Can Improvements in Schools Spur Building Investments? Evidence from New York City

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1. Introduction

For most households in the U.S. the public school to which they send their children is tied to the geographic location of their home, and almost ninety percent of elementary school aged children in the United States are enrolled in public schools. Economic theory predicts that households take into account the quality of the public school when making residential decisions. Since Tiebout's seminal piece (1956), arguing that households "vote with their feet" in response to preferences over packages of local public goods, this idea has been a central component in theories of local public finance. A large body of literature has documented that school quality alters the demand for housing in a neighborhood as measured by the capitalization of school quality in house prices (Oates, 1969; Black, 1999; Black and Machin, 2010; Nguyen-Hoang and Yinger, 2011). Demand for schools may also affect the quality of the housing stock by creating incentives, through increased rents, for property owners to better maintain their buildings. Exploration of this potential relationship has been absent from the discussion on how schools influence communities.

This paper explores whether variation in the performance of local schools (as measured by test scores) can explain different levels of capital investments in the housing stock. I argue that neighborhoods with high performing schools are able to attract and retain households with children. This increases demand for housing in the neighborhood overall, and can also change the demand for larger and potentially better maintained housing units. As the willingness to pay for a higher quality unit rises in the neighborhood this increases the benefit to property owners of investing in the maintenance of their properties.

Beginning with Oates (1969) research on the capitalization of local public spending it has been widely established that households are willing to pay for a higher quality public school, as measured by the capitalization of school attributes into house prices. Black (1999) introduced the boundary discontinuity method to identify the capitalization of school quality into house prices, finding that a one standard deviation increase in average test scores is associated with a two percent increase in housing values. Summarizing this literature, Black and Machin (2010) and Nguyen-Hoang and Yinger (2011) find that on average a one standard deviation improvement in test scores is associated with a 3 to 5 percent increase in housing values. This literature documents that schools do change the demand for housing in a particular neighborhood. Though some have suggested that schools may also shape the supply of housing in a neighborhood (Figlio and Lucas, 2004; Bayer, Ferreira and McMillan, 2007) there has currently been no empirical investigation of this potential relationship.

To investigate whether a relationship exists between schools and property owner capital investment activity, I rely on detailed building level investment data in New York City as well as measures of school performance. I explore whether consistent measures of school performance are associated with higher levels of investment activity. To identify whether this relationship is causal, that good schools can spur investment activity, I incorporate a boundary discontinuity identification strategy. I test whether this relationship holds when comparing buildings that are very close to one another and thus subject to the same neighborhood forces, but on opposite sides of an elementary school attendance zone boundary. Finally I test whether households respond to changes in school performance, exploring whether improvements in test scores over a five-year period are associated with higher levels of residential investments.

My results suggest a significant relationship between performance in math and English Language Arts (ELA) and property owner capital investment behavior. In my preferred specification, I estimate that a one standard deviation improvement in test scores is associated with a 2.5 percent increase in dollars invested in a building. When exploring the relationship between long term changes in school performance and investment activity, I again see that property owners are sensitive to these changes in school performance when making the decision to invest in their property. Specifically, I find that a one standard deviation improvement in test scores over 5 years is associated with a 2.4 percent increase in dollars invested in a property.

The paper proceeds as follows. I begin by providing some background on property owner investment behavior and laying out a simple theoretical framework which describes the ways in which school performance could induce property owners to invest in their properties. I then describe the data as well as the New York City public schools. I continue with the empirical methodology and results followed by some concluding thoughts.

2. Residential Investment Behavior

The investment decisions of property owners play a large role in determining the trajectories of America's neighborhoods. Annual expenditures on residential improvements exceeded 236 billion dollars in 2007 which is about half the amount spent on new construction over the same time period.[1] This large sum highlights the importance of understanding which factors influence property owner investment activity.

The small body of research on investment behavior has shown that neighborhood characteristics can be critical determinants of investment behavior. Positive perceptions of one's neighborhood are correlated with greater levels of investments (Shear, 1983; Galster, 1987). Galster (1987) finds that homeowners who perceive their neighborhood to be of higher quality are more likely to engage in activities correcting exterior structural defects but engage in repair activity with the same frequency. More recently, Sharygin (2010) finds that in neighborhoods which experience high levels of house price appreciation housing re-investment is more likely to occur.

Other studies have explored specific neighborhood characteristics finding that well maintained curbs, gutters or sidewalks as well as proximity to amenities such as a lakefront and accessibility to the central business district can increase the likelihood that households will invest in their property (Mayer, 1981; Helms, 2003). There has been some research on the relationship between neighborhood crime and investment activity, with conflicting results (Mayer, 1981; Boehm and Ihlanfeldt, 1986) There is also some evidence that investment is less likely to occur in neighborhoods with a higher share of black households (Mayer, 1981).

There has been almost no work examining the relationship between school quality and housing investments. The only study to specifically explore whether school quality is correlated to investment activity was conducted by Boehm and Ihlandfeldt (1986) and

[1] Based on estimates from the 2007 Census of Buildings.

they are limited to an indicator for whether a household has a positive perception of their local school. They find no significant relationship between their measure of perception of school quality and housing investments. This paper adds to the existing knowledge on capital investment behavior by exploring whether objective measures of school performance are related to property owner capital investments.

To motivate the empirical analysis I rely on a simple model of housing investment behavior, first written out by Mayer (1981). A property owner, assumed initially to be an absentee landlord, will invest in their property, or increase their capital stock, to the point where the market value of an additional unit of capital is equal to the marginal cost of capital plus the fixed costs of adjusting the current home.[2] Assuming that the money earned from providing housing services[3], H, is a function of capital stock, K, and current maintenance, M, we define the following production function $H = h(K,M)$. Given the current market conditions there exists an optimal level of capital stock, K*, based on the optimal amount of maintenance, M*, that allows the property owner to maximize their profits. If the initial level of capital stock in a building is K_0, then the likelihood that a property owner will engage in reinvestment activity will be based on the gap between the current capital stock and the optimal capital stock, $I = f(K^* - K_0)$. If the gap is large and positive this provides an incentive for the property owner to make an investment.[4]

[2] Fixed costs include factors such as disturbing tenants and meeting with contractors, and in part explain why landlords do not continuously invest in the property.
[3] Mayer notes that inputs such as heating fuel are used to produce housing services, but that the inclusion of these inputs will not alter this theoretical analysis.
[4] Capital investments are lumpy and have associated economies of scale and fixed costs, such as filing a building permit or relocating tenants, which could be incorporated into a more complex theoretical model. I rely on this simpler capital stock adjustment to motivate this empirical analysis, which does not change the predictions of the theoretical model. See Mayer (1972) for a framework of fixed costs.

