Power of a Promise: How has the New Haven Promise Affected Housing Values and Student Outcomes?

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Abstract:

In late 2010, Yale University and the Community Foundation for Greater New Haven announced the New Haven Promise, a full-tuition scholarship commitment to every city resident enrolled in public schools who attained a 3.0 GPA and 90% attendance. Modeled after the Kalamazoo Promise in Michigan, policymakers hoped that the Promise could help revitalize a struggling urban school system and catalyze a college-going atmosphere. I approach the question of whether New Haven Promise is achieving its short-term goals of improving student outcomes and community economic development using two main datasets: home sales transactions and individual-level data from the cohort of New Haven Public Schools students set to graduate in 2014. Using a boundary discontinuity approach, I infer the value that parents ascribe to the Promise by comparing capitalization of school quality into house prices in the period before and after New Haven Promise, finding that home buyers are willing to pay 8.67% more per one standard deviation increase in test scores after 2011. However, there is no statistically significant difference between this capitalization value in New Haven after 2011 and surrounding towns. As for student outcomes, the Promise has motivated New Haven residents of high ability to earn higher GPAs and increased attendance rates for residents of middling ability. There are no positive effects on resident students of lower ability.

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1 INTRODUCTION

For students of New Haven Public Schools (NHPS), a college degree is more attainable than ever before. Students who have attended a New Haven public school continuously since at least 9th grade, maintained a high school grade point average of 3.0 or above, attended 90% of school days, and have completed 40 hours of community service are now eligible for up to full tuition subsidies at Connecticut state colleges and universities.[1]

Based on a belief that gains in human capital acquisition can catalyze urban development and revitalization, place-based scholarship programs have sprung up around the nation, now in place in some 30 cities (see Appendix Figure 1 for comparison of major programs). Aimed at encouraging highly educated local residents to stay in their home communities, Promise scholarships are frequently contingent on attending a public tertiary education institution in their home state. With respect to funding, donors to Promise programs vary significantly in their composition and possible intentions. In New Haven, Yale University is the program's sole donor. In El Dorado, Arkansas, the Murphy Oil Corporation is the program's sole donor. Of note is that the corporations, universities, and private donors who have funded Promise programs all seem to be interested in investing in local secondary and tertiary education as a way to revitalize their home communities. New Haven Promise's webpage states the goal of "growing home-ownership in the City" as a primary goal of the Promise.[2]

Using a boundary discontinuity design to mitigate the effect that unobserved neighborhood characteristics may have on school quality and housing prices, I estimate a price function for house sales in New Haven, as well as in the surrounding towns. The results of this study show that New

[1] If federal aid and/or other scholarships can cover the full tuition price, the New Haven Promise can also be applied to the total cost of education including room and board.

[2] "FAQs," New Haven Promise. 2013. Web. 28 Mar. 2015.

Haven Promise has not increased the value of New Haven homes in relation to neighboring towns, but that the Promise may have a sorting effect within New Haven that has made homes in higher-achieving school attendance zones worth even more since 2011. In particular, a one-standard deviation increase in test scores adds an additional 8.67% value to house prices within New Haven after 2011, equivalent to $20,361 at the median house price in 2006.

This study also utilizes data from NHPS administrative records to ascertain effects on student effort and outcomes, as measured by attendance, suspensions, GPA, and credits earned at each high school grade level for the cohort of students expected to graduate in 2014. I exploit the variation in residency among students in NHPS, comparing resident and non-resident 11^{th} grade outcomes against 9^{th} grade outcomes (Promise was announced midway into 9^{th} grade and implemented that following summer). For GPA, there is a significant impact of New Haven residency for students who are already high performers (defined as having a 9^{th} grade GPA above 3.0). In addition, students who are in the middling group of attendance in ninth grade are also positively affected by the program.

Finally, district-level difference-in-difference estimates exploiting variation over time and between New Haven Public Schools and Bridgeport Public Schools show that the enrollment decline in New Haven high schools was reversed after 2011. The differential effect observed in the NHPS after 2011 was to add 609 more enrolled high school students and 717 more middle school students, though there were no statistically significant effects on elementary school enrollment, SAT participation, or SAT scores.

2 BACKGROUND

2.1 PROMISE PROGRAMS

In Kalamazoo, where the first Promise program was announced in 2005, the short-term effects of the program on both community and student outcomes have been positive. Students are electing to attend more rigorous academic institutions, such as the University of Michigan over Western Michigan University, students are taking the SAT at higher rates, and levels of violence and student discipline rates are down (Bartik and Lachowska 2012; Miller 2010). Preliminary research on the El Dorado Promise also shows positive effects on student outcomes, particularly on African-American and low-income students' standardized math test scores (Ash and Ritter 2014). Like New Haven Promise, the flagship Kalamazoo Promise makes grants up to 100% of college tuition for public school students enrolled since kindergarten. Though key aspects of the Kalamazoo Promise mirror the New Haven Promise, there are also differences – namely, there is no minimum GPA requirement for recipients of the Kalamazoo or El Dorado Promise and no community service requirement (see Appendix Figure 1). Overall, the design of the New Haven Promise is less universal and prioritizes prior academic achievement. As such, New Haven Promise is important to study because impacts on student effort and behavior motivated by the New Haven program may be different than those encouraged by the more universal Promise programs.

2.2 NEW HAVEN PUBLIC SCHOOLS

New Haven Public Schools (NHPS) is one of Connecticut's largest urban school districts, serving a student population that is more diverse and of lower socioeconomic status than state averages and surrounding districts (see table 1). Lauded by *New York Times* columnist Nicholas

Kristof as “ground zero for school reform in America”, the NHPS’s experiments as part of its School Change Initiative, announced in October 2009, have garnered national attention.[3] The School Change Initiative has undergone many iterative changes and includes measures for developing a performance-based teacher evaluation system and comprehensive educator retraining. But the New Haven Promise, announced in November 2010, is a keystone component of the broader School Change Initiative. Yale presidents Richard Levin and Peter Salovey and former mayor John DeStefano Jr. make frequent appearances at school assemblies and town events to tout the opportunity provided by Promise; banners lining the New Haven Green celebrate Promise scholars (see appendix figure 2). NHPS hoped the Promise could be “the ultimate game-changer for our students” and this paper finds it appropriate to attribute changes in real estate value and student behavior to the Promise as a specific component of the School Change Initiative because it is most easily measurable in real terms to New Haven residents.[4] Whereas improved teacher quality is a slow and often unobservable outcome, especially to homebuyers and parents, the New Haven Promise is quantifiable and guaranteed. Moreover, focus group surveys have also shown that students and parents do not perceive specific changes in instructional quality or learning environments as a result of the School Change Initiative, but almost all parents and students were aware of the availability of Promise scholarship money (Gonzalez *et al* 2014). Changes in capitalization of quality into real estate or student outcomes in the short-term are more likely related to the Promise than to teacher quality improvement, though it is ultimately impossible to disentangle their specific effects.

[3] Kristof, Nicholas, “The New Haven Experiment,” *New York Times*, Feb. 15, 2012.

[4] “New Haven School Change: Shaping the Future”, NHPS Office of Communications, November 2013.

2.2.1 Table 1: New Haven and Surrounding Town School District Characteristics

	New Haven	West Haven	East Haven	Hamden	North Haven	Woodbridge	Bridgeport	Connecticut
Total Enrollment	19,048	6,194	3,386	5,897	3,576	723	20,087	556,184
White	15.0%	40.4%	74.0%	43.6%	80.9%	74.6%	8.4%	65.0%
African American	44.5%	21.8%	2.9%	31.0%	3.8%	3.1%	38.8%	13.8%
Hispanic	37.9%	30.5%	17.2%	15.5%	5.9%	4.3%	48.6%	16.5%
Free Lunch Eligible	77.8%	57.6%	42.3%	37.5%	8.8%	4.3%	98.8%	34.4%
English Language Learners	12.8%	10.2%	6.1%	4.4%	1.5%	2.8%	13.0%	5.5%
Proficient at 4th Grade Math State Test	67.4%	79.0%	70.3%	81.9%	90.2%	97.1%	55.3%	85.2%
Per Pupil Expenditures	$ 16,498	$12,904	$13,378	$15,412	$12,173	$16,196	$13,479	$ 14,031

Source: Connecticut Department of Education

Note: In these Connecticut towns, town boundaries and school district boundaries are the same.

Another recent improvement effort within NHPS is the district's school construction program. The district's 15-year school construction project was started in 1995 and focused primarily on remodeling existing schools as well as building some new schools. Though the $1.375 billion program affected 34 schools in New Haven, it had little effect on school attendance boundaries by 2006, the start of this paper's analysis, as the program was nearing its completion. Studies of home values in relation to school attendance zones must consider that school attendance boundaries may not always be static, but in New Haven they have been reasonably constant over the last nine years (Neilson and Zimmerman 2011). The data used in this paper for school attendance boundaries includes all schools that were open by the 2007-08 school year.

Finally, the existence of a strong school choice program in New Haven (20 magnet schools with a student population of 7,325) poses problems for location-based analysis. However, the program is still in its nascent stages for the elementary school population. Attendance of schools outside of one's regular attendance zone is more common for middle and high school students. Moreover, neighborhood preference based on regular attendance zones is the top criteria for admission to any magnet elementary schools that do employ a lottery system. For instance, 100% of available

kindergarten seats at Edgewood Magnet School and 85% at the lower-performing King-Robinson Magnet school were allotted to applicants with neighborhood preference in 2014.[5]

School construction, magnet programs, and teacher evaluation reform aside, the New Haven Promise still stands out as the centerpiece of public school reform in the post-2011 period. Parents and students perceive Promise as the centerpiece of the School Change Initiative and is clearly quantifiable to homebuyers. For these reasons, changes to real estate value or student effort and outcomes after 2011 can be reasonably associated with the effect of the Promise program.

2.3 CONTRIBUTION TO THE LITERATURE

Several studies have examined capitalization of school quality into housing prices, but room exists for further evaluation, especially with regard to changes in capitalization value in response to school district interventions. Promise programs are place-based in nature and aim to "revitalize communities" as much as they hope to improve individual student outcomes. The boundary discontinuity design enabled by Geographic Information System (GIS) software is particularly appropriate to evaluating housing prices in response to a place-based scholarship program, as this gives New Haven residency a clear advantage not afforded to residents of surrounding towns who attend NHPS schools. The results of this study are relevant to donors considering funding Promise programs as ways of increasing the attractiveness of home ownership or residency within their school district, as well as for identifying the value that home buyers ascribe to particular attendance zones within a school district.

[5] "Edgewood Magnet Lottery Results Data." New Haven Public Schools of Choice. 2014. Web. 31 Mar. 2015.

This paper also contributes to the body of literature studying incentives in urban school districts. Given the strict eligibility cutoffs, is the New Haven Promise an effective way to motivate students to achieve those goals? Are students reaching for higher GPAs or attending more school in the hopes of receiving the scholarship, or is the Promise merely an *ex-post* reward for students who would have achieved the cutoffs anyway?

3 LITERATURE REVIEW

The New Haven Promise is unique as a scholarship program because it is place-based. Promise programs across the nation have proven to be effective fighters of enrollment declines in public school districts, helping mitigate declines in both Pittsburgh and Kalamazoo (Gonzalez, 2011; Miller, 2010). Kalamazoo Promise researcher Timothy Bartik points out that many real estate signposts within the Kalamazoo public school district advertise "Promise Eligible House" status.[6] Promise-induced enrollment in the Kalamazoo Public School District increased by roughly 1,000 students in the year immediately following its announcement (Bartik and Lachowska 2012). The enrollment increases were also consistent with the eligibility structure, with greater effects in elementary school than in high school. Long-term effects on communities are yet unproven, but the hope is that Promise programs will also be more likely to bring college graduates back to the district. There has yet to be an academic study examining Promise programs' effect on within-district real estate prices; the broader literature on the capitalization of school quality in real estate values will be reviewed for this portion of analysis.

[6] Timothy Bartik quoted in Caplan-Bricker, Nora. "Some Cities are Promising Free College to High School Students. Does it Work?" *The New Republic*, Feb. 21, 2014.

Literature related to student effort in school is also relevant for this study. Whether or not Promise acts as a motivator for New Haven students to increase their achievement in high school is a highly relevant question for policymakers who hope that the scholarship can induce students to become more college-ready. Promise is structured as a delayed reward for increased effort in school and can be compared to other incentives with similar structure.

3.1 Capitalization of School Quality in Real Estate Values

There is reason to believe that Promise programs may also effects on the local real estate market, as receipt of the scholarship is dependent on residency within New Haven. A review of the literature has emphasized the importance of using neighborhood boundary fixed effects at every side of each school attendance zone, controlling for time and seasonality, and controlling for school quality at the smallest unit possible. Moreover, the body of literature on educational inputs and outputs also suggests that outputs such as state test scores are the most appropriate measure of perceived school quality.

Tiebout (1956) was the first to model housing choices based on the availability of local public goods (such as public schooling) and taxes, based on the premise that residential mobility creates competition among housing communities and that home buyers have perfect information about the quality and cost of public services. With regard to public schooling, Tiebout's sorting model shows that the most efficient outcome is for individuals to self-segregate by characteristics associated with demand, creating more or less homogenous communities with residents who have similar levels of income, socioeconomic status, and number of children. The New Haven Promise comprises an exogenous shock of sorts to the Tiebout model, as it provides a public good to residents of New Haven that is not funded by tax expenditures, but by an outside institution. Still, the same mechanism should

apply. Home buyers who place similar value on schooling-related goods will congregate in locations eligible for the Promise, and in the process may bid up real estate values.

3.2 THE BOUNDARY DISCONTINUITY APPROACH

Black (1999) pioneered the usage of the boundary discontinuity approach, looking within a set of suburban Massachusetts school districts.[7] She restricts the sample to houses located near attendance district boundaries and controls for neighborhood characteristics with a set of pairwise boundary dummy variables. Her work finds that parents are willing to pay 2.1% more ($3,948 at the median home price in Massachusetts) for each 5% increase in test scores at the elementary school level. Black's major contribution is methodological, using school attendance boundary fixed effects to control for unobservable differences in neighborhood quality. These boundary dummies account for unobserved characteristics shared by the houses on either side of the attendance district boundary, thus creating a buffer zone of houses which can be presumed to share similar neighborhood characteristics.

