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Does Public School Administrative Spending Affect District House Prices?

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by

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ABSTRACT

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Public schools are often criticized for the way in which they elect to distribute their limited resources. Perhaps the most critical assets for schools are teachers and administrators, and the compensation of these individuals varies widely amongst public school districts. There exists an optimal level of spending on district administration. Districts that pay administrators above or below this optimal point are likely not allocating their resources in the best possible manner, and educational quality may suffer. We hypothesize that within districts where either of the above situations is the case, home prices will be lower, as homebuyers will be less willing to pay for homes within a district where the schools do not function efficiently and allot taxpayer dollars well. Using boundary discontinuity methods, we find a district's amount of administrative spending per pupil, to be highly significant and inversely related to district house prices. We also find a significant inverse relation between a district's level of non-administrative spending per pupil and home values, and a significant positive correlation between a district's level of wealth and house prices. Thus, based upon its valuation by homebuyers, we conclude that school spending within Capital District schools is currently above its optimum point. Additionally, we find the significance of district size, student-to teacher ratio and test scores, to district house prices, to vary by specification, and do not find race or teacher salaries to be significant.

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CHAPTER ONE

Introduction

Public schools are often criticized for the way in which they elect to distribute their limited resources. Perhaps the most critical assets for schools are teachers and administrators, and the compensation of these individuals varies widely amongst public school districts. There exists an optimal level of pay for district administrators. Districts that pay administrators above or below this optimal point are likely not allocating their resources in the best possible manner, and educational quality may suffer.

Resources lost to excess administration are resources that districts could have allocated to other things that would improve students' educational experiences (e.g. more advanced placement courses, music programs, and physical education). Conversely, districts that do not adequately compensate their administrators may struggle to attract quality personnel, potentially causing a decline in educational quality. School districts need a strong administration that is capable of overseeing school programs and resolving issues when they arise. Thus, we take the level of administrative spending in a district to be symbolic of the district's ability to allocate its resources efficiently.

We hypothesize that within districts where either of the above situations is the case, home prices will be lower, as homebuyers will not want to live in a district whose schools do not function efficiently and allot taxpayer dollars well. By inefficiently allocating their resources, schools are likely hurting the quality of the education they offer their students. Parents and other taxpayers will notice that these schools are not allocating their resources well, and will be less willing to pay less for homes within these districts, and thus house prices there will fall. We hypothesize the relationship between house prices and administrative spending to be ∩-shaped, with the optimal point of administrative spending being the maximum of the curve.

The economic literature has clearly demonstrated that there is a relationship between public school quality and district house prices. This literature has shown a strong positive correlation between test scores in school districts and the house prices within those districts (Brasington 1999, Downes and Zabel 2002, Crone 2006, etc.). The literature has shown that correlations between other quality measures (e.g. per student spending, value-added, class size) and house prices are weaker (Brasington and Haurin 2006, Seo and Simons 2009, Iberman and Lovenhiem 2013, etc.). We anticipate both administrative salary spending and total administrative spending per pupil, measures of school efficiency, to be capitalized in house prices as well. Previous economic studies have observed the relationship between administrative spending and student performance, but to our knowledge, no study has investigated the potential correlation of administrative spending levels and house prices (Brewer 1996, Jaggia and Kelly-Hawke 1999, Jacques and Brorsen 2002, etc.).

Independent variables that we will control for within the hedonic model include: house characteristics (number of bedrooms, number of bathrooms, year built, square footage, lot size, stories, property tax rate), non-administrative expenditures per pupil, student test performance, the student-to-teacher ratio, race, poverty, average teacher salaries, and the regressor of primary interest, total administrative spending per pupil. We will observe a sample of 445 houses from New York State's Capital Region that sold in 2012 or 2013. Within our sample, we will only include houses located in the proximity of the district boundary. This use of boundary methods will help us to eliminate much of the omitted variable bias that exists in the equation due to our inability to sufficiently control for all neighborhood characteristics.

Using these boundary discontinuity methods, we find a district's amount of administrative spending per pupil, to be highly significant and inversely related to district house prices. However, though definitively negative, we do not find the relationship between a district's level of administrative salary spending per pupil, a subset of total administrative spending, and home values to be of significance. We find a significant inverse relation between a district's level of non-administrative spending per pupil and home values, and a significant positive correlation between a district's level of wealth and house prices. Thus, based upon its valuation by homebuyers, we conclude that school spending within Capital District schools is currently above its optimum point. Additionally, we find the significance of district size, student-to teacher ratio and test scores, to district house prices, to vary by specification, and do not find race or teacher salaries to be significant.

In recent years, New York State, as the nation, has witnessed a substantial increase in its number of public school administrators. From fiscal year 1992 to fiscal year 2009, New York State experienced a 4 percent increase in its number of public school students, but a 26 percent increase in its number of administrators and non-teaching staff (Scafidi 2013). One would expect that increases in administrative expenditures would correlate to increases in student test performance. However, this has not been the case. Both nationally and within New York State, increases in administrative spending have not been shown to correlate with improved school quality and student performance, and thus we conclude that administrative spending levels within the United States are currently above the optimal (Scafidi 2013). Our regression results demonstrate this to be the case within the Capital Region as well.

CHAPTER TWO

A Review of School Costs and Housing Prices

To our knowledge, the economic literature has not explored the potential correlation between levels of administrative spending and district house prices, as we will discuss in this paper. Thus, we are not able to perform a literature review of papers that investigate this specific relationship. As an alternative, we will review the literature on school costs, specifically administrative spending, and house prices each individually.

A. School Spending and Student Performance

To date, the majority of economic literature on school spending pertains to its correlation with student performance. Though economists have discussed the issue extensively in the literature, they have yet to reach a consensus. The literature better defines the correlation between levels of school administrative spending per pupil and student performance, suggesting an inverse relationship between the two.

A.1. Overall Levels of School Spending and Student Performance

Communities are deeply invested in their public schools and many community members have strong feelings about the magnitude of local school budgets. Schools generate positive externalities for their communities and school quality is an important determinant of students' future productivity and earnings. As cited by Hanushek (1996), national school spending totals about four percent of the U.S. gross domestic product, and is the most significant piece of most local government budgets. Thus, the question of whether altering the school budget would influence student performance is of great importance to community members. It is a delicate balance between keeping tax rates low and ensuring that students have the resources they need to succeed.

The literature discussion over the connection between school spending and student performance began with a 1966 U.S. Government report on educational equality, frequently cited as the "Coleman Report." The report found that school expenditures have only a minor impact on student achievement, concluding that family background is instead the most significant determinant of achievement (Coleman et al. 1966). Twenty years later, Hanushek cited similar findings (1986, 1989). Analyzing the then existing body of literature, Hanushek concluded that school expenditures have no relation to test performance, once one controls for family background (1986, 1989). Instead of requesting increased funding, Hanushek suggests that schools should instead provide teachers with performance incentives (1989). His findings reflect an important synthesis of the existing research, as his search for data uncovered 187 "qualified studies" in 38 separately published books and articles (1989).[1] The data used in these "qualified studies" is representative of all regions of the Unites States and contains information on multiple grade levels, different measures of performance and different statistical approaches (1989).[2]

Hedges, Laine and Greenwald (1994) (henceforth HLG) contest Hanushek's (1986, 1989) results, as they instead find a positive correlation between levels of school spending

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[1] Hanushek (1989) defines a " qualified study" as a "production-function estimate that is: (1) published in a book or refereed journal; (2) relates some objective measure of student output to characteristics of the family and the schools attended; and (3) provides information about the statistical significance of estimated relationships" (46).

[2] "About one-third draw their data from a single school district, whereas the remaining two-thirds compare school performance across multiple districts. Additionally, a majority of the studies (104) use individual students as the unit of analysis, with the remainder relying upon aggregate school, district, or state-level data. The studies are about evenly split between primary schooling (grades 1-6) and secondary schooling (grades 7-12). Over 70 percent of the studies measure school performance by some kind of standardized test. However, those that use non-test measures (such as dropout rates, college continuation, attitudes, or performance after school) are for obvious reasons concentrated in studies of secondary schooling. There is no indication that differences in sample and study design lead to differences in conclusions, and thus only an overall tabulation of results is presented." (Hanushek 1989, 46)

and student performance. Using a meta-analysis method, they conclude that a ten percent increase in a school's real resources will improve students' measured achievement by 0.7 standard deviations (HLG 1994). They claim that Hanushek's (1989) "vote counting methodology" gives no indication of the magnitude of relationships between variables and assert that his tests had a low degree of statistical power (HLG 1994). Hanushek (1994) immediately responds to this criticism, claiming that Hedges, Laine and Greenwald's meta-analysis is flawed, as they omitted many of the studies that show increasing expenditures has no effect from their analysis. To further back up his initial conclusions, Hanushek (1994) cites a statistic from the U.S. Department of Education: in the 25 years to 1994, real expenditures per pupil rose more than 100 percent, while student performance remained constant at best and likely declined. Despite this, Hedges and Greenwald (1996) again refute Hanushek's findings. They claim that expansion in the level and comprehensiveness of education and a decline in the social capital available in families have acted as substitutes for school resources, and thus argue that increased resources do in fact result in increased student productivity (1996).

In recent years, Hanushek's findings (1986, 1989, and 1994) have remained fiercely debated, and a number of more recent studies have found at least a weak correlation between per pupil school expenditures and student achievement. Sander (1999) finds a slightly positive correlation between these two variables. Using 1996 data from the Illinois Goal Assessment Program, standardized tests issued by the state all third and eighth grade students; Sander (1999) concludes that expenditures per pupil have a significant link to students' results on the eighth grade math assessment. Though significant, the magnitude of the result is small, as the findings indicate that "expenditures per pupil would have to more than double to increase test scores by one standard deviation" (Sander 1999, 229).

Papke (2005) also cites a positive correlation between spending per pupil and student achievement, a finding based on data solely from within the state of Michigan. Proposition A, passed by the Michigan State government in 1994, greatly altered the funding structure of the state's public K-12 schools, thus making Michigan an optimal place to perform this study. Though Papke (2005) has access to all Michigan state test scores from 1992 to 1998, she elects to focus specifically on fourth grade math test scores, as this data set is the most complete and consistent. Papke (2005) finds that a ten percent increase in a district's real spending increases school pass rates on the fourth grade state math test by between one and two percentage points. Notably, her findings also show that this statistically significant effect is largest for schools with initially poor performance (Papke 2005).

We must note, however, that these studies by Sander (1999) and Papke (2005) only incorporate data from a single state. In contrast, Hanushek's (1989, 1994, and 1996) studies utilized a sample with a significantly greater geographic and economic diversity. It is possible that funding may affect schools in different states differently, as the states' educational systems and levels of expenditures vary greatly. For instance, in contrast to the findings of Sander (1999) and Papke (2005), a recent study of Vermont schools by Sherlock (2011) finds no significant correlation between levels of school spending and student test performance. Measuring the impact of changes under Vermont's Equal Education Opportunity Act, Sherlock (2011) concludes that this shift in resources had no significant effect on the passing rates of the state's fourth grade reading and writing tests.

She finds a slightly positive, though insignificant, correlation between per student spending and the passing rate on the fourth grade state math test. Sherlock (2011) also provides suggestive, though inconclusive, evidence that resources are more effective at increasing passing rates at initially lower spending schools, though not at lower achieving schools.[3] If considering the law of decreasing marginal returns, this suggestion is logical.