We next consider the neighborhood characteristics, N, surrounding this property which affect the rents that tenants are willing to pay for a given amount of housing services. The property owner faces a revenue function which is determined both by the neighborhood characteristics and the level of housing services $R(H,N) = P(H,N) \cdot H$ where R is the rent received by the landlord and P is the per service unit price at each level of housing services.[5]

The optimal provision of housing services results from maximizing the following profit function, defining P_K and P_M as the prices of capital[6] and maintenance respectively

$$\max_{M,K} P(H,N) \cdot H(K,M) - P_K K - P_M M \quad (1)$$

The following first order conditions follow from this profit function

$$\partial R/\partial H \cdot \partial H/\partial K - P_K = 0 \quad (2)$$

$$\partial R/\partial H \cdot \partial H/\partial M - P_M = 0 \quad (3)$$

Given P_K and P_M the property owner can decide upon the optimal level of housing services, capital stock and maintenance.

5 I again follow Mayer (1981) and define housing services as in Muth (1969).

6 P_K is the "rental" price of capital, again drawing from Mayer (1981) reflecting the asset price, interest rate, depreciation rate, property tax rate, and any potential appreciation.

As this research is focused on whether school performance can shape investment activity, a critical component of this theoretical model is how neighborhood characteristics increase the probability of investments. Focusing specifically on school performance, for schools to increase housing investment they must not only increase rents, but they must *increase rents from providing a higher quality dwelling*. Stated more formally, the change in rents associated with a given change in housing stock, $\partial R/\partial H$, must be dependent on a particular neighborhood amenity, N, in this case schools. For this relationship to hold, households must exhibit complementarities in their preferences for both higher performing schools and higher quality housing.[7] I argue that households with children could exhibit these types of complementarities in their preference structures. As this is an empirical question, I draw descriptive results from the American Housing Survey (AHS) to provide suggestive evidence of these complementarities.

Households with children are more sensitive to the performance of their local public school, as compared to other households. Consider that 26 percent of households with children in the 2009 AHS cite the quality of the local public school as a primary reason for choosing their neighborhood, in comparison to just 6 percent of households without children. Also, households with children require more space and often more bedrooms and bathrooms than households without children. According to the 2009 AHS households with children live in units that are on average 300 square feet larger than those of households without children. On average households with children live in units

[7] Some households without children may also exhibit such complementarities in their preferences if they believe that good schools are necessary components of vibrant neighborhoods and they are searching for high quality dwelling units (see Hilber and Mayer, 2009, for a discussion on why households without children are still willing to pay for public schools).

that have 3.2 bedrooms and 1.7 bathrooms, whereas households without children live in units with 2.5 bedrooms and 1.5 bathrooms.

Neighborhoods with good schools could therefore be attracting households with children, and leading to a higher level of demand for larger and better maintained units in the neighborhood. This increases the market rents on these larger and better maintained units in the neighborhood, increasing the probability that a property owner will engage in maintenance activity. Formally we can focus on the desired capital levels, K*, and now assuming that $\partial R/\partial H$, the change in rents associated with a given change in the housing stock, is a function of N,

$$K^* = g\ (N, P_K, P_M) \tag{4}$$

the investment decision can now be defined as a function of the price of capital (P_K), the price of maintenance (P_M) inputs as well as the quality of the neighborhood (N). In capturing neighborhood attributes I focus specifically on the performance of the local public school.

Shifting to the perspective of an owner occupier with a child who is about to be school age, the decision to invest becomes a two-step process. First the household must make the decision of whether to stay in the neighborhood and send their child to public school or private school or alternatively whether they will move to a new unit in a neighborhood with a higher performing school system.[8] In neighborhoods with better schools these households may be more willing to stay in the neighborhood and improve their housing stock to meet their new housing needs rather than move to a new unit and incur the high costs associated with moving.[9] We can equate this again to $\partial R/\partial H$ being a function of N, where schools increase both the sales value of the house and the consumption value to the homeowner, increasing the likelihood that a homeowner will engage in investment activity.

Additionally, there is some evidence that households without children care about the quality of the local public school in their neighborhood (Hilber and Mayer, 2009). This relationship could arise as households without children view the performance of the public school as a signal of the general neighborhood quality or the future neighborhood quality which will shape the value of their asset. Overall there is reason to believe that school performance could influence the amount of investment activity that takes place in a neighborhood.

3. Data

[8] As there are many schooling options in the New York metropolitan area, some households may choose to leave New York City all together. If households with children are more likely to leave New York City all together this will bias my results towards a null finding, even if in fact households with children do exhibit complementarities in their preferences for housing and schools.

[9] This simple model assumes that households do not have foresight into their future housing needs. Relaxing this assumption, however, leads to a similar conclusion. If households on the other hand know that they will need more space once they have children, they may still purchase a home that needs renovations and either renovate right away or wait depending on their certainty of staying in the home once they have children. If the schools are good, this may increase a family's certainty of staying in the neighborhood, and increase the chances they will renovate either now or in the future. And if schools improve while a family lives in the neighborhood, this may have an even greater marginal impact on a household's likelihood of staying and renovating.

This analysis focuses on investment activity in New York City, relying on data from a number of different sources. Data on property owner investment decisions comes from the New York City Department of Buildings (DOB) between the years 2003 through 2010. This rich dataset includes a detailed description of every permit filed, the estimated cost of the investment, the estimated additional square footage that would be added to the unit, as well as a few sentences describing the scope of each project. According to the DOB, a permit must be filed for any work that involves "public safety and health, the structural integrity of the building, new structural loads, new anchorages," or a number of other items under the city's building code. All jobs that involve cutting away any portion of a wall or adding new walls also require building permits. This dataset should therefore include all jobs that add square footage to a unit or add additional rooms to a unit, plus other types of changes.[10] It is important to note, that some of the work allowed in these permits may never be completed, and many will not begin for a number of months after the permit is issued.[11]

These data are merged to each building in New York City through the Primary Land Use Tax Lot Output (PLUTO) which is a database created by the Department of City Planning describing every building in New York City. This dataset includes details

[10] Of course some projects that require a permit may be completed without a permit, and therefore this dataset will most likely include an undercount of investment data.

[11] Applying for a building permit can be a complicated process. A New York State licensed professional engineer or registered architect must submit construction plans to obtain a permit. A department plan examiner then reviews the plans for any potential problems, such as legal or zoning objections. When all potential objections are satisfied, the Department of Buildings then approves the application. It is also possible for a professional engineer or registered architect to certify that plans comply with applicable laws. For more information on applying for a building permit in New York City see http://www.nyc.gov/html/dob/html/development/permits_howto.shtml. The New York City Department of Buildings records all of these permits, including information on the property location, the date the permit was approved, the estimated cost of the project, the additional square footage that will be added to the property as well as a detailed description of the project which is about one or two sentences in length.

on all buildings in New York City, identifying the building type[12], age and size.[13] My sample includes a total of 631,287 residential buildings, together with 304,578 building permits filed for alterations of these buildings. These permits request over 24 billion dollars of investment, over 32 million square feet added to residential buildings and over 49,000 building permits filed to add additional rooms to a housing unit.[14] Table 1 includes a summary of the building investment data by year, throughout the sample period 2003-2010. Based on this data I construct three different measures of building level investments, summing investment data from July 2006 through June 2010 so that I am able to observe sufficient variation at the building level. I also construct a lagged measure of investment at the school attendance zone level, summing investment data from July 2003 through June 2006, to control for previous levels of investment at the neighborhood level.[15]

To establish the baseline levels at which school performance is capitalized into housing values in New York City, I also incorporate data on house price sales. These data are used primarily to suggest that New York City is an appropriate site for this analysis, as school quality is capitalized into housing values just as the broader literature

[12] I model these variables as dummies for each building type, using single family homes as the omitted category.