Though there is no consensus on the best way to address neighborhood effects, boundary fixed effects have become an important tool for economists who wish to mitigate omitted variable bias in housing price analysis (Brasington and Haurin 2006). The core presumption here is that houses within short distances of each other are generally similar in unobserved neighborhood characteristics. When boundary fixed effects are included, the estimated effect of additional school quality as measured by test scores has a smaller effect than represented by a simple hedonic price regression. Previous studies have found that with boundary fixed effects, the coefficient on school test scores is about half of its value in the simple hedonic regression (Black 1999). More recent work has confirmed these estimates, concluding that "the estimated effect of a one-standard deviation increase in a school's average test

[7] Also referred to as boundary fixed effects

score on the cost of housing declines by nearly 75 percent, from $124 to $33 per month, when boundary fixed effects are included in the analysis," (Bayer 2007). However, other studies have also found that the effects of school quality on house price are underestimated for high-quality schools. Dougherty *et* al (2009) find that the effect of test score nearly doubles in the sample restricted by geography when compared to the sample of all houses. Chiodo, Hernandez-Murillo, and Owyang (2010) estimate nonlinear hedonic pricing equations and find that the price premium for houses in above-average school attendance zones is about 10-12% and almost trivial for houses in below-average school attendance zones.

Studies vary in their methodology, generally differing in their approach to mitigating spatial fixed effects or their definitions of "neighborhood". I follow more recent studies such as (Bogart and Cromwell, 2000; Figlio and Lucas, 2004; Chiodo *et al*, 2010) in including time and seasonality variation along with Black's boundary fixed effects. Some studies, such as Clapp, Nanda and Ross (2008) have used inconsistent spatial categories for neighborhood and school characteristics; in particular, using district-level school quality measures and Census-tract fixed effects for controlling neighborhood characteristics, with no measure accounting for boundary fixed effects. Clapp, Nanda, and Ross (2008) are the only researchers to look at a dataset that includes the houses of interest in this study, covering all houses in the state of Connecticut. They find that a one standard deviation in test scores leads to a one and a third percent increase in property values. I aim to achieve greater precision than the results found by Clapp, Nanda, and Ross by using school-specific, rather than district-specific, school quality measures and adding boundary fixed effects as well as Census-tract fixed effects for comparison. Gibbons *et al* (2009) raise another valid concern that the boundary discontinuity in house prices could arise from omitted geographical features (such as major roads or railway tracks) or other location-specific amenities. However, using small buffer zones around the attendance lines (.30 at their largest) helps alleviate this concern, as housing does not often exist within such short distances of major landscape-disrupting features such as highways, etc.

Bayer *et al* (2006) attempt to separate observable and unobservable neighborhood characteristics, embedding these variables into a sorting model to measure the relationship between test scores and house prices as home buyers sort themselves on a preference for similar socio-demographic characteristics. They point out that Black's approach leaves open the possibility that the presence of school boundaries leads to sorting, so that neighborhoods on either side of a school attendance zone contain people with fundamentally difference preferences for public goods. However, this strategy also has significant shortcomings because these socio-demographic variables are also endogenous to the value of the house (Nguyen-Hoang and Yinger 2011; Dougherty *et al* 2009). Namely, income and education levels are clearly related to demand for house and school quality, and in this model where households simultaneously select housing price and school quality, there is an endogeneity problem because both of these variables depend on the demand variables of income and education level (Nguyen-Hoang and Yinger 2011). This study follows Dougherty *et al* (2009) and Chiodo *et al* (2010) in employing boundary fixed effects as the control for neighborhood characteristics, providing census variables as a comparison only – because of endogeneity issues.

Data sets that include double sales that occur before and after rezoning are particularly useful, because they can control for all time-invariant house and neighborhood characteristics, but the sample of houses within New Haven that sold multiple times within five years of the New Haven Promise is less than 100 and redistricting is minimal (Ries and Somerville 2010; Bogart and Cromwell 2000). Houses that sell multiple times in one time period may also be different in unobserved characteristics than houses that remain held by a single owner.

Housing prices have also tended to react to changes in information about school quality (Bogart & Cromwell, 2000; Figlio & Lucas, 2004). Figlio and Lucas exploit a government-instituted school-evaluation program to find that discrete grade distinctions between schools contribute to housing price differences, even controlling for other publicly observed school attributes such as test scores. They find that houses in school attendance zones rated "A" command a 19.5 percent price

premium over houses in zones rated "B", holding constant other measures of school, neighborhood, and property qualities (Figlio and Lucas 2004). Bogart and Cromwell (2000) find that house prices similarly respond to a disruption of neighborhood school assignment following rezoning in Shaker Heights, Ohio. With $4 million in annual pledged spending from Yale University, and 54,967 housing units in the city (according to the 2010 Census Bureau American Community Survey), the annual value of the program to each housing unit is about $73.[8] Assuming a discount rate of 5% and that the program continues in perpetuity, the present value of the Promise is about $1,540 per housing unit – a sum that might be priced into current real estate values if home buyers value the expected future tuition subsidy provided by Promise. Though the Promise program does not offer homebuyers new evaluative information about school quality, it could act as a mechanism urging homebuyers to pay more attention to school quality or seek out publicly available information on school quality, such as state test scores.

3.3 USE OF TEST SCORES AS A MEASURE OF SCHOOL QUALITY

Using state test average scores (in this case, the Connecticut Mastery Test, or CMT) as a measure of school quality is an oft-debated methodological approach, but this study ultimately finds them appropriate. Previous research that finds school inputs such as per-pupil spending have no apparent impact on student achievement (Hanushek 1986, 1997) or house values (Downes and Zabel 2002). Value-added measures of achievement, such as the improvement in cohort performance over time, have also been used in capitalization studies. Though value-added measures of output would seem to be a more ideal measure of quality, this information is importantly not often available to home buyers or would require a high level of sophistication for home buyers to discover. Moreover,

[8] Bailey, Melissa, "Public School Kids Get a College 'Promise,'" *The New Haven Independent*, Nov. 9, 2010.

constructing such data sets requires longitudinal tracking of students over time. Brasington (1999), Downes and Zabel (2002), and Brasington and Haurin (2006) find minimal support for using value-added quality measures as home buyers tend to use more traditional measures of school quality in their own valuations.

3.4 INCENTIVES ON EDUCATIONAL INPUTS AND OUTPUTS

The design of the New Haven Promise – with its minimum GPA requirement – also makes the literature on incentives related to academic output relevant. Standard agency theory suggests that contracts which are conditional on output would be optimal to incentivize students to exert extra academic effort without having a way to observe effort perfectly (Bartik and Lachowska 2012). But if students themselves do not know the relationship between educational inputs and outputs, this incentive system is likely to fail. Indeed, studies of incentives tied to academic outputs have found little effect on low-ability groups and significant effects on high-ability groups. A study of a cash reward experiment for students who graduated Israeli high schools found the strongest effects on high-ability women (Angrist and Lavy, 2009). Similarly, Leuven, Oosterbeek, and Van der Klaauw (2010) find that a random cash reward for college freshmen who completed their first-year requirements had effects only on high-ability groups. Fryer's (2011) work with primary and secondary-age students in urban schools found that incentives tied to outputs were less effective than incentives tied to inputs.

Though the New Haven Promise is guaranteed to students who meet the eligibility requirements, it is not an immediate reward and students may not perceive it as a credible promise. Students must achieve the eligibility targets, file a formal application, and then apply for all federal and state aid for which they qualify – a lengthy process that takes place months after college applications are due and months to years after students have made decisions about their effort in school. After all other aid is accounted for, the New Haven Promise administrative staff make direct

payments to Promise recipients' financial aid accounts. The tuition subsidy is thus quite opaque and delayed. A study of behavioral responses to incentives shows that rewards provided with a delay (in this case, a financial reward for performance on a math test, given a month later) have no impact on student performance, whereas immediate rewards do (Levitt *et al* 2012). Thus, the effectiveness of the Promise as a motivator for student behavior may be constrained because its rewards are reaped long after students make decisions about their effort in school. Moreover, as much literature shows, students may be uncertain about how increases in their inputs (effort and/or time) map to increases in educational outputs.

4 DATA

4.1 RESIDENTIAL REAL ESTATE PROPERTY TRANSACTIONS

Connecticut Assessors' Offices for New Haven, West Haven, Woodbridge, Hamden, North Haven, and East Haven provided data on residential property sale transactions covering all sales between January 2006 and December 2014.[9] Though there was slight variability in record keeping, basic house characteristics were recorded consistently by all assessors' offices. All assessors' records included sale price, living area square footage, lot size square footage, number of bedrooms, number of full and half bathrooms, and year of original construction (see appendix table 4 for summary statistics).[10] All towns also recorded a rating of the property based on construction materials and maintenance, but these ratings were excluded from the inter-town comparison because of inconsistency between rating scales, some using letters and some using a numeric scale with varying intermediate degrees. Within New Haven, there were 4,554 home sales between 2006 and 2014.

[9] The Connecticut Office of Policy and Management also publishes a consolidated record of

[10] Year of original property construction was not available in North Haven.

Within the .30 mile buffer boundary around the New Haven town line including home sales from the surrounding five towns, there were 2,514 sales.

All addresses of home sales within New Haven and surrounding towns were geocoded in ArcMap using the ArcGIS U.S. Street Locator. Over 99% of the home addresses were successfully geocoded into the final dataset. Using a geographic information system to accomplish spatial geocoding was key to sorting houses into their school attendance zones and overlaying census information over individual house points.

4.2 SCHOOL ATTENDANCE ZONE BOUNDARIES

I follow Black (1999) in selecting elementary school attendance zones as the primary geographic unit of analysis for the real estate study. Elementary schools are appropriate for this study because the design of the Promise program rewards long-term residents of New Haven, with only students who attend New Haven Public Schools from kindergarten through 12th grade eligible for the complete tuition subsidy. Appendix figure 4 shows a map of school attendance zones along with their mean combined CMT math and reading scores averaged over 2009-2011. Elementary school attendance zones are also the form of attendance boundary that best allows for sufficient within-district variation. New Haven, for instance, only has two comprehensive public high schools: Wilbur Cross and James Hillhouse. Moreover, as mentioned in the background section, New Haven's robust school choice programs at the middle and high school levels pose problems for location-based analysis.

In New Haven, school attendance zones categorized by exact addresses were obtained and mapped into an ArcMap file containing all streets within the New Haven town polygon. Using a selection by attribute query in the US Streets address locator, each address range (usually a set of house numbers along a street, such as 1-200 Dixwell Avenue) was selected and a complete school

attendance zone was drawn along the parcels of land that belonged to the particular school attendance zone.[11]

For surrounding towns, address-level school attendance zone data was not readily available. Many school districts do not digitize records of their attendance zone streets, precluding a digital query of streets and addresses. In lieu of exact street addresses, I instead geocode bus route stops, which were used to create a rough proxy for school boundaries in surrounding districts by drawing a polygon around the outer edges of bus stops. Bus stops function well as an outer boundary of the school attendance zone because Connecticut law mandates that buses be provided to all students living outside of ¾ of a mile from the school. All schools in the sample except Helen Street School (where all students live within ¾ of a mile) in Hamden have bus service; the attendance zone for Helen Street was then attributed to the houses not assigned to other schools that were still within ¾ mile of the school. This paper contends that the rough bus route boundaries are a reasonable proxy for this analysis because the primary boundary of interest, New Haven School District versus surrounding town districts, is exact – it is the New Haven town boundary.

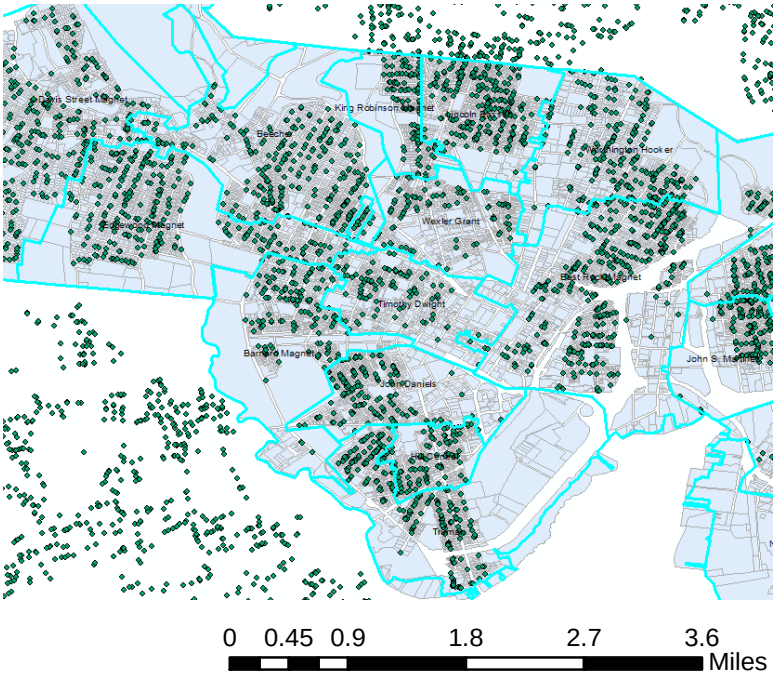
4.3 2010 Census American Community Survey Data

For regressions that used census block demographic information as a comparison against those using boundary fixed effects, the 2010 American Community Survey (ACS) was the source of data. Census blocks are the smallest unit for which data is recorded, and generally consist of between 600 and 3000 residents. I follow Black (1999) in using census blocks as proxies for neighborhoods. For each census block, the ACS includes variables such as percentage of residents of a certain age, race,

[11] Map of land parcels provided by the New Haven Office of Information Technology Geographic Information System.

education level, marital status, and income level. Thus, each home sale address point was overlaid into the census block data, with each house therefore spatially associated with its socio-demographic characteristics.

Figure 1: Example of Data Collection and Sorting

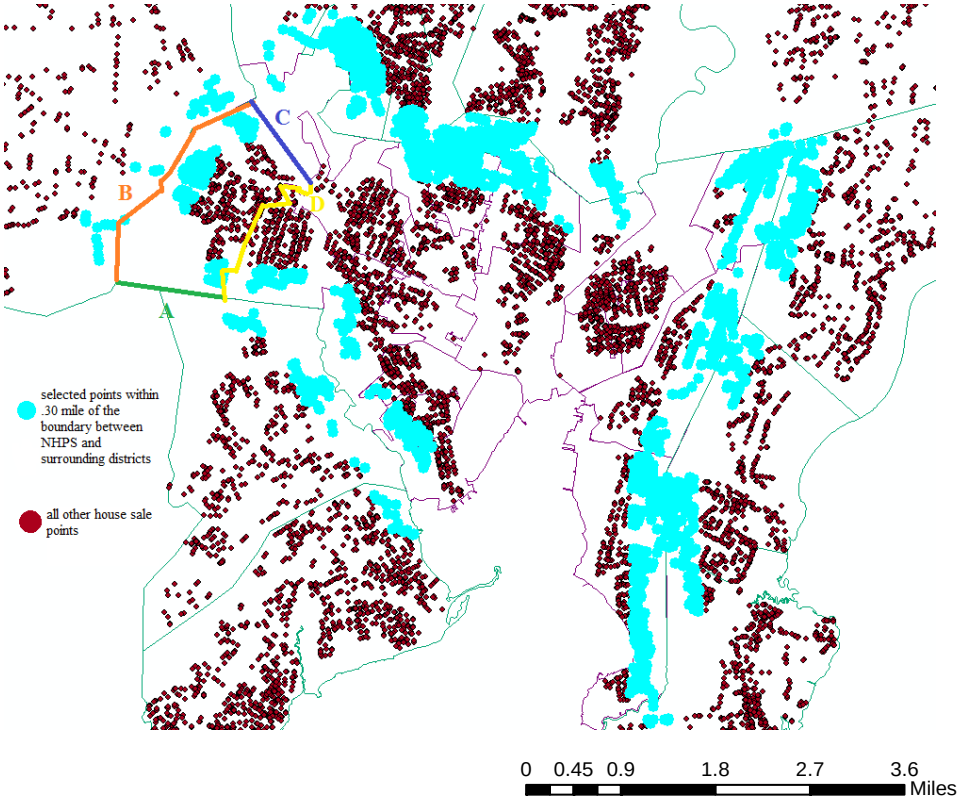


Green dots represent geocoded home sales transactions. Each geolocation point also stores the associated house characteristics provided by the Assessors' offices. Bright blue lines represent the spatial boundaries of elementary school attendance zones. The sky blue layer with grey lines stores census information from the 2010 American Community Survey. As the diagram shows, each school attendance zone is made up of many census blocks, which I use as crude approximations of neighborhood characteristics in the regression specifications that do not use boundary fixed effects. Based on its geographic location, each green property sale point can therefore be coded with its school attendance zone and associated census block demographic information.