A.2. Levels of Administrative School Spending and Student Performance

There is no clear consensus within the economic literature about the relationship between the level of public school spending and the level of student achievement. However, the literature has suggested that there is an inverse correlation between a district's level of administrative inputs (on a per student basis) and student performance within that district. Brewer (1996) was one of the first to extensively investigate this relationship, and argues that test scores and per pupil administrative expenditures are simultaneously related. For this reason, Brewer (1996) elects to use a simultaneous equations estimator to determine the correlation between the variables. His data comes exclusively from New York State, and he examines a panel of school districts over the 1978 to 1987 period. Separating the data into elementary, middle school and high school segments, overall, he finds a weak negative correlation between administrative inputs per student and the pass rates on state tests, with inconsistency between the models used (Brewer 1996).[4] Brewer concludes that, "more administration lowers teacher productivity and has a negative marginal product at current expenditure levels" (1996, 998). Though

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[3] It is important to note that lower spending schools do not necessarily have low levels of achievement. It is very possible for schools to have below average spending, and for a variety of reasons (e.g. economies of scale), still have high levels of student achievement.

[4] Brewer (1996) uses an ordinary least squares model (OLS), a fixed effects model and a three-stage least squares regression mode (3SLS) model within this study.

Brewer (1996) finds a weak correlation between per pupil spending and student performance, the significance of his results is weak, potentially indicating that his instruments were inadequate.[5]

In line with the findings of Brewer (1996), Jaggia and Kelly-Hawke (1999) conclude that there is an inverse relationship between per pupil administrative spending and student test performance. Jaggia and Kelly-Hawke (1999) utilize data from the 1992 Massachusetts Educational Assessment Program (MEAP) test. The State of Massachusetts administers MEAP tests annually to all fourth, eighth and twelfth grade students to measure student learning.[6] Using an ordered logit model, as test results were in groups, Jaggia and Kelly-Hawke (1999) find that per pupil administrative spending is inversely correlated to students' MEAP test performance at all grade levels, and the effect is large enough to be significant at the fourth and eighth grade levels. Resources allocated to administration likely come at the expense of resources for instruction. Jaggia and Kelly-Hawke (1999) also find that family background and the stability of community contribute significantly to student performance.

Similarly, Jacques and Brorsen (2002) conclude that there is an inverse relationship between per pupil spending on student support services (i.e. administration and counseling) and student performance on standardized tests. They elect to use data from the Oklahoma Department of Education, specifically the results of the state's

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[5] Brewer (1996) instead found that increasing the number of teachers in a district had the greatest impact on test pass rates.

[6] The fact that all of the schools were located within the same state helps to remove a great deal of omitted variable bias from the study (Jaggia and Kelly-Hawke 1999).

Criterion Referenced Test (CRT) and Norm Referenced Tests (NRT).[7] Jacques and Brorsen's (2002) study corrects for the heteroskedasticity created by differences in school district size, helping to give the model greater statistical power. Using a maximum likelihood distribution, an alternative to ordinary least squares, Jacques and Brorsen (2002) find a statistically insignificant, negative correlation between per pupil spending on school administration and student performance. They conclude that high administrative spending displaces funds that could be utilized in a more productive manner, and suggest that school administrators may take up valuable student instruction time with announcements and assemblies (Jacques and Brorsen 2002). Yet, it is important to note, that schools with lower test scores and more problems overall may need to hire more administrators and school counselors, and it is possible that "socioeconomic variables may not fully capture the problems that these schools face" (Jacques and Brorsen 2002, 997).[8]

Mensah, Schoderbek and Sahay (2013) (henceforth MSS) also examine the relationship between levels of school administrative spending and student achievement. They note that in recent years a number of states have passed measures to limit administrative expenses in their public schools. At the forefront of this movement was the Chicago School Reform Act, passed by the Illinois State Legislature in 1988, which imposed limits on the maximum levels of non-instructional costs within the Chicago public school system (MSS 2013). New Jersey, the state of origin for MSS's (2013) data, passed

[7] The State administers the CRT to students in grades 5, 8 and 11 to determine if students are at grade level. The State also administers the NRT to students in grades 3 and 7 as a test of knowledge, not to ensure the correct grade level. Test results were available by school district and grade for each district in the sample for 1994-1995 (Jacques and Brorsen 2002).

[8] This issue may cause omitted variable bias within Jacques and Brorsen's (2002) equations. Specifically, this explains why we expect an ∩-shaped relation between administrative spending levels and house prices, in which the optimal level of administrative spending varies from district to district.

legislation in 2004, anchoring per pupil administrative costs to the lower of, "per-pupil admin costs average for the district's region" and "the prior year's admin costs adjusted by the cost of living or 2.5 percent, whichever is less" (MSS 2013, 2). In 2011, New Jersey passed another law limiting the level of public school administrative spending, instituting a salary cap for district superintendents. Under this new cap, the maximum yearly salary a superintendant can be paid is $175,000 per year, for large districts with over 6,500 students, with less for smaller districts (MSS 2013). These laws put New Jersey at a competitive disadvantage in attracting well-qualified administrators and encouraged an exodus of school administrators to other states without pay restrictions (MSS 2013).

Due to these changes in school administrative pay scales, and the variance thus produced, New Jersey is an excellent place to study the effect of administrative expenditures on test scores. Mensah, Schoderbek and Sahay (2013) use data from the New Jersey Department of Education, specifically a sample of 217 Kindergarten to Grade 12 districts for the years 2002-2009. Their dependent variable is the weighted test score averages for the state's standardized tests, administered at the fourth, seventh and twelfth grade levels. Using a one-way fixed effects model, MSS (2013) find administrative spending per pupil to be negatively associated with student test performance, though this correlation they do not find the correlation to be significant in the two-way models.[9]

Overall, the literature suggests that there is at least a weak negative correlation between administrative expenditures per pupil and test scores (Brewer 1996, Jaggia and Kelly-Hawke 1999, Jacques and Brorsen 2002, MSS 2013). The relationship between

[9] The two way models analyzed were the two-way fixed effects model (time and school district) and the two-way random effects model. The one-way fixed effects model is only fixed time-wise.

administrative spending per student and district house prices has yet to be defined within the economic literature.

B. Public School Quality and House Prices

It is clear that the quality of local public schools is capitalized into the housing market, but the question of what is the most appropriate measure of school quality remains. To date, the literature has shown a reasonably strong positive correlation between district schools' performance on state tests and house prices within that district. The literature has also explored average district expenditures per student, value-added, and student to teacher ratios as potential measures of school quality, but the correlations of these variables with the housing market are found to be significantly weaker.

B.1. Capitalization of School Test Scores in House Prices

One of the earliest papers to analyze the capitalization of school test scores in district house prices is that of Hayes and Taylor (1996). Using data from the Dallas Independent School District (DISD), they find that district house prices reflect school test scores and that homebuyers value the marginal effects of schools on student performance ("value-added"). The significance of their initial findings, however, is limited, as the study's sample size is quite small. To measure the housing market, Hayes and Taylor (1996) used the selling prices of the 288 DISD properties that sold in July 1987. The breadth of test scores used is also limited, as the only measure incorporated in the study is average sixth grade achievement on the Iowa Test of Basic Skills; a measure of high school performance is not used.

Later studies build on this early work of Hayes and Taylor (1996), increasing both the number of houses and variety of student test scores included in the sample. Similar to

Hayes and Taylor (1996), Brasington (1999) finds a positive correlation between student performance on standardized tests and district house prices. Brasington (1999) uses a significantly larger sample of houses, a greater diversity of properties and an increased variety of performance measures.[10] He utilizes data from the Ohio Department of Education on passage rates of the state's standardized tests, administered to students in grades 4, 9 and 12. For housing prices, Brasington (1999) uses 1991 sample data from major metropolitan communities in Ohio, from 128 different communities for a sample size of over 27,000 houses. This is a significantly larger sample than used in previous studies (Hayes and Taylor 1996). Using both a traditional hedonic price estimation model and a hedonic model corrected for spatial autocorrelation, Brasington (1999) finds that the housing market does indeed value proficiency test passage rates, though not the value-added by the school district.

Black (1999) is a frequently cited paper examining the relationship between school test scores and district house prices. She builds greatly on the existing literature in that she is able to better control for neighborhood characteristics, as well as socioeconomic status, within her sample. To do this, Black (1999) looks only at houses situated on school attendance boundaries, thereby the houses in the sample differ only in what school the children attend. This method successfully removes the variation between neighborhoods. Black (1999) uses test score data from the Massachusetts Educational Assessment Program

[10] Brasington (1999) includes a large number of variables in his study. He finds that test scores, per pupil expenditures and student-to-teacher ratios have significant effects on district house prices. This finding is logical, as these measures are widely publicized and easily available to homebuyers. Brasington (1999) concludes that teacher salaries and student attendance may also have some impact on house prices, but the relationship is not significant. He finds that school graduation rates, levels of teacher experience and levels of teacher of education are not capitalized in house prices whatsoever.

(MEAP), a standardized test given to all Massachusetts students in grades 4, 8 and 12.[11] She sums and averages student math and reading performance in three testing periods (1988, 1990, 1992) in attempt to remove any variance that might occur by using test data from only a single year. Black's (1999) sample of recent house transactions is quite large as well, as she uses the prices from all border purchases and sales from 1993 to 1995 in the Middlesex, Essex and Norfolk counties of Massachusetts - all suburbs of Boston.[12]

Using a hedonic pricing model, Black (1999) finds that for a five percent increase in test scores, approximately a one standard deviation rise; parents are willing to pay 2.1 percent more for a house in that district.[13] She suggests that a move "from a school that scores in the twenty-fifth percentile of the sample to a school in the seventy-fifth percentile of the sample would result in a house price increase of $5,452" (Black 1999, 595). Black (1999) notes that this result is significantly smaller than that found in many previous studies that did not sufficiently control for neighborhood characteristics, and speculates that these studies likely overestimated the effects of test scores.[14]

Though Downes and Zabel (2002) also find a positive relationship between school test scores and local house prices, the models used to come to this result differ greatly from those used in other studies. Rather than using recent selling prices for individual homes as their models' dependent variable, Downes and Zabel (2002) use data on estimated home

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[11] Massachusetts administers MEAP tests in five subject areas: reading, science, social studies, mathematics and writing (Black 1999). Black (1999) elects to use only math and reading scores in her study.

[12] These are excellent districts to use in her sample as they are fairly small and their populations are reasonably homogeneous. Within these three counties, there are 39 separate school districts (Black 1999).

[13] For a house with the sample's mean price of $188,000, this represents exactly $3,948 more (Black 1999).

[14] Black (1999) also notes that the preferences of Boston homeowners may be different from homeowners in other parts of the country. This is logical, as the state of Massachusetts as a whole, places great value on education and is known for having high quality schools.

values from the American Housing Survey (AHS). AHS does not include data solely from recently sold homes, rather it contains "detailed information on particular homes through time that includes the current owner's evaluation of the house price, house characteristics, and self-reported information on the house's current occupants" (Downes and Zabel 2002, 9). As a measure of student performance, they elect to use test score data from the Illinois School Report Card, for districts in Chicago over 1987 to 1991. Using a hedonic model and correcting for endogeneity, Downes and Zabel (2002) find that homebuyers are willing to pay more for a house situated near a school with higher standardized test scores. They estimate the elasticity of this relationship between house prices and test scores to be roughly one. As Black (1999) demonstrates to be necessary, Downes and Zabel (2002) control for a large set of neighborhood variables.

