# MEASURING ACT 60: COMPARING LEARNING RATES IN VERMONT AND ITS NEIGHBORS IN THE EQUALIZED FUNDING ERA

by

Doug Rosin

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Advisor: Peter Matthews

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**Abstract:**

With the passage of Act 60 in Vermont in 1997, Vermont became one of the first states to detach public education spending from local property tax revenue. The bill followed a long line of legislation aiming to increase funding in public schools, which has previously been shown to return mixed results suggesting that while funding does work to increase scores, much of the variation in student achievement is dependent on early childhood factors. Due to the unique nature of Act 60 equalizing the school funding mechanism across the entire state instead of just particular districts, the effect of this legislation on student outcomes provides a novel insight into the impact of additional funding revenue. Using a natural experiment approach, this paper finds varied effects of funding equalization on learning rates in border districts, but concludes that Vermont districts have significantly less difference in learning rates between high and low income districts than the surrounding states.

## I. Introduction

In the landmark paper "Where is the Land of Opportunity" (2014), Raj Chetty and his associates demonstrate that economic mobility in America correlates strongly with the area in which an individual grew up due to the varied residential segregation, income inequality, primary school quality, social capital, and family stability across the United States (Chetty 2014). This report should be read as a damning indictment of the American Dream; after all, how can a

county claim to be a meritocracy if something as simple as your hometown has a significant impact on your future economic outcomes? Despite decades of governmental reliance on public schools as the favored solution to solve these problems of poverty, inequality, and economic insecurity, leading to countless initiatives to increase public school funding in the hopes of raising test scores and improving student outcomes (Kantor and Lowe 2013), there still exist large racial and economic testing gaps (Aud et al. 2010, Aud et al. 2010, Fryer and Levitt 2004, see Figure 1)

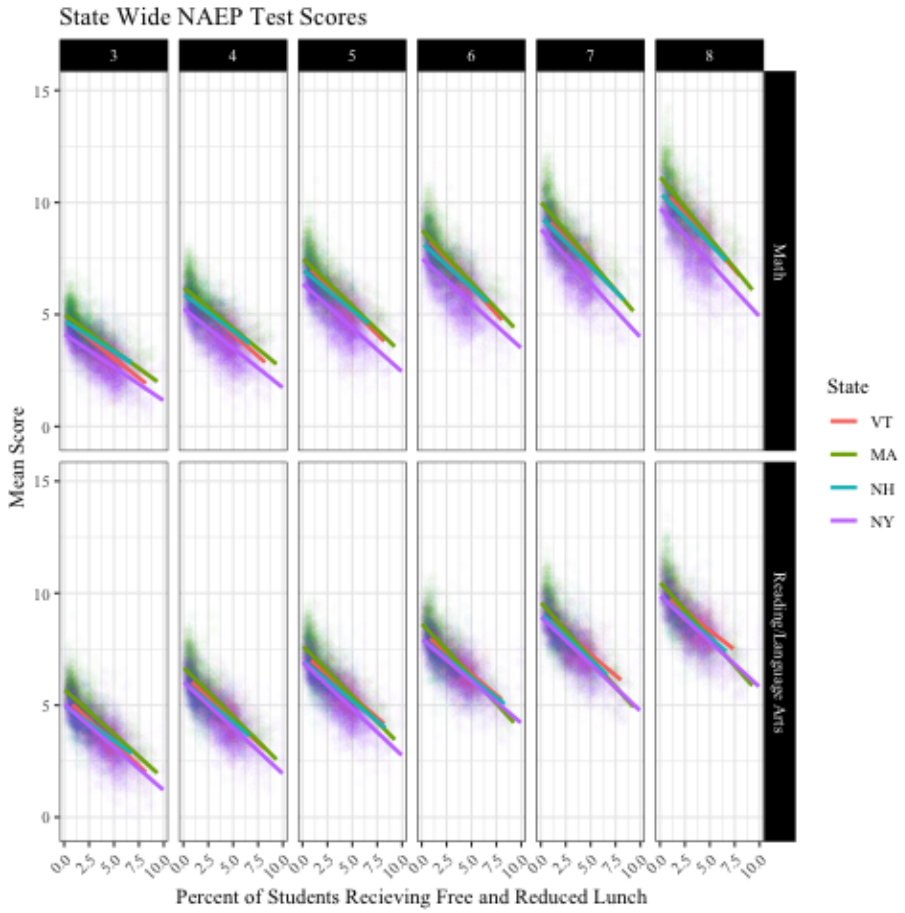


Figure 1 Visualises the significant difference in student test scores, regardless of grade, subject, or state, dependent on the income level of the district. Percent of Students Receiving Free and Reduced Lunch is on a linear scale of 0 to 10, with 1, for example, indicating that 10% of students receive free or reduced lunch. See Appendix B for visualization of within achievement gaps portending on within district inequality.

At first glance, the logic behind funding schools makes sense, as income adjusted high school dropout rate (used as a proxy for educational quality) was one of the five major factors

identified as having a significant effect on intergenerational economic mobility (Chetty et al. 2014). There is a strong narrative ingrained in the common mind of Americans arguing that children, especially those living in cities or very rural areas, are falling victim to underfunded public schools, while the rich kids living in the suburbs excel thanks to superior school funding and teaching (Kozol 1991). Furthermore, if America could truly be a meritocracy, then leveling the playing field of economic inequality by providing each child with a quality education seems like a reasonable place to start.

A substantial body of research supports these claims that providing additional funding resources to schools can significantly benefit students' education. A kink in the Texas funding formula was exploited to show that the additional money provided to some schools, which is exogenous and unrelated to the theoretical cost of educating the students, was shown to increase test scores, lower dropout rates, and increase graduation rates and college enrollment (Kreisman and Steinburg 2020). This funding was particularly impactful in later grades, after students had been exposed to the funding rich environment, and felt most strongly in poorer districts with high populations of marginalized students. Further research found that increasing property tax levies, the funds of which were directed towards teacher salaries, increased test scores and raised college enrollment (Baron 2022), again with particular effect felt in poorer districts (Abott et al 2020). Finally, revenue directed towards improving school facilities can help improve student outcomes in low-income districts, supporting the hypothesis that improving the learning environment, not just the quality of teaching and instruction, can help students learn (Rauscher 2020).

Nonetheless, upon closer examination, it becomes apparent that many parts of the narrative of failing public schools in low income districts are built on false pretexts. While

children from high poverty schools score lower on NAEP tests for mathematics and reading and language arts than children from low poverty schools(Aud et al. 2010), the gaps in these test scores have already formed by the time that American children enter kindergarten, and, moreover, have been shown to hold steady or slightly decrease between kindergarten and eighth grade (Downey 2020). Students from low socioeconomic status (SES) backgrounds exhibit significantly lower cognitive and non-cognitive skills when entering school than high SES kids (Garcia and Weiss 2017). Furthermore, seasonal testing models have indicated that achievement gaps between high and low SES kids increase over the summer and decrease during the school year, suggesting that, contrary to the assumption that public schools are perpetrators of inequality, these institutions are actually working to improve equality in educational outcomes (Downey 2004). With regards to teacher quality, value-added models show that while good teachers have a massive impact on both economic and social student outcomes, these teachers are everywhere (Isenberg et al. 2016, Chetty et al. 2014). In sum, schools serving lower SES students, and therefore the schools that are likely less well funded due to local property taxes acting as the primary funding source for most public schools (Allegretto et al. 2022), are performing just as strongly as well-funded schools serving typically high SES students when we observe the rates at which students are actually learning. Achievement gaps form before students even enter kindergarten, and the children who start behind stay behind (Garcia and Weiss 2017).

*The History of Act 60*

Just over 25 years ago, the Vermont legislature passed Act 60, a bill designed to equalize property tax rates and per student expenditure across school districts. In this paper, we use a natural experiment design on the Vermont-New York and Vermont New Hampshire border in

order to study the effect of funding equalization on student outcomes, contributing to the breadth of literature investigating whether equalizing achievement is really as simple as equalizing funding.

Historically, local governance has played an outsized role in public school education funding responsibility. For example, in the 2017-2018 fiscal year, local property taxes and public and private revenue comprised 45.3% of the funds for public elementary and secondary schools nationwide, with property taxes making up over 80% of this number (36.6% of the total) (Allegretto et al. 2022). This heavy reliance on property taxes, however, creates an inequality problem for both the taxpayers and the students going to these schools. Prior to Act 60, Vermont was a striking example of this inequality. In the 1997 fiscal year, directly before Act 60 was passed, Vermont tax rates ranged from a low of $0.12 cents per $100 of property value to fund expenditure of over $12,000 per pupil, to a high of $2.28 per $100 to fund a per pupil budget of just $7,850 (Saas 2007). The inequity in both tax rates and spending between property poor towns and property rich towns prompted the lawsuit *Brigham vs. State* (1997), which settled with the ruling that Vermont's school funding system "...deprives children of an equal educational opportunity in violation of the Vermont Constitution."