Figure 2: Houses Along Boundaries Generally Part of Associated Neighborhoods

Example of School Attendance Zone Boundaries on Satellite Image Map. This image, showing the neighborhood split in attendance between New Haven's Ross Woodward School and East Haven's Grove Tuttle School. Even across the town boundary (which also functions as a school attendance zone boundary), houses on either side are clearly part of the same subdivision and are similar in their neighborhood characteristics.

Figure 3: **Example of Data Collection and Sorting with Boundary Fixed Effects**



The above is an example of sorting data points for inclusion in the analysis of house sales within .30 mile of the New Haven Public Schools district. Highlighted blue points are the residential sales of interest that fall within a .30 mile straight-line distance, on each side of the boundary. From there, for the boundary fixed effects analysis, the data are further sub-sectioned into those that lie in each side of each school attendance boundary. Each home sale was mapped to its nearest attendance zone boundary line shared by two elementary schools. There were 47 total boundaries within the NHPS and 14 outer boundaries between NHPS and neighboring towns. For instance, those house sales points which are closest to orange boundary B (the leftmost boundary of Davis Street School, labeled in orange) are then associated with boundary B for the boundary fixed effects analysis.

4.4 New Haven Public Schools Data on the Class of 2014

NHPS provided individual-level data on student behavior and outcomes, including year-end statistics from 9th grade to 11th grade for measures such as attendance, GPA, suspensions, and number of credits earned. The NHPS dataset also includes time invariant variables such as residency

(New Haven, Other, or Unknown), graduation outcome (graduated, dropped out, transferred, still enrolled), and New Haven Promise outcome (received or did not receive). For privacy reasons, the district could not release further identifiers such as school, gender, race, or eligibility for free- or reduced-lunch. Though there were 1,608 original observations, between 126 and 430 data points were dropped from each regression. The dropped data points were due to missing data for either 9th or 11th grade outcomes, in many cases reflecting students who transferred into the district after 9th grade or dropped out of school before the end of 11th grade. For the purpose of running regressions looking at behavioral changes between 11th grade and 9th grade, these students had missing data values and could not be used. Certainly, it is important to acknowledge that high transfer rates pose problems for data analysis. According to superintendent Garth Harris, 14.6% of Hillhouse High School students transferred into the school after October 1 in 2012.[12] Harris notes that "Cross and Hillhouse [the city's only two comprehensive high schools] become a safety net for kids who leave other schools." Still, applying the empirical method for studying student behavior is still of interest to see how the New Haven Promise impacts those students who graduated, dropped out after 11th grade, or are still enrolled. Accordingly, results may overstate the impact of Promise, because students who dropped out early or transferred in late are not included in the study.

4.5 CONNECTICUT EDUCATION DATA AND RESEARCH (CEDAR) AGGREGATE STATISTICS

Through the Connecticut Education Data and Research portal, statistics tracking school-, district-, and state-level average performance on a variety of measures is publicly available for the years 2006-2011. Unpublished data for 2012-2014 on selected outcome measures was provided

[12] Bailey, Melissa. "District Eyes Redrawing School Boundaries," *New Haven Independent*, Jan 26. 2012.

upon request by an education consultant for the Connecticut State Department of Education. Total enrollment by grade level, SAT participation by gender, and average SAT scores were available through 2014 at the time of the data request and are thus the outcome measures considered in this portion of the analysis.

5 ECONOMIC AND EMPIRICAL MODELS

5.1 ECONOMIC MODEL FOR REAL ESTATE VALUES

This two-period model aims to show how the New Haven Promise influences home-buying behavior. As any homebuyer knows, housing decisions are made on criteria much farther-ranging than the characteristics of the house itself. Neighborhood amenities, neighborhood quality, and associated school attendance zone are also key drivers of home value. Especially for parents of young children, purchasing the right to attend a certain public school can be a primary consideration in property selection. Parents are also forward-looking, anticipating their children's educational trajectory. In particular, parents know that the ability to attend college is predicated on two criteria: achieving college acceptance and having the funds available to finance a college education. The mechanism of interest here is whether or not home buyers believe the New Haven Promise increases their children's possibility of attending college enough (by effectively making tuition free) to increase parents' willingness to choose houses within New Haven. Alternatively, the model also allows for the possibility that the New Haven Promise incentivizes parents to sort towards higher quality schools within New Haven – perhaps a scenario in which parents who would previously send children to private schools or out-of-district schools are now pushed to choose houses within high school quality attendance zones.

The model is restricted to home buyers with children or expecting to have children. In the first period, before their children have reached college-attending age, parents make a housing choice from an inelastic supply of houses limited to size H. They make an appropriate housing choice to maximize utility based on consumption, house quality, neighborhood quality, and school quality. In period one, parents also make a decision regarding how much to save for period 2, when they may need to pay for their children's college tuition. Each house h has associated quality q_h, associated neighborhood quality q_h^N, and associated school quality q_h^S. q_h^S represents parents' presumption of school quality, in this paper represented by CMT scores. CMT scores are also used as the primary measure of school quality in the empirical methods, and school quality is presumed to have a direct contemporaneous effect on utility. Parents are altruistic, wishing for their children to have the highest quality possible elementary schooling and highest possible chance for college admittance. Parents also may enjoy indirect effects of high quality schooling, such as children's exposure to higher quality peers and friends. q_h^S drops out of the utility function in the second period because the child or children have reached college-attending age and quality of schooling no longer has direct effects on utility. C, an indicator variable for college attendance, has a positive effect on parents' utility in the second period.

$$max_{h\in\{1,2,3\ldots,H\}}\, U\left(q_h, q_h^N, q_{h,}^S\, c_1\right) + \beta \in \left[U(q_h, q_h^N, c_2, C\right] \tag{1}$$

$$s.t.$$

$$c_1 = y_1 - p_h - s \tag{2}$$

$$c_2 = y_2 - p_h + s - \varphi(p_h^C C) \tag{3}$$

The utility maximization function is subject to budget constraints in each period. In the first period, parents expend income y_1 on the cost of their housing, p_h, and also on savings in order to pay for future college tuition, s. In the second period, when children are attending college, parents still expend income on the cost of their housing, p_h, but are now able to consume out of their savings if the

price of college is less than their total savings. p_h^C thus represents the price of college associated with their housing choice, conditional on C=1, college attendance. That said, if their children do not attend college at all, parents are able to consume all of their savings. Due to the Promise program, for New Haven residents, p_h^C has the potential to be zero if children attend the public school system continuously and meet the eligibility requirements.

However, this model does not assume that all children are admitted to college. Rather, college admittance, φ, is a probability function dependent on quality of primary and secondary schooling as well as other unobserved characteristics such as effort, parents' educational background, etc. Parents value whether or not their children attend college, with higher utility associated with college admittance and attendance. College attendance is conditional on college admittance, which itself is determined in part by the quality of the school district where the household chooses to live, q_h^S.

$$\Pr(\varphi = 1) = f(q_h^S, \varepsilon) \quad (4)$$
$$if\ \varphi = 0, C = 0$$

The requirements of the New Haven Promise program – a 3.0 GPA, 90% attendance, and enrollment in a public school – are attainable enough that forward-looking parents and children can be reasonable assured of free college tuition. In the model, the effect of the college tuition subsidy created by New Haven Promise is to substantially reduce p_h^C, keeping in mind that parents may still have to support room, board, textbook, and technology fees. Still, it may be true that parents can find alternative housing choice *h* that maximizes their utility in a school district where the average q_h^S is higher. Put differently, the college tuition subsidy (which could total up to $40,000 over four years), may still not be enough to induce parents to value New Haven Public schools any more than they did previously. In order for New Haven Promise to have effects measurably capitalized into the real estate

market, the effect of lower presumed school quality or other unobserved reasons that parents may not value the NHPS must be mitigated by the utility gained from the college tuition scholarship.

5.2 Empirical Approach for Real Estate Values

The empirical application with regard to real estate values will look at two key areas restricted by geography; first, home sales within the New Haven School District and second, home sales along the borders between New Haven and surrounding towns. If there are significant differences pre-2011 and post-2011 or within New Haven and on the border of New Haven, then there may be evidence that the Promise program has prompted home buyers to increase their valuation of school quality in general, or school quality in New Haven in particular. Put differently, parents may be sorting toward higher quality schools in New Haven, or be sorting into the district itself.

This paper follows Black (1999) closely in its estimation strategy. If the supply of housing is assumed to be reasonably inelastic, a standard hedonic price function can be used to describe the equilibrium housing market, where sale price is described as a function of the characteristics of the house itself and its location (neighborhood characteristics and school attendance zone). The basic price function is this:

$$\ln(price_{icjt}) = \alpha + \beta H_{icjt} + \delta N_c + \gamma CMT_j + \tau_t^{year} + \tau_t^{season} + \varepsilon_{icjt} \quad (5)$$

where $price_{icjt}$ is the sale price of house *i* in time *t*, within census block *c* and elementary school attendance zone *j*. The vector H_{icjt} includes characteristics of the house as reported in the assessors' reports, such as living area square footage, number of bedrooms and bathrooms, year the house was built, as well as a grade for the quality of the house based on its building materials and maintenance. N_c is a vector of neighborhood characteristics as determined by the census block and includes

demographic variables that cover the racial composition of the neighborhood, the education status of its residents, their average income and age distribution, as well as others. The variable of primary interest, CMT_j, is the sum of the school's average math and reading CMT scores, averaged over three years from 2009-11. Time is included in order to study the capitalization of perceived school quality both before and after 2011, when Promise was announced, with year dummy variables accounted for in τ_t^{year}. Seasonality is also controlled for in τ_t^{season}, a dummy variable accounting for quarterly seasonality effects.

However, as discussed earlier, there are problems with this basic hedonic regression due to unobserved house or neighborhood characteristics correlated with school quality that contribute to omitted variable bias. To mitigate this issue, I follow Black (1999) in employing a regression discontinuity design, replacing the vector of observed neighborhood characteristics (N_c) with a set of boundary dummies that indicate houses that share an attendance district boundary. The new price function for the comparison of within-New Haven house sales is as follows:

$$\ln(price_{ibjt}) = \alpha + \beta H_{ibjt} + \varphi_b + \gamma CMT_j + \mu D_i^{post2011} + \delta\left(CMT_j * D_i^{post2011}\right) + \tau_t^{year} + \tau_t^{season} + \varepsilon_{icbt} \quad (6)$$

where φ_b is the full set of pairwise boundary dummies, $D_i^{post2011}$ is a dummy term representing a home sale after 2011, and the interaction term $\left(CMT_j * D_i^{post2011}\right)$ represents the differential effect of test scores in the period post-2011. For the study comparing New Haven house sales to surrounding town house sales, I then modify the price function further:

$$\ln(price_{ibjtm}) = \alpha + \beta H_{ibjtm} + \varphi_{bm} + \gamma CMT_{jm} + \mu D_i^{post2011} + \delta\left(CMT_{jm} * D_i^{NH}\right) + \rho\left(D_i^{NH} * D^{post2011}\right) + \sigma_m + \tau_t^{year} + \tau_t^{season} + \varepsilon_{icbtm} \quad (7)$$

where *m* represents the town, σ_m represents the fixed effects associated with each town, and the new interaction term $\left(D_i^{NH} * D^{post2011}\right)$ represents the differential effect on sale price that being within New Haven and after 2011 has.

5.3 Economic Model for Student Effort and Outcomes

As with most classic models of education, in this model students make utility-maximizing choices with regards to time allocation and achievement in school in period one, looking ultimately to increase income in period two. The model aims to show how an intervention such as the New Haven Promise may increase the utility associated with time allocated to studying in period one because achievement during secondary education (namely, reaching the 3.0 GPA cutoff and 90% attendance) can lower the cost of receiving tertiary education. As long as students understand the mapping between college attendance, C, and associated future income, then sacrificing some leisure time in period one could be the utility-maximizing choice for some students.

$$max_{l_1} U(A_1, l_1, C, y_2) \tag{8}$$

$$s.t.$$

$$T_1 = e_1 + l_1 \tag{9}$$

where

$$A_1 = f(e_1, q^s, \varepsilon) \tag{10}$$

$$C = g(p^C, A_1, \varepsilon) \tag{11}$$

$$where\ p^C = \begin{cases} p^C, & if\ D^{NH} = 0\ or\ A_1 < c \\ 0, & if\ D^{NH} = 1\ and\ A_1 > c \end{cases} \tag{12}$$

$$and\ lny_2 = \alpha + \beta C + \delta X + \gamma X^2 + \varepsilon \tag{13}$$

Students derive utility from A_1, their achievement in high school, l_1, the time devoted to non-academic leisure activities, C, college attendance, and y_2, their income in the post-college time period. Their achievement in high school is determined by e_1, the effort they expend on non-leisure academic activities, as well as q_h^S, the quality of their schooling and a random error term accounting for family background and other unobserved characteristics. Their time is constrained by equation 9, where total time in period one, T_1, is the sum of hours spent on academic effort, e_1, and hours spent on leisure activities, l_1. The choice to attend college depends on variables that account for the probability of gaining college admission as well as the student's ability to pay for tuition. The choice of college attendance, C, is therefore a function of p^C, the price of tuition, and A_1, achievement in period one. A_1 affects both the student's likelihood of being admitted to college as well as their own confidence in entering college, assuming that higher achievement is associated with higher likelihood of being admitted and wanting to attend college. Equation 13 is Mincer's human capital earnings function, with C replacing years of schooling and X representing years of experience. Students in this model are also assumed to be aware that income in period two, y_2, is increasing in C. Students expect that college attendance increases the wages earned in the period after graduation.