[13] This dataset, however, does not allow me to separately identify which buildings are owner occupied vs. renter occupied, thus I pool results for these two types of properties.

[14] As I believe filing a permit signals that the property owner intends on investing in the property, I do believe this is the appropriate measure of investment even though some of these projects may not be completed.

[15] I chose this time period so that I am able to observe sufficient variation in the post period while controlling for investment in the prior period. I chose to control for investment in the prior period at the school zone level rather than at the individual property level because of the short time period for which I have property level investment activity. Neighborhood level investments in the prior three years should provide a clear picture of ongoing investments in a neighborhood, and we may expect neighborhood investments to be correlated with increased investment in a particular property. Property level investment activity in the past three years does not provide sufficient information on the property's history to inform us whether this property is in need of a current renovation.

has shown throughout the country (Black and Machin, 2010; Nguyen-Hoang and Yinger, 2011). Through an arrangement with the New York City Department of Finance (DOF) and the Furman Center for Real Estate and Urban Policy, I have obtained a database that contains sales prices and dates for the transactions of all residential properties between 2006 and 2008.[16] My baseline sample includes 43,999 sales, with a mean value of $327,000 per property.[17]

Data on school performance comes from the New York City Department of Education. Importantly, and uniquely, New York City is a single tax district, meaning property tax rates are constant across school zones throughout the school district.[18] I include fourth grade English Language Arts and mathematics performance levels for the school years 2003-2004 through 2005-2006. I then use an elementary school boundary file to map all school zones onto building parcels. I have data on attendance zone boundaries from two points in time, the 2003 and 2008 school years. I remove from the analysis the eight attendance zones with boundaries that changed over this time period. I also remove from my sample zones where a school opened or closed during my study period, which includes fewer than 70 attendance zones. In total my sample includes just under 600 attendance zones.

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[16] This dataset includes a wider range of years, but for the purpose of this analysis I rely only on a small segment of the dataset.

[17] This sample is significantly smaller than my sample of properties for which I have investment data. For this reason I estimate results for housing values and investment activity separately, on a different sample of housing units.

[18] As part of the larger NYC budget, the Department of Education is financed through a mix of city tax revenue and state and federal aid, which contrasts with other school districts nationwide that are primarily financed through property taxes. In 2009, for example, 40% of the NYC tax revenue came from property taxes, 21% came from personal income taxes, 13% came from general sales taxes and 8% came from corporation taxes (IBO, 2010). The remainder of the budget was funded through state and federal categorical grants. In 2010, 30% of the $60 billion dollar NYC budget went to the Department of Education (IBO, 2010).

Additional neighborhood descriptive variables are drawn from the 2000 Decennial Census at the census tract level, including descriptions of household race, household composition and levels of education. These variables serve as controls for other neighborhood characteristics that may be related to increased investment activity. Data on neighborhood level crime, also measured at the census tract level between 2004 and 2006, are provided by the New York City Police Department.

4. New York City Schools and Measuring School Performance

Between 2000 and 2010 the New York City population grew from 8 million to 8.3 million and the number of households with children increased, from 920,000 to 970,000. There was wide variation between neighborhoods, however, in the degree to which they attracted and retained households with children. Of the 2,200 census tracts in New York City, 57 percent experienced growth in the share of households with children. The share of elementary school aged children attending public schools remained fairly constant, declining from 81 percent to 79 percent.[19]

New York City remains the largest system of public schools in the United States, serving over one million students. The majority of students in New York City public schools are eligible for free or reduced price lunch (70 percent). Additionally most of the students are minorities; 32 percent of the students are black, 40 percent are Hispanic and 13 percent are Asian. Even though only a small share (15 percent) of students are white, New York City public schools still educate a much larger share of white students than the

[19] Estimates are drawn from the 2000 Decennial Census and the 2005-2009 American Community Survey.

two other largest urban school districts in our nation, Los Angeles and Chicago, which both serve white populations of 8 percent.

Though there is a great deal of choice associated with the selection of public high schools and middle schools in New York City, elementary schools are predominantly 'zoned' schools. Of the 480,000 students attending public elementary schools in the 2005-2006 school year, 3 percent attended charter or magnet schools.[20] Many charter schools have opened since 2006, but they still make up a small share of elementary schools. In the 2008-2009 school year 11.5 percent of public elementary school students attended charter or magnet schools.[21] Throughout the study period, elementary school students attending public schools are for the most part required to attend their zoned elementary school. Additionally, New York City requires households to provide two documents displaying proof of residence for a household to register their child in the zoned elementary school, further strengthening the link between housing and schools.[22]

I build on existing literature to create a reliable measure of school performance (Black, 1999; Bayer et al., 2007). Test scores are currently the most commonly-used metric of school quality, viewed as key intermediate measures that provide information on how well the school is educating students as well as how students are likely to perform in the future (Currie and Thomas, 2001).[23] I use three year averages of the mean

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[20] Based on data from the 2005-2006 Common Core of Data.
[21] Based on data from the 2008-2009 Common Core of Data.
[22] http://schools.nyc.gov/ChoicesEnrollment/Elementary/default.htm
[23] There is a great deal of criticism of school level standardized test scores being used as a measure of school quality, as these scores are more representative of the socio-economic status of the student body, rather than the ability of the school to educated its student body. Additionally there is increasing evidence of cheating on these exams as well as teaching to the test, both of which create misleading information on school level performance of the student body. These tests, however, remain the most widely used measures of school performance.

performance levels in 4th grade for both math and English Language Arts[24] (taking the simple average of math and ELA within each year)[25] over the 2004-2006 school years as test scores are often quite volatile from year to year and using multiple years of data creates a more stable measure of school performance (Kane and Staiger, 2002). There is wide variation in the performance of public schools throughout the five boroughs of New York City. Performance in New York City elementary schools based on these three year averages ranged from 582 to 715 with a mean of 656. I standardize these three year mean performance levels into Z-scores so that they have a mean of zero and standard deviation of one.

5. Empirical Analysis

To establish the relationship between investment activity and school performance, I explore whether school performance and house prices are correlated in New York City, as a large body of literature has documented outside of New York. Figure 1 displays the relationship of the log of median home values in New York City census tracts to the mean performance in math and ELA and shows a strong positive correlation. Once I establish this baseline relationship I further explore whether a similar correlation exists between school performance and investment activity. Figure 2 also shows a strong correlation between the log of total dollars invested between 2006 and 2010 within each school zone and the mean performance levels in math and English Language Arts. The

[24] I rely on math and English Language Arts as these are the subjects for which mean scores are reported throughout the study period.
[25] I have also run this models for math and English Language Arts separately and results are consistent. For ease of presentation I have limited my results to this one consistent measure.

following section explores whether these relationships hold after controlling for other factors which may be driving the relationship between investment activity and school performance.

