the percentages of the district population that is black (BLACK_R), Hispanic (HISP_R), and that have graduated high school (EDUC_R) are consistent with our expectations; the former two are significantly negative across regressions and the latter maintains a significantly positive coefficient for all three regressions. The coefficient of the percentage of families that are beneath the poverty line (POV_R) is consistent to our expectation of a negative sign when tested against graduation rates (GRADRATE), but is insignificant when tested against mean scaled ELA test scores (MEAN_ELA) and mean scaled Math test scores (MEAN_MATH). The unemployment rate of a district (UNEMP_R) is insignificant for all three regressions. The natural log of the median household income of a district (HOUSE_Y) has a significantly positive coefficient for all three regressions, which is consistent with our expectation. These results suggest that academic achievement can be a function of socioeconomic status, highlighting achievement gaps corresponding to income levels as well as demographic makeups of districts. These results are robust to the time fixed effects model with the exception of the unemployment rate of a district (UNEMP_R) when tested against graduation rates (GRADRATE), which has a significantly negative coefficient in the time fixed effects model.

As previously mentioned, the values of the coefficients within our random effects estimations are subject to scrutiny due to the possibility of omitted variable biases generated from unobserved time invariant fixed effects across districts that are not controlled for by the random effects estimator. Nevertheless, although the exact value of the coefficient may not be extremely precise, we can confidently assert significant effects that are consistent with our initial expectations.

6. Conclusions and Policy Recommendation

The research endeavors of this paper concerned the dependence on local property tax funding of public school districts, and its relationship with academic achievement as measured by graduation rates and standardized test scores. This was examined theoretically and then empirically through panel based econometric methods.

A positive relationship between districts that assign a higher reliance on local property tax funding and academic achievement is evidenced by our empirical results within a time fixed effects model and a random effects model. School district per-pupil property tax revenues were found to have a significant positive association with graduation rates and eighth grade English Language Arts standardized test scores, but not with eighth grade Math standardized test scores. These findings illustrate a linkage that is consistent with the findings of Mensah et al. (2013) and Fiva & Rønning (2008), studies that conducted similar empirical investigations of school districts in New Jersey and Norway respectively.

These empirical conclusions sustain our theoretical argument and our research hypotheses by affirming that districts that pay higher property taxes enjoy higher academic achievement. We can distinguish our findings from those of Mensah et al. (2013) through the means of which property tax revenue was measured, which was via per-pupil revenues instead of property tax shares of total revenues, and by expanding our model to include non-local revenues, that is per-pupil state and federal revenues that are primarily used to equalize funding gaps that naturally arise from disparities in property values. The empirical results regarding these measures also supported our hypotheses; holding per-pupil property tax revenues constant, districts with higher per-pupil state and federal revenues experienced worse graduation rates and test scores than those with fewer non-local revenues, which is analogous to our findings concerning per-pupil property tax revenues.

The implications of these findings are manifold. On the one hand, they affirm the obvious: per-pupil funding disparities that have not been corrected through equalization attempts of non-local aid cause those underfunded schools to suffer academically. However they also imply a more intricate and problematic repercussion that arises as a consequence of the structure of the finance system in place, in that while simply contributing greater amounts of state and federal aid to property tax poor districts may in some cases do well to bridge the funding gap, it doesn't provoke the intended effect on incentives and consequently achievement. The effects of taxpayer accountability on administrations are more significant; federal and state revenues fail to facilitate the community engagement that is necessary for administrative efficiency in stimulating student performance. Hence, by utilizing a system where we depend on property tax funding we are stifling the academic achievement of districts that cannot afford to or do not rely on it. The disparities disenfranchise members of property tax poor communities, dissuading them from engaging in administrative decisions that change the scope of educations that are provided in the schools in question.

Mensah et al. (2013) and Kenyon (2007) contend that addressing the fairness of the system is important to fixing it by recommending that state and federal revenues should aim to relieve the burden of taxpayers who pay high property taxes in proportion to their household income. Although this lack of parity in property tax revenues in relation to household income is certainly apparent and affects the equality of the system, our results indicate that adjusting the system in this way may sacrifice efficiency and academic achievement in the process of making it more equitable.