In concordance with most of the literature, Brasington and Haurin (2006), Crone (2006), and Seo and Simmons (2009), all find a significant positive correlation between district test scores and local house prices. Brasington and Haurin (2006) conclude that test scores are consistently capitalized into house prices, with an increase in test scores of one standard deviation found to raise house prices by 7.1 percent. Crone (2006), using home sale data from the 21 school districts in Montgomery County, Pennsylvania, also finds a positive correlation between these two variables.[15] To measure student performance, Crone (2006) uses data from state mandated tests in math and reading at both the high school and elementary level. Using a hedonic model, he concludes that some test score averages are better predictors of district house prices than others are. For example, Crone (2006) finds

[15] Montgomery County, Pennsylvania is a suburban county located near Philadelphia. The sample of recent housing transactions used in this study stretches from January to July 2000, a total sample size of 3,150 house sales (Crone 2006).

both fifth grade math and reading test scores to be significant at the one percent level, but not high school reading tests.[16] Likewise, Seo and Simons (2009) find that a one standard deviation increase in test scores results in a three to five percent change in housing prices.

Sedgley, Williams and Derrick (2008) (henceforth SWD) also find evidence that standardized test scores are capitalized into house prices, though the measured effects they find are smaller than other studies. SWD (2008) address potential omitted variable bias by incorporating school performance measures over the K-12 grade range, in contrast to the majority of studies that utilize test scores from only one or two grade levels. Using a hedonic model incorporating spatial discontinuity and data on house prices from Howland County, Maryland, SWD (2008) find that eighth grade test scores and student's SAT scores are consistently capitalized into house prices.

In line with prior studies, Dhar and Ross (2012) find that student test performance relates to district house prices. Rather than examining differences across school attendance zone boundaries, as Black (1999), they elect to use a sample of houses on differing sides of school district boundaries. They suggest that this is an improvement on prior studies as many factors, such as school spending and property taxes, do not vary within districts, and school attendance lines are subject to change. As a measure of student achievement, Dhar and Ross (2012) elect to use a three-year moving average of student performance on eighth grade mathematics state tests.[17] To measure school district housing markets, Dhar and Ross (2012) use cross-sectional data for a sample of housing transactions, situated

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[16] Crone (2006) suggests that high school reading tests may not be reliable gauges of student achievement and school quality.

[17] Dhar and Ross (2012) elect to use a three-year moving average as this helps to minimize error.

near school boundaries, in Connecticut from 1994 to 2004.[18] Using a hedonic price equation, they find that a one standard deviation increase in test scores produces between a four and six percentage point increase in house prices within the district. The magnitude of this effect is smaller than those found in some OLS and traditional boundary fixed effects estimates, but is comparable to previous studies using attendance boundaries (Dhar and Ross 2012).

B.2. Capitalization of Other Distinct Measures of Student Performance in House Prices

In the past ten years, the body of economic literature on capitalization of school quality in house prices has expanded beyond test scores to incorporate broader measures of student performance, such as school district rankings. Figlio and Lucas (2004) were the first to explore the relationship between these alternative measures of district performance and house prices. They use data from Florida's School Accountability Program, a program in which each of the state's public schools receives a letter grade of between "A" and "F".[19] As separate variables, they include measures of schools' fourth grade reading performance and fifth grade math performance on the FCAT. To measure the housing market, Figlio and Lucas (2004) use detailed data on repeated sales of individual residential properties in "platted subdivisions" from the mid-1980s to early 2002, within 37 separate counties.[20]

[18] This is the same data set used by CNR (2005) and provided by Banker and Tradesman.

[19] Specifically, the letter grades in the first three years of the program were based upon student performance on three state examinations: fourth grade reading performance on the Florida Comprehensive Assessment (FCAT), fifth grade math performance on the FCAT and fourth grade performance on the FloridaWrites! Test.

[20] "Platted subdivisions" are defined as distinct neighborhoods typically developed at about the same time with similar houses, in terms of square footage, style and lot size. Normally consist of less than 200 houses. Using these "platted subdivisions" allows for better control of neighborhood variance (Figlio and Lucas 2004).

Figlio and Lucas (2004) conclude that the housing market responded quite significantly, at least initially, to these "school report cards" - to a greater degree even than it ever responded to test scores alone. They find that the most significant market price adjustments occurred within the first year of the program, and then the adjustments tapered off, suggesting "that the volatility of school grades in Florida led to a reduction in their informative power", as grades received by schools varied greatly from year to year (Figlio and Lucas 2004, 603).[21] Figlio and Lucas (2004) find that over the first three years of the school grading program, the average premium associated with receiving a letter grade of "A" instead of "B" was 8.7 percent, and the premium for receiving a grade of "B" instead of "C" was nonexistent, once other measures of school and neighborhood quality were controlled for.

Similar to Figlio and Lucas (2004), Zahiroviv and Turnball (2009) find that house prices do respond to categorical rankings of school performance. Zahiroviv and Turnball (2009) examine houses within a single school district, East Baton Parish, Louisiana, a district with a troubled history of segregation, for the period of 1994 to 2002. East Baton Parish is an ideal place to conduct this study due to its unified city-county local government, which minimizes property tax and public service variation across the sample, and recent policy changes creating permanent school attendance zones.[22] Interestingly,

[21] These premiums were much larger in the first year of the school grading program - the premium for "A" versus "B" was 19.5 percent and the premium for "B" versus "C" was 15.6 percent (Figlio and Lucas 2004).

[22] Zahirovic and Turnball (2009) further explain this policy change, stating, "As a legacy of a 40-year desegregation lawsuit, the local school system was under direct federal court control for more than 15 years. In the years preceding our first policy event, students were randomly assigned to individual schools in an effort to equalize racial composition, a method that eliminated school quality as a location-specific house attribute (e.g., it was not unusual for different children in the same family to attend different schools). In a surprise move in the summer of 1996, the presiding judge ordered the elimination of random school assignment in favor of stable attendance zones, thereby creating a direct tie between house location and

they find that student test scores have no significant effect on house prices when broader school performance measures are published (Zahiroviv and Turnball 2009).

Seo and Simons (2009) also find that school district ratings are capitalized into house prices. They gather house price data from Cuyahoga County, Ohio - the central county of the Cleveland metropolitan area - for the years 2000 and 2005. Specifically, they obtain data on over 30,000 housing sale transactions from the county auditor, with the data coming from 30 separate school districts. As measures of student performance, Seo and Simons (2009) elect to use both the passage rate on the state's fourth grade mathematics exam and the Ohio Department of Education's school "report card" designations.[23] Performing their regression analysis with a spatial error model, they find that though all measures of school quality have some varying degree of explanatory power, it is school district ratings and student test scores that are most capitalized into house prices (Seo and Simons 2009). They find that a one standard deviation increase in either of these variables results in a three to five percent change in housing prices (Seo and Simons 2009). Seo and Simons (2009) conclude that the No Child Left Behind Act of 2001 has greatly increased the availability of school quality information and that this information is increasingly being capitalized into housing prices.

B.3. Capitalization of Value-added Measures in House Prices

Rather than basing school quality solely on student outcomes (i.e. test scores), a more recent body of economic literature has focused on "value-added" statistics as a

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school quality. This change from random to zone school assignment represents a natural experiment and an opportunity to observe how the local housing market values the policy changes" (1095).

[23] This variable is "a comprehensive measure calculated on how well each student does on all tested subjects in grades 3-8 and on the 10th grade graduation test." 13 of the 31 school districts in Cuyahoga County received a rating of excellent in 2005 (Seo and Simons 2009, 313).

potentially improved measure of school quality. These "value-added" statistics measure changes in a student's performance over a period of time, for example, the improvement in a student's score on a state math test from fourth to fifth grade. Considering the fact that schools have no control over the level of knowledge that students have upon enrollment, and must then consistently work to augment this knowledge; value-added, as it measures real student learning, is in a theory, a good measure of school quality. Nevertheless, the literature has not demonstrated value-added to be capitalized into district house prices in the same manner as state test scores and district rankings, likely because it is difficult for homebuyers to readily observe valued-added.

One of the earliest studies to examine this relationship between value-added measures and house prices is Hayes and Taylor (1996). Their findings differ greatly from the later literature in that they suggest that the marginal effect of schools on student performance is in fact capitalized in house prices (Hayes and Taylor 1996). It is important to note, however, that their sample size was quite small (under 300 houses) and thus, it is difficult for one to draw broader conclusions based on this finding.

Using a significantly larger sample size of than Hayes and Taylor (1996), Brasington (1999) finds that value-added measures are not capitalized into home prices, as proficiency test scores are. [24] Brasington (1999) suggests the possibility that "parents do not choose schooling based on which school districts are best able to improve students' academic achievement", and instead they choose "school systems based on peer effects, valuing the type of children who attend the district" (410). For this reason, value-added may be useful for measuring improvement in student performance, but is not useful as a

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[24] The sample consisted of over 27,000 houses located in 128 different communities (Hayes and Taylor 1996). See Section 2.1 above for further discussion of this paper's methods.

measure of school quality in housing market studies (Brasington 1999). Downes and Zabel (2002) also find no correlation between value-added measures and house prices, thereby adding further support to the conclusion that "homeowners do not consider the extent to which a community's schools contribute to a cohort's test performance" (19).

Using a hedonic model to measure value-added schooling, Brasington and Haurin (2006) also find no correlation between this variable and the housing market. Notably under the value-added model, "good schools are not necessarily the ones with the highest test scores, because high levels of achievement may reflect parent characteristics" (Brasington and Haurin 2006, 246). Brasington and Haurin (2006) use house price data from 310 school districts situated within urban Ohio, over 77,000 housing transactions during the year 2000. To measure student performance, they collect data from the Ohio Department of Education, and specifically examine the percentage of students passing all parts of the fourth and ninth grade proficiency tests (Brasington and Haurin 2006). They find that the housing market consistently values school districts' average proficiency tests scores, but not value-added measures (Brasington and Haurin 2006).[25] Brasington and Haurin (2006) suggest that this failure of the housing market to consider value-added data is due to the fact that the accessibility of information drives consumer choices, and school proficiency test performance receives greater publicity than value-added data.

Though they find state test scores and school district rankings to be capitalized in house prices, Seo and Simons (2009) find only a weak correlation between value-added measures and the housing market. They find a one standard deviation change in value-

[25] Brasington and Haurin (2006) specifically find that "house prices vary by about 14 percent when comparing a school district with student achievement that is one standard deviation below the mean to a district with achievement that is one standard deviation above the mean" (246).

added measures to correlate to less than one percent change in house prices. This finding is only significant at the ten percent level (Seo and Simons 2009).

The findings of Iberman and Lovenhiem (2013) provide further support to the conclusion that there is currently no correlation between school value-added measures and district house prices. In August 2010, the *Los Angeles Times* released average school value-added data for all 470 public elementary schools in Los Angeles, and in addition released value-added estimates for 6,000 third through fifth grade teachers in the Los Angeles Unified School District (LAUSD). Iberman and Lovenhiem (2013) use this data, along with home sales data from the Los Angeles County Assessor's Office for the period of April 2009 to September 2011, to observe how home values in the county changed following the release of the value-added data. Notably, their study is the first to incorporate teacher-level value-added data, in addition to school level data (Iberman and Lovenhiem 2013). They conclude that property values do not respond to released value-added information, both at the school and teacher level. Iberman and Lovenhiem (2013) suggest that this failure by the public, and thus the housing market, to appreciate value-added data, could be due to value-added data's statistical complexity and an overall lack of understanding in the public as to its true meaning.

B.4. Capitalization of Per Pupil Expenditures in House Prices

Hanushek (1986, 1989, and 1996) found that school spending is not capitalized in student performance and suggested that per pupil expenditures are not a viable measure of school quality. Later studies dispute these findings, and suggest that school expenditures positively correlate with student achievement levels. Likewise, findings on the correlation between school expenditures and house prices vary, with certain studies suggesting at least a weak positive correlation and others finding no evidence of any relationship.