The Promise is expected to affect period one choices because students are aware that increased academic effort in period one not only raises their chances of being admitted to college, but also has the potential to drop the price of tuition to zero. Equation 12 shows that the New Haven Promise acts to reduce p^C to zero if the student is able to achieve the eligibility requirements captured in the cutoff term *c*, given that they are a New Haven resident. However, if the student is not a New Haven resident ($D^{NH} = 0$) or fails to meet the eligibility requirements ($A_1 < c$), then p^C remains its original value. If Promise is received, the probability that the student chooses to attend college rises, as the price associated with attendance has dropped. Given these mechanisms, the model predicts that New Haven Promise should have the effect of increasing e_1 for New Haven residents. Likewise, for students who attend NHPS schools but are not New Haven residents, the Promise adds no incentive to increase

effort because the price of college for non-residents has not been changed.[13] Finally, because e_1 is unobservable in the given data, the empirical approach will instead look to observable measures of achievement associated with effort, such as GPA and attendance.

5.4 EMPIRICAL APPROACH FOR STUDENT EFFORT AND OUTCOMES

The empirical approach of the section on student behavior will capitalize on the variation in eligibility between both cohorts of graduates and within cohorts of graduates. A natural source of variation exists: students' eligibility for Promise is dependent on their time of continuous residency in New Haven and attendance of New Haven Public Schools. Because the program's announcement was sudden, changes in student achievement and effort in school linked to an exogenous change in their eligibility for a tuition subsidy can be seen as program effects. Comparing changes in student performance by their eligibility status can give an approximation of students' changes in attitude toward school after the announcement of Promise. The data provided by NHPS is limited in that residency eligibility is time invariant, so it is not possible to determine what percentage of the Promise subsidy students are eligible for, or how recently they have enrolled in the district. Due to privacy limitations, the data also does not include students' schools so accounting for school fixed effects is not possible.

I expect the impact of New Haven Promise on each of the ability groups (as defined by their starting GPA in 9th grade) to be different. To address this, I follow Sacerdote (2001) and Gonzalez *et al* (2014) among many others in using a linear spline when looking for sharp changes in the rate of improvement in student outcomes over time or between groups. The goal of using a spline is to allow

[13] Approximately 25% of New Haven high school students are non-residents (due to the large number of inter-district magnet high schools in New Haven), so this comparison group is non-trivial.

for a change in regression slope reflecting the different effects for students with initially low, middling, or high GPAs. This paper will use a linear spline with two knots, using the 33rd and 67th percentile as a guide. Splitting students into their starting GPA categories, before the effect of Promise, will help elucidate the differential effects of New Haven Promise as a motivator depending on students' initial outcome levels.

$$GPA11_i = \alpha + \beta_1 LowGPA9_i + \beta_2 MidGPA9_i + \beta_3 HighGPA9_i + \delta_1\left(LowGPA9_i * D_i^{NH}\right) + \delta_2\left(MidGPA9_i * D_i^{NH}\right) + \delta_3\left(HighGPA9_i * D_i^{NH}\right) + \varepsilon_i$$

where GPA in 11th grade for student i, $GPA11_i$, is the dependent variable. It is determined by the spline variables for 9th grade GPA ($GPA9_i$) at below the 33rd percentile (GPAs of 1.78), between the 33rd and 67th (1.78-2.72) and above the 67th percentile (above 2.72). The other independent variables account for the interaction between an indicator variable for New Haven residency, D_i^{NH}, and ninth grade GPA. GPA in ninth grade is expected to be highly correlated to GPA in eleventh grade, so $\beta_1, \beta_2, \beta_3$ are all expected to be significant and of positive magnitude. The mechanism of the model presented above predicts that $\delta_1, \delta_2, \delta_3$ should also be of positive magnitude, as students who have New Haven residency now have additional motivation to achieve in school in order to increase their chances of being admitted to college and be eligible for the Promise scholarship. However, the coefficient on δ may differ across groups. Students in the middling group, for instance, may believe that they are within reach of the cutoffs and get more motivation than students in the low group for whom the cutoffs may seem unreachable. The same produce using the linear spline based on percentiles will be used for the other outcome variables of attendance, suspensions, and credits earned.

5.5 Exploiting Variation Across Time and Communities to Estimate Effects on District-Wide Outcomes

In order to exploit variations between time and communities, a reasonably appropriate comparison community must be chosen for the difference-in-difference analysis (see Appendix Figure 3 for comparative statistics on New Haven and Bridgeport). The two towns and their associated public school districts have similar median household incomes, percentage of population in labor force, size of school enrolled populations, and racial demographic breakdowns. Using publicly available data from the Connecticut Education Data and Research (CEDaR) database on school-level enrollment records, the number of students taking the SAT, and school-average SAT scores, the community-level effect of New Haven Promise can be ascertained by utilizing a district-level difference in difference between New Haven and Bridgeport, before and after the 2011 announcement of Promise. These difference-in-difference estimates will be specified by the following equation:

$$Enrollment_{dt} = \alpha + \beta D_d^{NH} + \gamma D_t^{post2011} + \delta(D_d^{NH} * D_t^{post2011})_{dt} + \varepsilon_{dt}$$

where D_d^{NH} is a dummy for the New Haven Public Schools district, $D_t^{post2011}$ is a dummy indicating before or after 2011, and$(D_d^{NH} * D_t^{post2011})$ is the interaction of the two previous terms. The dependent variable will change depending on the specification, but the RHS of the equation will remain the same. In addition to total district enrollment, I will examine enrollment in kindergarten, in grades K-4, in grades 5-8, and in grades 9-12. Difference-in-difference estimates for changes in SAT participation and SAT score will be estimated in the same way.

6 RESULTS

6.1 EFFECTS ON RESIDENTIAL PROPERTY VALUES WITHIN NEW HAVEN

Summary statistics for house characteristics within New Haven and in the surrounding towns can be found in table 2. In New Haven, the mean house sale price was $212,358 and the mean fourth grade CMT score (sum of reading and math, averaged from 2009-2011) was 466.2. The results presented in table 3 below focus on estimating which factors influence home values within New Haven. To control for neighborhood characteristics, I use boundary fixed effects in columns 2, 4 and 6 and census demographic information in columns 1, 3, and 5. Column 1 looks at the entire sample of residential house sales in New Haven, 2006 to 2011. Columns 2-7 limit the sample by distance to a school attendance boundary. Columns 6 and 7 have an added interaction term for the effect of CMT score post-2011. Across all columns, as expected, lot size, living area square footage, elementary test score, number of bathrooms, year the house was built, and the New Haven city assessor's assessment grade of the condition of the house are all significant and positively correlated with sale price.

The key finding of this section is that the coefficient on the interaction term between New Haven and post-2011 house sales is positive and significant, .0022 in column 6 where boundary fixed effects are used and .0021 in column 7 where census socio-demographic variables are used. This suggests that home buyers in New Haven after the Promise program was announced are placing greater premiums on elementary school quality. The negative coefficients of large magnitude on post-2011 itself are also of interest. The burst of the housing bubble is evident in New Haven, with an average house price of $192,109 in 2006-2011 compared to an average house price of $229,112 in 2006-2010. Appendix figure 5 shows the trajectory of average house sale values by individual year. (The effects of annual variation in home prices are controlled for by a set of year dummies.) That the value home buyers assigned to better quality schools became greater after 2011, despite an overall

more depressed housing market than in years prior, is an indication that the change in capitalization of school quality can be attributed to the Promise program – or at least the broader set of school reform measures undertaken post-2011.

The results presented in table 3 also point to other factors that heavily influence house sale values in New Haven. In the regressions that use census demographic information instead of boundary fixed effects to approximate neighborhood characteristics, demographic variables of the census block group associated with the house also have an explanatory impact on housing price. The percentage of blacks and Hispanics in the census block are negatively correlated with housing price, as is the percentage of the population with less than a high school degree of education and the percentage of the population whose highest level of education is high school or equivalent. For instance, in the sample that includes all houses within the New Haven town boundary, a 5% increment increase in the proportion of black residents in the census block is associated with a 3% decrease in home sale prices. House style is another factor that can affect home price negatively. In all columns other than column 1, two- and three-family house styles are associated with lower sale prices when other characteristics such as living area square footage are controlled for. Consistent with previous literature, the results also show that home buyers do pay price premiums for higher quality schools. In particular, the basic hedonic regression coefficient on the house's attendance zone mean CMT score indicates that a one standard deviation increase in the average CMT score is associated with a 2.52% increase in the house price, equivalent to $5,923 at the median (see table 4 for a comparison of results under different specifications).

As for the differences in coefficient estimates between samples that used boundary fixed effects and those that used census variables, the results indicate that when boundary fixed effects are included, the coefficient on test score actually rises. This finding contrasts previous findings from Black (1999) and Bayer (2007) but confirms Dougherty *et al* (2009) and Chiodo *et al* (2010). That is, the basic hedonic regression (column 1) does not seem to overstate the value home buyers attribute to

better schools, but rather, understates it. One possibility to explain why these results differ from some previous papers is the type of school district studied. New Haven Public Schools is a far more urban school district than Boston suburbs or Bay area suburbs. Within NHPS, a significant portion of residential property sales are of townhomes, condos, or multi-family houses, which may contribute noise to the general regression on all houses. Moreover, excluding these homes from the analysis entirely as Black (1999) and Bayer (2007) do would be inappropriate in New Haven, where such homes comprise a significant portion of residential family housing. In the NHPS, controlling for neighborhood boundaries may not only be an important control for demographic characteristics but also for the style of housing. In any case, the difference in findings does not diminish the usefulness of boundary fixed effects as a methodological tool to control for unobserved characteristics that differ between neighborhoods.

Table 2:

SUMMARY STATISTICS: HOUSE, SCHOOL, NEIGHBORHOOD CHARACTERISTICS

Distance from Boundary (mi.)	New Haven Full Sample	New Haven Within .30	East Haven Within .30	West Haven Within .30	North Haven Within .30	Hamden Within .30	Woodbridge Within .30
House Characteristics							
Sale price	$ 212,358	$ 198,949	$ 194,975	$ 209,220	$ 208,400	$ 169,137	$ 272,365
	$ (166,429)	$ (180,027)	$ (95,308)	$ (53,805)	$ (28,388)	$ (139,658)	$ (165,889)
Ln Sale Price	12.0	11.9	12.1	12.2	12.2	11.7	12.4
	(0.8)	(0.8)	(0.5)	(0.3)	(0.1)	(1.2)	(0.6)
Bedrooms	4.2	3.8	3.1	3.6	3.2	6.1	3.5
	(1.7)	(1.6)	(1.0)	(1.3)	(.45)	(2.1)	(1.2)
Bathrooms	2.2	2.0	1.5	2.0	1.4	3.7	2.3
	(1.0)	(1.0)	(.5)	(.9)	(.42)	(1.3)	(.9)
Living Area	2,227	1,884	1,344	1,829	1,366	1,245	1,951
	(1032)	(963)	(538)	(753)	(243)	(839)	(750)
Year Built[1]	1922	1933	1904	1890	-	1950	1956
	(31)	(30)	(319)	(300)	-	(22)	(38)
Lot Size	7,035	7,823	12,108	14,532	46,609	7,767	90,641
	(4,221)	(4,961)	(17,913)	(48,877)	(55,589)	(7,137)	(465,996)
Sale Year	2010	2010	2010	2010	2011	2010	2010
	(3)	(2.7)	(2.7)	(2.8)	(2.1)	(2.7)	(2.7)
School Characteristics							
Elementary Test Score[(2)]	466.2	485.5	475.1	485.7	535.5	477.7	567.4
	(39.4)	(35.3)	(23.2)	(5.7)	(0)	(76.8)	(8.9)
District Per Pupil Spending	$ 16,498	$ 16,498	$ 13,378	$ 12,904	$ 12,174	$ 15,412	$ 16,196
	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Neighborhood Characteristics							
% of Population Less than 20	32%	36%	28%	33%	30%	38%	24%
% of Population Over 65	12%	12%	16%	13%	18%	10%	26%
% of Population Black	33%	37%	4%	22%	3%	48%	4%
% of Population Hispanic	25%	26%	15%	33%	5%	14%	4%
% of Population Completed less than High School	19%	18%	11%	21%	11%	10%	10%
% of Population Completed High School Only	28%	33%	44%	39%	44%	28%	19%
% of Population Completed Bachelor's Degree Only	14%	14%	10%	10%	18%	14%	28%
% of Population Completed Graduate Degree	18%	13%	6%	9%	10%	11%	25%
% of Population Never Married	42%	43%	33%	39%	27%	48%	15%
Median Household Income	$ 49,932	$ 49,569	$ 58,432	$ 41,182	$ 81,938	$ 52,027	$ 104,194
	$ (26,083)	$ (19,446)	$ 12,792	$ (13,694)	(0)	$ (16,628)	$ (17,791)
N	4554	1281	553	83	5	529	62

Means shown, standard errors in parentheses

1) Data unavailable in North Haven

2) Elementary Test Score is measured for each elementary school, repesenting the sum of 4th grade math and reading CMT scores, averaged over three years.