As long as public education systems continue to use property tax revenues as a means to fund the districts that they are drawn from, achievement gaps will prevail unless active parental and taxpayer engagement in administrative procedures can be stimulated exogenously. In order to promote both taxpayer equality and academic efficiency within the confines of public education funding, the current system needs to be phased out in favor of one that draws from a more equitable pool of tax revenue. By incorporating a proportional tax system in which members of different income brackets provide the same percentage of their income towards an aggregated fund devoted to financing public schools, we can experience a fair system that also promotes taxpayer accountability. The transition to this system would have to be gradual, aiming to preserve the incentive effects of taxpayers in property tax rich districts while stimulating those in property tax poor districts.

7. References

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8. Appendix I

Table 1
Description of variables

Variable	Definition
Dependent Variables	
GRADRATE	Graduation rate
MEAN_ELA	Mean scaled score of the ELA standardized test administered by New York State
MEAN_MATH	Mean scaled score of the Math standardized test administered by New York State
Socio-Economic Factors	
HOUSE_Y	Median Household Income of school district
POV_R	Percentage of families that are beneath the poverty line in school district
BLACK_R	Percentage of the population that is black in school district
HISP_R	Percentage of the population that is Hispanic in school district
UNEMP_R	Unemployment rate of school district
EDUC_R	Percentage of population with at least a high school degree in school district
School District Factors	
INST_PP	Per-Pupil expenditure on instruction
CAP_PP	Per-Pupil expenditure on capital outlays
ENROLL	Total student enrollment
School District Revenues	
PROP_PP	Per-Pupil revenue generated from property taxes
STATE_PP	Per-Pupil revenue generated from State aid
FED_PP	Per-Pupil Revenue generated from Federal aid

Table 2
Descriptive Statistics of variables

Variable	Scale	Count	Mean	Median	Standard Deviation	Variance	Min	Max	VIF
GRADRATE	Percent	5091	81.648	83.000	10.329	106.683	28.000	100.000	
MEAN_ELA	Percent	4459	661.081	661.000	10.513	110.525	622.110	703.750	
MEAN_MATH	Percent	4459	672.577	674.000	15.050	226.493	614.093	710.000	
HOUSE_Y	In $000	5114	63.294	54.072	26.879	722.455	29.813	238.000	5.300
POV_R	Percent	5114	7.106	6.300	4.666	21.773	0.000	27.900	3.300
BLACK_R	Percent	5112	4.819	2.100	8.106	65.705	0.000	76.438	2.040
HISP_R	Percent	5112	5.411	2.748	7.294	53.209	0.000	62.662	2.740
UNEMP_R	Percent	5114	6.929	6.613	2.542	6.460	0.000	21.783	1.540
EDUC_R	Percent	5114	88.717	89.100	5.052	25.520	64.800	99.700	3.300
INST_PP	In $000	5114	11.092	10.489	2.927	8.565	5.662	41.548	4.060
CAP_PP	In $000	5114	1.629	0.705	2.723	7.415	0.015	63.435	1.090
ENROLL	In 000	5114	2.654	1.641	3.192	10.187	0.055	38.704	5.650
PROP_PP	In $000	5114	8.482	6.434	6.110	37.337	0.413	57.572	6.330
STATE_PP	In $000	5114	8.928	8.818	3.513	12.344	1.047	30.686	3.710
FED_PP	In $000	5114	0.860	0.765	0.530	0.281	0.051	6.935	3.640