Both Hayes and Taylor (1996) and Downes and Zabel (2002) find no evidence that school expenditures are capitalized into district home prices. Instead, both conclude that it is student test score performance that has the greatest correlation with home prices (Hayes and Taylor 1996, Downes and Zabel 2002). Downes and Zabel (2002) come to the specific conclusion that it is school outputs (i.e. test scores) and not inputs (i.e. per pupil expenditures) that are valued by the housing market. Crone (2006) also finds that a district's expenditures per pupil have no effect on house prices within that district, once one controls for student achievement.

In contrast, both Brasington (1999) and Brasington and Haurin (2006) find a positive correlation between per pupil expenditures and district house prices. Once community income levels, tax rates and racial composition are incorporated into the model, Brasington (1999) concludes that higher per student expenditures correlate with higher house prices. Brasington and Haurin (2006) also find that the housing market highly values school expenditures, measuring the elasticity of house prices with respect to per-pupil expenditures at .49.

Seo and Simons (2009) find a significantly smaller correlation between school expenditures and house prices, and suggest that per pupil expenditures are in fact a weak measure of school quality. They conclude that a one standard deviation change in per pupil expenditures correlates to less than a one percent change in house prices (Seo and Simons 2009). Interestingly, they find that spending per student in lower ranked districts is comparable to that in higher ranked districts; thus meaning that, these districts are less efficient overall in terms of both inputs and outputs (Seo and Simons 2009). Seo and Simons (2009) also note that, overall, "tax burdens are greater to taxpayers in poor school districts", though these schools have lower test scores, meaning that individual taxpayers are often forced to pay relatively more for lower quality schools (325).

B.5. Capitalization of Racial Composition in House Prices

A recent question evoked by the literature is that of whether racial preferences are capitalized in house prices. With increasing segregation in American schools, Clapp, Nanda and Ross (2005) (henceforth CNR) are one of the first to ask the question of whether homebuyers pay for test scores or demographic composition. CNR (2005) utilize data from eighth grade Connecticut State tests in math, reading and writing, and incorporate neighborhood fixed effects into their model. Their housing price data originates from Banker and Tradesman, a provider of real estate data for the state of Connecticut, and contains the over 350,000 transactions that took place between 1994 and 2004. Using this data and a hedonic model, CNR (2005) find that a one standard deviation increase in test scores leads to a one and one third percentage point increase in house prices. This correlation, though positive, is smaller than most prior studies, and confirms Black's (1999) finding that "failing to control for neighborhood unobservable leads to an overstatement of the effect of test scores on property values" (CNR 2005, 454). Interestingly, they find that homebuyers within the state of Connecticut place greater value on demographic composition than student test scores when deciding where to purchase a home (CNR 2005). CNR (2005) find strong evidence that a neighborhood's increase in percentage of Hispanic residents correlates with a fall in the house prices within that neighborhood. Conducting a long-run analysis, they conclude that a ten-percentage point increase in a neighborhood's percentage Hispanic residents correlates to between a five and ten percent decline in that area's home prices (CNR 2005).

Chiodo, Hernandez-Murillo, and Owyang (2010) (henceforth CHO) also find a neighborhood's racial composition to be capitalized into its house prices. To measure house prices, CHO (2010) collect data from a local real estate company for the period of 1998 to 2001, a total sample of almost 40,000 home sales. To measure school quality, they elect to use state math test scores provided by the Missouri Department of Elementary and Secondary Education (CHO 2010). Using the school attendance boundary method first developed by Black (1999) and data from the 15 school districts within St. Louis County, they find statistically significant evidence of a correlation between racial composition and house prices.

Bayer, Ferreira, and McMillian (2007) (henceforth BFM), however, find no correlation between a neighborhood's racial composition and house prices within that neighborhood.[26] Building upon the model of Black (1999), they also elect to use a boundary discontinuity model and make use of school attendance zone boundaries (BFM 2007). Using restricted data from the 1990 United States Census and San Francisco Bay County public records of home sales between 1992 and 1996, BFM (2007) conclude that neighborhood race is not directly capitalized into housing prices.[27] Rather, they conclude that the "negative correlation of neighborhood percent black and housing prices is due

[26] Controlling for boundary fixed effects; BFM (2007) also find that for an increase in average school performance of five percent, households are willing to pay less than one percent more for houses within that district.

[27] This use of restricted microdata from the U.S. Census allows for a greater control of socioeconomic variables, this data "links detailed characteristics for nearly a quarter of a million households and their houses in the San Francisco Bay Area with their precise residential location" (BFM 2007, 590)

entirely to the fact that blacks live in lower-quality neighborhoods"(BFM 2007, 589). Interestingly, BFM (2007) also suggest that individuals have heterogeneity in preferences for schools and neighbors, preferring to self-segregate based on both race and education.

B.6. Capitalization of Other Variables in House Prices

Various studies have suggested the capitalization of other variables, mainly student-to-teacher ratios and teacher salaries, into house prices. To date, however, the significance of these findings is limited, and we will only briefly discuss them here. Brasington (1999) finds that the housing market does indeed capitalize pupil-to-teacher ratios, and similarly Crone (2006) finds an inverse relationship between class size and housing values at the high school level. Both Brasington (1999) and Seo and Simons (2009) find that a district's average teacher salary factors into the district's housing market. Specifically, Seo and Simons (2009) find that a one standard deviation change in average teacher salary generates between a three and five percent change in house prices.

CHAPTER THREE

Model and Theory

The purpose of this study is to observe the capitalization of public school administrative spending in district house prices. Within our study, we utilize the hedonic price model, originally developed by Rosen (1974), and modified by Black (1999) to control for neighborhood variation across school boundaries. Below, we will also discuss the theoretical correlations between home price and a number of explanatory variables: home characteristics, border dummies, and district characteristics, specifically the regressor of primary interest, administrative spending per pupil.

A. The Hedonic Housing Price Model

To estimate the effects of administrative spending on house prices, we will use a standard hedonic estimation; a model frequently cited in the housing literature. Rosen (1974) developed the hedonic model, and Black (1999) later modifies his early model to control for neighborhood variation across school boundaries. The standard hedonic estimation assumes that there is an inelastic supply of housing and with that, a variety of consumers whose preferences for housing vary. Rosen (1974) describes the hedonic estimation, stating:

> A class of differentiated products is completely described by a vector of objectively measured characteristics. Observed product prices and the specific amounts of characteristics associated with each good define a set of implicit or hedonic prices. A theory of hedonic prices is formulated as a problem in the economics of spatial-equilibrium in which the entire set of implicit prices guides both consumer and producer locational decisions in characteristics space (Abstract).

As Black (1999), we make the important assumption that house prices are associated with a district's public school quality. In making this assumption, we assume that homebuyers consider public schools to be something of great value, and thus they scrutinize them closely when making the decision to purchase a house. When purchasing a home, consumers are constrained by the houses that are currently for sale and the public schools available, and perhaps most significantly, their income.

In equilibrium, all homebuyers with the same preferences and income are able to achieve the same level of utility, as price compensates for greater amenities. The hedonic price function depicts this equilibrium, with a home's selling price described as a function of its characteristics and location, with the price of each characteristic representative of the marginal value assigned by the homebuyer. Thus, the basic equilibrium relationship is defined as:

$$\textbf{(1) } \ln(\text{homeprice}_{ijk}) = \alpha + X_{ijk}\beta + Y_j\eta + Z_k\delta + \gamma \text{Adminspend}_j + \varepsilon_{ijk},$$

where homeprice_{ijk} is the price of house *i* in neighborhood *k* within school district *j*. The vector X_i includes the characteristics of house *i*, such as the year built and number of bedrooms. The vector Y_j is a measure of school district characteristics, such as student-to-teacher ratios and student test scores. Finally, the vector Z_k is a measure of neighborhood characteristics, such as public goods. In our study, the regressor of primary interest is $Adminspend_j$, the measure of total administrative spending per pupil in school district *j*.

Past studies, including Hayes and Taylor (1996) and Brasington (1999), have made use of similar equilibrium models.[28]

However, there is a significant flaw with this approach. It is not possible to observe all relevant neighborhood characteristics and thus, results are subject to omitted variable bias. To remedy this situation, our model will make use of boundary discontinuity methods. As Black (1999) and Dhar and Ross (2012), our sample only includes houses located in the direct proximity of a school district boundary.[29] We make the assumption that there is little variance amongst these neighborhoods situated near district borders. Thus, in our model, we are able to replace $Z_{k,}$ the measure of neighborhood characteristics with a set of boundary dummies that indicate houses that share a district boundary. When using boundary methods, we define the relationship as:

$$\textbf{(2) ln (homeprice}_{\mathbf{ijb}}\textbf{)} = \boldsymbol{\alpha} + \boldsymbol{X}_{\mathbf{ijb}}\boldsymbol{\beta} + \mathbf{Y}_{\mathbf{j}}\boldsymbol{\eta} + \boldsymbol{K}_{\mathbf{b}}\boldsymbol{\delta} + \boldsymbol{\gamma}\mathbf{Adminspend}_{\mathbf{j}} + \boldsymbol{\varepsilon}_{\mathbf{ijb}},$$

where K_b is a vector of boundary dummies. These boundary dummies are able to account for any unobserved characteristics shared by houses on either side of the district boundary. By looking only at houses very close to school district boundaries, we are able to largely avoid the bias associated with omitted neighborhood characteristics.

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[28] It is important to note that that previous studies had a different regressor of primary interest (e.g. test scores).

[29] Note that Black (1999) made use of attendance district boundaries within her study. We instead utilize school district boundaries, as Dhar and Ross (2012) do. School district boundaries most often have been in place for many years, giving households a chance to sort by school preferences (Dhar and Ross 2012). In contrast, school attendance zones frequently change. Additionally, school finance variables do not largely vary across attendance zones - only changing across district boundaries (Dhar and Ross 2012). Thus, as our study's regressor of primary interest is a school district's level of administrative spending per pupil, it is logical to utilize school district boundaries.

B. Statement of Theory

We theorize that when school districts spend more or less than the optimal amount on administrative salaries, house prices within those districts will be lower. In this section, we will discuss the theoretical correlations between home price and a number of explanatory variables: home characteristics, border dummies, and district characteristics, specifically the regressor of primary interest, administrative spending per pupil. We hypothesize district house prices (LOG_SALE_PRICE) to be dependent upon several things: house characteristics (BEDS, BATHS, SQFT, LOG_ACRES, YEAR, STORY, PROP_TXRATE_ASMT), the district's level of administrative spending per student (ADMNSPND_PP), number of students (STUDENTS_NUM), number of schools (NUMSCHOOLS), percentage of district revenues from local sources (LOCALREV_PCNT), student-to-teacher ratio (STDNT_TO_ TEACH), total district non-administrative expenditures per pupil (NON_ADMNSPND_PP), and median teacher salary (TEACHER_SALARY).