Act 60 worked in two ways to structure educational funding equality. First, it established property wealth, as it concerns education funding, as a state resource. This restructuring allowed state officials to pool all intakes from a $1.12 per $100 property value tax, combine the money with other sources of state education funding, and redistribute evenly to school districts. Secondly, the state ensured that all towns that approved the same amount of additional spending above the state block grant would pay the same tax rate to generate this money by grouping

towns according to their additional spending setting a local share property tax accordingly (Saas 2007).

Despite meeting the *Brigham* condition that "children who live in property-poor districts and children who live in property-rich districts should be afforded a substantially equal opportunity to have access to similar educational revenues," the initial forms of Act 60 caused significant uproar and dissent among Vermont towns. Due to the structure of additional spending placing most of the funding responsibilities on property rich towns, these towns were disincentivized from approving additional spending, resulting in lower per-pupil spending than before Act 60 passed (Saas 2007). Furthermore, residents in these towns skirted legislative jurisdiction by transferring funding responsibilities to local nonprofit education foundations that could be funded by private donation. In 2003, these foundations contributed more than $12.2 million to school budgets. To respond to these dilemmas, the state passed Act 68 in 2003, which equalized and incentivized funding by allowing districts to tax at higher rates and receive additional funding dependent on this rate. For example, if a property rich and a property poor district taxed at $1.00 above the base property tax, the revenue from this additional tax would be pooled and distributed equally between these two districts. Act 60 narrowed education funding disparities in Vermont (Downes 2004), and Act 68, despite its modifications to funding mechanisms, maintained this key feature (Schmidt and Scott 2006).

While the financial effects of Act 60 have been well documented by previous research, studying the impact of this policy on student outcomes across equalized districts in Vermont has been inhibited due to educational record keeping primarily focusing on the national and state level until No Child Left Behind in 2001 (Dee and Jacob 2010). This paper attempts to determine the effect of funding equalization policy in Vermont on student outcomes in two ways.

Using a natural experiment to compare districts on the Vermont and New Hampshire border and Vermont and New York border, we find that funding has a narrow, if any impact on improving learning rates in lower income districts. However, in the second part of the study comparing learning rates in high and low income districts within each state, we conclude that there is significantly less inequality between Vermont districts than in neighboring states.

## II. Data and Methods

### *Methods*

This study examines the impact of school funding equalization on student outcomes in Vermont through two methods: a natural experiment comparing learning rates in school districts on Vermont's eastern border with New Hampshire and western border with New York, and a within state comparison of districts serving populations above and below the state median income lines. The natural experiment design aims to provide an experimental setting that controls for all demographic factors that could cause variance in a students education, such as parent profession and background, environment outside of school, and cultural importance of education. By comparing learning rates between districts on Vermont's border, we assume that all outside factors that contribute to a child's education are very similar on both sides of the border due to the arbitrary nature of a border, so the only difference in the education of children who attend these border schools is theoretically the manner in which their education is funded. For kids in New Hampshire and New York, their education is funded in large part from local property taxes, therefore establishing a connection between the economic background of the school district and the funding which it receives, whereas in Vermont schools, funding in public schools is disconnected from district economic states due to Act 60 funding equalization.

Vermont districts, as expected, receive the highest proportion of their funding from state resources (89%), while New Hampshire and New York are two of the only six states where more than 50% of district revenue is generated from local property taxes. New Hampshire receives the highest proportion of its funding from local resources in the nation, excluding District of Columbia (Allegretto et al. 2022, Table 1).

There are two possibilities for how school funding equalization could impact learning rates. The first hypothesis assumes the prevalent narrative connecting school funding to student outcomes. Hypothesis 1 states:

> If school funding is equalized across school districts and disconnected from property taxes in one state but not another, then student outcomes in poorer districts will decline more rapidly in the property-tax dependent state than in the equalized state. This difference in student outcomes could be apparent through a number of pathways. The learning rate might decline in each state depending on district economic conditions, but will drop faster in the unequalized state in comparison to the equalized. On the other hand, student learning rates in the unequalized state might decline as economic conditions worsen, while learning rates in the equalized state remain independent of economic conditions. Finally, in the case that student learning rates are positively associated with poorer districts, Vermont students still learn at faster rates than students in other states.

On the other hand, Act 60 and funding equalization might have no effect on student outcomes. Hypothesis 2, the null hypothesis for any effect from Act 60, states:

> If school funding is equalized across districts and disconnected from property taxes in one state but not another, then the relationship between economic conditions and student

outcomes in a district will follow similar trends in each state. If student outcomes improve, remain steady, or decline at slower rates in the unequalized state in comparison to the equalized state, then we conclude that equalized funding is not the mechanism driving variation in student learning rates.

In sum, this experiment tests to see if disconnecting school funding from local property taxes, and therefore local economic prosperity, has an effect on the educational outcomes of students living in poorer districts.

In the intra-state experiment, all school districts in the sample are split into a high-income (advantaged) or low-income (disadvantaged) test group based on the percent of students they serve receiving free and reduced lunch. We test for the impact of school district economic prosperity on learning rate. The funding positive hypothesis states that there will be a smaller gap in learning rates, if there even is a difference at all, between high and low income school districts in Vermont than in New Hampshire or New York due to the equalization of funding in Vermont (and implied equalization of school quality). The funding null hypothesis states that students in Vermont, New Hampshire, and New York will learn at similar rates, regardless of the prosperity of their district or the funding level of their school.

In sum, the regression model for the inter-state border experiment is written as:

$$LearningRate_i = \beta_0 + \beta_1 State_i + \beta_2 PctFreeReducedLunch_i + \beta_3 (State_i \times PctFreeReducedLunch_i) + \beta_X \mathbf{X}_i + \varepsilon_i \quad (1)$$

while the regression model for the intra-state district comparison experiment is written as:

$$LearningRate_i = \beta_0 + \beta_1 State_i + \beta_2 IsAdvantaged_i + \beta_3 (State_i \times IsAdvantaged_i) + \beta_X \mathbf{X}_i + \varepsilon_i \quad (2)$$

The control vector is the same for each regression equation and includes grade that the learning rate is from, the percentage of students in the district that live in rural areas, the percentage of

students who come from families with single mothers, the percentage of the students in the district that are white, an interaction term between state and grade level, and the unemployment rate for the district. Grade ranges from 3 to 8 when score is the dependent variable and from 4 to 8 when learning rate is the dependent variable, since there is no 2nd grade data to calculate the learning rate for the 3rd graders. Grade, and its interaction with the state variable, is important to control for in case of differential effects of funding as students experience more time in school (Kreisman and Steinburg 2020). The percentage of students who live in rural areas is an appropriate control because of the challenges of sparsity (Kreisman and Steinburg 2020). Coming from a single parent family has a significant impact on children's outcomes in adulthood (Chetty et al. 2014), unemployment rate provides a second measure of district economic conditions, and achievement gaps between white and minority students have been well documented (Aud et al. 2010). Massachusetts is excluded from the natural experiment analysis in this paper due to the small length of border it shares in Vermont, so for continuity it is also excluded from within state economic comparison.

*Data and Variables*

Both the testing and covariate data from this experiment is from the Stanford Educational Data Archive. Testing data consists of NAEP math and reading and language arts scores on a district-grade-year level. Covariate data was kindly collected by the Stanford researchers from the ACS for community level statistics such as the unemployment rate, single motherhood rate, and the median income in the county of the school district and the Common Core of Data (CCD) for school characteristics including the percentage of students receiving free or reduced price

lunch, the racial composition of the grade, and the percentage of students that are English language learners.

The dependent variable across each study is student learning rate, which is chosen over test scores for its ability to measure the value-added of a school. Using absolute test scores biases the study of student achievement in favor of high income students, who enter kindergarten scoring higher than their low income peers (Downey 2020). Learning rates, on the other hand, measure year over year improvement in student performance, providing insight into how a school is helping its students develop, regardless of their starting point. Learning rate is imputed in the data through calculating the difference between two successive years of test scores for each district for a specific grade, year, and area of study. For example, the 3rd graders who took the NAEP math test in 2013 in the Battenkill Valley Supervisory Union are for the most part the same students as the 4th graders taking the NAEP math test in 2014 in that Supervisory Union. NAEP test scores are standardized to the grade that the student is in, such that the average 3rd grader should receive a 3, a 4th grade should receive a 4, and so on, so when calculating the difference between 3rd and 4th grade scores for Battenkill Valley, the expected learning rate is 1. A higher learning rate indicates that students are learning more than a grade level per year, which is a strong indicator of school quality, while a learning rate of below 1 indicates that students are learning under one grade a year over the course of a year. Nonetheless, test scores data is included as a robustness check.