Table 3
Time Fixed Effects

	GRADRATE		MEAN_ELA		MEAN_MATH	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
ln[PROP_PP]	1.590***	0.413	0.758+	0.433	-1.016*	0.484
ln[STATE_PP]	-0.472	0.399	-4.341***	0.473	-4.412***	0.539
ln[FED_PP]	-2.927***	0.36	-4.203***	0.416	-4.775***	0.488
ENROLL^2	0.0211***	0.00214	-0.00134	0.00253	-0.0152***	0.00302
ENROLL	-0.897***	0.0606	-0.0922	0.0677	0.252**	0.0834
ln[HOUSE_Y]	9.034***	0.589	9.346***	0.743	11.81***	0.874
POV_R	-0.244***	0.0391	0.0677	0.0417	-0.0699	0.053
BLACK_R	-0.236***	0.0171	-0.135***	0.0162	-0.217***	0.0193
HISP_R	-0.112***	0.0224	-0.138***	0.0228	-0.123***	0.0296
UNEMP_R	-0.110*	0.0546	-0.0656	0.0557	-0.111	0.068
EDUC_R	0.228***	0.0401	0.176***	0.0406	0.199***	0.05
ln[INST_PP]	-2.161*	0.864	-0.825	0.96	-0.0862	1.131
ln[CAP_PP]	0.0149	0.0858	0.291**	0.0902	0.312**	0.115
Year 2005	-4.735***	0.425				
Year 2006	-4.291***	0.424	-5.684***	0.446	-23.53***	0.529
Year 2007	-3.921***	0.394	0.619	0.4	-19.52***	0.487
Year 2008	-1.701***	0.36	0.881*	0.376	-11.14***	0.49
Year 2009	-2.194***	0.358	4.125***	0.308	-2.290***	0.437
Year 2010	-0.463	0.35	3.115***	0.308	-0.888*	0.442
Year 2011	0.471	0.361	-1.377***	0.292	0.0919	0.433
Intercept	-27.25***	6.27	552.7***	7.948	546.2***	9.162
Adj. R-sq	0.59		0.611		0.689	

All standard errors are corrected for heteroskedasticity
+ Significant at 0.10
* Significant at 0.05
** Significant at 0.01
*** Significant at 0.001

Table 4
Time and District Fixed Effects

	GRADRATE		MEAN_ELA		MEAN_MATH	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
ln[PROP_PP]	-0.338	1.373	3.315+	1.712	-3.640+	2.203
ln[STATE_PP]	0.888	1.242	6.631***	1.781	5.590**	1.712
ln[FED_PP]	-0.322	0.439	-2.068***	0.577	-1.270*	0.594
ENROLL^2	0.0438**	0.0157	-0.0625**	0.023	-0.0360+	0.0217
ENROLL	-2.354*	1.056	1.137	1.426	0.579	1.393
ln[HOUSE_Y]	-3.741	2.868	-5.284	3.615	-4.046	3.289
POV_R	-0.165+	0.0929	0.210*	0.0994	0.181+	0.107
BLACK_R	-0.0795	0.122	-0.25	0.17	-0.0411	0.17
HISP_R	0.0668	0.0855	-0.17	0.141	-0.0793	0.132
UNEMP_R	0.138	0.0934	0.0676	0.12	-0.0605	0.137
EDUC_R	-0.029	0.0956	0.0667	0.134	0.0625	0.135
ln[INST_PP]	-5.016*	2.262	-4.548	2.788	-1.035	2.913
ln[CAP_PP]	0.143+	0.0824	0.302**	0.0917	0.194+	0.105
Year 2005	-5.672***	0.827				
Year 2006	-5.061***	0.707	-3.971***	0.854	-22.72***	0.917
Year 2007	-4.503***	0.56	1.729*	0.697	-19.13***	0.73
Year 2008	-2.191***	0.469	1.097+	0.586	-11.42***	0.616
Year 2009	-2.531***	0.362	3.789***	0.448	-2.819***	0.487
Year 2010	-1.167***	0.309	2.885***	0.337	-1.548***	0.381
Year 2011	-0.417	0.285	-1.787***	0.258	-0.913**	0.312
Intercept	144.4***	32.92	700.8***	41.72	716.1***	39.65
Overall R-sq	0.0007		0.0028		0.0678	

All standard errors are corrected for heteroskedasticity
+ Significant at 0.10
* Significant at 0.05
** Significant at 0.01
*** Significant at 0.001