B.1. House Characteristics

When purchasing a home, buyers pay premiums for a number of things. Larger homes are generally more expensive, as they cost more to build and buyers put a premium on this increased space. Thus, we anticipate the number of bedrooms in a house (BEDS), the number of bathrooms (BATHS), a home's square footage (SQFT) and the acreage of the lot (LOG_ACRES) to positively correlate with a home's selling price (LOG_SALE_PRICE).[30] We also expect a positive correlation between the year in which a

[30] To minimize the effect of variance in lot size, we utilize the log of a lot's acreage. We also run regressions (not included in appendices) that include the linear form of ACRES, and find that the inclusion of LOG_ACRES makes little difference in our regression results.

home was built (YEAR), and selling price. Newer homes have more modern amenities and are less costly to maintain than older homes, attributes likely valued by homebuyers. All homeowners are required to pay property taxes on their homes, and this property tax rate varies by school district and county. In this study, we measure the property tax rate (PROP_TXRATE_ASMT) to be the amount of property taxes paid by a homeowner in 2011 divided by the county assessment of the property's value. We expect this number to inversely correlate with house price, as higher property taxes are not desirable to buyers.[31]

B.2. Regressor of Primary Interest: Administrative Expenditures

The regressor of principal interest within our primary equation is the level of school district administrative expenditures per pupil (ADMNSPND_PP).[32] This figure includes all expenditures "for board of education and executive administration services", along with all expenditures from the "office of the principal services" (NCES Data Glossary).[33] We anticipate this relationship between administrative spending per pupil and home prices to be ∩-shaped, as buyers seek districts that will allocate their taxpayer dollars well and provide a high-quality education to students. To estimate this hypothesized relationship, we will utilize a quadratic function within our regression

[31] It is also possible that there exists a direct relationship between tax rates and district expenditures, potentially creating endogeneity within the regression equation. By using property tax rates, as opposed to simply taxes paid, we hope to eliminate this. Tax rates correspond to the level of a district's property tax base. Thus, if a district has a high tax base, its property tax rates may not be that high - even though it is able to maintain a high level of expenditures.

[32] From here forward, we will refer to the model that includes administrative expenditures per pupil (ADMNSPND_PP) as the *primary* regression equation. We refer to the specification that incorporates administrative salary expenditures per pupil (ADMNSAL_PP) as the *secondary* regression equation.

[33] ADMNSPND_PP represents the sum of two categories of the Common Core of Data LEA Finance Survey: Total General Administrative Support Service Expenditures (E08) and Total School Administrative Support Service Expenditures (E09). We then divide this sum to get total administrative spending per pupil. This figure also includes administrative salaries. The data glossary is provided when a data table is generated on the NCES site.

equations, as this will allow us to calculate the optimal level of district administrative spending.[34]

When ADMNSPND_PP is above its optimal point, an increase in administrative spending will drive house prices down; but, when it is below the optimal, an increase in administrative spending will drive house prices up. Resources lost to excess administration are resources that districts could have allocated to other things, such as additional classroom teachers or early childhood education programs, which would likely improve school quality. On the contrary, schools need a certain level of administration to oversee district programs, and resolve issues when they arise. Thus, a very low level of administrative spending is likely not ideal, either.

Within our secondary regression, we will consider a district's total administrative salary spending per pupil, a subset of administrative spending (ADMNSAL_PP). This figure includes district expenditures on salaries for "board of education staff, board support staff, staff relations and negotiation staff, the superintendant and the superintendent's staff", as well as the salaries of "school principals and their staffs, and department chairs" (NCES Data Glossary).[35] Similar to the above, we expect the relationship between ADMNSAL_PP and LOG_SALE_PRICE to be ∩-shaped.

[34] Note that this optimal level likely varies from district to district, and we will calculate the optimal for the entirety of the sample.
[35] This level of total administrative salary spending is the sum of two variables from the Common Core of Data LEA Finance Survey: Salary - General Administrators - Support Service Expenditures (V15) and Salary - School Administrators - Support Service Expenditures (V17). We divide the sum of these two categories by the total number of students in a district to get our value of total administrative salary spending per pupil (ADMNSAL_PP).

B.3. Other Independent Variables

We also expect a district's size, level of wealth, student-to-teacher ratio, median teacher salary, and total expenditures per pupil to be capitalized within district house prices. When seeking schools for their children, parents desire schools where their child will receive individualized attention and not simply be lost amongst thousands of other pupils. At the same time, larger school districts often have a greater variety of programs (e.g. advanced placement courses, more athletic teams, etc.); attributes sought-after by students and parents.[36] Districts with a large number of schools (NUMSCHOOLS) are also desirable, as even though a district may be large, schools will likely remain smaller and students will still receive personal attention at the school level.[37] We thereby expect a positive correlation between NUMSCHOOLS and LOG_SALE_PRICE.

Wealthier communities, having a higher tax base, are better able to support their schools. More impoverished communities, usually having lower levels of property tax revenues, are more reliant on funding from the state and federal governments to meet their district school budgets. Thereby, the percentage of district revenues coming from local sources (LOCALREV_PCNT) is a good proxy for district wealth.[38] Parents generally do not want their children to attend a high poverty school, believing that this will put them at

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[36] Due to limited degrees of freedom within our regression equation, we will not be able to estimate this relationship as quadratic within our regression equation. Instead, it will remain linear. However, we do not expect this to be an issue, as we anticipate that the vast majority of Capital Region districts will be situated on the right side of the curve, above the optimal point, making the linear form an acceptable alternative.

[37] The other explanatory variable that might be significant here is the number of students per individual school. Districts often have multiple elementary schools, and a single large high school. Future studies should consider controlling for this variable.

[38] There is a high correlation between LOCALREV_PCNT and the number of students eligible to receive free / reduced price lunch (LUNCH), in our sample -.72, as both are measures of district poverty. Thus, we do not control for LUNCH in our regressions.

an educational disadvantage; thus, we expect a positive correlation between LOCALREV_PCNT and LOG_SALE_PRICE.

The optimal student-to-teacher ratio (STDNT_TO_TEACH) is that which allows students to receive the personalized attention they require to learn course material, but does not create an excess of teachers, and with that excess spending on teacher salaries. As the number of teachers within a district increases, the marginal return (e.g. student performance increase) seen from each additional teacher decreases. School boards and taxpayers frequently debate the optimal magnitude of the student-to-teacher ratio, seldom reaching a consensus. When the student-to-teacher ratio is very high, above its optimal point, parents will demand increased individual attention for their students, and we expect a reduction in the ratio to result in higher home values. On the contrary, if the ratio is already very low, taxpayers will view the hiring of further teachers as wasteful spending, and a further reduction in the ratio will result in lower home values.[39] Interestingly, Brasington (1999) and Crone (2006) find an inverse relationship between a district's student-to-teacher ratio and house prices within those districts. Based on the above logic, it is likely that within the school districts analyzed by Brasington (1999) and Crone (2006), the student-to-teacher ratio was already above its optimal level.

To provide students with the resources that they require, districts must maintain a certain level of spending. We measure this spending as a district's level of total non-administrative expenditures per pupil (NON_ADMNSPND_PP).[40] We hypothesize the

[39] Due to limited degrees of freedom within our regression equation, we estimate the relation between STDNT_TO_TEACH and LOG_SALE_PRICE as linear, rather than the hypothesized quadratic. We anticipate that the vast majority of Capital Region districts will be situated on the right side of the curve, above the optimal point, making the linear form an acceptable alternative.

[40] Within our regression equation, we desire to control for a district's level of total spending per pupil. However, when a district's level of administrative spending rises, we also see a rise in a district's total

relationship between NON_ADMNSPND_PP and LOG_SALE_PRICE to also be ∩-shaped, as we believe there to be an optimal level of district spending per pupil.[41] If spending per pupil is below the optimal point, students likely do not have access to the resources (e.g. current technology, reasonable class sizes, etc.) that they need to learn, and the quality of education they receive suffers. Yet, if NON_ADMNSPND_PP is already above its optimal point, the benefits of this increased spending will be significantly less tangible and taxpayers will be more likely to view this increased spending as wasteful. Prior studies measuring this relationship find total school expenditures per pupil to have either a slightly positive correlation (Brasington 1999 and Brasington and Haurin 2009) or no correlation whatsoever (Hayes and Taylor 1996, Downes and Zabel 2002, and Crone 2006) with district house prices.

A commonly used measure of school quality is student test performance. When seeking high quality schools, homebuyers frequently examine district achievement on standardized tests. Student test performance, though by no means a perfect gauge, represents a readily accessible measure of school quality. In order to graduate a New York State High School and receive a state-issued Regents Diploma, a student must pass both the Comprehensive English Regents and a Mathematics Regents Exam.[42] For these

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spending, as admin spending is a subset of total spending. This relationship potentially creates endogeneity within the regression equation. To prevent this, we utilize a district's level of non-administrative spending per pupil (NON_ADMNSPND_PP) within our primary regression. Within our secondary regression, we use a district's level of non-administrative salary spending per pupil (NON_ADMNSAL_PP).

[41]Due to limited degrees of freedom within our regression equation, we estimate the relation between NON_ADMNSPND_PP and LOG_SALE_PRICE as linear, rather than the hypothesized quadratic. We anticipate that the vast majority of Capital Region districts will be situated on the right side of the curve, above the optimal point, making the linear form an acceptable alternative. It is important to note that this optimal point is likely correlated with district size, as school spending is highly based on economies of scale. Thus, this optimal point likely varies by school district.

[42] To meet Regents Diploma requirements, students can pass any one of three state Mathematics Regents Exams: Integrated Algebra, Geometry and Trigonometry. In our study, we used the pass rate on the

reasons, we expect a positive correlation between RGNTS_ENGLISH and RGNTS_MATH, and district home values. The economic literature supports our hypothesis; as overall, the literature has found a positive and direct relationship between school test scores and district home prices (Hayes and Taylor 1996, Brasington 1999, Black 1999, Downes and Zabel 2002, Crone 2006, etc.).

Race also likely factors into one's school and neighborhood preferences and the literature has not come to a consensus on the relationship between race and house prices. CNR (2005) and CRO (2010) both find a statistically significant correlation between race and home prices. BFM (2007), however, do not; instead they conclude that "the negative correlation of neighborhood percent black and housing prices is due entirely to the fact that blacks live in lower-quality neighborhoods" (589). We anticipate an inverse relationship between a district's percentage of minority students (NONWHITE) and LOG_SALE_PRICE. We recognize, however, that this relationship may not in fact be a product of racial preferences, but rather simply a result of minorities living in lower-quality neighborhoods. Additionally, we exclude urban school districts, and thus there is little variation between school districts' percentages of nonwhite students within our sample. In a different geographic region, with greater racial variation between school districts, there is a greater chance that NONWHITE would be significant.

Additionally, we expect a district's median teacher salary (TEACHER_SALARY) to be capitalized in district home prices. To attract quality teachers to their schools, districts must pay teachers a fair salary. However, it is also possible for schools to overpay teachers

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Integrated Algebra exam. Of these three exams, the material included in Integrated Algebra is of the lowest level. Note that some districts may offer a "local diploma", allowing students to meet graduation requirements without passing the state-specified Regents Examinations.

- allocating resources to teacher salaries that the district could have utilized more effectively elsewhere. We anticipate the relationship between TEACHER_SALARY and LOG_SALE_PRICE to be ∩-shaped, as the curve does have an optimal point.[43] When below its optimal point, an increase in median teacher salary will likely allow schools to attract higher quality teachers, raising school quality and thus district home prices. Notably, Seo and Simmons (2009) find a positive and significant relationship between teacher salaries and district house values, while other studies find less significant and more variable results (Brasington 1999).