Table 3: Regression Results on ln(Sale Price) with Whole Sample and Restricted by Distance, Varying between Census Variables and Boundary Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Distance from Boundary	All houses, all time	.15 mile, all time (boundary FE)	.15 mile, all time (no boundary FE)	.30mile, all time (boundary FE)	.30 mile, all time (no boundary FE)	.15 mile, post 2011 (boundary FE)	.15 mile, post 2011 (no boundary FE)
Elementary Test Score	0.0006***	.0025***	.0017***	.0027***	.0011***	.0013***	0.0004
	(.0002)	(.0005)	(.0005)	(.0003)	(.0003)	(.0006)	(.0006)
Post-2011						-1.27***	-1.34***
						(.331)	(.328)
Post2011*CMT Score						.0022***	.0021***
						(.0007)	(.0007)
Bedrooms	0.0024	.0284**	.0256**	.0155*	.0102	.0270**	.0243*
	(.0092)	(.0133)	(.0131)	(.0094)	(.0093)	(.0133)	(.0131)
Bathrooms	.0765***	.0434*	.0373*	.0744***	.0728***	.0444**	.0383*
	(.01440)	(.0224)	(.0219)	(.0148)	(.0145)	(.0223)	(.0218)
Lot size (1000 SQFT)	.0095***	.0062	.0022	.0105***	.0099***	.0061	.0020
	(.00244)	(.0045)	(.0040)	(.0027)	(.0025)	(.0045)	(.0040)
Living Area (1000 SQFT)	.1470***	.1405***	.1797***	.1403***	.1517***	.1408***	.1806***
	(.0169)	(.0270)	(.0257)	(.0178)	(.0172)	(.0269)	(.0257)
Style: Two Family	-.0195	-.0857**	-.0657*	-.0810***	-.0648***	-.0837**	-.0636*
	(.0318)	(.0354)	(.0348)	(.0257)	(.0252)	(.035)	(.035)
Style: Three Family	-.0283	-.1249***	-.0989**	-.0812**	-.0676**	-.1228**	-.0962**
	(.0385)	(.0474)	(.0466)	(.0343)	(.0339)	(.0473)	(.0465)
Year Built	.0020***	.0011**	.0006	.0010***	.0012***	.0010**	.0005
	(.0003)	(.0004)	(.0004)	(.0003)	(.0003)	(.0004)	(.0004)
Assessor's Grade	.2820***	.3417***	.3428***	.4134***	.3168***	.3455***	.3469***
	(.0262)	(.0434)	(.0418)	(.0275)	(.0267)	(.0433)	(.0418)
% of Population Less than 10	0.1063		.3425		.1309		.3227
	(.1756)		(.2742)		(.1796)		(.2736)
% of Population Over 65	-.2933		-.2006		-.2095		-.1910
	(.1535)		(.2299)		(.1578)		(.2294)
% of Population Black	-.6090***		-.7493***		-.6273***		-.7488***
	(.0627)		(.1134)		(.0713)		(.1131)
% of Population Hispanic	-.4254***		-.5824***		-.4000***		-.5902***
	(.0851)		(.1370)		(.0913)		(.1367)
% of Population Completed Less than High School	-.9040***		-.9189***		-.8521***		-.9252***
	(.1585)		(.2244)		(.1623)		(.2239)
% of Population Completed High School	-.9401***		-1.035***		-.8578***		-1.040***
	(.1536)		(.2404)		(.1621)		(.2398)
% of Population with Bachelors	.0548		.1379		.1062		.1242
	(.1789)		(.2693)		(.1791)		(.2687)
% of Population with Graduate	-.1805		-.4643**		-.1684		-.4915**
	(.1357)		(.1977)		(.1366)		(.1974)
% of Population Never Married	.0263		.1655		.0324		.1639
	(.1086)		(.1741)		(.1142)		(.1737)
Median Household Income	0		0		0		0
	0		0		0		0
Control for Seasonality	YES	YES	YES	YES	YES	YES	YES
Control for Annual Variation	YES	YES	YES	YES	YES	YES	YES
Boundary Fixed Effects	NO	YES	NO	YES	NO	YES	NO
Number of Boundaries	-	47	-	48	-	47	-
Census Variables	YES	NO	YES	NO	YES	NO	YES
N	4554	2137	2137	3953	3953	2137	2137
R^2	0.4302	0.4931	0.4901	0.5151	0.5137	0.4954	0.4927
Adjusted R^2	0.427	0.4777	0.4829	0.5067	0.51	0.4798	0.4853

Note: Dependent Variable: lnPrice, standard errors in parentheses
***p<0.01, ** p<0.05, * p<0.1

Table 4: Magnitude of Results under Different Specifications

	(1) Basic hedonic regression	(2) .15 with boundary fixed effects	(3) .30 with boundary fixed effects	(4) Differential Effect of New Haven, Post 2011
Coefficient on Elementary Test Score	0.00064	0.0025	0.0027	0.0022
Magnitude of Effect (percent change in house price as a result of a one standard deviation increase in test score)	2.52%	9.85%	10.64%	8.67%
$ Value (at mean house price of $252,488 In 2006$)	$6,367	$24,870	$26,860	$21,886
$ Value (at median house price of $234,900 In 2006$)	$5,923	$23,138	$24,989	$20,361

(1) Results presented in this table are based on estimates from table 2, columns 1, 2, 4, and 6
(2) A one standard deviation increase in test score in New Haven amounts to an 8.45% increase.

6.2 Effects on Real Estate Values between New Haven and Neighboring Districts

In this section, home sales within a .15 and .30 buffer on either side of the New Haven School District outer boundary are compared.[14] Table 5 shows the results of the price estimation regression using boundary fixed effects and table 6 shows the results of the price estimation using census demographic variables, for comparison. In these specifications, the boundary distance buffer used was .30 miles, as the sample size of houses within .15 miles of the New Haven town boundary was only 470 homes. Across both tables, coefficients in the sample using census demographic variables instead of boundary fixed effects to control for neighborhood characteristics show estimates of similar sign and magnitude for almost all variables. The interaction term on New Haven, post-2011 is insignificant though positive in both tables. Both tables still show, however, an increase in the importance placed

[14] In Connecticut, school district boundaries and town boundaries are the same. The NHPS outer boundary is the New Haven town boundary and therefore is adjacent to neighboring towns/districts.

on elementary test scores after 2011, as the coefficient on the interaction between test scores and post-2011 is positive and significant.

These results indicate that home buyers both in New Haven and in surrounding towns have placed greater emphasis on CMT scores since 2011. In particular, the interaction effect between CMT scores and the period of time after 2011 has an effect of .0010 on the natural log of home sales. The effect of being on the New Haven side of the border also has positive effects for home value, regardless of time – an additional 1.0186 over Hamden (the omitted comparison district in this regression). Houses in Woodbridge are also worth more in comparison to Hamden, whereas houses in East and West Haven are worth less in comparison to Hamden. However, the regression is inconclusive as to whether houses in New Haven after 2011 have become more valuable than before 2011, as the coefficient on the interaction between New Haven residency and after 2011 is insignificant, though it is positive.

These inter-town regressions also show that differences between school attendance zones are often stark. The coefficient on houses in the boundary neighborhood near the Worthington Hooker district, New Haven's highest-scoring elementary school at an average of 579.9 combined on the math and reading CMT test, is 1.036 vs. .3392 for its immediate bordering attendance zone, East Rock School (with an average CMT math and reading score of 460.1). Likewise, another lower-performing school with an attendance zone bordering Worthington Hooker, Lincoln Bassett, has a negative coefficient of -.4588. Regression coefficients on the individual years also show the pattern of housing bubble burst and slow recovery, with steadily more negative coefficients from 2008 on.

Table 5: Price Regression for Houses within .30 mile of an Attendance Zone Boundary, Comparing Houses along the Border between New Haven and Surrounding Towns (Boundary Fixed Effects)

	Within .30 mile of Boundary, Fixed Effects
Main and Interaction Effects	
Elementary Test Score	.0024***
	(.0004)
Post 2011*Test Score	0.0010*
	(.0005)
New Haven Dummy	1.0186***
	(.2255)
New Haven*Post 2011	.0029
	(.0533)
House Characteristics	
Lot Size	.0006***
	(.0001)
Living Area	.3553***
	(.0272)
Bedrooms	-0.0815***
	(.0145)
Bathrooms	0.1054***
	(.0244)
Year Built	0.0016***
	(.0002)
Other Education Variable	
Per Pupil Spending	-0.001***
	(.0002)
School Boundaries[(1)]	
Edgewood	0.2804***
	(.0770)
Davis	-0.0296
	(.0750)
Katherine Brennan	0.2201***
	(.1062)
Beecher	0.0244
	(.1002)
King Robinson	-0.0575
	(.1287)
Lincoln Bassett	-0.4588***
	(.0760)
Worthington Hooker	1.036***
	(.1333)
East Rock	0.3392***
	(.1156)
Bishop Woods North	-0.7431***
	(.1289)
Bishop Woods East	-.4883**
	(.2958)
Ross Woodward	-0.6098***
	(.2963)
Nathan Hale	0.0694
	(.0398)
Truman	-0.1599
	(.3234)
Barnard Magnet	0.1077
	(.3270)
Towns[(2)]	
Woodbridge	0.6902***
	(.2022)
East Haven	-1.976***
	(.3922)
West Haven	-2.6239***
	(.4817)
Years	
2006	-2.7946***
	(.7604)
2007	-2.7775***
	(.7582)
2008	-2.9211***
	(.7611)
2009	-3.1514***
	(.7611)
2010	-3.1520***
	(.7606)
2011	-3.7843***
	(.7113)
2012	-3.7953***
	(.7106)
2013	-3.7323***
	(.7105)
2014	-3.9042***
	(.7107)
Seasons	
Winter	-0.0293
	(.0398)
Spring	0.0197
	(.0377)
Summer	0.0383
	(.0350)
Constant	26.4326***
	(2.9602)
Control for Seasonality	YES
Control for Annual Variation	YES
Boundary Fixed Effects	YES
Census Variables	NO
Number of Boundaries	14
N	2400
R^2	0.3466
Adjusted R^2	0.3379

(1) All boundaries included, number of boundaries is smaller than in the within-New Haven regression because only considering the outer boundaries of each school attendance zone that border another town.

(2) Hamden omitted

Table 6: Price Regression for Houses within .30 mile of an Attendance Zone Boundary, Comparing Houses along the Border between New Haven and Surrounding Towns (Census Variables)

	Within .30 mile of Boundary, Census Variables
Main and Interaction Effects	
Elementary Test Score	0.0034***
	(.0011)
Post 2011*Test Score	0.0008*
	(.0004)
New Haven Dummy	0.7955***
	(.2093)
New Haven*Post 2011	0.0351
	(.0500)
House Characteristics	
Lot Size	0.0005***
	(.0001)
Living Area	0.2732***
	(.0270)
Bedrooms	-0.0379**
	(.0139)
Bathrooms	0.0761***
	(.0230)
Year Built	0.001***
	(.0002)
Other Education Variable	
Per Pupil Spending	-0.0007***
	0.0001
Census Variables	
Under 20	-0.3386
	(.4281)
Over 65	-0.5677
	(.4817)
% of Population Black	-1.341***
	(.4346)
% of Population Hispanic	-0.9957***
	(.2674)
% of Population Completed Less than High School	-1.231***
	(.2762)
% of Population Completed High School	-0.7806***
	(.2651)
% of Population with Bachelor's Degree	0.1983
	(.3133)
% of Population Never Married	0.0445
	(.1620)
Median Income	0
	(.0)
Towns[(1)]	
Woodbridge	0.206
	(.2051)
East Haven	-1.3127***
	(.3745)
West Haven	-1.3478***
	(.4658)
Years	
2006	-1.4887***
	.7216
2007	-1.5073***
	(.7193)
2008	-1.6438***
	(.7220)
2009	-1.8872***
	(.7220)
2010	-1.8803***
	(.7215)
2011	-2.3006***
	(.6769)
2012	-2.3129***
	(.6765)
2013	-2.2919***
	(.6760)
2014	-2.4438***
	(.6762)
Seasons	
Winter	-0.0056
	(.0376)
Spring	0.0264
	(.0355)
Summer	0.0396
	(.0330)
Constant	22.9065***
	(2.8806)
Control for Seasonality	YES
Control for Annual Variation	YES
Boundary Fixed Effects	NO
Census Variables	YES
Number of Boundaries	14
N	2400
R^2	0.4125
Adjusted R^2	0.4033

(1) Hamden omitted

***p<0.01, ** p<0.05, * p<0.1

6.3 EFFECTS ON STUDENT EFFORT AND OUTCOMES

The class of 2014 are an important cohort to study because they are the first cohort of students to have gone through a preponderance of high school knowing about the opportunity of the Promise program. These students were just finishing their freshman year in high school when the first class of scholars graduated. New Haven Promise was announced in late November and media attention refocused on the program when the first class of scholars graduated in June 2011. Moreover, the class of 2014 was the first class of students eligible for 100% of the tuition subsidy, as the program had been phased in over four years. Data analysis in this section depends on exploiting the fact that approximately 25% of New Haven Public Schools students do not live in New Haven and are therefore disqualified from receiving Promise.[15] Looking for changes in student effort or behavior between 11th grade (the latest year for which data was available) and 9th grade can help determine if Promise provided any kind of extra incentive or motivation to those 75% of students who were eligible for the program by their New Haven residency. As can be seen in the summary statistics in table 7, students who attend NHPS but are not New Haven residents differ significantly from the population of students who do have New Haven residency. On all observable characteristics, they perform higher than students with New Haven residency – for instance, with average ninth grade GPAs 0.59 points higher. See appendix figure 6 for histograms showing the distribution of outcomes recorded in the NHPS data set.

Table 8 shows the results of fitting the spline regression model to data on 9th and 11th grade outcomes of GPA, attendance rates, credits earned, and suspensions. There are a number of statistically significant interaction effects, showing the difference in slope of the regression on students who had New Haven residency versus those who did not. For students who were New Haven residents

[15] This high proportion of out-of-district high school attendees is concentrated in the district's many inter-district magnet high school programs, open to all Connecticut Residents.

and part of the initially high-achieving group (with a 9th grade GPA above the 67th percentile), the effect of the Promise announcement was to the increase their 11th grade GPAs by .20 more per unit of increase in 9th grade GPA than non-New Haven residents. There are also large effects for attendance among students starting in the middle group, increasing by 1.65 per unit of increase in 9th grade attendance over the non-New Haven residents.[16] See appendix figure 7 for plots of the spline regressions.

These results may suggest that students who are higher-performing to begin with understand the mapping of effort to achievement better than students who start at a lower level of achievement. This difference is consistent with the body of literature indicating that incentives tied to academic outputs (like GPA) have impacts primarily on high ability groups, whereas incentives tied to academic inputs (like attendance) have more universal impacts. The only significant increase in a variable for the middling group was in attendance, which is notably easier for students to control than an output variable such as GPA or credits earned.

For the initially lowest performing group of students, the results are less encouraging. The only significant estimate suggests that the effect of New Haven residency decreases attendance rates. With regard to suspensions, being a part of the "low" group is categorized by having zero suspensions in ninth grade. The interaction effect of New Haven residency and being part of the initial zero suspensions group shows that New Haven residents are more likely to be suspended than non-residents after Promise is announced. If we assume that the mechanism of the economic model is accurate and students who believe they are within reach of the eligibility cutoffs are reasonably motivated to increase their effort, then the increases in attendance for middling students and the increases in GPA for higher achieving students reflect this increase in effort. For the highest achieving group of students, the positive increase in GPA for New Haven residents may reflect two possibilities: the 67th

[16] Coefficient is large because attendance was recorded as a decimal value.

percentile was a GPA of 2.72, so many of the high-achieving students still needed to increase their GPAs to reach the eligibility cutoff of 3.0. Additionally, because the Promise increases the affordability of college and makes college attendance easier, high-achieving students may also be increasing effort in school to raise GPAs in order to attend better colleges. On the other hand, for the lowest-performing students, the Promise appears to have had negative impacts on effort. For this group, the eligibility cutoffs imposed by the Promise may seem too far out of reach to motivate behavioral changes.