Table 5
Random Effects

	GRADRATE		MEAN_ELA		MEAN_MATH	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
ln[PROP_PP]	2.003**	0.709	2.390**	0.758	0.373	1.056
ln[STATE_PP]	-1.496*	0.697	-2.376**	0.752	-2.641**	0.941
ln[FED_PP]	-1.676***	0.436	-3.612***	0.551	-3.033***	0.581
ENROLL^2	0.0173***	0.00438	-0.00802*	0.00389	-0.0268***	0.00675
ENROLL	-0.811***	0.136	0.104	0.126	0.553**	0.184
ln[HOUSE_Y]	8.944***	1.096	9.283***	1.187	12.29***	1.443
POV_R	-0.252***	0.0639	0.106	0.0653	0.0248	0.0828
BLACK_R	-0.271***	0.0325	-0.169***	0.031	-0.262***	0.0401
HISP_R	-0.0939*	0.0413	-0.148***	0.0445	-0.130*	0.0569
UNEMP_R	0.0434	0.0746	-0.0299	0.0793	-0.104	0.101
EDUC_R	0.154*	0.0699	0.190*	0.0753	0.218*	0.0878
ln[INST_PP]	-2.975*	1.378	-1.368	1.408	0.183	1.899
ln[CAP_PP]	0.116	0.0815	0.320***	0.0917	0.219*	0.105
Year 2005	-4.744***	0.511				
Year 2006	-4.256***	0.457	-4.762***	0.508	-22.35***	0.552
Year 2007	-3.823***	0.384	1.304**	0.441	-18.64***	0.467
Year 2008	-1.505***	0.313	1.331***	0.394	-10.47***	0.402
Year 2009	-2.039***	0.28	4.317***	0.288	-1.845***	0.327
Year 2010	-0.632*	0.278	3.209***	0.271	-0.808*	0.318
Year 2011	0.0735	0.279	-1.442***	0.241	-0.283	0.297
Intercept	-17.09	11.82	545.3***	13.42	531.1***	16.01
Overall R-sq	0.5872		0.6084		0.6863	

All standard errors are corrected for heteroskedasticity
+ Significant at 0.10
* Significant at 0.05
** Significant at 0.01
*** Significant at 0.001

Table 6
Random Effects excluding expenditure variables

	GRADRATE		MEAN_ELA		MEAN_MATH	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
ln[PROP_PP]	1.128**	0.539	1.990**	0.599	0.457	0.754
ln[STATE_PP]	-1.838*	0.682	-2.472**	0.728	-2.532**	0.885
ln[FED_PP]	-1.928***	0.438	-3.744***	0.546	-3.036***	0.565
ENROLL^2	0.0155***	0.00421	-0.00835*	0.00387	-0.0263***	0.00687
ENROLL	-0.758***	0.135	0.116	0.124	0.541**	0.185
ln[HOUSE_Y]	8.562***	1.065	9.041***	1.154	12.32***	1.429
POV_R	-0.262***	0.0627	0.105	0.0639	0.0331	0.0815
BLACK_R	-0.273***	0.0327	-0.172***	0.0315	-0.263***	0.0404
HISP_R	-0.106***	0.0411	-0.153***	0.0444	-0.131*	0.057
UNEMP_R	0.0353	0.0741	-0.037	0.0797	-0.107	0.101
EDUC_R	0.161*	0.0699	0.196*	0.0762	0.219*	0.0877
Year 2005	-4.363***	0.467				
Year 2006	-3.950***	0.428	-4.635***	0.498	-22.36***	0.532
Year 2007	-3.598***	0.361	1.372**	0.434	-18.67***	0.46
Year 2008	-1.331***	0.3	1.471***	0.392	-10.42***	0.392
Year 2009	-1.863***	0.266	4.539***	0.278	-1.733***	0.304
Year 2010	-0.480+	0.265	3.447***	0.263	-0.670*	0.302
Year 2011	0.201	0.276	-1.306***	0.235	-0.288	0.288
Intercept	-18.43	11.76	545.0***	13.43	530.6***	15.95
Overall R-sq	0.5863		0.6073		0.6858	

All standard errors are corrected for heteroskedasticity
+ Significant at 0.10
* Significant at 0.05
** Significant at 0.01
*** Significant at 0.001