A.4. Border Dummies

Using a similar method to Black (1999) and Dhar and Ross (2012), we incorporate a set of border dummies as explanatory variables to better control for neighborhood characteristics. Each of the 22 border dummies represents a single school district boundary - the geographic line that determines which high school a child attends (Figure 4). We assume that the neighborhoods on either side of this boundary will be largely identical, the only significant difference being the school district in which the houses are located. By limiting the sample to houses in the direct proximity of this district border, we are able to better control for neighborhood differences and prevent a substantial amount of omitted variable bias

In contrast to Black (1999), we elect to use school district boundaries as opposed to school attendance zones. As Dhar and Ross (2012) suggest, our method represents an improvement on many prior studies, as school attendance lines are subject to change, and

[43] Due to limited degrees of freedom within our regression equation, we estimate the relation between TEACHER_SALARY and LOG_SALE_PRICE as linear, rather than the hypothesized quadratic. We anticipate that the vast majority of Capital Region districts will be situated on the right side of the curve, above the optimal point, making the linear form an acceptable alternative.

a number of factors, such as school spending, do not vary within districts. Thereby, as our regressor of primary interest is a district's level of total administrative spending per pupil, it is logical that we would use school district borders rather than attendance boundaries. Further discussion of our methods and selection of district borders is included below in the data section.

CHAPTER FOUR

Data

In order to observe the relationship between levels of public school administrative spending and district house prices, we select 445 Capital Region homes for our sample, and proceed to run a regression analysis of this data set. The homes we select come from a total of 29 different school districts, each located on one of 22 separate district boundaries, within seven different counties. We select each home for its direct proximity to a certain school district boundary, allowing us to better control for variation in neighborhood characteristics. Below, we will discuss our methods for selecting both district boundaries and individual houses. Data on school districts comes from the National Center for Education Statistics, while home data comes directly from the online real estate database, Zillow.

A. District Borders

Before selecting a sample of individual homes, we first select a sample of qualified district borders located within the Capital District of New York State. As mentioned above, only homes located on district boundaries are included within the sample, as to prevent the omitted variable bias caused by an inability to control for neighborhood characteristics (Black 1999). In selecting boundaries, we seek to include districts with a large disparity in administrative expenditures, but that are otherwise reasonably similar. Administrative measures that we examine here include total administrative expenditures per pupil, total administrative salary spending per pupil, student-to-administrator ratio, and superintendent compensation. District boundaries with a significant variance in at least one of these four categories are marked for further analysis.

To best measure the housing market's capitalization of administrative spending, we seek to only include boundaries where the districts on each side of the boundary line are fairly similar and thus eliminate district borders from our sample for a variety of reasons (Figure 1):[44]

1. As city and rural school districts both have special needs and often elect to allocate their resources very differently, we exclude all borders in which a city district borders a rural district.[45]
2. Similarly, as high poverty districts have different needs and resource levels, we exclude all boundaries in which a high-need district borders a low or average need district. For example, we will not consider the boundary between the Niskayuna and Schenectady school districts.
3. Test scores represent a readily accessible, though likely imperfect, measure of student learning and school quality. A great variance in test scores across a district boundary likely represents a significant difference between districts. We elect to exclude boundaries for which this is the case.[46]
4. We exclude district borders in which the districts vary greatly in geographical area and overall size. School spending is greatly reliant on economies of scale, and it is

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[44] Our data on school districts, unless otherwise noted, comes directly from the National Center for Education Statistics (NCES) and the Common Core Data (CCD) surveys, and we will discuss the specifics of its acquisition below in the "School District Data" Section. .

[45] For this "urban-centric local" categorization, a measure of a school district's location relative to populous areas, the NCES utilizes data from the 2000 Census.

[46] As a broad measure of student performance, we use the greatschools.org "greatschools" rating. This "greatschools" rating, a single number on a scale of one to ten, is based upon a district high school's scores on a number of New York State administered Regents Exams. NYS conducts Regents Examinations in a variety of areas to measure student learning, and students are required to pass certain exams to receive their "Regents Diploma". Thus, a significant variance in this value represents a substantial difference in student performance. We exclude district boundaries where the differential in this "greatschools" rating is greater than two.

important to control for this factor. For instance, it would not be reasonable to use the Shenendehowa / Mechanicville border, as Shenendehowa is a very large district both in area and in students, having more than seven times the students of Mechanicville.

5. Additionally, we eliminate boundaries in which districts' total expenditures per student differ by more than $6000. A drastic difference in school spending per student likely represents fundamental differences in the way districts are structured.
6. We exclude boundaries where school taxes vary significantly, by more than one percentage point, on each side of the boundary. A low tax base and high school tax rates, often results in lower district home values, as homebuyers demand compensation for this increased tax burden.[47]
7. We also eliminate district boundaries in which districts have dissimilar racial compositions, as race potentially plays a role in school preferences.
8. We only consider districts with a separate high school (i.e. offering grade 12). School districts without high schools of their own send students to schools in nearby districts, thus creating unwanted variation in the sample.
9. Geography also causes the elimination of several potential boundaries.[48] For instance, though the two districts are otherwise similar, we exclude the Bethlehem / East Greenbush border, as its entirety is the Hudson River. Likewise, we exclude

[47] Here we use school tax data from the New York State Education Department, as published by *The Albany Business Review* in their June 2011 report on Capital District schools. *The Albany Business Review* computes "taxes for multiple-municipality districts using the tax rate of the municipality that contains the largest portion of the district".

[48] As we utilize the online property database, Zillow, we are able to see these geographic anomalies upon looking up a district border.

the North Colonie / Shenendehowa border, as the Mohawk River serves as the districts' border. The potential for neighborhood variation is greater when a geographical boundary is present - the boundary effectively creates separate neighborhoods.

10. Finally, we exclude district borders for which there are simply not enough houses near the border. Due to geographical restraints, some school districts, mainly rural districts, simply do not have a substantial number of houses within one and a half miles of their borders.

B. School District Data

Within our sample of school districts, we control for the following variables, each having the potential to affect house prices: administrative expenditures per pupil, total number of students, number of schools, percentage of district revenues from local sources, student to teacher ratio, non-administrative expenditures per pupil, median teacher salary, and performance on the New York State English and Math Regents Exams.[49] We access this school district data through the National Center for Education Statistics' (NCES) online data center. The data reported by the NCES comes from a set of school surveys known as the Common Core of Data (CCD). The Department of Education conducts this series of surveys annually and the specific set we utilize comes from the 2009-10 school year. The CCD surveys contain data on all public elementary and secondary schools, all local education agencies and all state education agencies in the United States (nces.org).

[49] Note that administrative expenditures per pupil is measured in dollars, total number of students is listed in basic numerals, number of schools is listed in basic numerals, percentage of district revenues from local sources is listed as a decimal from 0 to 1, student to teacher ratio is listed as a numeric ratio, non-administrative expenditures per pupil is measured in dollars, median teacher salary is measured in dollars, and passage rate of the New York State English and Math Regents Exams is listed as a decimal from 0 to 1.[49]

Specifically, the CCD surveys contain three primary types of information: general descriptive information on schools and school districts, information on students and staff, and fiscal data (nces.org). The data reported within our study is a mix of these three surveys, with all figures on administrative expenditures and school spending coming from the CCD LEA Finance Survey. See Figure 2 within the Appendices for descriptive statistics on this data set.

We elect to utilize CCD data from the 2009-10 school year for one critical reason: when the Department of Education publishes the CCD surveys, the housing market does not instantaneously change overnight. Rather, it takes time for changes in school district quality to impact house prices. Homebuyers generally do not access data directly from the CCD surveys; rather they look at reports produced by the local media - reports that take time to produce. For instance, a primary source of school data for residents of the Capital Region is *The Albany Business Review's Schools Report*, published annually each June. The 2011 edition of this report incorporates data from the 2009-10 school year. If an individual were to buy a house in March of 2012, this is the school report that they would see. Thus, it is logical to utilize data from the 2009-10 year.

C. House Selection

Following the selection of qualified district borders, we seek to find recently sold homes in the vicinity of these borders. We assume school quality to be capitalized in home prices, and thus recent sales to represent homebuyers' valuations of schools. Using the real estate database Zillow's mapping technology, we select homes that sold in either 2012 or 2013, and are located in the direct proximity of a school district boundary. In urban and suburban areas, the houses we select are all located within one mile of the school boundary.[50] In rural areas, the density of houses is often significantly less, and we thus by necessity expand this boundary to one and a half miles. We include a sample of either 25 houses or 10 houses from each qualified district boundary; with the selection dependent on the number of border houses available that fit the above criteria. We select a considerable number from each side of the boundary, though not always an equal number due to data availability.

Granted that a house meets these above criteria, we eliminate houses from our border sample for two other critical reasons:

1. Occasionally, families transfer homes between members. Though this "sale" is often included in the county records as a property transaction, the selling price of the home is not reflective of true market value. For instance, owners may transfer a home for a trivial amount, such as $1. To account for this phenomenon, we remove all homes from our sample with a selling price below $30,000.
2. As Zillow is our sole source of home data, we are limited to the data available on the site. Thus, if a border house shows as sold in 2012 or 2013, but Zillow does not have data on the home's specific traits (i.e. number of bedrooms, square footage, etc.); we exclude it from the sample.

D. House Data

We control for the following home characteristics within our sample: number of bedrooms, number of bathrooms, square footage, property acreage, year built, property tax

[50] We attempt to use homes located as close to the district boundary as possible, but are constrained by the sample of houses that sold in 2012 and 2013. Most houses included in the sample are located significantly less than one mile from the border, one mile simply represents the absolute maximum for urban and suburban areas.

rate, number of stories and school district.[51] We acquire data on these independent variables, with the exception of school district, from the online real estate database, Zillow. Specifically, we use the data listed under the "County Records" section of the site's data section.[52] For a considerable number of houses, the Zillow website does not contain information on what school district the house is located within. For this information, we utilize the website greatschools.org, specifically its "School and District Boundary Map" feature.[53] See Figure 3 within the Appendices for descriptive statistics on this data set.

[51] We calculate property tax rate as the property taxes that the homeowner paid in 2011 divided by the county assessment of the property's value. Occasionally, Zillow did not have information available for the 2011 tax year. In that case, we utilize data from 2010. If data from 2010 was also not available, we use 2012 instead. Note also that property tax rate is listed as a decimal between 0 and 1.

[52] The Zillow database reports two types of home data: "All Sources" and "County Records". In describing the difference between the two, the website states that "All Sources" is "data from broker listing feeds, user-submitted information, and county records", while the information found in "County Records" is "only what is recorded in county records". Believing the data from "County Records" to be most consistent across school districts and counties, we use this data for our sample, rather than "All Sources".

[53] Using this map feature, it is possible to enter a property address, and instantly look up its school district. Though Zillow contains school district information for some properties, for consistency, we utilize greatschools.org for all properties.

CHAPTER FIVE

Statistical Tests of Theory

To estimate the capitalization of various measures of school quality into house prices, we utilize equation (2). We control for house characteristics, school district characteristics, and utilize a set of border dummies to control for neighborhood variation. We assume that school quality substantially influences house prices. Using boundary discontinuity methods, we find a district's amount of administrative spending per pupil, to be highly significant and inversely related to district house prices. We find a significant inverse relation between a district's level of non-administrative spending per pupil and home values, and a significant, positive correlation between a district's level of wealth and house prices. Additionally, we find that the significance of district size, student-to teacher ratio and test scores, to district house prices, varies by specification, and we do not find race or teacher salaries to be significant. Multicollinearity and omitted variable bias present some concern within our regression equation.

A. Regression Equations

To observe the effect of school districts' administrative expenditures on district house prices, we form a specific regression equation based upon the hedonic housing price model.[54] We define this logarithmic-linear equation as:

[54] Note that we do not control for graduation rate within the regression equation, as we expect that endogeneity exists between a district's level of administrative spending and graduation rates. Districts often hire more administrators with the goal of improving graduation rates. Additionally, graduation rates are in fact likely not excellent judges of school quality. They do not reasonably account for those students that transferred to other schools or those did not graduate within four years, but completed their diploma requirements later on. Thus, they are especially bad measures for districts having a high turnover of students.