5.1 Baseline Models

I begin the empirical analysis with a set of simple cross section regressions to test whether housing prices and investment activity are correlated with school performance after controlling for a series of critical neighborhood factors. I estimate the following regression

$$Y_{izn} = \gamma \, SCH_{z} + \alpha \, X_{n} + \beta \, U_{izn} + \varepsilon_{izn} \qquad (5)$$

where *i* represents the building parcel, *z* represents the attendance zone and *n* the census tracts. I begin by estimating the capitalization of school performance into housing values with Y_{izn} representing the log of real house prices per unit, between 2006-2008. I then include the dependent variables of interest, investment activity, measured between 2006 and 2010. In this series of models Y_{izn} represents three different measures of investment activity in the building: the log of dollars invested per unit, the log of square feet added per unit[26] and the total number of permits filed specifically requesting the addition of a bedroom or a bathroom. SCH_z represents the independent variable of interest, the mean performance in math and English Language Arts between 2004-2006. X_n represents a

[26] As there are many buildings with no investments during this time period, in order to retain valuable information about these properties in the analysis, I replace zero values with ones and then take the logarithm. This follows from Engen and Gale (2000) as this transformation does not alter the median values of investment.

vector of neighborhood level controls, which are mostly drawn from the 2000 Decennial Census. U_{izn} represents a vector of building characteristics including type, age, square footage, and lagged investment behavior, measured in 2006.

Results from the hedonic regression for housing sales between July of 2006 and June of 2008 are presented in Table 2. Model (1) presents results with no neighborhood controls, and model (2) includes neighborhood controls. Consistent with the existing literature, the results suggest that school performance is capitalized into housing values. The magnitude of the coefficient on test scores declines significantly once neighborhood characteristics are included in the model, but remains quite large and the coefficient remains highly significant, consistent with existing research. Based on these models a one standard deviation increase in test scores is associated with a 7.8 percent increase in housing values.

To establish whether school performance is also correlated with an investment response, in Table 3 I estimate the relationship between school performance and building investments. I include both controlled and uncontrolled models. Overall I find that all forms of investment are positively associated with the mean performance in math and English. I find that levels of investment are higher in buildings located near higher performing elementary schools. A one standard deviation increase in performance on math and ELA is associated with a 1.6 percent increase in dollars invested and 1.7 percent increase in square footage added to the building.

To provide a sense of the magnitudes of these coefficients, the median nonzero investment during this time period cost an estimated $15,000 and included an additional 470 square feet. Therefore a 1.6 and 1.7 percent increase in investments, respectively, is equivalent to an additional $240 and eight square feet, on average. Looking at the number of permits filed specifically requesting the addition of a bedroom or bathroom, a one standard deviation increase in test scores is associated with an additional permit filed for every 1,000 units. These results are strongly statistically significant and provide the first piece of evidence that school performance can affect the supply of housing in a neighborhood in addition to the demand for housing.

Building characteristics have varying, sometimes conflicting relationships with investment activity. In general I find that building characteristics differ in their association with the three different measures of investment. For example, I find a greater number of dollars invested per unit in multifamily buildings, but fewer square feet or bedrooms/bathrooms added in these types of buildings. These differences in investment patterns across building types appear to capture constraints on the types of investments that are possible in these different building types. For example, to invest in a multifamily building there are constraints on the square footage or bedrooms one can add to a unit, which is not generally the case in a single family home or a two-six family home.

Neighborhood characteristics also have varying associations with investment activity.[27] The most important factor to highlight regarding these neighborhood characteristics, is that the magnitude of the coefficient on test scores greatly diminished with their inclusion, though it remains statistically significant and positive across all measures of investment. This drop in the size of the coefficient as neighborhood characteristics are added highlights that some of the apparent association between test

[27] Across all investment types we see a higher level of investment activity in neighborhoods with a greater amount of dollars invested in the previous period. We can interpret this variable as a control on lagged investments in the neighborhood, allowing us to separately identify the relationship between schools and future investment while holding previous investment constant.

scores and investment may be driven by differences in the neighborhoods that have high performing schools in comparison to those neighborhoods that have low performing schools.

Taking a look at one measurable neighborhood characteristic, building composition, Table 4 shows the distribution of housing type for neighborhoods with different levels of school performance. Neighborhoods in the upper half of the performance distribution have a much higher share of single family homes than do neighborhoods in the bottom half of the distribution. Neighborhoods in the top quartile also have a significantly larger share of units in condominiums and cooperative buildings (25.4%) than do neighborhoods in the bottom quartile (8.3%). Neighborhoods in the bottom quartile instead have a much higher share of units in multifamily rental buildings (27.6%) than do neighborhoods in the top quartile (12.2%). These large differences in observable characteristics of neighborhoods suggest that there may be large differences in unobservable characteristics that are driving the relationship between investment activity and school performance. To control for potentially omitted variables, I employ a boundary discontinuity design.

5.2 Boundary Discontinuity

To isolate the influence of school performance, I build on a simple boundary discontinuity method developed by Black (1999). I compare two parcels that are embedded in the same neighborhood that differs only by elementary school performance. Unlike my previous methodology, I am now able to compare buildings in the same neighborhood that differ only by elementary school performance.[28] I limit my analysis to building parcels close to the attendance zone boundary on either side where both sides are included in the same community school district. I limit my sample to buildings within smaller bands around the boundary from 1,000 feet down to 500 feet, which is approximately the length of one city block. I define these clusters as boundary groups, as these boundary groups are composed of adjoining census blocks and building lots. I limit my analysis to boundary groups that have at least ten buildings on each side of the boundary. A typical boundary group includes between 100 and 500 buildings. I have 1,619 such boundary groups in this analysis, which includes 595 different elementary schools. This method controls for the unobserved variations in neighborhoods. I further limit my analysis to elementary schools within the same community school district to reduce variation that is not caused directly by the performance of the school.

To assess whether this methodology allows me to compare buildings within neighborhoods that are more similar than the neighborhoods I was previously comparing, I explore the differences in the housing stock on either side of the elementary school boundary. I assign a dummy describing each side of the boundary as either the high side or the low side and test whether there are observable differences in the housing stock on either side of the boundary. I present these results in Table 5. I find that there are some small significant differences in the housing stock on either side of an elementary school attendance zone. There are no significant differences in the number of units in a building on either side of the boundary, there are slightly fewer condominium buildings on the side of the boundary with higher test scores, and these buildings are slightly bigger and

[28] Again, as New York City is a single tax district, property tax rates are the same on either side of the attendance zone boundary, limiting the variation across the boundary to the differences in the school itself.

older on average, though these differences are very small.[29] These findings are consistent with those of Black (1999) and Kane et al. (2006) who find differences in the number of bedrooms and size of the unit on either side of an elementary school attendance zone boundary. This approach therefore does compare neighborhoods that have a more similar housing stock but are served by a different elementary school. To provide a sense of the magnitude of differences in test scores across this boundary, the average test score gap is 0.7 of a standard deviation, which is equal to 10 points on the standardized test. I next use the boundary discontinuity approach to estimate the relationship between school performance and investment activity.