Table 7:

Summary Statistics: New Haven Residents Differ Significantly from Out-of-District Students

	New Haven Residency[(1)]	Other Residency[(2)]	Difference in Means[(3)]
9th Grade GPA	2.18	2.77	-0.59
	(1.00)	(.83)	(9.77)
11th Grade GPA	2.12	2.72	-0.6
	(1.08)	(.93)	(8.92)
9th Grade Attendance	0.9	0.95	-0.05
	(.17)	(.05)	(6.17)
11th Grade Attendance	0.85	0.92	-0.07
	(.17)	(.08)	(9.90)
9th Grade Suspensions	0.25	0.04	0.21
	(.83)	(.27)	-(6.74)
11th Grade Suspensions	0.17	0.07	0.1
	(.55)	(.40)	-(3.31)
9th Grade Credits Earned	6.64	7.5	-0.86
	(1.86)	(1.26)	(8.86)
11th Grade Credits Earned	6.43	7.28	-0.85
	(2.61)	(1.87)	(6.00)
N	995	269	

(1), (2) Means shown, standard errors in parentheses

(3) Difference shown, t-statistic in parentheses; t-test performed assuming unequal variances

Table 8: Spline Regressions on 11th Grade GPA, Attendance, Credits, and Suspensions as Explained by 9th Grade Outcomes in the Same Category

	(1)	(2)	(3)	(4)
	GPA	Attendance	Credits Earned	Suspensions[4]
Low Group[1]	0.82***	0.60***	0.57***	0.07
	(.04)	(.05)	(.07)	(.08)
Mid Group[2]	1.17***	0.47	1.3***	
	(.09)	(.56)	(.35)	
High Group[3]	0.86***	0.73	0.15	0.04
	(.10)	(1.07)	(.29)	(.07)
NH Residency*Low	-0.02	-0.11***	0.01	0.26***
	(.03)	(.02)	(.05)	(.09)
NH Residency*Mid	-0.08	1.65**	-0.31	
	(.10)	(.63)	(.39)	
NH Residency*High	0.20**	-0.87	-0.53	0.08
	(.08)	(1.22)	(.37)	(.07)
Constant	0.35***	0.36***	2.44***	0.08***
	(.05)	(.04)	(.30)	(.01)
Knot 1	1.79	0.92	6.50	1.00
Knot 2	2.72	0.97	7.75	-
N	1264	1178	1264	1482
R^2	0.81	0.25	0.21	0.09
Adjusted R^2	0.81	0.24	0.20	0.09

The dependent variable is the 11th grade outcome of the corresponding column, i.e. 11th grade GPA for column 1 and 11th grade Attendance for column 2. Standard errors in parentheses.

(1) The low group is selected for by 9th grade outcomes below the 33rd percentile.

(2) The mid group is selected for by 9th grade outcomes between the 33rd and 67th percentiles.

(3) The high group is selected for by 9th grade outcomes above the 67th percentile.

(4) 9th grade suspensions at the 33rd and 67th percentile were both 0, so this spline is set with one knot, to separate students into groups with any suspensions or none at all.

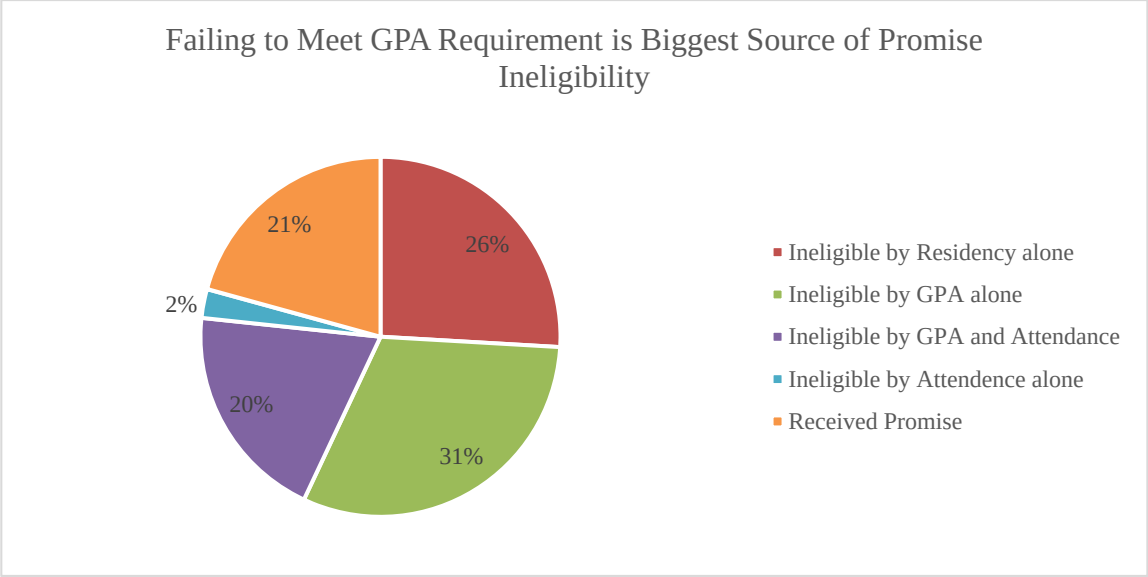
(5) Each sample is restricted to students who have data for both 9th and 11th grade.

***p<0.01, ** p<0.05, * p<0.1

6.4 OBSERVATIONS ON ELIGIBILITY: WHO ARE (AND AREN'T) THE PROMISE SCHOLARS?

Looking more broadly at the data, it is clear that the New Haven Promise enjoys a high take up rate among students who are eligible for it, but also that this pool of eligible students is a small percentage of all those who graduate and may pursue tertiary education. 930 students graduated from the New Haven school district in 2014, and of these students 185 received the Promise scholarship.[17] Of the 697 graduates who were New Haven residents, 31% were ineligible for Promise because their cumulative GPA (at the end of 11th grade) was below 3.0, though they had met the 90% attendance requirement. Another 20% of students were eligible by residency, but did not meet either of the GPA or attendance requirements. GPA appears to be the largest hurdle for students who did not receive Promise – of those students who were eligible by residency, 51% were ineligible for Promise either by GPA alone or because of both GPA and attendance. Only 30 students who graduated and met all three observable criteria (residency, attendance, and GPA – community service hours are not available) did not ultimately receive the Promise, suggesting that almost all students eligible for the program are benefitting from it. Put differently, the New Haven Promise enjoys a high take-up rate of 86%.

[17] New Haven residency was a time-invariant variable in the dataset provided by New Haven Public Schools. Ineligibility due to residency reasons may have been because of time spent outside of the NHPS system or not being enrolled before 10th grade.



Source: New Haven Public Schools Administrative Data

Though data for 2014 graduates' college enrollment and persistence to match the individual-level data on high school performance is not yet available, it is possible to create a rough estimate of the number of high school graduates enrolling in college who are not benefitting from the Promise scholarship. In 2012, the last year for which data was available, 59% of graduates from James Hillhouse High were enrolled in college in the first year after graduation, and 51% of Wilbur Cross High graduates were enrolled.[18] Approximately 45% of New Haven graduates are not enrolling in college after graduation. If we take the same rate of out-of-town ineligibility as was found in the data for 2014 (25%) and 45% as a rate of students who are not enrolling in college, this leaves 30% of the graduating class as students who enroll in college and are New Haven residents, but are not eligible for help from Promise. There has already been an important change to program policy acknowledging this problem – an initiative called Passport to Promise for students with GPAs between 2.5 and 2.99. Still, Passport to Promise is limited to 20 recipients per year and not comparable to the full Promise program, as it grants a scholarship of only $1,000 for the first year of tertiary education. If students are

[18] National Clearinghouse StudentTracker for High Schools Report, Jan. 10, 2014.

able to maintain a 2.0 GPA after two semesters, then they become eligible for the full Promise program.

6.5 Results from Difference-in-Difference Estimates

Post-2011, it appears that the total enrollment decline in NHPS high schools reversed, although a closer examination of total enrollment by grade level suggests that this may not be due to the Promise program. Because the Promise program rewards students by length of residency (with those enrolled since Kindergarten eligible for the full subsidy), if the program was to have an impact on enrollment it would be expected to be concentrated in the lower grades, as was the case in Kalamazoo (Bartik and Lachowska 2012). However, the reverse is true in New Haven. For the district in aggregate, table 9 shows that New Haven experienced a total enrollment increase of 1,263 students in the post-2011 time period when accounting for time trends and existing trends within NHPS and BPS. For grades 9-12, the difference-in-difference estimate shows that the urban school district enrollment decline continued past 2011 for the comparison district, Bridgeport, but the effect of being in New Haven post-2011 was to increase enrollment by 608.75 students. New Haven Promise promotional materials laud this total enrollment decline reversal as a win for the program, as the "10% enrollment increase in the five years since 2011 has netted the district an estimated $25-40 million increase in aggregate revenue."[19] However, looking at other grade segments, it becomes clear that the enrollment increase is concentrated in the middle and high schools and may not be significantly attributable to Promise. Kindergarten enrollment, for instance, was not statistically different between the two districts and the same was true for grades K-4.

[19] PromiseNet 2014 Conference Materials, New Haven, Conn. Also accessible at: http://newhavenpromise.org/promise-infographic/

However, at grades 5-8, there is a positive and significant effect of 716.9 additional students for New Haven after 2011. Since Promise eligibility is based on a sliding scale beginning at 100% for students who attend NHPS schools beginning in kindergarten, these enrollment increases concentrated at the later grade levels refute the idea that students are moving into the district purely to take advantage of Promise. Still, students who are enrolled in the district from 6-12 grade are eligible for 80% of the scholarship which may still act as a significant motivator for enrollment in NHPS. Increases in high school enrollment are much less likely to be attributable to the Promise, as students who start in NHPS in 10^{th} grade are completely ineligible and students who start in 9^{th} grade are only eligible for 65% of the scholarship. In all, figures on enrollment increases are at best murky on Promise-induced changes as they show little effect on grades K-4. That being said, combined with the results from the previous section showing increased value placed on school quality since 2011, it is plausible that homeowners – in particular, homeowners with middle-school aged children – are choosing houses in New Haven due to the Promise scholarship and either enrolling anew in middle school or staying enrolled.

Difference-in-difference estimates examining the change in SAT participation in total and by gender were all statistically insignificant, as seen in table 10. In general, SAT participation rates in NHPS and Bridgeport are both nearing 100%, reaching 97% for the New Haven graduating classes of 2013 and 2014. School-wide test days and fee waivers, separate from the Promise program, have helped with this increase. Average composite scores have hovered in the range of 1200 (out of 2400) since 2006 for both New Haven and Bridgeport, with no statistically significant change attributable to time or location differences.

Table 9: Difference-in-Difference Estimates for District Enrollment by Grade Level

	Total District Enrollment (All Grades)			Total District Enrollment (Kindergarten)			Total District Enrollment (K-4)			Total District Enrollment (5-8)			Total District Enrollment (High School)		
	(1) NHPS	(2) Bridgeport	Difference	(3) NHPS	(4) Bridgeport	Difference	(5) NHPS	(6) Bridgeport	Difference	(7) NHPS	(8) Bridgeport	Difference	(9) NHPS	(10) Bridgeport	Difference
2006-2010	19901.2	20719	-817.8	1635.2	1806.2	-171	7685.4	8624.8	-939.4	5393.8	6194.2	-800.4	5010.6	5283.6	-273
	(117.3)	(306.1)	(327.8)	(100.7)	(23.7)	(103.5)	(92.5)	(48.1)	(104.2)	(58.5)	(213.0)	(220.9)	(75.2)	(106.8)	(130.6)
2011-2014	20690.7	20245.7	445	1751.7	1888.7	-137	7918.7	8856.2	-937.5	5748.2	5831.7	-83.5	5081.75	4746	335.75
	(337.6)	(156.8)	(372.2)	(34.0)	(12.7)	(36.3)	(153.1)	(59.4)	(164.2)	(37.6)	(48.9)	(61.7)	(218.4)	(85.4)	(234.6)
Difference	789.5	-473.3	1262.8***	116.5	82.5	34	233.3	231.4	1.9	354.4	-362.5	716.9***	71.15	-537.6	608.75***
	(357.4)	(343.9)	(495.0)	(106.3)	(26.9)	(121.6)	(178.8)	(76.4)	(186.5)	(69.5)	(218.5)	(256.3)	(230.9)	(136.7)	(253.6)
N			18			18			18			18			18
R^2			0.3637			0.4019			0.886			0.6125			0.395
Adjusted R^2			0.2274			0.2738			0.8616			0.5295			0.2654

Source: Connecticut Department of Education Statistics

Table 10: Difference-in-Difference Estimates for SAT Participation (by gender) and SAT Composite Score

	Total SAT Participation Rate			Female SAT Participation Rate			Male SAT Participation Rate			Average Composite SAT Score		
	(1) NHPS	(2) Bridgeport	Difference	(3) NHPS	(4) Bridgeport	Difference	(5) NHPS	(6) Bridgeport	Difference	(7) NHPS	(8) Bridgeport	Difference
2006-2010	0.745	0.511	0.234	0.722	0.502	0.22	0.526	0.317	0.209	1231	1198	33
	(.02)	(.02)	(.02)	(.03)	(.02)	(.04)	(.03)	(.01)	(.03)	(5.2)	(8.4)	(9.88)
2011-2014	0.885	0.655	0.23	0.873	0.633	0.24	0.613	0.521	0.092	1208	1171	37
	(.03)	(.06)	(.07)	(.04)	(.05)	(.06)	(.02)	(.09)	(.09)	(8.0)	(19.4)	(20.98)
Difference	0.14	0.144	-0.004	0.151	0.131	0.020	0.087	0.204	-0.117	-23	-27	4.00
	(.03)	(.07)	(.07)	(.05)	(.05)	(.072)	(.04)	(.09)	(.09)	(9.54)	(21.14)	(21.5)
N			18			18			18			18
R^2			0.8227			0.7977			0.6519			0.5368
Adjusted R^2			0.7848			0.7544			0.5773			0.4375

Source: Connecticut Department of Education Statistics

7 CONCLUSION

On measures of real estate values, student effort, and district-wide outcome measures, the impact of the New Haven Promise has been limited. There is evidence of increased value placed on houses in higher-performing school attendance zones after 2011 in New Haven, with an additional 8.67% increase in house prices for a one standard deviation increase in test score after 2011. However, there is no evidence that New Haven houses have become any more attractive in relation to surrounding towns. That is, home buyers may be sorting to higher-performing schools within New Haven as a result of the Promise, but there is little reason to believe the New Haven Promise is attracting out-of-town homebuyers or new families into the city. Results from the difference-in-difference analysis are also mixed, showing statistically significant increases in enrollment after 2011 in the middle and high schools but not in the elementary schools.

The claim that New Haven Promise has helped reverse the enrollment decline trend is unsubstantiated by the data, as the enrollment gains are concentrated in later years when students' eligibility for Promise is reduced or even zero. The idea that home buyers may price the tuition subsidy into house sales values also remains unsubstantiated, as the gains in New Haven house values associated with school quality are not statistically different from the gains associated with school quality in neighboring towns. Looking at the estimates on enrollment together with the real estate study suggest that the Promise is not attracting new families to move into the district and enroll their children in NHPS from elementary school on. There is more support for a theory that New Haven Promise prompts families already living in New Haven to stay enrolled in the district, or search for and bid up prices of homes in good attendance zones with the expectation of staying in the district.