9. Appendix II

Figure 1
Histogram depicting the distribution of Graduation Rates

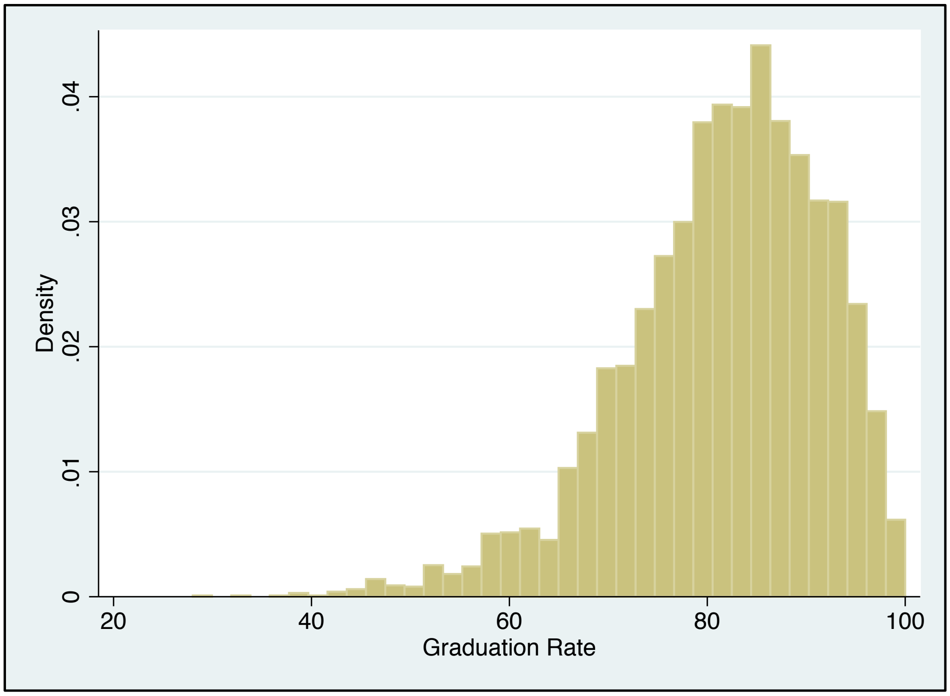

Figure 2
Histogram depicting the distribution of Mean Scaled ELA Scores

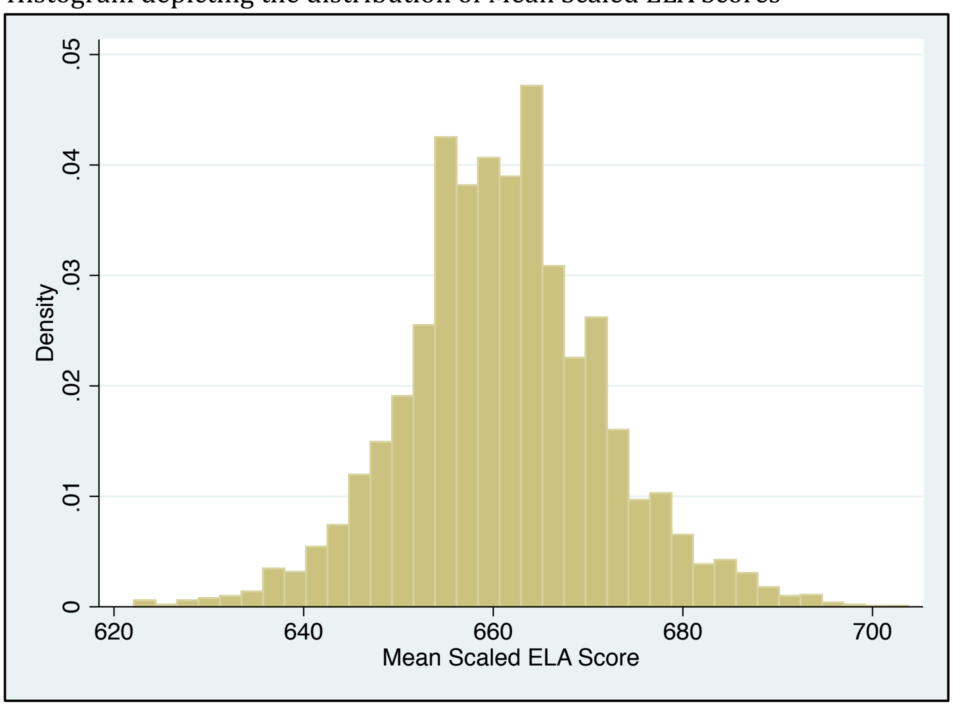