I estimate the following empirical model

$$Y_{ikz} = \gamma \, SCH_{kz} + \beta \, U_{ikz} + \eta_k + \varepsilon_{ikz} \qquad (6)$$

where *i* represents the building parcel and *z* represents the attendance zone. In this model I add *k*, which identifies the boundary group in which that household is located. I once again begin by estimating the hedonic regression, modeling Y_{ikz} as the log of the real sales price of the building, to first establish a causal relationship between the value of housing and school performance. I then estimate the relationship between school performance and investment activity, allowing Y_{ikz} to represent the investment activity in the building. SCH_{kz} represents the school characteristics. In this model, as I do not separately control for neighborhood characteristics, the boundary group fixed effect ensures that I am comparing adjacent neighborhoods and therefore implicitly controls for

[29] The high side of the boundary has buildings that are less than one square foot bigger than units on the low side of the boundary and less than one year older on average.

neighborhood differences, conducting a within neighborhood analysis. I include U_{ikz}, representing the same set of building level control variables. I then add η_k which represents boundary group fixed effects, so that I can compare buildings in similar neighborhoods where the only difference between the units is the school performance.

Table 6 presents results from the hedonic regressions with boundary group fixed effects. Again using this specification it does appear that school performance is capitalized into housing values, but now at a smaller rate. Results from the specification relying only on buildings that are within 500 feet from the attendance zone boundary, show that a one standard deviation improvement in school performance is associated with a 1.8 percent increase in housing values. These results are consistent with the existing literature.

Looking at the key dependent variables of interest in Table 7, the measures of investment activity, I find a positive and significant relationship between the total dollars invested in a building as well as the square footage added to the building and school performance. Focusing first on total dollars invested in a building, the coefficient is larger when relying on the boundary discontinuity approach. The regression model that includes the most narrow sample of buildings, suggests that a one standard deviation improvement in test scores is associated with a 2.5 percent increase in dollars invested, which can be equated to an additional $375, based on the average dollar amount of an investment. Second, looking at square footage added to a building, results are still positive and strongly significant, but the coefficient is about half the size it was previously, bringing the estimate down to an additional 4 square feet added based on a one standard deviation improvement in test scores. The coefficient on test scores is no longer statistically significant in the regression of permits filed for a bedroom/bathroom. As the standard errors have not increased dramatically in this specification, and are still narrow enough to detect a moderate effect size, this finding suggests that the additional permits filed in neighborhoods with higher performing schools could have been driven by un-measurable differences in these neighborhoods. [30]

5.3 Changes in School Performance

Results from this first specification suggest that over the long run, in neighborhoods with higher performing schools the supply of housing will expand and the housing stock will be maintained at a higher level in terms of dollars invested. As an additional strategy to isolate the relationship between schools and investments, I focus on changes in school performance over a longer time period. Under this specification I explore whether improvements in school performance can induce property owners to invest in their buildings. By focusing on changes in school performance, rather than levels of school performance I am more clearly capturing characteristics of the school, rather than other neighborhood characteristics that are closely correlated to school level standardized test scores. In addition to isolating the relationship between schools and investments, this second research question has clear policy implications, identifying whether investments in schools can spur investment in the local housing stock. To answer this question I examine long term improvements in school performance, and ask

[30] I run two additional robustness checks. First, I ran these models with neighborhood controls. As attendance zone boundaries are not perfectly aligned with census tracts this specification still allows some variation within boundary groups. My results on investment activity remain unchanged under this alternative specification. Second, I ran these models only for single family homes, to see if results were different for this subset of houses, and results are qualitatively unchanged, though they are less precisely estimated.

whether these improvements can drive additional investment activity, controlling for the baseline levels of school performance, as well as building and neighborhood characteristics. I measure improvements in school performance as changes in the mean performance of math and English Language Arts between 2001 and 2006.

To estimate this relationship, I expand on model (6) and include changes in school performance. All other variables remain the same, with sales prices observed between 2006 and 2008 and investments between 2006 and 2010. Specifically I estimate the following model:

$$Y_{ikz} = \delta\, \Delta SCH_{kz} + \gamma\, SCH_{kz} + \beta\, U_{ikz} + \eta_k + \varepsilon_{ikz} \qquad (7)$$

where ΔSCH_{kz} represents the change in school performance. Again I begin by estimating the hedonic regression, with results presented in the first column of Table 8.[31] I find that both baseline levels of performance and improvements in school performance are capitalized into housing values. Specifically a one standard deviation improvement in test scores over five years increases property values by an additional 2.8 percent.

I then estimate the supply response to long term changes in school performance, presenting results in columns 2, 3 and 4 in Table 8. Focusing on the key independent variables of interest, I find a strong and consistently positive relationship between improvements in test scores and investment activity over this five year period. I find a strong significant relationship between improvements in schools and dollars spent on investments. I estimate that a one standard deviation improvement in test scores over

[31] For these specifications I present only results from the narrowest comparison group for ease of presentation. The full set of results are available from the author upon request.

five years leads to a 2.4 percent increase in dollars invested in residential properties. I also find a significant relationship between improvements in schools and square footage added to residential buildings. This coefficient however is quite small, as a one standard deviation improvement in performance is associated with a 0.4 percent increase in the size of the investment (which for the median investment would be almost an additional 2 square feet). Finally I find that improvements in schools do lead to additional permits filed for the addition of a bedroom or bathroom. A one standard deviation improvement in schools over 5 years is associated with an additional permit filed to add a bedroom or bathroom for every 1,000 buildings. [32]

5.4 Change in Population

To shed some light on the mechanism behind this relationship I explore whether this shift in investments is driven entirely by a change in the population in the local neighborhood. As I have described, improvements in schools can both attract and retain households with children who have different housing needs. To try and tease apart whether the investment effect is driven entirely by a change in the neighborhood population rather than changes within the school I control for the baseline student population as well as the changes in student population over the same five year period. I use the student population as a proxy for the neighborhood composition. I next estimate model (7) with additional controls for student composition.

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[32] As an alternative specification, I also model long term changes in school performance between 2002 and 2007. Results are very similar under this alternative specification, except for the regression estimating predictors of square footage added. Though results are not statistically significant for square footage added the coefficient is of the same magnitude.

Again I first estimate the hedonic regression and present results in the first column of Table 9. I find a strong positive relationship between levels of school performance, improvements in school performance and sales values. Looking at the changing student composition, I find that an increase in the minority composition of the student body is associated with declines in property values, holding mean performance levels constant.