The 3.0 GPA requirement separates the New Haven Promise from more universal programs, bringing it closer to being a broad-based merit scholarship rather than a true Promise program as exists in

Kalamazoo. 51% of students who fail to meet the Promise eligibility requirements are failing because of GPA alone or because of the GPA and attendance requirement together. Results of the spline regression on student outcomes when separated by ability groups also show that New Haven Promise does not act as a significant motivator for the bottom 33rd percentile of students. The only significant result for this group showed a decrease in attendance rate between 9th and 11th grade. However, consistent with previous literature on incentives tied to output, I do find that New Haven Promise has a positive impact on high-ability resident 9th graders with GPAs above the 67th percentile. Middling students with New Haven residency also show positive progress over their non-resident peers in the period after Promise, with regard to increased attendance rates between 9th and 11th grade.

Promise programs should be lauded for their aspiration to revitalize whole communities by making the opportunity of college education feasible for all students. However, the short-term outcomes in New Haven do not point to the sorts of broad changes in student outcomes that studies of the more universal Kalamazoo Promise have found. Though effects in the real estate market have not yet been studied in other Promise cities, the results in New Haven do not suggest that home buyers "price" Promise scholarships into the value of Promise-eligible houses.

Appendix

Figure 1: Comparison of Major Promise Programs

	Kalamazoo Promise	El Dorado Promise	Pittsburgh Promise	New Haven Promise
First Eligible Class	2006	2007	2008	2011
Residency Requirement	Yes	No	Yes	Yes
Pro-rated Eligibility	Yes, 100% since kindergarten, 65% for those enrolled as freshmen, not eligible after freshman year	Yes, 100% since kindergarten, 65% for those enrolled as freshmen, not eligible after freshman year	Yes, 100% since kindergarten, 75% for those enrolled as freshmen, not eligible after freshman year	Yes, 100% since kindergarten, 65% for those enrolled as freshmen, not eligible after freshman year
Amount Received	Full tuition	Up to $7,595 (highest resident tuition payable at an Arkansas public university)	Up to $10,000	Full tuition
Eligible Colleges	Michigan public schools, since 2014 15 private liberal arts colleges are also eligible	Any accredited two- or four-year college or university in the U.S.	Pennsylvania public schools	Connecticut public schools (including trade schools)
Students Funded	3,200	1,444	4,833	364
Attendance Requirement - High School	None	None	90%	90%
GPA Requirement - High School	None	None	2.5	3.0, or 2.5-2.99 for Passport to Promise
GPA Requirement - College	2.0	2.0	2.0	2.5
Funding	Anonymous private donors	Major donor: Murphy Oil ($50M)	Major donor: University of Pittsburgh Medical Center ($100M), other private foundations, corporations, individual donors	Major donor: Yale University, supported by Yale-NH Hospital and Wells Fargo, with administrative support from Community Foundation for Greater New Haven
Other Features			Paired with supporting initiatives to increase high school completion/college readiness. School-based mentoring and outreach	Required 40 hours of community service; eligibility was phased in (Class of 2011 only eligible for 25% scholarship, 2012 50%, 2013 75%, 2014 100%)

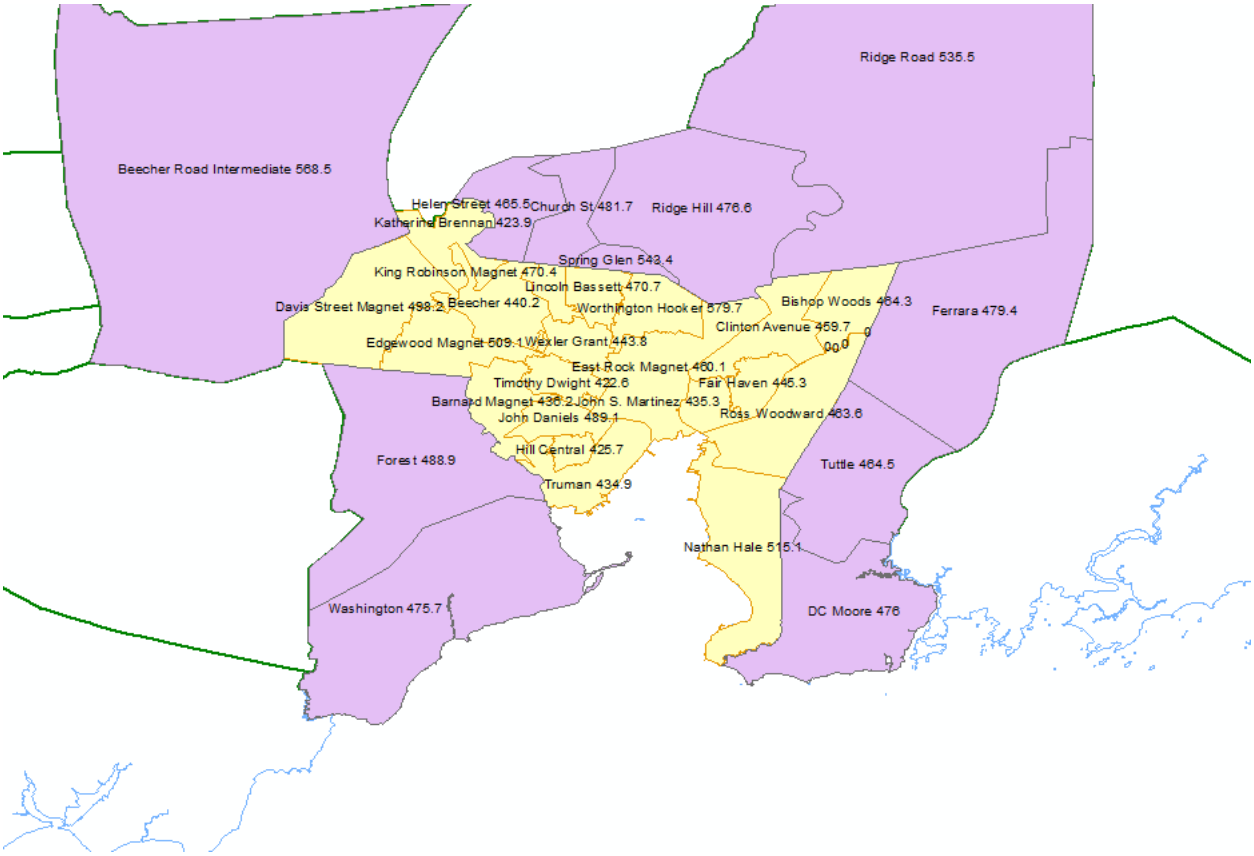
Figure 2: New Haven Promise Banners along the Town Green

Figure 3: Demographic comparison of New Haven, Bridgeport, Hartford School Districts

	New Haven	**Bridgeport**	**Hartford**
Per capita income and benefits	$23,026	$19,743	$16,448
Median Household Income	$38,482	$39,822	$28,931
Number of Households	49,308	50,824	45,895
Population 3 years and older enrolled in school	43,336	43,596	41,254
Population enrolled in High School	7,398	8,944	8,445
Employment Status – In Labor Force	65.4%	67.5%	60.9%
% of Families whose Trailing 12-month Income is Below Poverty Level	21.8%	31%	31%
Total Housing Units	57,045 (49,308 occupied/7,737 vacant)	58,475 (50,824 occupied/7,651 vacant)	54,182 (45,895 occupied/8,287 vacant)
Race: White alone	46.7%	48.6%	32.2%
Race: Black alone	34.4%	34.5%	37.2%
Race: Identifies as Hispanic	26.3%	36.7%	42.4%
Population 25 and Over: Less than High School	19.5%	26.9%	32.1%

Source: National Center for Education Statistics, American Community Survey 2008-2012

Figure 4: School Attendance Zones with Associated Mean CMT Math and Reading Sum Scores Averaged over 2009-2011



Note: Attendance zones in surrounding towns were not coded beyond those districts directly adjacent to NHPS, i.e. North Haven's Ridge Road elementary school does not cover all of North Haven, but it does cover all those houses within .30 mile of the boundary touching New Haven.

Figure 5:

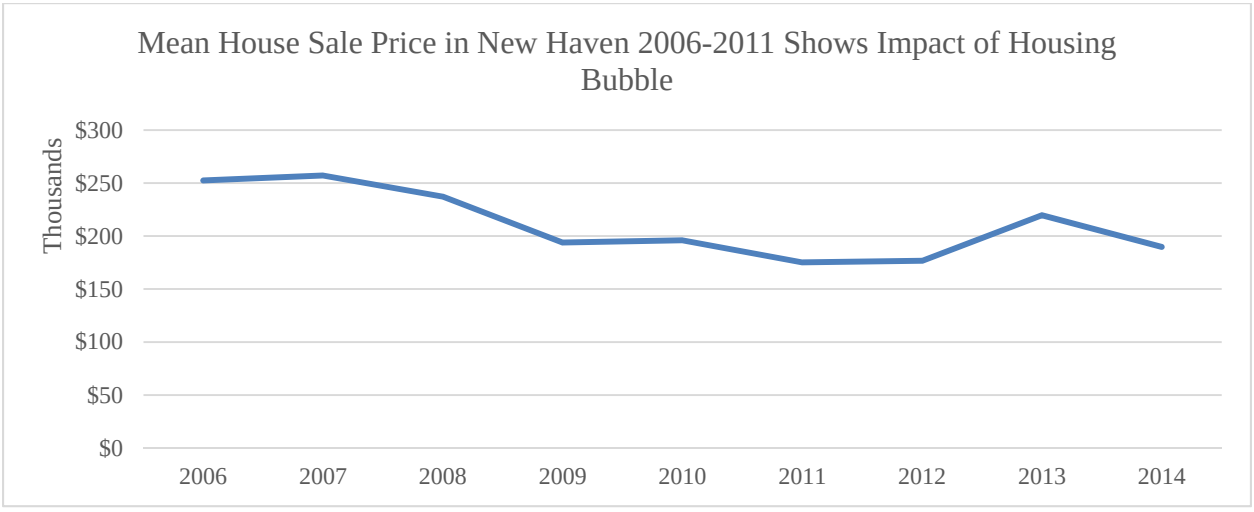


Figure 6: Histograms Showing Distribution of 9th grade GPA, Attendance, Suspensions, and Credits earned (All Students)