Figure 3
Histogram depicting the distribution of Mean Scaled Math Scores

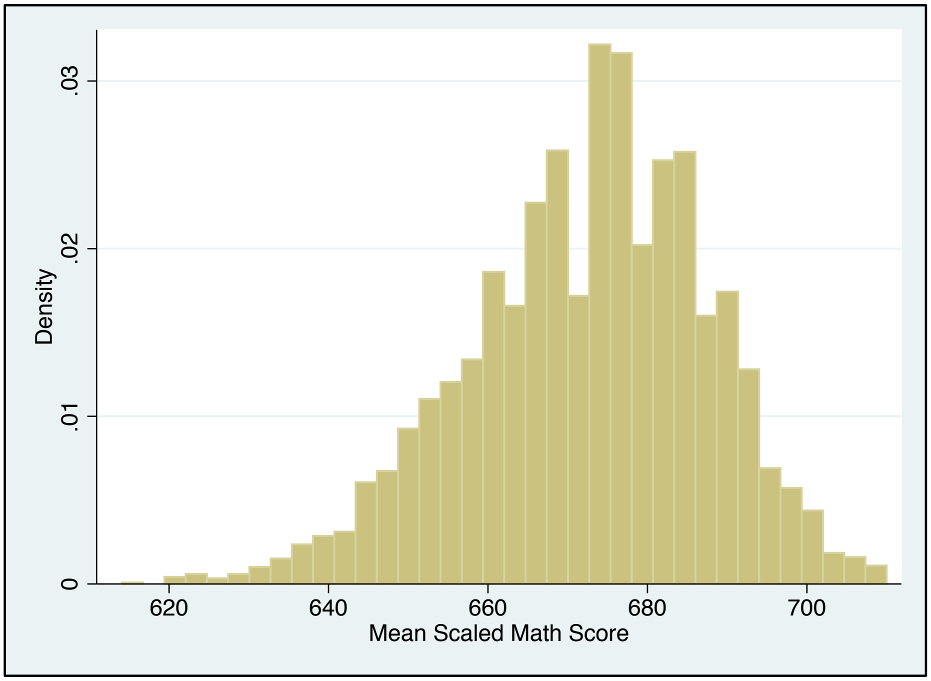

Figure 4
Histogram depicting the distribution of Per-Pupil Property Tax Revenues (In thousands)