(3) LOG_SALE_PRICE =

$$\begin{aligned}\textbf{LOG\_SALE\_PRICE} = {} & \beta_1\text{BEDS} + \beta_2 \text{ BATHS} + \beta_3\text{SQFT} + \beta_4\text{LOG\_ACRES} \\ & + \beta_5\text{YEAR} + \beta_6 \text{ STORY} + \beta_7\text{PROP\_TXRATE\_ASMT} \\ & + \beta_8\text{STUDENTS\_NUM} + \beta_9\text{NUMSCHOOLS} \\ & + \beta_{10}\text{LOCALREV\_PCNT} + \beta_{11}\text{STUDENT \_TO\_TEACH} \\ & + \beta_{12} \text{ NON\_ADMNSPND\_PP} + \beta_{13}\text{TEACHER \_SALARY} \\ & + \beta_{14}\text{RGNTS\_ENGLISH} + \beta_{15}\text{RGNTS\_MATH} \\ & + \beta_{16}\text{NONWHITE} + \beta_{17}\text{ADMNSPND\_PP} \\ & + \beta_{18}\text{SQ\_ADMNSPND\_PP} + \beta_{19}\text{BORDER\_DUMMIES} \\ & + \text{Eo}\end{aligned}$$

[55]

We expect that the beta-coefficients measuring house characteristics will be positive, with the exception of β-PROP_TXRATE, as each measured characteristic adds value to the home. We also anticipate that the beta-coefficients of NUMSCHOOLS, LOCALREV_PCNT, RGNTS_ENGLISH and RGNTS_MATH will positively correlate with LOG_SALE _PRICE, as each of these variables represents a desirable school district characteristic. The coefficients of the explanatory variables STUDENTS_NUM, STUDENT_TO_TEACH, NON_ADMNSPND _PP, and TEACHER_SALARY are dependent on if the values fall above or below the optimal point, as we hypothesize the relationship between these variables and house prices to be ∩-shaped. Similarly, we expect an ∩-shaped relation between both SQ_ADMNSAL_PP and SQ_ADMNSPND_PP and LOG_SALE_ PRICE.[56] The sign of the beta-coefficients for each of the 22 border dummies included in the regression are dependent on homebuyers' preferences for certain neighborhood characteristics.

[55] We will also consider this equation with a variable controlling for a district's total level of administrative salary spending per pupil (SQ_ADMNSAL_PP). In this alternative version of the regression equation, we will replace SQ_ADMNSPND_PP with SQ_ADMNSAL_PP.

[56] The reasons for these expectation are expanded upon above in the section describing the explanatory variables.

B. Significance of Results

We find a significant correlation between school quality measures and district house prices (Figures 5 and 6). This finding supports our initial assumption that house prices are good estimators of school quality, with our regressions being of a reasonably good fit, having a r-squared values of .68 and .69, respectively (Figures 5 and 6).

B.1. Home Characteristics

As expected, we find strong correlations between a home's characteristics and the selling price of that home. We find a house's number of bathrooms, square footage, acreage, and year built to positively correlate with a home's sale price, all being significant at the one percent level (Figures 5 and 6). Surprisingly, we do not find the number of bedrooms to be significant within our regressions, and its beta coefficient is in fact slightly negative. One possible explanation of this result is the fact that assessors' classifications of "bedrooms" and household uses of rooms may vary. One owner may elect to use a room as a study, while another may use it as a bedroom. Thus, future studies may want to consider a home's total number of rooms as opposed to its number of bedrooms when completing their regression analysis.[57] As anticipated, we find an inverse relationship between a home's property tax rate (PROP_TXRTE_ASMT) and a home's sale price. We estimate that an increase in the property tax rate of one percentage point will cause a home's sale price to fall by approximately 2.5 percent. We find near identical results in the secondary regression when we exchange the regressor of primary interest (ADMNSPND_PP) for total administrative salary spending per pupil (ADMNSAL_PP) (Figure 6).

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[57] We would have liked to control for a home's total number of rooms, but this data was unfortunately not available through the Zillow website.

B.2. Administrative Spending Levels

Our regressor of primary interest is a district's level of total administrative spending per pupil (SQ_ADMNSPND_PP), and we find the correlation between this variable and district house prices to be of five-percent significance (Figure 5). Using a quadratic equation, we calculate the optimal point of administrative spending per pupil at $939. Within our sample, administrative spending levels in close to three-quarters of the school districts exceed this optimal point. The mean level of administrative spending per pupil within our sample is $1,046 and at this point, we estimate that a $10 increase in administrative spending will result in a .86 percent decrease in home values, holding constant all other explanatory variables. In an average sized district of 2,300 pupils, a $10 increase would require a $23,000 increase in the district budget.

Within our secondary model, we measure the correlation between a district's level of administrative salary spending per pupil (SQ_ADMNSAL_PP), a subset of administrative spending, and home values (Figure 6). We find a definitively negative, though insignificant correlation between the two variables. We estimate the optimal point of the curve at $517, and find that 28 of 29 districts spend more than that amount on administrative salaries. The mean of our sample is $631, and at this point, we estimate that a $10 increase in ADMNSAL_PP will result in a 1.38 percent decrease in district home values, holding all other independent variables constant. The total level of administrative spending composes a larger portion of district budgets that administrative salary spending alone, and thus it is logical that the relationship between SQ_ADMNSPND_PP and home values is of greater significance. Hence, we conclude that overall, administrative spending within the Capital District is well above the level that optimizes school quality. When a district allocates too great an amount of its resources to administrative costs, as is the case within the Capital Region, other programs likely suffer, and school quality likely falls.

Though there is not a large body of economic literature on this correlation, there exist a number of public opinion surveys measuring citizen opinions on administrative spending. A 2012 national survey by the Fordham Institute finds that the vast majority of respondents, 69 percent, supported the notion of “reducing the number of district-level administrators to the bare minimum” as a good way to save money “because it means cutting bureaucracy without hurting classrooms" (Farkas and Duffett, 2). In contrast, only 20 percent, of respondents said that reducing administrative expense is a less than optimal way to save money “because districts need strong leadership and good leaders cost money" (Farkas and Duffett, 2).[58] The results of this survey support our assertion that homebuyers believe public school administrative spending to be too high; currently above the level that optimizes school quality. At the same time, it is important to remember that districts can only reduce their administrative budgets so far, as schools need a certain number of quality administrators to function effectively.[59]

In our review of the existing economic literature, we did not find prior research that investigated the relationship between district administrative spending and district home values. Thus, we cannot compare our results directly to prior papers, and recognize

[58] The results of this study by the Thomas B. Fordham Institute, an educational research organization based in Ohio, are based on a"1,009 interviews conducted in March 2012 with a randomly selected, nationally representative sample of adults eighteen or older (the statistical margin of error is plus or minus three percentage points" (2). Note that the Fordham Institute is politically conservative, and this may have some impact on survey practices and results.

[59] Within our primary regression, we find that when administrative spending levels are equal to zero, an increase of $10 in ADMNSPND_PP will result in a 7.5 percent increase in home values. Similarly, in our secondary regression, we estimate that an increase in administrative salaries of $10 will result in a 6.2 percent increase in home values, when ADMNSAL_PP is equal to zero.

that confidence in a single paper's results is low. We recommend that future papers continue to explore this relationship, potentially using a larger sample of homes, or homes within different parts of the country.

B.3. Other District Characteristics

Our regression results demonstrate a substantial correlation between school quality and district home prices. To provide their students with quality educations, school districts must maintain a certain level of spending. However, within our models, we find a district's non-administrative expenditures per pupil (NON_ADMNSPND_PP and NON_ADMNSAL_ PP) to inverse correlate with LOG_SALE_PRICE.[60] Within both specifications, we find this relationship to be significant at the one percent level (Figures 5 and 6). Based on the results of the primary regression, we estimate that an increase in NON_ADMNSPND_PP of $1,000 corresponds to a 2.8 percent fall in home values (Figure 5). Within a district of 2,300 students, the average within our sample, this $1,000 increase per pupil would require a $2.3 million increase in the school budget. Hence, we suggest that total spending per pupil is too high within Capital District schools, exceeding its optimal point and not maximizing school quality. This finding is in contrast to the prior literature that found either a positive correlation (Brasington 1999 and Brasington and Haurin 2009) or no correlation (Hayes and Taylor 1996, Downes and Zabel 2002, and Crone 2006) whatsoever between the two variables. It is thus likely that within the districts used in these studies, total expenditures per pupil was below its optimal point.

[60] For the reasons discussed above, within the primary regression we utilize a district's level of non-administrative spending per pupil (NON_ADMNSPND_PP). Within the secondary model, we use a district's level of non-administrative salary spending per pupil (NON_ADMNSAL_PP).

We find the relationship between size of a school district, measured by its total number of students (STUDENTS_NUM) and number of schools (NUMSCHOOLS), with a home's selling price (LOG_SALE_PRICE) to vary with model specification. Within both regressions, we find a negative correlation between STUDENTS_NUM and LOG_SALE_PRICE. This correlation is not significant within the primary regression, and is only significant at the ten percent level within the secondary regression. Based on the secondary regression, we estimate that an increase in district enrollment of 250 students will result in a 2.2 percent decrease in home values within that district (Figure 6). This result implies that parents within the Capital Region favor smaller school districts and are willing to pay a premium to live within these districts. Most likely, parents fear that within larger districts their children will receive less individualized attention and become lost amongst the thousands of other pupils.

Additionally, we find districts with a large number of schools to be desirable to homebuyers (Figures 5 and 6). Within our secondary regression, we find the relationship between NUMSCHOOLS and LOG_SALE_PRICE to be positive and significant at the five percent level (Figure 6). Even though a district may be large, if students are divided between a considerable number of schools, they will still be able to receive personal attention at the school level. Though definitively positive, we do not find this correlation to be significant in our primary regression (Figure 5).

Homebuyers also exhibit a strong aversion to homes located within high poverty districts. LOCALREV_PCNT is a good proxy for district wealth, as wealthier communities generally have higher tax bases, and more locally raised funds available to support school budgets. Within our primary regression, we estimate that for each increase of a single percentage point in a district's revenue from local sources (LOCAL_ REV_PCNT), district home prices increase by 1.7 percent (Figure 5). This result, significant at the one percent level in both models, suggests that parents do not want their children to attend high poverty schools, likely believing that it will put them at an educational disadvantage.

As demonstrated above by the inverse relationship between a school's number of students and district home prices, homebuyers desire schools in which their children will receive individual attention. Thus, it is logical that the ratio of students-to-teachers (STDNT_TO_TEACH) should also inversely correlate with district home prices. We find a negative correlation between STDNT_TO_TEACH and LOG_SALE_PRICE within both models, but only find this relationship to be significant within the secondary regression (Figures 5 and 6). Based on the results of the secondary regression, we estimate that an increase of one in the student-to-teacher ratio corresponds to a 9.2 percent fall in home values (Figure 6). This result implies that STDNT_TO_TEACH is currently above its optimal point on the curve, suggesting the marginal value of more teachers to student learning to be greater than the raised salary costs resulting from hiring more teachers. Brasington (1999) and Crone (2006) also find an inverse relationship between a district's student-to-teacher ratio and the house prices within those districts.