In addition to the state of the school district, primary independent variable in this study is the percent of students in a school district or supervisory union receiving free and reduced lunch, which is determined nationwide such that children in households making below 130% of the poverty level receive free lunch, while students living in households making between

130%-185% of the poverty level receive reduced price lunch (Feeding America). This variable is advantageous over a direct measure of income for two reasons. First, simply measuring income or the percent of people living in poverty in a district likely has a direct impact on tax rates. Secondly, the percent of students receiving free or reduced lunch is advantageous over the percent of students living in poverty because this variable encompasses a broader scope of the economic conditions in a school district. Families with incomes up to incomes that are 200% of the poverty rate are typically classified as low-income, and there is provocative literature and personal accounts suggesting that a single poverty line can not encapsulate the living conditions of many people coming from diverse backgrounds and that the poverty line is simply too low (Sherman and Water 2019). In the robustness check, the district poverty rate and the log of district median household income are included as independent variables.

*Funding Background*

Per 2017 reports, Vermont has the 12th highest per student expenditure in the nation at $15,009 per student, while New York has the highest at $23,102 per student and New Hampshire has the 8th highest at $15,700 per student. However, while Vermont spends 5.9% *more* in high poverty districts than in low poverty districts ($15,978 per student compared to $15,043 per student), New Hampshire spends 6.7% less ($14,405 per student in low-income districts compared to $15,376 in high-income districts). New York does spend 9.7% more in high poverty districts, but these statistics are likely skewed by higher New York City expenditures. Nationwide, states tend to spend 2.7% less in low income districts than in high income districts (National Center for Education Statistics). This data affirms earlier findings of Act 60 equalizing per pupil expenditure across high and low income districts in Vermont (Downes 2004), and further

suggests that the effect of funding reform from Act 60 and 68 have had lasting effects on school district funding. We therefore maintain the funding equalization assumption implicit in the design of this research in good faith.

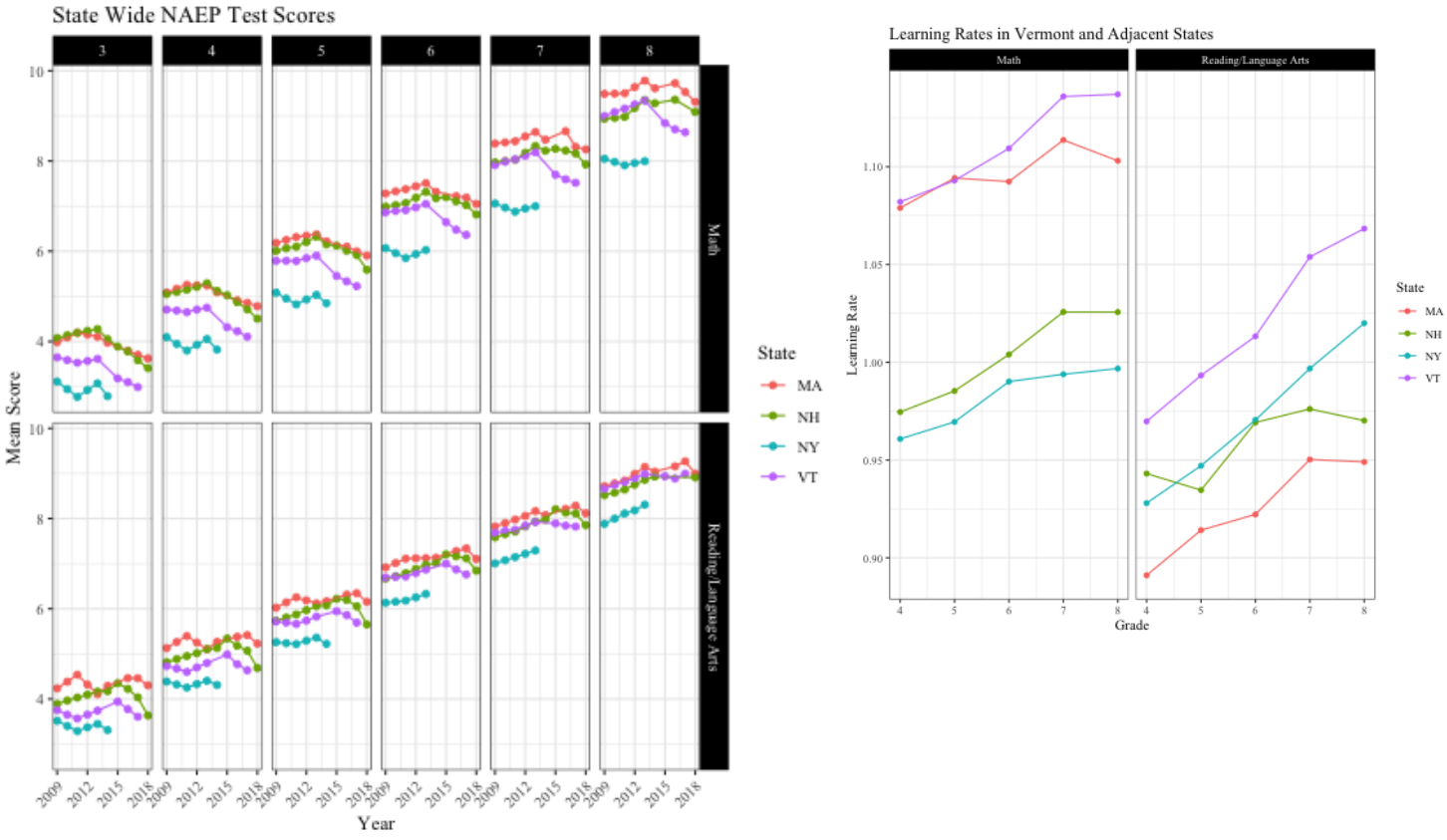


Figure 2 (Left): Tracks statewide achievement on NAEP tests across grades and years, from 3rd grade on the far left through 8th grade on the right, from 2009 to 2018. Figure 3 (Right) shows the average learning rates for students in each state as they progress through school in both Math and Reading and Language arts.

## IV. Results

Table 1: Descriptive Statistics

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 84,227 | 5.406 | 1.694 | 3 | 8 |
| Score | 84,227 | 6.238 | 2.132 | −0.328 | 15.101 |
| Students in Grade | 84,227 | 262.482 | 2,002.504 | 20 | 76,970 |
| PctRural | 84,215 | 4.001 | 4.475 | 0.000 | 10.000 |
| PctBlack | 84,215 | 0.436 | 0.872 | 0.000 | 8.354 |
| PctWhite | 84,215 | 8.523 | 1.878 | 0.000 | 10.000 |
| Pct English Language Learner | 84,195 | 0.209 | 0.401 | 0.000 | 3.569 |
| PctFreeReducedLunch | 84,215 | 3.054 | 1.935 | 0.030 | 9.952 |
| SES Status | 83,704 | 0.749 | 0.806 | −2.513 | 2.863 |
| Log(Median Income) | 83,704 | 11.106 | 0.336 | 10.305 | 12.350 |
| Poverty Rate | 83,704 | 0.092 | 0.052 | 0.002 | 0.347 |
| Unemployment Rate | 83,704 | 0.677 | 0.210 | 0.014 | 1.655 |
| Pct on SNAP | 83,704 | 0.075 | 0.054 | 0.001 | 0.426 |
| PctSingleMother | 83,704 | 1.463 | 0.541 | 0.101 | 4.756 |
| Learning Rate | 55,475 | 0.993 | 0.666 | −3.519 | 5.576 |

Table 1: Descriptive statistics. Further breakdowns of descriptive statistics for Vermont and districts on the easter and western vermont border can found in the Appendix A.

When evaluating the Vermont, Massachusetts, New York, and New Hampshire public school education systems from the perspective of math and reading scores, two prominent trends emerge when comparing Vermont to its neighbors across both subjects. We see that Vermont 3rd graders are behind their peers in Massachusetts and New Hampshire (Figure 2), yet as students progress through each grade, Vermont students learn at much higher rates (Figure 3), eventually almost completely closing the gaps with Massachusetts and New Hampshire. It therefore appears that some mechanism within the Vermont education system is helping add more value to students' education.