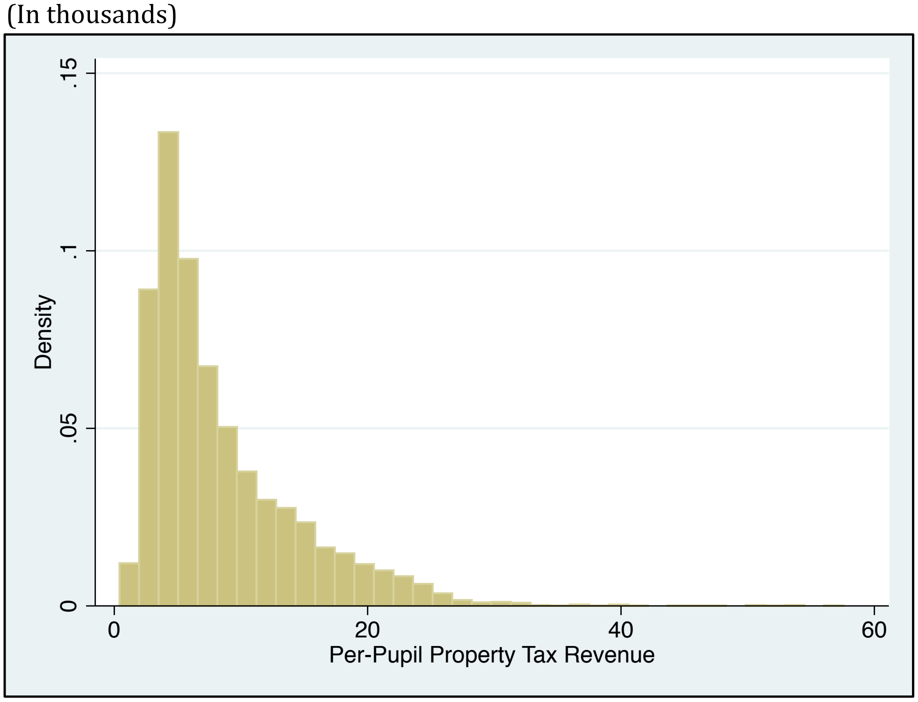

Figure 5

Scatter plot and best fit line of Graduation Rates versus the corresponding natural log of Per-Pupil Property Tax Revenues

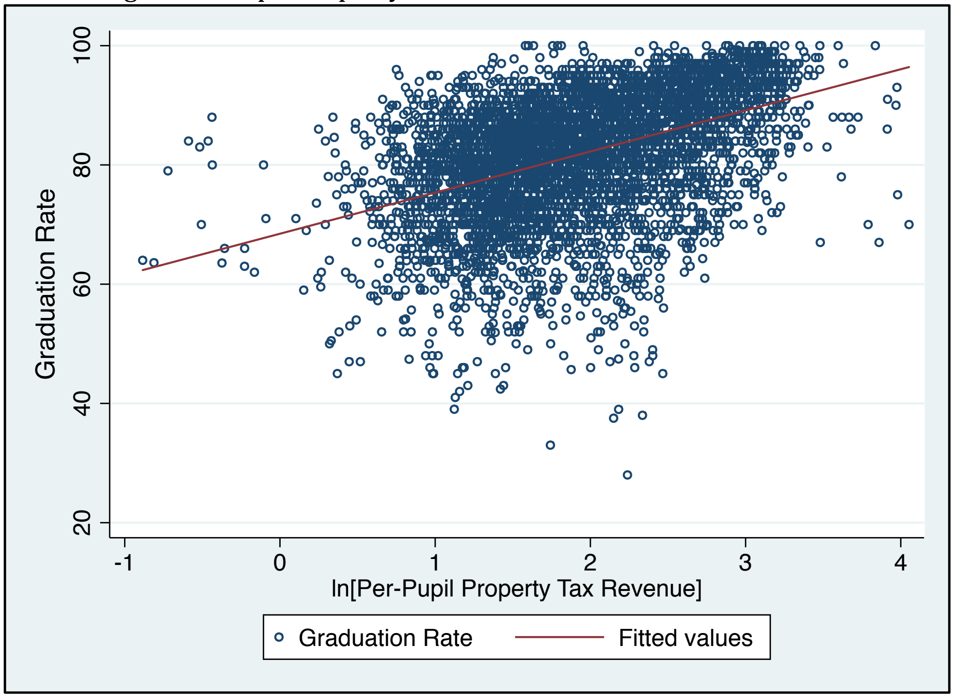

Figure 6

Scatter plot and best fit line of Mean Scaled ELA Scores versus the corresponding natural log of Per-Pupil Property Tax Revenues