Moving to my key dependent variables of interest in columns 2, 3 and 4 of Table 9, I find a positive significant relationship between test scores and investment activity. First, I find a strongly significant positive relationship between both levels and changes in school performance and dollars invested in a building, even after controlling for both levels and changes in the student population. Next looking at the square footage added, the coefficients are approximately the same magnitude, and though the coefficients on levels are still significant, the coefficients for changes between 2001-2006 are no longer precisely estimated, and fall out of traditionally statistically significant levels. Finally, considering the addition of a bedroom or bathroom, I again find no significant relationship between levels of school performance and these additional rooms, and results for changes in school performance remain consistent but standard errors are slightly wider leading the coefficient to fall out of traditionally statistically significant range. This analysis provides some suggestive evidence that it is not only the changes in student (or neighborhood) composition that lead to additional investments, but that improving test scores have an independent relationship with investment activity, particularly in terms of total dollars invested in renovations.

6. Conclusion

There is a large body of empirical research estimating the rate at which school quality is capitalized into housing values (Black and Machin, 2010; Nyguyen-Hoang and Yinger, 2011). Though some authors discuss the potential of schools to shape the supply of housing (Figlio and Lucas, 2004; Bayer, Ferreira and McMillan, 2007), this paper is the first to provide empirical support for this theory. In my preferred specification I find that a one standard deviation improvement in test scores is associated with a 2.5 percent increase in dollars invested in a property and a 1 percent increase in the square footage associated with the investment. Furthermore, when examining how changes in school performance influence investment activity, I find that improvements in schools do spur additional investments, beyond the baseline levels of performance.

These findings suggest that existing estimates of the rate at which school quality is capitalized into housing values are biased upwards, as these studies do not take into account improvements made to the housing stock in response to improvements in schools. Based on the estimates in this analysis the size of this bias is relatively small. Given a median home value of $350,000 and a median home improvement of $375, the increase in housing value would be about 0.1 percent. If, however, the supply of building is constantly changing as schools are changing, then this estimate may be a lower bound for the cumulative impact of schools on the supply of housing in a neighborhood.

This research provides a first look into how schools may shape the supply of housing in a neighborhood, opening the door for a range of additional research questions. Schools may be key components in developer decisions on where to add new projects and the types of buildings that are constructed. Also, as school choice becomes a more common method of school reform, this research suggests this could have implications for the condition of a neighborhood's housing in addition to its value. Given the long historical link in the United States between schools and housing, it is important that we understand how these institutions affect the health of our nation's housing stock.

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Table 1 Summary of Permits for Investments filed between 2003 and 2010

	Total Estimated Cost of Project (in billions of dollars)	Total Square Footage Added (in millions of feet)	Number of Bed/Baths Added
Year			
2003	$1.83	4.24	5,590
2004	$3.06	5.25	5,610
2005	$3.04	5.69	6,660
2006	$3.38	5.57	6,470
2007	$3.57	4.92	6,900
2008	$3.53	2.97	6,060
2009	$2.91	1.97	5,910
2010	$2.99	2.13	6,130
Total	$24.31	32.74	49,330

Figure 1 Median Home Values and Performance in Math and English Language Arts

Figure 2 Total Dollars Invested and Proficiency in Math and English Language Arts

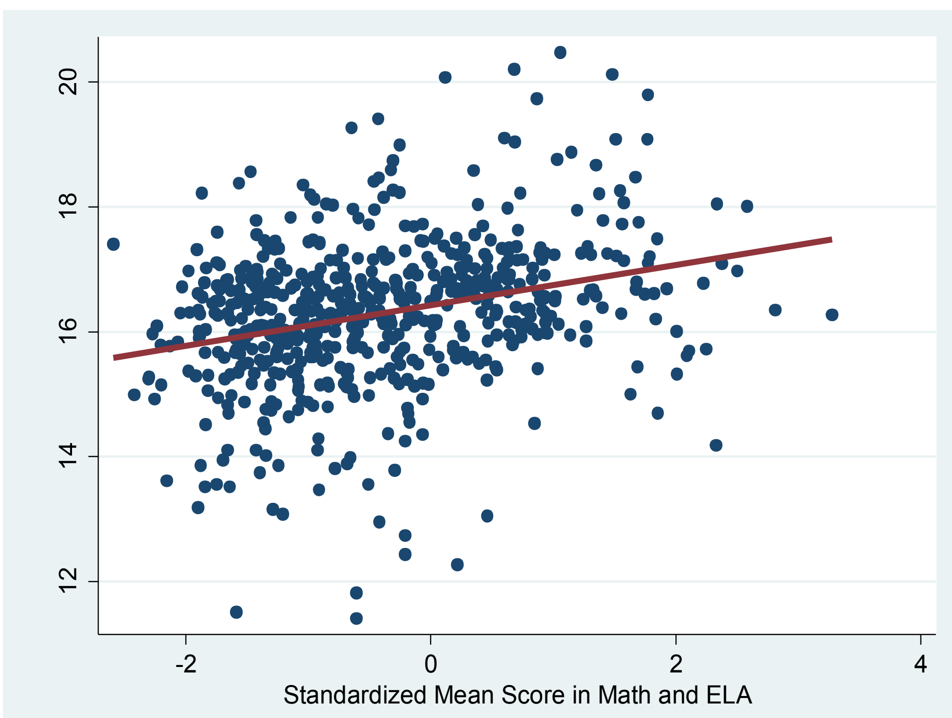

Table 2 Hedonic Regression for Sales between July 2006 and June 2008

	(1)	(2)
Standardized Mean Performance for School Years 2004-2006	0.213***	0.078***
	(0.003)	(0.004)
Building Characteristics in 2003		
Average Square Feet (thousands)	0.012**	-0.001
	(0.005)	(0.005)
Age of Building	0.002***	-0.001
	(0.001)	(0.001)
Age of Building Squared	-0.000***	0.000
	0.000	0.000
Two-Six Family Building	-0.122***	-0.066***
	(0.007)	(0.007)
Multi-Family Rental Building	-0.136***	-0.078**
	(0.036)	(0.035)
Multi-Family Ownership Building	0.241***	-0.027
	(0.048)	(0.046)
Neighborhood Characteristics		
Log of Dollars Invested between July 2003 and June 2006†		0.023***
		(0.003)
% Black in 2000		0.218***
		(0.016)
% Hispanic in 2000		-0.004
		(0.026)
% Households with Children in 2000		0.897***
		(0.081)
% Over 65 in 2000		0.706***
		(0.079)
Share attend public elementary school in 2000		-0.154
		(0.023)
Share of Female Headed Households in 2000		-1.210***
		(0.057)
Share with college degree in 2000		1.334***
		(0.040)
Share with no high school diploma in 2000		-0.129***
		(0.048)
Average Violent Crimes Per Capita for 2004-2006		-0.697**
		(0.313)
Population Growth between 1990 and 2000		0.067***
		(0.013)
House Price Growth between 1990 and 2000		-0.029***
		(0.004)
Year Two	-0.071	-0.080***
	(0.006)	(0.006)
Constant	12.815***	12.167***
	(0.019)	(0.071)
N	43,999	43,999

†Variable measured at school zone level. Rest of neighborhood variables measured at attendance zone level.