Table 2: Western Border Experiment Learning Rate Results

| | *Dependent variable:* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Math Learning Rates | | | | Reading/Language Arts Learning Rates | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Vermont Indicator | 0.13** | | 0.58*** | 0.33 | 0.10* | | 0.41** | 0.68** |
| | (0.05) | | (0.17) | (0.33) | (0.05) | | (0.16) | (0.31) |
| PctFreeReduced Lunch | | −0.01 | 0.06** | 0.02 | | 0.01 | 0.06* | 0.06* |
| | | (0.02) | (0.03) | (0.03) | | (0.02) | (0.03) | (0.03) |
| Grade | | | | −0.06** | | | | 0.06** |
| | | | | (0.03) | | | | (0.03) |
| PctSingleMother | | | | 0.28*** | | | | 0.04 |
| | | | | (0.11) | | | | (0.10) |
| PctRural | | | | −0.004 | | | | −0.01 |
| | | | | (0.01) | | | | (0.01) |
| PctWhite | | | | 0.01 | | | | −0.01 |
| | | | | (0.03) | | | | (0.03) |
| Unemployment Rate | | | | −0.10 | | | | 0.05 |
| | | | | (0.22) | | | | (0.21) |
| Pct English Language Learners | | | | −0.34*** | | | | −0.58*** |
| | | | | (0.11) | | | | (0.20) |
| 2011 | | | | −0.05 | | | | −0.13 |
| | | | | (0.08) | | | | (0.08) |
| 2012 | | | | 0.08 | | | | −0.01 |
| | | | | (0.08) | | | | (0.08) |
| 2013 | | | | 0.08 | | | | −0.04 |
| | | | | (0.09) | | | | (0.08) |
| 2014 | | | | 0.57** | | | | 0.24 |
| | | | | (0.23) | | | | (0.20) |
| 2016 | | | | −0.06 | | | | −0.10 |
| | | | | (0.11) | | | | (0.11) |
| 2017 | | | | −0.13 | | | | −0.01 |
| | | | | (0.12) | | | | (0.12) |
| Vermont ×PctFreeReducedLunch | | | −0.11*** | −0.10** | | | −0.07** | −0.09** |
| | | | (0.04) | (0.04) | | | (0.04) | (0.04) |
| Vermont ×Grade | | | | 0.04 | | | | −0.03 |
| | | | | (0.04) | | | | (0.04) |
| Constant | 0.98*** | 1.11*** | 0.71*** | 0.80* | 0.92*** | 0.95*** | 0.67*** | 0.45 |
| | (0.04) | (0.08) | (0.14) | (0.46) | (0.04) | (0.07) | (0.13) | (0.44) |
| Observations | 726 | 726 | 726 | 726 | 714 | 714 | 714 | 714 |
| $R^2$ | 0.01 | 0.001 | 0.02 | 0.08 | 0.01 | 0.0001 | 0.01 | 0.05 |
| Adjusted $R^2$ | 0.01 | -0.001 | 0.02 | 0.06 | 0.004 | -0.001 | 0.01 | 0.02 |

*p<0.1; **p<0.05; ***p<0.01

Table 2: All regressions are OLS, with standard errors in parentheses. The dependent variable in columns (1)-(4) is math learning rates in Vermont and New York border districts, whereas the dependent variable in columns (5)-(8) is reading/language arts learning rates in these districts. All percentage variables (including unemployment rate) are on a linear scale of 0-10. Year is treated as a factor variable, while grade is treated continuously with a range of 3 to 8. In the regressions with state indicators, the indicator for New York is omitted.

Table 2 displays OLS regression results comparing Vermont and New York border districts. While there is a positive effect from being in Vermont for both math and reading learning rates, the negative sign on the interaction coefficient between Vermont school districts and the percent of students receiving free and reduced lunch indicates that while students in richer Vermont

border districts learn at faster rates, this effect decreases in poorer districts. We calculate that while New York students in districts with more than 33% of students receiving free and reduced price lunch learn at faster rates in Math (4), only in districts where more than 75% of students receive free or reduced price lunch do New York students tend to learn at faster rates than Vermont students in reading and language arts (8). Nonetheless, given that in both subjects, the initial advantage of attending school in Vermont decreases as district prosperity decreases, the New York border experiment supports the Null Hypothesis.

Table 3: Eastern Border Experiment Learning Rate Results

| | *Dependent variable:* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Math Learning Rates | | | | Reading/Language Arts Learning Rates | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Vermont Indicator | 0.02 | | 0.20 | 0.71*** | −0.02 | | −0.22 | 0.18 |
| | (0.05) | | (0.17) | (0.27) | (0.06) | | (0.19) | (0.32) |
| PctFreeReducedLunch | | −0.09*** | −0.09*** | −0.08*** | | −0.04** | −0.05** | −0.08*** |
| | | (0.02) | (0.02) | (0.02) | | (0.02) | (0.02) | (0.03) |
| Grade | | | | 0.12*** | | | | 0.10*** |
| | | | | (0.02) | | | | (0.03) |
| PctSingleMother | | | | −0.03 | | | | 0.08 |
| | | | | (0.08) | | | | (0.10) |
| PctRural | | | | −0.02** | | | | −0.005 |
| | | | | (0.01) | | | | (0.01) |
| PctWhite | | | | 0.04 | | | | 0.04 |
| | | | | (0.08) | | | | (0.10) |
| Unemployment Rate | | | | −0.09 | | | | 0.21 |
| | | | | (0.16) | | | | (0.20) |
| Pct English Language Learner | | | | −0.57* | | | | −0.30 |
| | | | | (0.32) | | | | (0.38) |
| 2011 | | | | 0.08 | | | | 0.12 |
| | | | | (0.09) | | | | (0.10) |
| 2012 | | | | 0.18** | | | | −0.02 |
| | | | | (0.09) | | | | (0.11) |
| 2013 | | | | 0.23*** | | | | 0.31*** |
| | | | | (0.09) | | | | (0.11) |
| 2014 | | | | −0.16 | | | | −0.04 |
| | | | | (0.10) | | | | (0.12) |
| 2015 | | | | −0.38*** | | | | −0.30** |
| | | | | (0.12) | | | | (0.14) |
| 2016 | | | | 0.01 | | | | 0.09 |
| | | | | (0.09) | | | | (0.11) |
| 2017 | | | | 0.11 | | | | 0.14 |
| | | | | (0.10) | | | | (0.11) |
| 2018 | | | | 0.11 | | | | −0.19 |
| | | | | (0.12) | | | | (0.14) |
| Vermont ×PctFreeReducedLunch | | | −0.03 | −0.05 | | | 0.05 | 0.05 |
| | | | (0.04) | (0.04) | | | (0.04) | (0.05) |
| Vermont ×Grade | | | | −0.11*** | | | | −0.09** |
| | | | | (0.04) | | | | (0.04) |
| Constant | 1.07*** | 1.44*** | 1.41*** | 0.58 | 1.02*** | 1.16*** | 1.21*** | 0.16 |
| | (0.03) | (0.07) | (0.07) | (0.81) | (0.03) | (0.08) | (0.09) | (0.96) |
| Observations | 768 | 768 | 768 | 758 | 756 | 756 | 756 | 746 |
| $R^2$ | 0.0001 | 0.04 | 0.05 | 0.15 | 0.0001 | 0.01 | 0.01 | 0.08 |
| Adjusted $R^2$ | -0.001 | 0.04 | 0.04 | 0.13 | -0.001 | 0.004 | 0.003 | 0.05 |

*p<0.1; **p<0.05; ***p<0.01

Table 3: All regressions are OLS, with standard errors in parentheses. The dependent variable in columns (1)-(4) is math learning rates in Vermont and New Hampshire border districts, whereas the dependent variable in columns (5)-(8) is reading/language arts learning rates in these districts. All percentage variables (including unemployment rate) are on a linear scale of 0-10. Year is treated as a factor variable, while grade is treated continuously with a range of 3 to 8. In the regressions with state indicators, the indicator for New York is omitted.

In a similar fashion to what is observed in western Vermont, there is a strong initial positive effect of attending school in Vermont in the Eastern Border Experiment (Table 3). However, in this case, the observed effect of Vermont and district economic conditions together on learning rates supports hypothesis 1, suggesting that Act 60 has a positive effect on learning rates in funding-equalized districts. In math testing, despite the stronger negative correlation between percentage of students receiving free and reduced lunch and district learning rates in Vermont, the initial advantage that attending school in Vermont provides is large enough that even in a theoretical district where 100% of students receive free/reduced lunch, Vermont students would still learn 0.2 grades more than New Hampshire students in a year. Furthermore, the interaction effect between Vermont and the percentage of students receiving free or reduced priced lunch is compensatory for reading/language arts learning rates on this border, such that Vermont students' learning decreases less quickly than New Hampshire students' learning rates as district economic conditions decline.