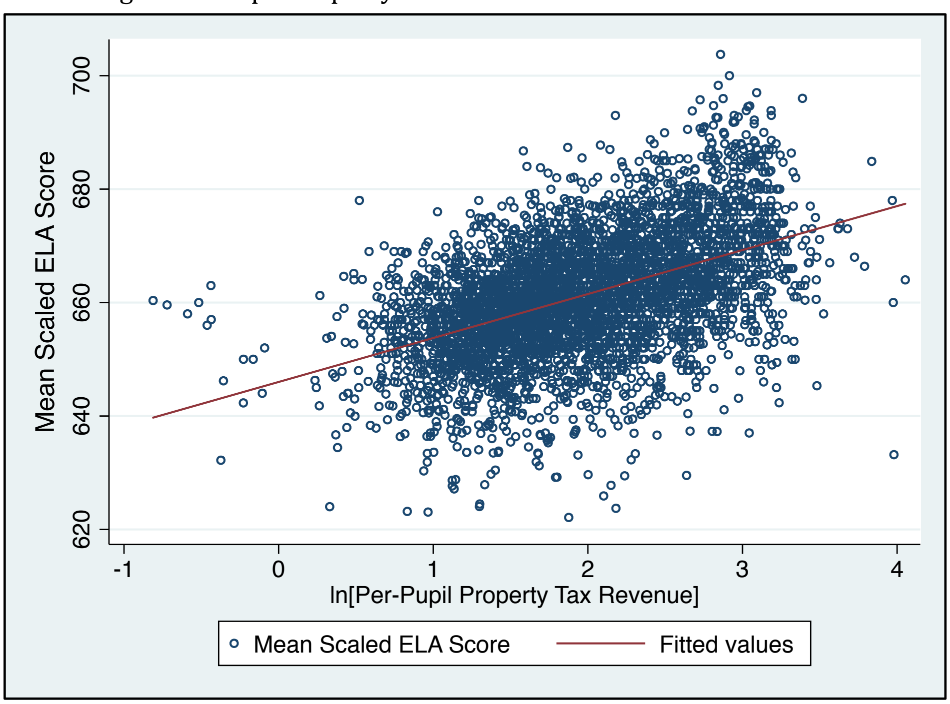

Figure 7

Scatter plot and best fit line of Mean Scaled Math Scores versus the corresponding natural log of Per-Pupil Property Tax Revenues

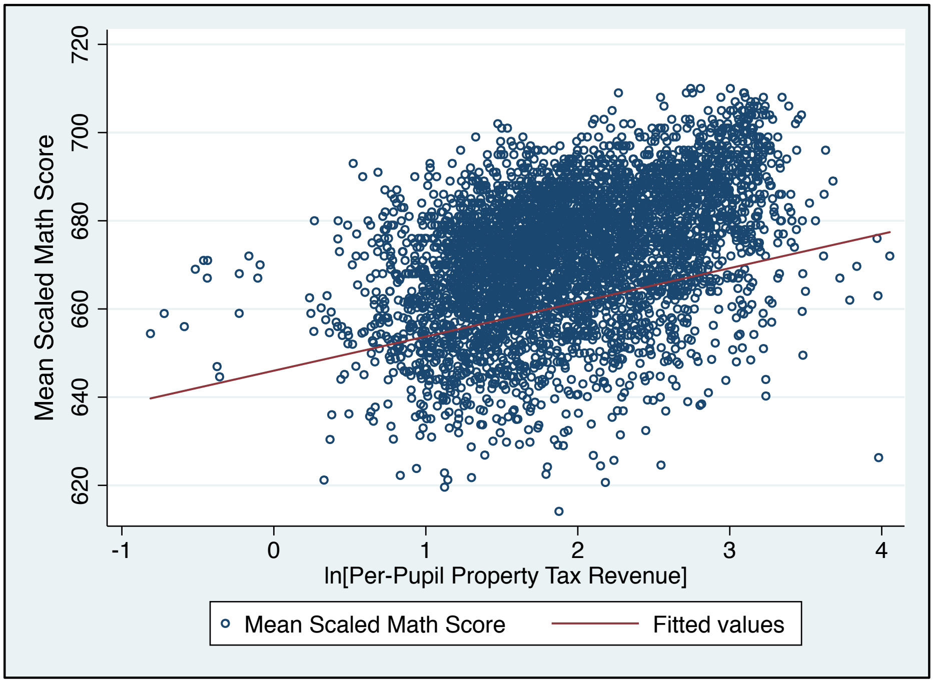

Figure 8

Histogram depicting the distribution of Per-Pupil Total Revenues (In thousands)