Table 3 Predictors of Investment Activity between 2006 and 2010

	Log of Total Dollars Invested		Log of Square Footage Added	
	(1)	(2)	(3)	(4)
Standardized Mean Performance for School Years 2004-2006	0.103***	0.016***	0.026***	0.017***
	(0.004)	(0.005)	(0.001)	(0.001)
Building Characteristics in 2003				
Average Square Feet (thousands)	0.034***	0.028***	0.000	-0.001
	(0.002)	(0.002)	(0.000)	(0.000)
Age of Building	-0.014***	-0.008***	0.001***	0.000***
	(0.001)	(0.001)	(0.000)	(0.000)
Age of Building Squared	0.000***	0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Two-Six Family Building	0.234***	0.028***	-0.023***	-0.023***
	(0.008)	(0.008)	(0.002)	(0.002)
Multi-Family Rental Building	0.928***	0.254***	-0.038***	-0.046***
	(0.042)	(0.041)	(0.011)	(0.011)
Multi-Family Ownership Building	2.037***	0.820***	-0.039***	-0.072***
	(0.050)	(0.050)	(0.013)	(0.013)
Neighborhood Characteristics				
Log of Dollars Invested between July 2003 and June 2006†		0.169***		0.009***
		(0.004)		(0.001)
% Black in 2000		-0.145***		0.038***
		(0.021)		(0.006)
% Hispanic in 2000		0.239***		0.000
		(0.033)		(0.009)
% Households with Children in 2000		-4.423***		0.358***
		(0.092)		(0.024)
% Over 65 in 2000		-2.689***		0.121***
		(0.091)		(0.024)
Share attend public elementary school in 2000		-0.539***		-0.027***
		(0.026)		(0.007)
Share of Female Headed Households in 2000		1.740***		-0.204***
		(0.071)		(0.019)
Share with college degree in 2000		3.263***		0.219***
		(0.046)		(0.012)
Share with no high school diploma in 2000		3.331***		0.150***
		(0.058)		(0.016)
Average Violent Crimes Per Capita for 2004-2006		0.082***		0.005
		(0.027)		(0.007)
Population Growth between 1990 and 2000		-0.007***		0.002***
		(0.001)		(0.000)
House Price Growth between 1990 and 2000		0.014***		-0.005***
		(0.004)		(0.001)
Constant	0.631***	-1.807***	0.078***	-0.199***
	(0.019)	(0.087)	(0.005)	(0.023)
N	631,287	631,287	631,287	631,287

†Variable measured at school zone level. Rest of neighborhood variables measured at attendance zone level.

Table 3 Predictors of Investment Activity between 2006 and 2010 (continued)

	Number of Permits Filed for Bedroom/Bathroom	
	(5)	(6)
Standardized Mean Performance for School Years 2004-2006	0.005***	0.001***
	(0.000)	(0.000)
Building Characteristics in 2003		
Average Square Feet (thousands)	0.004***	0.004***
	(0.000)	(0.000)
Age of Building	-0.000***	-0.000***
	(0.000)	(0.000)
Age of Building Squared	-0.000***	-0.000***
	(0.000)	(0.000)
Two-Six Family Building	-0.007***	-0.012***
	(0.000)	(0.001)
Multi-Family Rental Building	-0.012***	-0.031***
	(0.003)	(0.003)
Multi-Family Ownership Building	-0.001	-0.038***
	(0.003)	(0.003)
Neighborhood Characteristics		
Log of Dollars Invested between July 2003 and June 2006†		0.006***
		(0.000)
% Black in 2000		0.000
		(0.001)
% Hispanic in 2000		0.003
		(0.002)
% Households with Children in 2000		-0.122***
		(0.006)
% Over 65 in 2000		-0.057***
		(0.006)
Share attend public elementary school in 2000		-0.021***
		(0.002)
Share of Female Headed Households in 2000		0.040***
		(0.005)
Share with college degree in 2000		0.101***
		(0.003)
Share with no high school diploma in 2000		0.097***
		(0.004)
Average Violent Crimes Per Capita for 2004-2006		0.000
		(0.002)
Population Growth between 1990 and 2000		0.000***
		(0.000)
House Price Growth between 1990 and 2000		0.000
		(0.000)
Constant	0.015***	-0.073***
	(0.001)	(0.006)
N	631,287	631,287

†Variable measured at school zone level. Rest of neighborhood variables measured at attendance zone level.

Table 4 Housing Composition by School Level Performance in Math and ELA*

	Housing Composition			
	Single Family Homes	2-6 Family Homes	Multifamily Rental	Coop/Condo Apartments
School Performance				
Top Quartile	15.5%	47.0%	12.2%	25.4%
Upper Middle Quartile	17.2%	57.2%	14.5%	11.1%
Lower Middle Quartile	10.2%	57.2%	21.0%	11.6%
Bottom Quartile	7.6%	56.6%	27.6%	8.3%
Overall Distribution	12.5%	53.8%	20.8%	12.8%

*Unit of observation is a residential unit, rather than a building

Table 5 Differences Across Attendance Zone Boundary Groups

	High Scoring Attendance Zones (1)
Residential Units	-0.000
	(0.000)
Average Square Feet (thousands)	0.0013**
	(0.001)
Age of Building	0.002***
	(0.000)
Age of Building Squared	-0.000***
	(0.000)
Two-Six Family Building	-0.003
	(0.002)
Multi-Family Rental Building	0.010
	(0.011)
Multi-Family Ownership Building	-0.027*
	(0.014)
Constant	0.460***
	(0.006)
N	309,495

Table 6 Hedonic Regression for Sales between July 2006 and June 2008 with Boundary Group Fixed Effects

	<1000 feet from boundary (1)	<750 feet from boundary (2)	<500 feet from the boundary (3)
Standardized Mean Performance for School Years 2004-2006	0.040***	0.033***	0.018*
	(0.008)	(0.008)	(0.009)
Building Characteristics in 2003			
Average Square Feet (thousands)	0.001	0.001	0.002
	(0.006)	(0.006)	(0.008)
Age of Building	0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)
Age of Building Squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Two-Six Family Building	-0.012	-0.011	-0.007
	(0.008)	(0.009)	(0.011)
Multi-Family Rental Building	0.020	0.014	-0.012
	(0.040)	(0.042)	(0.045)
Multi-Family Ownership Building	-0.073	0.002	0.009
	(0.057)	(0.061)	(0.069)
Year Two	-0.082***	-0.082***	-0.080***
	(0.006)	(0.007)	(0.008)
Constant	12.760***	12.748***	12.707***
	(0.024)	(0.026)	(0.031)
Boundary Group Fixed Effects	X	X	X
N	33,730	29,085	21,876

Table 7 Predictors of Investment Activity between 2006 and 2010 with boundary group fixed effects