*Robustness*

Table 4: Score Regression Results

| | *Western Border Experiment* | | | | *Eastern Border Experiment* | | | |
|---|---|---|---|---|---|---|---|---|
| | Math Scores | | Reading/Language Arts Scores | | Math Scores | | Reading/Language Arts Scores | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Grade | 1.03*** | 0.97*** | 1.03*** | 0.97*** | 1.05*** | 1.04*** | 1.05*** | 0.99*** |
| | (0.01) | (0.02) | (0.01) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Vermont Indicator | 1.74*** | 1.36*** | 1.74*** | 1.28*** | 0.82*** | 0.98*** | 0.82*** | 0.66*** |
| | (0.17) | (0.26) | (0.17) | (0.24) | (0.17) | (0.24) | (0.17) | (0.24) |
| PctFreeReducedLunch | −0.31*** | −0.35*** | −0.31*** | −0.21*** | −0.35*** | −0.33*** | −0.35*** | −0.32*** |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.02) | (0.03) | (0.02) | (0.03) |
| PctSingleMother | | 0.09 | | −0.13 | | −0.40*** | | −0.46*** |
| | | (0.10) | | (0.09) | | (0.09) | | (0.09) |
| PctRural | | −0.02** | | −0.02** | | −0.02* | | −0.02** |
| | | (0.01) | | (0.01) | | (0.01) | | (0.01) |
| PctWhite | | −0.03 | | −0.09*** | | −0.07 | | −0.09 |
| | | (0.03) | | (0.03) | | (0.09) | | (0.09) |
| Unemployment Rate | | 0.34* | | 0.20 | | 0.44** | | −0.08 |
| | | (0.21) | | (0.19) | | (0.18) | | (0.18) |
| Pct English Language Learner | | −0.86*** | | −0.61*** | | 0.33 | | −0.24 |
| | | (0.10) | | (0.14) | | (0.35) | | (0.36) |
| 2010 | | 0.10 | | 0.17** | | 0.20** | | 0.13 |
| | | (0.08) | | (0.08) | | (0.10) | | (0.10) |
| 2011 | | 0.04 | | 0.11 | | 0.26** | | 0.22** |
| | | (0.09) | | (0.08) | | (0.10) | | (0.11) |
| 2012 | | 0.18** | | 0.19** | | 0.54*** | | 0.36*** |
| | | (0.09) | | (0.08) | | (0.11) | | (0.11) |
| 2013 | | 0.25*** | | 0.14* | | 0.70*** | | 0.64*** |
| | | (0.09) | | (0.08) | | (0.11) | | (0.11) |
| 2014 | | 0.21 | | −0.16 | | 0.68*** | | 0.81*** |
| | | (0.20) | | (0.17) | | (0.12) | | (0.13) |
| 2015 | | −0.30*** | | 0.31*** | | 0.14 | | 0.35*** |
| | | (0.11) | | (0.10) | | (0.11) | | (0.11) |
| 2016 | | −0.14 | | 0.30*** | | 0.03 | | 0.28** |
| | | (0.11) | | (0.10) | | (0.11) | | (0.11) |
| 2017 | | −0.23** | | 0.24** | | −0.08 | | 0.22* |
| | | (0.12) | | (0.11) | | (0.11) | | (0.11) |
| 2018 | | | | | | −0.07 | | −0.05 |
| | | | | | | (0.13) | | (0.14) |
| Vermont ×PctFreeReducedLunch | −0.21*** | −0.19*** | −0.21*** | −0.26*** | −0.23*** | −0.29*** | −0.23*** | −0.17*** |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Vermont ×Grade | | 0.08*** | | 0.01 | | 0.02 | | 0.01 |
| | | (0.03) | | (0.03) | | (0.03) | | (0.03) |
| Constant | 0.78*** | 1.30*** | 0.78*** | 2.26*** | 1.89*** | 2.69*** | 1.89*** | 3.64*** |
| | (0.18) | (0.41) | (0.18) | (0.38) | (0.12) | (0.84) | (0.12) | (0.86) |
| Observations | 1,144 | 1,144 | 1,144 | 1,134 | 1,135 | 1,119 | 1,135 | 1,101 |
| $R^2$ | 0.85 | 0.88 | 0.85 | 0.88 | 0.83 | 0.85 | 0.83 | 0.83 |
| Adjusted $R^2$ | 0.85 | 0.88 | 0.85 | 0.88 | 0.83 | 0.85 | 0.83 | 0.82 |

*p<0.1; **p<0.05; ***p<0.01

Table 4: All regressions are OLS, with standard errors in parentheses. The dependent variable in columns (1) and (2) is math NAEP test scores in Vermont and New York border districts, in (3) and (4) reading/language arts scores in these districts. The dependent variable in columns (5) and (6) are math test scores in Vermont and New Hampshire border districts, and in columns (7) and (8) the dependent variable is reading and language arts scores on the eastern Vermont border. All percentage variables (including unemployment rate) are on a linear scale of 0-10. Year is treated as a factor variable, while grade is treated continuously with a range of 3 to 8. In the regressions with state indicators, the indicator for New York is omitted.

Although it is known that district income is negatively associated with student achievement, prior research has shown that increased funding has been able to improve test scores in low income districts (Kreisman and Steinburg 2020, Baron 2022, Abbott et al. 2020). Therefore, we first check the robustness of these results by regressing the effect of state and district economic conditions on score. Since the dependent variable is raw test score, we control for grade level and find that, as expected, the effect of progressing one grade contributes to scoring about 1 grade level higher. The Vermont indicator also yields a strong positive coefficient, mirroring the

results from the learning rates tests, with the effect of attending school in Vermont now statistically significant and consistent across all regressions. There is also a noticeably stronger effect of roughly 0.4 grade levels in the western border experiment in comparison to the eastern border experiment. Declining district economic prosperity, both on its own and when interacted with the Vermont indicator, now yields a consistent and statistically significant negative coefficient, suggesting that while test scores decline with economic prosperity in all districts, these scores, for both reading and math, fall faster in Vermont than in New Hampshire and New York. In other words, New York and New Hampshire school districts are able to support poorer student bodies better than Vermont, where high achievement is primarily driven by richer districts. We find that New York students outperform Vermont students' test scores in districts where more than 71% of the student body receive free and reduced lunch for math and when more than 49% of the student body receives free and reduced lunch for reading and language arts. On the eastern border, New Hampshire students surpass Vermont students' math and reading and language arts test scores in districts where more than 34% and 38% of the student body receive free or reduced price lunch, respectively. These results support the null hypothesis for the effectiveness of Act 60 funding.

*Alternatives to Free and Reduced Lunch*

Table 5: Log Median Income Robustness Check

| | *Western Border Experiment* | | | | *Eastern Border Experiment* | | | |
|---|---|---|---|---|---|---|---|---|
| | Math Learning Rates | | Reading/Language Arts Learning Rates | | Math Learning Rates | | Reading/Language Arts Learning Rates | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Vermont Indicator | −3.22 | −5.00 | −8.78** | −9.19** | −3.85 | −5.14* | 2.13 | 1.88 |
| | (4.56) | (4.79) | (4.23) | (4.52) | (2.47) | (2.65) | (2.87) | (3.15) |
| Log(Median Income) | −0.09 | 0.03 | −0.75** | −0.58 | 0.49*** | 0.47*** | 0.30** | 0.48*** |
| | (0.37) | (0.38) | (0.34) | (0.36) | (0.11) | (0.13) | (0.12) | (0.16) |
| Grade | | −0.07** | | 0.05 | | 0.13*** | | 0.10*** |
| | | (0.03) | | (0.03) | | (0.02) | | (0.03) |
| PctSingleMother | | 0.25** | | 0.07 | | −0.04 | | 0.08 |
| | | (0.11) | | (0.11) | | (0.08) | | (0.10) |
| PctRural | | −0.01 | | −0.01 | | −0.03*** | | −0.01 |
| | | (0.01) | | (0.01) | | (0.01) | | (0.01) |
| PctWhite | | 0.03 | | 0.01 | | 0.05 | | 0.05 |
| | | (0.03) | | (0.03) | | (0.08) | | (0.10) |
| Unemployment Rate | | −0.14 | | −0.01 | | −0.12 | | 0.21 |
| | | (0.25) | | (0.24) | | (0.16) | | (0.19) |
| Pct English Language Learner | | −0.29*** | | −0.53*** | | −0.53* | | −0.21 |
| | | (0.11) | | (0.20) | | (0.32) | | (0.38) |
| 2011 | | −0.06 | | −0.13 | | 0.06 | | 0.12 |
| | | (0.08) | | (0.08) | | (0.09) | | (0.10) |
| 2012 | | 0.07 | | −0.004 | | 0.15* | | −0.03 |
| | | (0.09) | | (0.08) | | (0.09) | | (0.11) |
| 2013 | | 0.08 | | −0.02 | | 0.22** | | 0.30*** |
| | | (0.09) | | (0.08) | | (0.09) | | (0.11) |
| 2014 | | 0.57** | | 0.21 | | −0.18* | | −0.05 |
| | | (0.23) | | (0.20) | | (0.10) | | (0.12) |
| 2015 | | | | | | −0.40*** | | −0.31** |
| | | | | | | (0.11) | | (0.14) |
| 2016 | | −0.10 | | −0.12 | | −0.03 | | 0.07 |
| | | (0.11) | | (0.11) | | (0.09) | | (0.11) |
| 2017 | | −0.16 | | −0.04 | | 0.09 | | 0.12 |
| | | (0.12) | | (0.12) | | (0.10) | | (0.11) |
| 2018 | | | | | | 0.08 | | −0.21 |
| | | | | | | (0.12) | | (0.14) |
| Vermont ×Log(Median Income) | 0.31 | 0.44 | 0.82** | 0.87** | 0.36 | 0.52** | −0.20 | −0.14 |
| | (0.42) | (0.44) | (0.39) | (0.42) | (0.23) | (0.24) | (0.26) | (0.29) |
| Vermont ×Grade | | 0.06 | | −0.02 | | −0.11*** | | −0.09** |
| | | (0.04) | | (0.04) | | (0.04) | | (0.04) |
| Constant | 1.98 | 0.60 | 3.59 | 6.97* | −4.22*** | −4.88*** | −2.13 | −5.45** |
| | (3.97) | (4.18) | (2.56) | (3.95) | (1.15) | (1.84) | (2.68) | (2.20) |
| Observations | 726 | 726 | 714 | 714 | 761 | 758 | 749 | 746 |
| $R^2$ | 0.01 | 0.07 | 0.01 | 0.04 | 0.05 | 0.16 | 0.01 | 0.08 |
| Adjusted $R^2$ | 0.01 | 0.05 | 0.01 | 0.02 | 0.04 | 0.13 | 0.004 | 0.06 |

*p<0.1; **p<0.05; ***p<0.01

Table 5: All regressions are OLS, with standard errors in parentheses. The dependent variable in columns (1) and (2) is math NAEP learning rates in Vermont and New York border districts, in (3) and (4) reading/language arts scores in these districts. The dependent variable in columns (5) and (6) are math learning rates in Vermont and New Hampshire border districts, and in columns (7) and (8) the dependent variable is reading and language arts scores on the eastern Vermont border. All percentage variables (including unemployment rate) are on a linear scale of 0-10. Year is treated as a factor variable, while grade is treated continuously with a range of 3 to 8. In the regressions with state indicators, the indicator for New York is omitted.