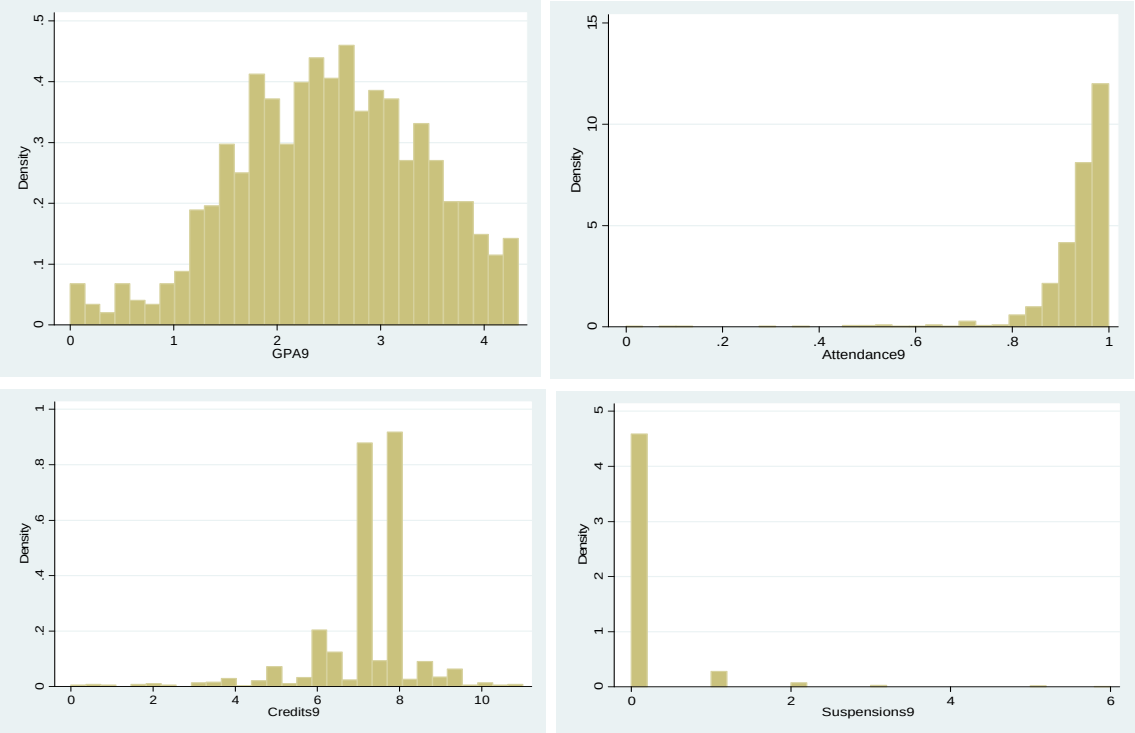
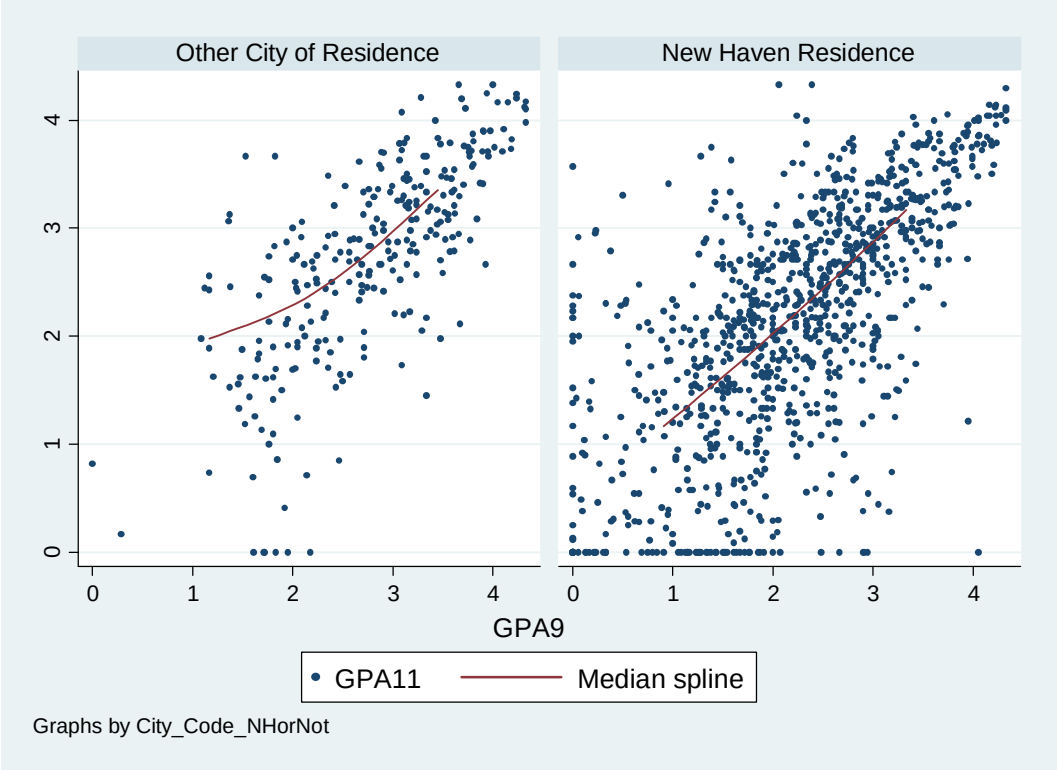
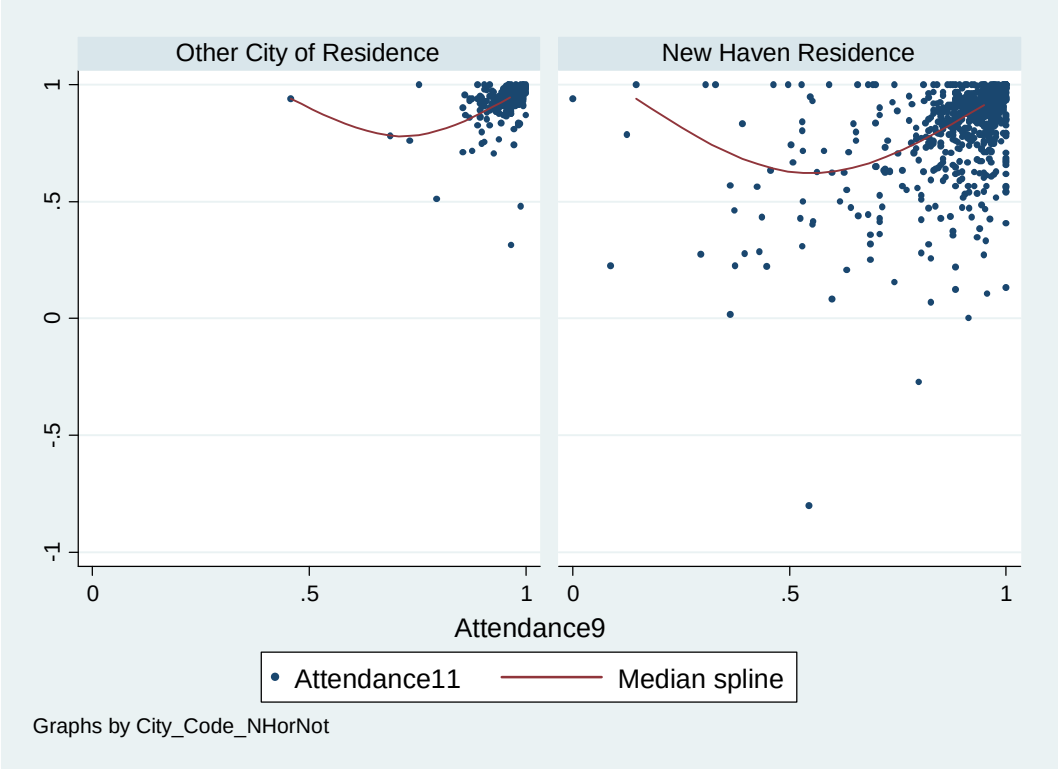
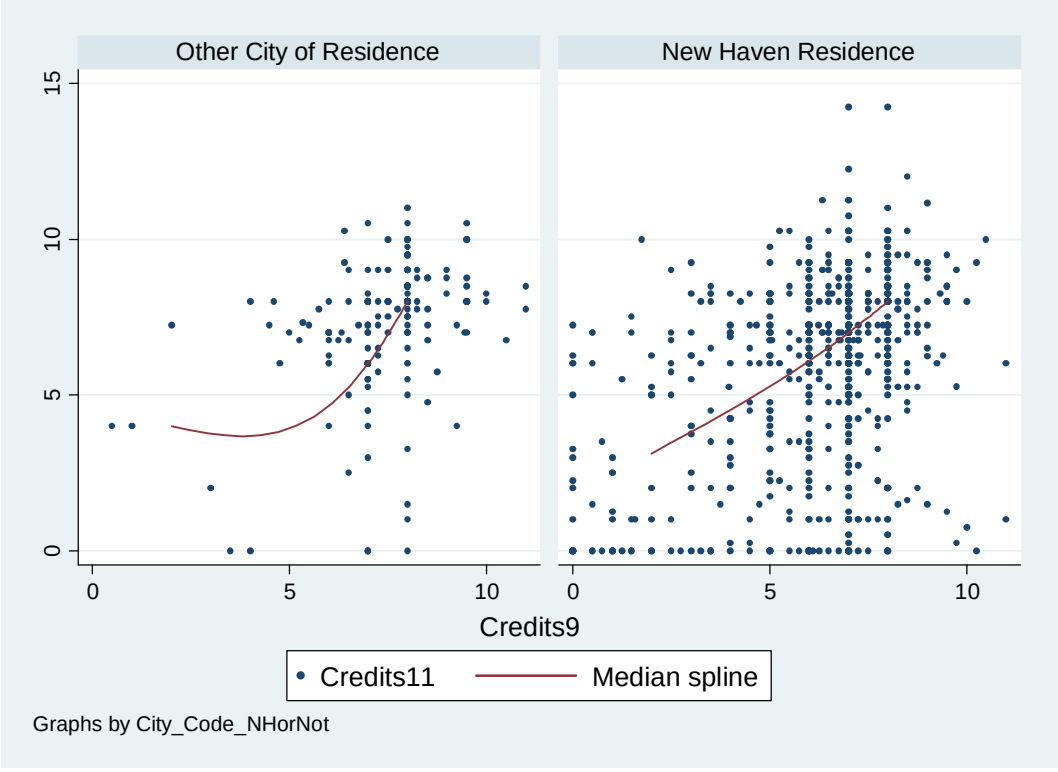


Figure 7: Spline plots of 11th Grade GPA, Attendance, Credits Earned, and Suspensions on 9th Grade Outcomes of the Same Category




Other City of Residence
New Haven Residence
1
.5
0
-.5
-1
0
.5
1
Attendance9
Attendance11
Median spline
Graphs by City_Code_NHorNot


Other City of Residence
New Haven Residence
15
10
5
0
0
5
10
Credits9
Credits11
Median spline
Graphs by City_Code_NHorNot

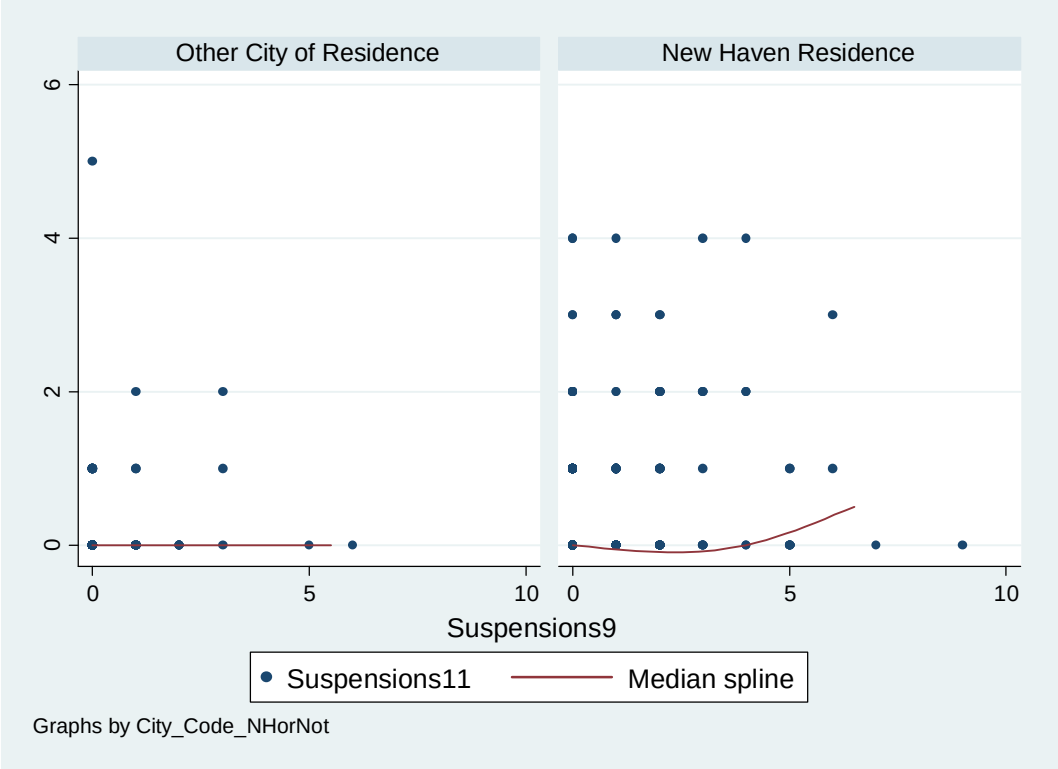
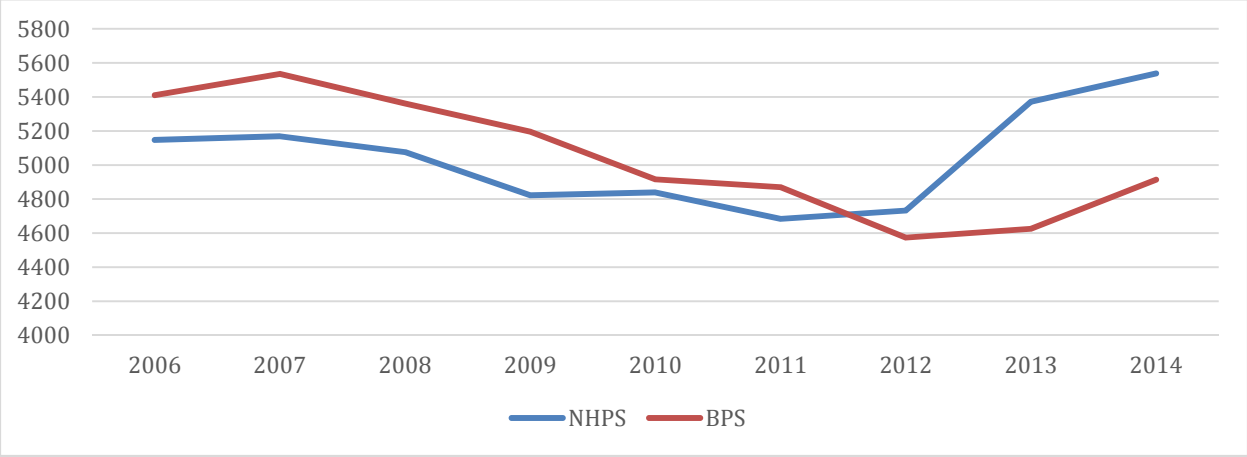
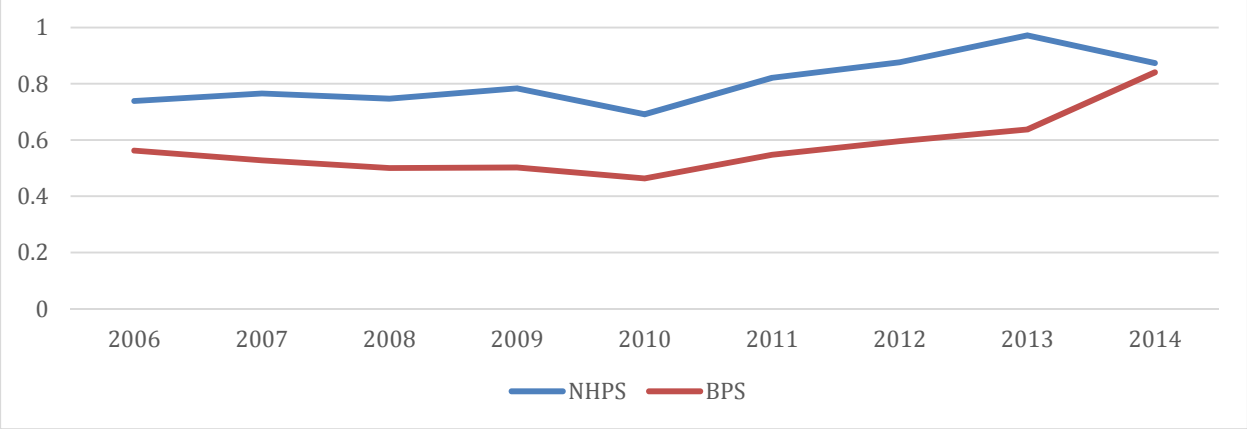

Other City of Residence
New Haven Residence
0
2
4
6
0
5
10
Suspensions9
Suspensions11
Median spline
Graphs by City_Code_NHorNot

Figure 8: Graphs Showing Trends in NHPS and BPS Enrollment, SAT Participation/Scores

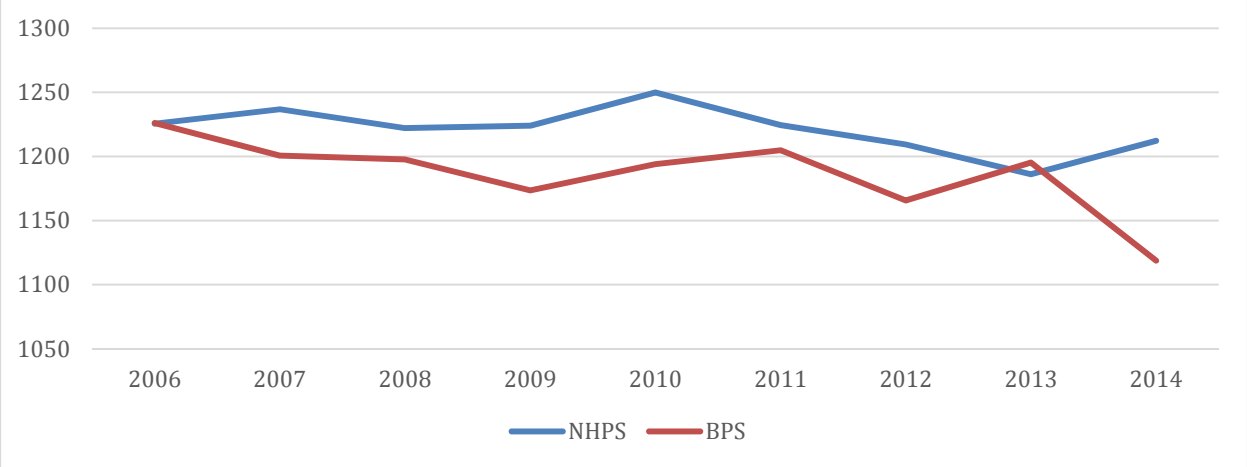
a. Total District Enrollment (High Schools Only)



b. Senior SAT Participation Rate



c. Average SAT Scores:



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