	Log of Total Dollars Invested			Log of Square Footage Added		
	<1000 feet from boundary	<750 feet from boundary	<500 feet from the boundary	<1000 feet from boundary	<750 feet from boundary	<500 feet from the boundary
	(1)	(2)	(3)	(4)	(5)	(6)
Standardized Mean Performance for School Years	0.016*	0.015	0.025**	0.009***	0.009***	0.010***
2004-2006	(0.010)	(0.010)	(0.012)	(0.003)	(0.003)	(0.003)
Building Characteristics in 2003						
Average Square Feet (thousands)	0.033***	0.033***	0.028***	-0.000	-0.000	-0.000
	(0.003)	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)
Age of Building	-0.002***	-0.002***	-0.003***	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Age of Building Squared	0.000***	0.000***	0.000***	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	0.000	0.000	0.000
Two-Six Family Building	-0.054***	-0.054***	-0.057***	-0.014***	-0.014***	-0.014***
	(0.010)	(0.011)	(0.013)	(0.003)	(0.003)	(0.003)
Multi-Family Rental Building	-0.476***	-0.509***	-0.525***	-0.032***	-0.034***	-0.039***
	(0.047)	(0.050)	(0.057)	(0.012)	(0.013)	(0.014)
Multi-Family Ownership Building	-0.456***	-0.491***	-0.542***	-0.063***	-0.072***	-0.075***
	(0.061)	(0.067)	(0.078)	(0.016)	(0.017)	(0.020)
Constant	0.945***	0.970***	1.040***	0.097***	0.100***	0.101***
	(0.026)	(0.029)	(0.034)	(0.007)	(0.007)	(0.009)
Boundary Group Fixed Effects	X	X	X	X	X	X
N	479,340	411,801	309,495	479,340	411,801	309,495

Table 7 Predictors of Investment Activity between 2006 and 2010 with boundary group fixed effects (continued)

	Number of Permits Filed for Bedroom/Bathroom		
	<1000 feet from boundary (7)	<750 feet from boundary (8)	<500 feet from the boundary (9)
Standardized Mean Performance for School Years 2004-2006	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
Building Characteristics in 2003			
Average Square Feet (thousands)	0.004***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)
Age of Building	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Age of Building Squared	0.000***	0.000***	0.000***
	0.000	0.000	0.000
Two-Six Family Building	-0.014***	-0.014***	-0.014***
	(0.001)	(0.001)	(0.001)
Multi-Family Rental Building	-0.044***	-0.043***	-0.043***
	(0.003)	(0.003)	(0.003)
Multi-Family Ownership Building	-0.078***	-0.075***	-0.072***
	(0.004)	(0.004)	(0.004)
Constant	0.025***	0.023***	0.024***
	(0.002)	(0.002)	(0.002)
Boundary Group Fixed Effects	X	X	X
N	479,340	411,801	309,495

Table 8 Regression for Sales and Investment Activity with Boundary Group Fixed Effects (<500 feet from the boundary) including measures of change in school performance

	Log of Housing Price Per Unit	Log of Total Dollars Invested	Log of Square Footage Added	Number of Permits Filed for Bed/Bath
	(1)	(2)	(3)	(4)
Change in Standardized Mean Performance for	0.028***	0.024***	0.004*	0.001**
School Years 2001-2006	(0.007)	(0.009)	(0.002)	(0.001)
Standardized Mean Performance for School Years	0.029***	0.030**	0.009***	0.000
1999-2001	(0.010)	(0.012)	(0.003)	(0.001)
Building Characteristics in 2003				
Average Square Feet (thousands)	0.003	0.028***	0.000	0.005***
	(0.008)	(0.004)	(0.001)	(0.000)
Age of Building	0.000	-0.003***	0.000	-0.000***
	(0.001)	(0.001)	(0.000)	(0.000)
Age of Building Squared	0.000	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Two-Six Family Building	-0.005	-0.057***	-0.014***	-0.014***
	(0.011)	(0.013)	(0.003)	(0.001)
Multi-Family Rental Building	-0.032	-0.514***	-0.041***	-0.043***
	(0.046)	(0.058)	(0.015)	(0.003)
Multi-Family Ownership Building	0.000	-0.560***	-0.076***	-0.073***
	(0.069)	(0.079)	(0.020)	(0.005)
Year Two	-0.080***			
	(0.008)			
Constant	12.719***	1.031***	0.101***	0.023***
	(0.031)	(0.034)	(0.009)	(0.002)
Boundary Group Fixed Effects	X	X	X	X
N	21,205	301,498	301,498	301,498

Table 9 Regression for Sales and Investment Activity with Boundary Group Fixed Effects (<500 feet from the boundary) including student population

	Log of Sales Price Per Unit	Log of Total Dollars Invested	Log of Square Footage Added	Number of Permits Filed for Bed/Bath
	(1)	(2)	(3)	(4)
Change in Standardized Mean Performance for School Years 2001-2006	0.027***	0.022**	0.004	0.001
	(0.007)	(0.009)	(0.002)	(0.001)
Standardized Mean Performance for School Years 1999-2001	0.036***	0.035**	0.009**	0.000
	(0.012)	(0.015)	(0.004)	(0.001)
Change in Share of Students Eligible for Free or Reduced Price Lunch for School Years 2001-2006	0.054	-0.198**	-0.024	-0.010**
	(0.069)	(0.088)	(0.022)	(0.005)
Share of Students Eligible for Free or Reduced Price Lunch in 2001	-0.006	-0.189*	-0.033	-0.007
	(0.083)	(0.106)	(0.027)	(0.006)
Change in Minority Student Population for School Years 2001-2006	-0.584***	-0.251	-0.029	-0.031**
	(0.182)	(0.222)	(0.056)	(0.013)
Minority Student Population in 2001	0.019	0.215**	0.026	0.002
	(0.080)	(0.098)	(0.025)	(0.006)
Building Characteristics in 2003				
Average Square Feet (thousands)	0.003	0.028***	0.000	0.005***
	(0.008)	(0.004)	(0.001)	(0.000)
Age of Building	0.000	-0.003***	0.000	-0.000***
	(0.001)	(0.001)	(0.000)	(0.000)
Age of Building Squared	0.000	0.000***	0.000	0.000***
	(0.000)	(0.000)	0.000	0.000
Two-Six Family Building	-0.005	-0.057***	-0.014***	-0.014***
	(0.011)	(0.013)	(0.003)	(0.001)
Multi-Family Rental Building	-0.031	-0.514***	-0.041***	-0.043***
	(0.046)	(0.058)	(0.015)	(0.003)
Multi-Family Ownership Building	-0.002	-0.559***	-0.076***	-0.072***
	(0.069)	(0.079)	(0.020)	(0.005)
Sale Year Two	-0.080***			
	(0.008)			
Constant	12.717***	1.016***	0.107***	0.028***
	(0.063)	(0.074)	(0.019)	(0.004)
Boundary Group Fixed Effects	X	X	X	X
N	21,205	301,498	301,498	301,498