We next check for the robustness of our learning rate results by using the log of district median income in place of the percentage of students receiving free and reduced price lunch. For math on the Western Vermont border, there is an initial negative effect of being in Vermont on learning rates, which, in conjunction with a small effect of median income on learning rates and a positive effect of the interaction between Vermont and median income on learning rates, supports the null hypothesis, as Vermont students only catch up to New York students learning rates at above median income levels and poor Vermont students seem to learn at significantly lower levels than their peers in New York. For reading and language arts, increasing median income levels again

has a compensatory effect on learning rates in Vermont, although Vermont students now surpass New York students at below minimum median income levels. These results tentatively support the hypothesis that Act 60 has a positive effect on Vermont student outcomes.

In the eastern border experiment, students across all district prosperity levels learn math at higher rates in Vermont. Specifically, while a 1% increase in income in New Hampshire is correlated with an increased learning rate of .0047, in Vermont this 1% increase in income is correlated with roughly double the increase in learning rate, or .0099. Vermont students learn at higher rates than New Hampshire students across the entire distribution of median incomes for reading and language arts as well, although in this case, in poor districts, Vermont students start out significantly ahead and richer New Hampshire districts slightly close the gap. In both cases, these results support the hypothesis that equalized funding contributes to improved learning outcomes in Vermont, as poor students learn at higher rates in Vermont than in New Hampshire.

*Intra-State Comparison*

Table 6: Intra-State Math Regression Results

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Math Learning Rate | | Reading Learning Rate | |
| | (1) | (2) | (3) | (4) |
| New Hampshire Indicator | −0.009 | −0.26*** | 0.01 | −0.04 |
| | (0.03) | (0.10) | (0.03) | (0.09) |
| New York Indicator | −0.09*** | −0.13 | −0.02 | −0.30*** |
| | (0.03) | (0.09) | (0.03) | (0.09) |
| Disadvantaged Indicator | −0.07 | −0.07* | −0.01 | −0.01 |
| | (0.04) | (0.04) | (0.03) | (0.04) |
| Grade | | −0.003 | | 0.02 |
| | | (0.01) | | (0.01) |
| PctSingleMother | | −0.07*** | | −0.04*** |
| | | (0.02) | | (0.01) |
| PctRural | | −0.002* | | −0.0002 |
| | | (0.001) | | (0.001) |
| PctWhite | | 0.01** | | 0.001 |
| | | (0.01) | | (0.01) |
| Unemployment Rate | | 0.01 | | 0.02 |
| | | (0.03) | | (0.03) |
| Pct English Language Learner | | −0.05* | | −0.01 |
| | | (0.03) | | (0.03) |
| New Hampshire ×Disadvantaged | −0.07 | −0.04 | −0.07* | −0.06 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| New York ×Disadvantaged | −0.08* | −0.03 | −0.12*** | −0.10** |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| New Hampshire ×Grade | | 0.04*** | | 0.01 |
| | | (0.02) | | (0.01) |
| New York ×Grade | | 0.01 | | 0.05*** |
| | | (0.01) | | (0.01) |
| Constant | 1.12*** | 1.13*** | 1.01*** | 0.95*** |
| | (0.03) | (0.11) | (0.02) | (0.10) |
| Observations | 12,763 | 16,012 | 16,229 | 16,068 |
| $R^2$ | 0.01 | 0.02 | 0.01 | 0.02 |
| Adjusted $R^2$ | 0.01 | 0.02 | 0.01 | 0.02 |
| *Note:* | | | | *p<0.1; **p<0.05; ***p<0.01 |

Table 6: All regressions are OLS, with standard errors in parentheses. The dependent variable in columns (1) and (2) is math NAEP learning rates, while in columns (3) and (4) it is reading and language arts NAEP learning rates. A disadvantaged district is a district whose percent of students receiving free or reduced price lunch is below the median percentage for the state. All percentage variables (including unemployment rate) are on a linear scale of 0-10. Year is treated as a factor variable, while grade is treated continuously with a range of 3 to 8. In the regressions with state indicators, the indicator for New York is omitted.

Across both reading and math testing, New Hampshire and New York students not only learn at slower rates than Vermont students, but there is also a larger gap between the learning rates of New Hampshire and New York students in advantaged and disadvantaged districts than there is in Vermont Districts. In math, Vermont students in disadvantaged districts tend to learn 0.07 grade levels less than students in advantaged districts; however, there is a 0.10 grade level gap between advantaged and disadvantaged districts in New York and a 0.11 grade level gap between these classifications of districts in New Hampshire, in both cases roughly a 50% larger gap than in Vermont. There is an even larger gap in reading learning rates between high and low-income districts in New York and New Hampshire, as there is only a 0.01 grade level learning rate drop for low-income Vermont districts but a 0.07 grade level drop in New Hampshire and a 0.11 grade level drop in New York. These results firmly support the pro- Act 60 hypothesis, as the learning rate gap between high and low income districts is substantially larger in states where funding has not been equalized. Table 7 summarizes results, with a Yes indicating that the result supports Act 60s impact on education and a No indicating that the null hypothesis holds.

Table 7: Summarizing Results

| | Border Learning Rate | Test Scores | Median Income | Intra-State Comparison |
|---|---|---|---|---|
| New York Math | NO* | NO* | NO | YES* |
| New York Reading | NO* | NO* | YES | YES |
| New Hampshire Math | YES* | NO* | YES | YES* |
| New Hampshire Reading | YES | NO* | YES | YES |

Table 7: No indicates that this test does not support the hypothesis that Act 60 contributed to improving student outcomes in Vermont, while Yes indicates that Act 60 did contribute to improving student outcomes in Vermont, particularly in low income districts. A star indicates that there. A star indicates whether a result is statistically significant in either the Vermont indicator or Vermont and Free and Reduced Lunch interaction term.

## V. Discussion

While the Vermont school system generally seems to benefit the majority of its student body, the question remains whether this impact is a matter of funding, particularly through the distributive funding formula which Vermont employs, or because of external factors such as differences in curriculum or advantageous home environments for the young Vermonters. We find that attending school in lower-income districts in Vermont has mixed results on student outcomes depending on the dependent variable and the manner in which outcomes are examined. Our most compelling results indicate smaller gaps in learning rates between students in advantaged

and disadvantaged schools in Vermont than in New Hampshire and New York (Figure 4). With this

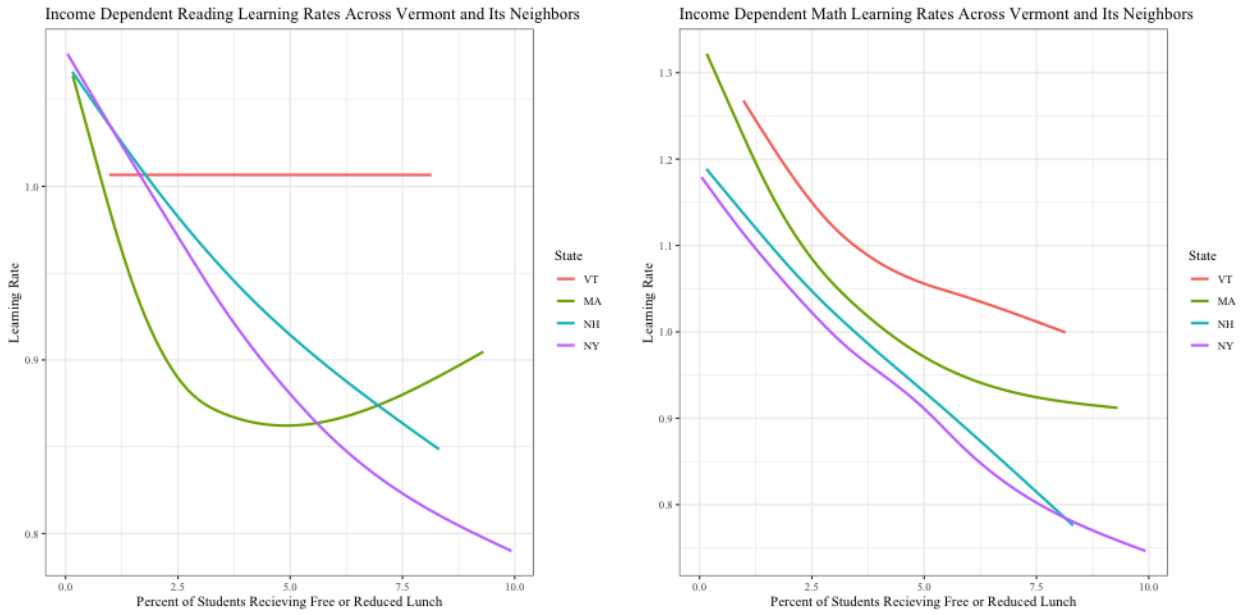


Figure 4 Plots the relationship between the percentage of students receiving free or reduced lunch in a school district with the learning rate of students in that district. The percent of students receiving free or reduced lunch is on a scale of 0 to 10. Learning rate is typically 1, representing a student learning one grade per year.

method of observation allowing us to control for curriculum and educational philosophy differences within a states' education system, the higher levels of funding that lower income districts theoretically receive as a result of Act 60 could therefore be critical in allowing high and low income students to succeed at similar rates. While the Vermont-New Hampshire border experiment offers tentative results suggesting that Act 60 aids learning in low-income Vermont communities, the Vermont-New York border experiment does not. Simple models relating district prosperity to learning rates affirms that there is very little impact of equalization on learning rates in these districts (Appendix B). Finally, while using test scores strongly indicates that only students from higher income districts excel in Vermont, this effect could still simply be due to the fact that students in these districts have entered schools with a predetermined

advantage. Ultimately, the differential results of these tests depending on location indicate that the effect of Act 60 might be felt most through Act 68 and the extent to which different districts within Vermont are willing to tax at higher levels in order to secure more tax-rate dependent revenue, or it could just be that educational funding does not have a big impact on how children perform and learn in school.

It is important to note the lack of causal inference allowed by this paper, and that differences in state curricula, home environments, and school expenditure likely act as confounding variables which were unfortunately not able to be accounted for due to data deficiencies or simple difficulty to quantify. Furthermore, this paper assumes equalized funding in Vermont, which is still certainly not the case, and similarity in home environments across state borders. It is an unfortunate feature of the pre No Child Left Behind era that most educational data keeping was confined to large school districts in cities, preventing a true difference in difference approach comparing learning rates and test scores across the same district from before and after 1997. This missing data also hurts our ability to fully understand the border experiments, as it is unknown whether the gaps observed in this paper have changed since the 1990s. Finally, the data available for this paper only allow for the learning rate variable to measure the change in mean district test score from one year to the next instead of from fall to spring, which means that student's summer experiences are partially captured in the analysis. This bias will likely positively influence the learning rate for students in wealthier districts and negatively influence the learning rates in poorer districts, leading to slightly larger gaps in the within-state experiment in particular.

Nevertheless, the results of this paper are crucial for aiding policymakers' understanding of the components of a child's education. Even in scenarios where Vermont children

outperformed New Hampshire or New York children, in almost every scenario presented in this paper, students in high income districts still outperformed students in low income districts (recall Figure 1 and the strong negative correlation between test scores and district income). While equalized funding might help in narrowing gaps in learning rates, fully closing the achievement gap will likely take more than funding schools. The presence of test score gaps that form before students enter school and sustain throughout each grade (Downey 2020, Figure 5) suggest that legislation should target preschool and home environments. Given that prominent social class and racial gaps in vocabulary have already opened by the time children are 3 years old (Farkas and Beron 2003), universal Pre-K solutions to narrow the achievement gap might still be too late to affect learning. Instead, direct cash transfers to disadvantaged families with young children, essentially paying people to alleviate poverty, could be a more successful and cost efficient way to close achievement gaps (Whitehurst 2016). Increasing contraceptive ability to decrease the percentage of children living in single-parent households (Heckman and Masterov 2007) or instituting parenting check-in home visits to act as an early warning system if parents need more support (Reeves 2017) are two further programs that could work to equalize early childhood conditions and close achievement gaps.

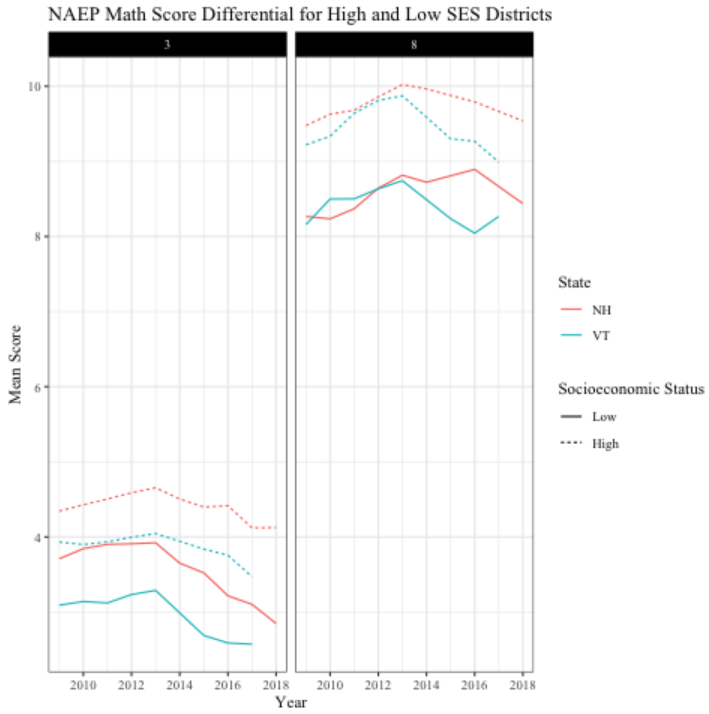


Figure 5 Using Math scores between Vermont and New York as an example, this graph demonstrates how students in disadvantaged districts enter 3rd grade far behind their peers at property-rich schools. While Vermont students eventually make up the initial gaps between their scores and New Hampshire students' scores, the achievement gaps between high and low income students remain largely unchanged.

This study joins literature from around the country in measuring the impact of changes in school funding formulas. While most other studies have used test scores to measure academic achievement, this study is unique in its selection of learning rates as the dependent variable in order to assess the value added of a school and avoid bias from student family backgrounds. This study finds that increases in funding as a result of Act 60 had mixed effects on lower income students' education. While students in low income districts are better protected in Vermont against worse learning rates as a whole for the state, small observed effects of funding boosting low income district learning rates in the border experiments suggest that high Vermont learning rates may be due to factors outside school funding.

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Appendix A- Summary Statistics

Table 7: Summary Statistics- New York Border Districts

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 434 | 5.426 | 1.707 | 3 | 8 |
| Score | 434 | 5.042 | 2.015 | 0.669 | 10.666 |
| Students | 434 | 75.726 | 38.094 | 20 | 178 |
| Pct Rural | 434 | 9.176 | 2.134 | 1.963 | 10.000 |
| PctBlack | 434 | 0.149 | 0.305 | 0.000 | 3.333 |
| PctWhite | 434 | 9.603 | 0.867 | 0.000 | 10.000 |
| PctEnlish Language Learner | 434 | 0.012 | 0.017 | 0.000 | 0.071 |
| PctFreeReducedLunch | 434 | 4.284 | 1.249 | 0.984 | 9.888 |
| SES Index | 434 | 0.175 | 0.313 | −0.736 | 0.726 |
| Log(Median Income) | 434 | 10.840 | 0.116 | 10.600 | 11.080 |
| Poverty Rate | 434 | 0.121 | 0.028 | 0.048 | 0.207 |
| Unemployment Rate | 434 | 0.784 | 0.148 | 0.485 | 1.173 |
| PctSNAP | 434 | 0.106 | 0.034 | 0.032 | 0.212 |
| PctSingleMother | 434 | 1.492 | 0.297 | 0.551 | 1.994 |
| LearningRate | 285 | 0.980 | 0.948 | −3.519 | 4.704 |

Table 8: Summary Statistics- Vermont Western Border Districts

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 710 | 5.483 | 1.712 | 3 | 8 |
| Score | 710 | 6.116 | 2.211 | 1.009 | 12.273 |
| Students | 710 | 137.361 | 74.511 | 20 | 356 |
| Rural | 710 | 4.997 | 3.979 | 0.000 | 10.000 |
| PctBlack | 710 | 0.327 | 0.546 | 0.000 | 2.787 |
| PctWhite | 710 | 9.209 | 0.999 | 5.220 | 10.000 |
| PctEnglishLanguageLearner | 710 | 0.087 | 0.361 | 0.000 | 2.783 |
| PctFreeReducedLunch | 710 | 3.960 | 1.534 | 0.924 | 8.200 |
| SES Index | 710 | 0.386 | 0.563 | −0.739 | 1.636 |
| Log(Median Income) | 710 | 10.885 | 0.164 | 10.570 | 11.310 |
| Poverty Rate | 710 | 0.124 | 0.050 | 0.047 | 0.254 |
| Unemployment Rate | 710 | 0.658 | 0.161 | 0.282 | 1.037 |
| PctSNAP | 710 | 0.120 | 0.044 | 0.043 | 0.234 |
| PctSingleMother | 710 | 1.566 | 0.344 | 0.816 | 2.378 |
| Learning Rate | 441 | 1.112 | 0.518 | −1.091 | 2.700 |

Table 9: Summary Statistics- Vermont Eastern Border Districts

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 427 | 5.403 | 1.686 | 3 | 8 |
| Score | 427 | 5.861 | 2.063 | 1.052 | 11.679 |
| Students | 427 | 97.220 | 40.036 | 20 | 218 |
| PctRural | 427 | 5.463 | 3.554 | 0.000 | 10.000 |
| PctBlack | 427 | 0.110 | 0.125 | 0.000 | 0.656 |
| PctWhite | 427 | 9.618 | 0.277 | 8.689 | 10.000 |
| PctEnglishLanguageLearner | 423 | 0.012 | 0.028 | 0.000 | 0.132 |
| PctFreeReducedLunch | 427 | 4.363 | 1.315 | 0.832 | 6.730 |
| SES Index | 415 | 0.269 | 0.602 | −0.695 | 2.114 |
| Log(Median Income) | 415 | 10.829 | 0.209 | 10.494 | 11.526 |
| Poverty Rate | 415 | 0.123 | 0.029 | 0.044 | 0.180 |
| Unemployment Rate | 415 | 0.676 | 0.178 | 0.084 | 1.035 |
| PctSNAP | 415 | 0.132 | 0.051 | 0.014 | 0.225 |
| PctSingleMother | 415 | 1.576 | 0.281 | 0.755 | 2.196 |
| Learning Rate | 264 | 1.085 | 0.586 | −0.465 | 3.235 |

Table 10: Summary Statistics- New Hampshire Border Districts

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 708 | 5.476 | 1.677 | 3 | 8 |
| Score | 708 | 6.296 | 2.095 | 1.379 | 13.433 |
| Students | 708 | 55.828 | 36.366 | 20 | 169 |
| PctRural | 708 | 8.029 | 3.645 | 0.000 | 10.000 |
| PctBlack | 708 | 0.095 | 0.134 | 0.000 | 1.071 |
| PctWhite | 708 | 9.512 | 0.425 | 7.979 | 10.000 |
| PercentEnglishLanguageLearner | 708 | 0.106 | 0.134 | 0.000 | 0.527 |
| PctFreeReducedLunch | 708 | 3.880 | 1.690 | 0.619 | 8.318 |
| SESIndex | 708 | 0.419 | 0.760 | −0.949 | 2.145 |
| Log(MedianIncome) | 708 | 10.866 | 0.278 | 10.450 | 11.643 |
| PovertyRate | 708 | 0.109 | 0.044 | 0.007 | 0.193 |
| UnemploymentRate | 708 | 0.636 | 0.227 | 0.118 | 1.271 |
| PctSNAP | 708 | 0.093 | 0.049 | 0.004 | 0.189 |
| PctSingleMother | 708 | 1.525 | 0.427 | 0.422 | 2.585 |
| LearningRate | 504 | 1.068 | 0.720 | −1.705 | 3.620 |

Table 11: Summary Statistics- Vermont

| Statistic | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Grade | 2,470 | 5.473 | 1.703 | 3 | 8 |
| Score | 2,470 | 6.085 | 2.101 | 1.009 | 12.273 |
| Score | 2,470 | 118.592 | 60.336 | 20 | 356 |
| PctRural | 2,470 | 6.507 | 3.849 | 0.000 | 10.000 |
| PctBlack | 2,470 | 0.174 | 0.323 | 0.000 | 2.787 |
| PctWhite | 2,470 | 9.517 | 0.613 | 5.220 | 10.000 |
| PctEnglishLanguageLearner | 2,466 | 0.036 | 0.199 | 0.000 | 2.783 |
| PctFreeReducedLunch | 2,470 | 4.017 | 1.370 | 0.832 | 8.200 |
| SESIndex | 2,221 | 0.421 | 0.514 | −0.739 | 2.114 |
| Log(MedianIncome) | 2,221 | 10.894 | 0.172 | 10.494 | 11.526 |
| Poverty Rate | 2,221 | 0.118 | 0.037 | 0.022 | 0.254 |
| Unemployment Rate | 2,221 | 0.659 | 0.157 | 0.084 | 1.037 |
| PctSNAP | 2,221 | 0.115 | 0.043 | 0.014 | 0.234 |
| PctSingleMother | 2,221 | 1.495 | 0.307 | 0.637 | 2.378 |
| LearningRate | 1,536 | 1.091 | 0.506 | −1.156 | 3.235 |

## Appendix B- Ancillary Graphs


Figure 6 Vermont students and New Hampshire students in border districts ultimately learn reading/language arts at fairly similar rates, although lower income Vermonters might be slightly advantaged. Percent Free and Reduced Lunch is on a 0 to 10 linear scale, where 10 represents 100% of students receiving free and reduced lunch.


Figure 7 Shows that Vermont and New Hampshire students learn math at generally similar rates, although Vermon students might possess slight advantages at higher and lower incomes. Percent Free and Reduced Lunch is on a 0 to 10 linear scale, where 10 represents 100% of students receiving free and reduced lunch.


Figure 8 Shows that students in Vermont and New York border school districts learn language arts at very similar rates, with Vermont slightly outperforming New York at higher income levels and New York slightly outperforming Vermont at low income levels. Percent Free and Reduced Lunch is on a 0 to 10 linear scale, where 10 represents 100% of students receiving free and reduced lunch.


Figure 9 shows that students on the Vermont and New York borders learn math at very similar rates. Percent Free and Reduced Lunch is on a 0 to 10 linear scale, where 10 represents 100% of students receiving free and reduced lunch.

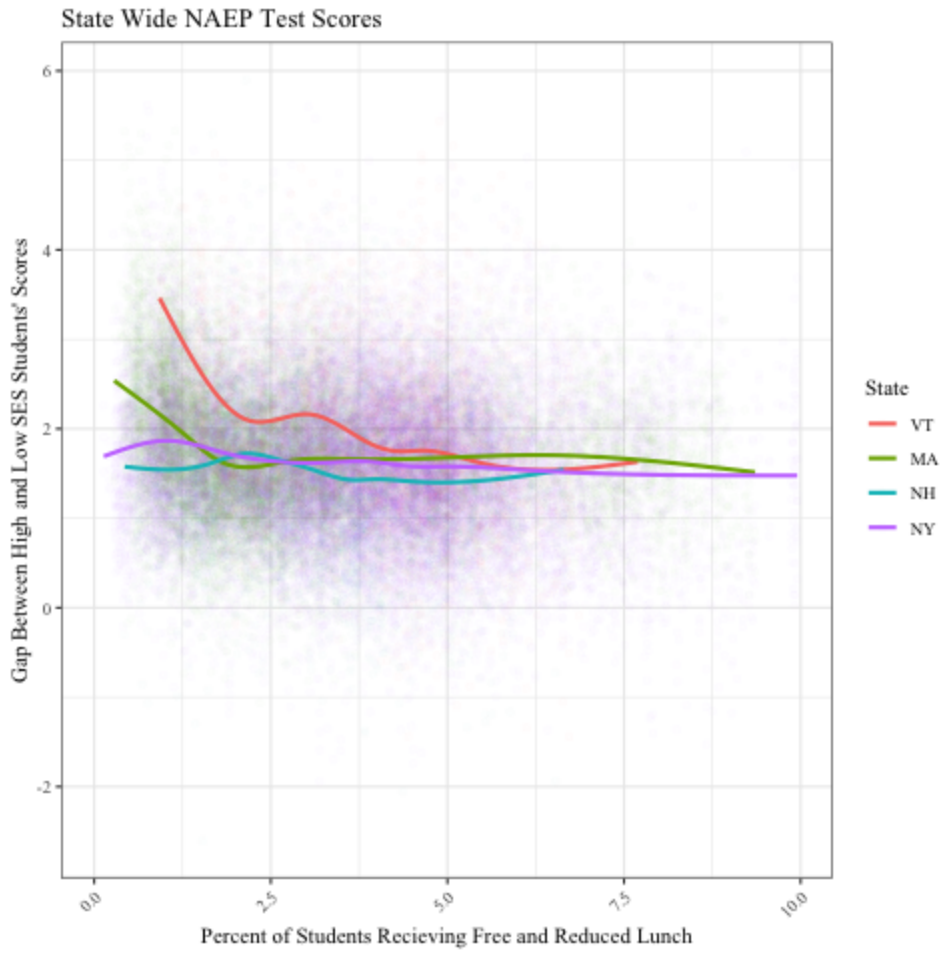


Figure 10 While the gap between high and low SES students' test scores might decrease slightly as district income drops, the average within district achievement gap between high and low SES districts is around 1.5. The Percent of Students Receiving Free and Reduced Lunch is linearly scaled from 0 to 10, with 2.5, for example, indicating that 25% of students receive free or reduced lunch in the district.