Interestingly, we do not find race to be capitalized within home prices. We find a negative correlation between a district's percentage minority students (NONWHITE) and district house prices within both models; however, our findings are not significant at a meaningful confidence level in either regression (Figures 5 and 6). This finding is in contrast to CNR (2005) and CRO (2010), but aligns with the results of Bayer, Ferreira and

McMillian (2007). BFM (2007) conclude the inverse correlation between a district's percentage of minority students and housing prices is due entirely to the fact that minorities frequently live in lower-quality neighborhoods. Using border dummies, we are able to sufficiently control for neighborhood characteristics. Thus, based on the conclusion of BFM (2007), it is logical that we do not find any significant correlation between NONWHITE and LOG_SALE_PRICE. Furthermore, it is important to note that our sample does not contain urban school districts. Hence, there is little variation between school districts' percentages of nonwhite students within our sample. In a different geographic region, with greater racial variation between school districts, there is a greater chance that NONWHITE would be significant.

A readily available measure of school performance is district test scores. We anticipated that student test scores (RGNTS_ENGLISH and RGNTS_MATH), a frequently cited measure of school quality, would directly correlate with district home prices. We measure district test scores as the percentage of students passing these two Regents Exams, but do not account for student score distribution. As expected, within both specifications, we find a highly significant, positive correlation between RGNTS_MATH and LOG_SALE_PRICE (Figures 5 and 6). Based upon the results of the primary specification, we estimate a one-percentage point increase in a district's pass rate on the Integrated Algebra Regents exam to correspond to a 1.5 percent increase in district home values. In contrast, within both models, we find a significant inverse correlation between RGNTS_ENGLISH and LOG_SALE_PRICE (Figures 5 and 6). The number of students simply passing these exams might not be the best measure of school quality, as parents generally do not seek out schools where their students will simply pass, but rather seek out school where their children will excel. For this reason, future studies should consider using an alternative measure of student test scores, such as the median or the percentage of students scoring above an 85 on the exams, as opposed to the percentage simply passing.[61]

We find a negative correlation between a district's median teacher salary (TEACHER_SALARY) and house prices within that district (Figures 5 and 6). However, we do not find this relationship to be significant within the primary model, and only find it significant at the ten percent level in the secondary model. Figure 6 suggests that an increase in TEACHER_SALARY of $1000 results in a 1.8 percent fall in district home values. Based on this result, we conclude that teacher salaries within Capital Region schools currently exceed their optimal amount, the amount that maximizes school quality. It is true that to attract quality teachers, districts must pay fair salaries. However, the district could potentially utilize the additional funds currently used to compensate teachers elsewhere. This result serves in contrast to the findings of Seo and Simmons (2009) and Brasington (1999), who both suggest that a positive correlation exists between teacher salaries and house prices. Seo and Simmons utilize 2005 school data from Ohio and their sample, similar to our study, has a median teacher salary of about $56,000. Thereby, we assume that there are distinct differences between the Ohio and New York teaching markets. In Ohio, a higher salary is likely necessary to attract quality teachers, and thus maximize school quality.

[61] Information on the percentage of district students scoring above an 85 on a certain Regents Exam is readily available through the New York State Department of Education (reportcards.nysed.gov).

B.4. The Border Dummies

We use a set of 22 border dummies to control for variation in neighborhood characteristics, but do not find any of these dummy variables to be of great significance within our regression equations (Figures 4, 5 and 6). Within both models, there are a similar number of positive beta coefficients and negative beta coefficients, for the border dummies. For a dummy to have a positive coefficient, there must be something that makes these neighborhoods especially desirable to homebuyers. For instance, proximity to an office park, school or shopping center, could make buyers willing to pay a premium for the properties.

C. Potential Bias in the Equation

We believe our regression equation to be a good estimate of the relationship between school district level variables, house characteristics, and house sale prices. We estimate the r-squared value, measuring the goodness of fit, at .69, and complete checks for heteroskedasticity, multicollinearity, omitted variable bias, and reverse causality. We do not find reverse causality or heteroskedasticity to be issues within the equation.[62]

Omitted variable bias and multicollinearity do present a few issues within our equation. We believe that the number of students per school is relevant to the regression equation; however, we were not able to control for this variable, potentially creating some bias within our equation.[63] Based on location, each house is assigned to a certain district

[62] We use White's test to look for heteroskedasticity within our regression equation. We do not believe serial correlation to be an issue here, as our data does not represent a time series and serial correlation most often represents correlation between error terms in consecutive time periods.

[63] We expect this omitted variable to cause a slight degree of positive bias within the beta-coefficients of STUDENTS_NUM and STUDENT_TO_TEACH. We expect a slight degree of negative bias with the remainder of the beta-coefficients.

elementary school, middle school, and high school.[64] District elementary schools, and potentially middle schools, may vary in size. In our regression, we found a district's number of schools (NUMSCHOOLS) to positively correlate with home prices, and number of students (STUDENTS_NUM) to inversely correlate to LOG_SALE_PRICE. These results are both of significance, suggesting that parents value smaller schools and individual attention for their students. The number of students per school likely relates to this result, and future studies should consider controlling for the size of the individual schools that a student attends.

However, the addition of a variable controlling for the number of students per school could potentially create multicollinearity within the equation, as this variable clearly relates to the STUDENTS_NUM and NUMSCHOOLS. Already, there exists a strong correlation between STUDENTS_NUM and NUMSCHOOLS (Figure 7).[65] As both of these variables are clearly significant, it is not appropriate to remove either from the equation. This multicollinearity, however, does have the potential to cause increased standard errors of the estimators and also make the estimators more sensitive to their specifications.

[64] In other parts of the state and country, schools have multiple high schools within the same district. Within our sample of Capital Region schools however, each district has only one high school.
[65] Correlation here is .966.

CHAPTER SIX

Policy Implications

We find that public school administrative spending, as measured by administrative salary spending per pupil and total administrative expenditures per pupil, is above the level that optimizes home prices, and thereby the level that maximizes school quality. One can potentially draw two very different conclusions from this finding: administrative spending is currently above the level that truly maximizes school quality or, homebuyers are simply poor judges of school quality, and current levels of administrative spending are actually optimal. For the reasons we will discuss below, we conclude that the first of these options is correct; the current level of administration within Capital Region schools is inefficient.

A. Public School Administrative Spending in the United States

Over the past sixty years, the number of administrators in U.S. public schools has increased dramatically. The Friedman Foundation, in a 2013 report by Benjamin Scafidi, presents its findings on school staffing. They find that from 1950 to 2009 the number the number of full time equivalent school employees increased by 386 percent, while the number of students in U.S. public schools only rose by 96 percent (Scafidi 2013).[66] Specifically, the number of public school teachers rose by over 250 percent and the number of administrators and non-teaching staff by over 700 percent (Scafidi 2013). One would expect some increase in school positions, as the structure of the U.S. education

[66] Milton Friedman created The Friedman Foundation for Educational Choice in 1996 to advocate for school choice within the public K-12 education system. Specifically, the organization "works to educate the public and policymakers about school choice, how it works, and why it is needed" (edchoice.org). Though the Friedman Foundation does have political motivations, the data for its report comes from a very reputable source, the National Center for Educational Statistics (NCES). Our school data also comes from NCES.

system has changed greatly over the past sixty years. Contributing to this increase is the integration of schools that took place in the 1950s, the increased availability of resources for special needs students, and the narrowing of the spending gap between poor and affluent schools (Scafidi 2013).

These factors do not explain, however, the significant increase in the numbers of administrators and non-staff personal within public schools since 1992. From fiscal year 1992 to fiscal year 2009, the number of K-12 administrators and non-teaching staff within U.S. public schools rose by 46 percent, 2.3 times faster than the increase in students over that 18-year period (Scafidi 2013). The Friedman Foundation calculates that nationally "public schools could have saved - and continued to save over $24 billion annually if they had increased / decreased the employment of administrators and other non-teaching staff at the same rate as students between FY 1992 and FY 2009" (Scafidi 2013, 2). It is important to note that within our study, we did not account for spending on non-staff positions, only spending on true administrator salaries.[67]

Using results from the long term National Assessment of Educational Progress (NAEP), the Friedman Foundation finds that over the past twenty years, even as student socioeconomic status rose, student test performance did not increase (Scafidi 2013).[68] The media often publicizes individual, "cherry-picked" examples of improvement in student

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[67] Our data on administrative salaries includes "board of education staff, board support staff, staff relations and negotiation staff, the superintendant and the superintendent's staff", as well as the salaries of "school principals and their staffs, and department chairs" (NCES Data Glossary). This report has also been criticized for the fact that, potentially the administrative increase seen above could be due to an increase in instructional staff who are not teachers - and not an increase in true administrators. In reality, this is not the case; for example, the number of employees that work for school district offices increase 47 percent from 1992 to 2009 (Scafidi 12).

[68] The study specifically utilizes data from the long-term NAEP assessment, as it is largely unchanged since its creation, and is good for measuring long-term trends (Scafidi 10).

performance; yet overall, student performance did not increase (Scafidi 2013, 2). The fact that schools have not seen gains from increased levels of administration supports the assertion that administrative spending nationally is currently above its optimal level.

B. Public School Administrative Spending in New York State

New York State, particularly, has seen a substantial increase in its number of public school administrators. From FY 1992 to FY 2009, New York State experienced a 4 percent increase in its number of students, but a 26 percent increase in its number of administrators and non-teaching staff (Scafidi 2013). The Friedman Foundation estimates that if this number had increased at the same rate as the state's number of students, annual budget savings would exceed $1.5 billion (Scafidi 2013). Districts could then allocate these funds to programs that would improve school quality, such as extracurricular opportunities and early childhood education programs.

Upon first glance, it may seem that New York State's test performance has increased in recent years, suggesting student performance gains to increased administrative expenditures. Upon closer examination, however, it is clear that this is not the case. In a 2010 report on national school quality, the National Academy of Sciences cites the following example: the number of "New York State eighth graders reaching the State's ‘proficiency’ standard increased from 59 to 80 percent between 2007 and 2009, while the same group’s scores on the national math test remained virtually unchanged. This is a phenomenon which is by no means unique to New York State” (52). Overall, student learning has not increased; the State has simply made its exams easier.

Though New York State's level of per pupil spending is the highest in the nation, with school districts spending over $18,000 per pupil on average in fiscal year 2009, the

State's standardized test performance is below the national average (U.S. Census Bureau).[69] The mean level of district expenditures per pupil within our sample, about $17,700 is close to the state average of $18,100 per student. Both of these figures greatly exceed the national average of $10,500 per student. Yet, this high level of spending has not produced significant returns to test scores. NYS performance on both the fourth and eighth grade NEAP exams remains below the national averages (U.S. Census Bureau). The above findings suggest that administrative spending and total spending within New York State are currently above their optimal levels; increased numbers of administrators and rising levels of district spending simply are not improving student performance and school quality.

C. Potential Remedies

Both nationally and within New York State, increases in administrative spending have not been shown to correlate with improved school quality and student performance, and thus we conclude that administrative spending levels within the United States and NYS are currently above the optimal. Our regression results demonstrate this to be the case within the Capital Region as well. We find that an increase in a district's administrative spending per pupil corresponds to a decline in district house prices. It is not the case that homebuyers are simply underestimating the levels of administrative expenditures needed to optimize student performance. As discussed above, it is clear that large increases in administrative spending do not drastically alter student performance. Making cuts to a school budget, however, can be difficult, as there is always someone that

[69] The tremendous geographical diversity throughout New York State can make it difficult to formulate meaningful comparisons between regions. High levels of spending in NYC districts and rural districts upstate, often exceeding $24,000 per pupil, inflate this per pupil spending average.

cares greatly about a particular issue. Potential remedies for reducing school district administrative expenses include consolidation and outsourcing.

In practice, there exist two main types of district consolidation: school consolidation and administrative consolidation. School consolidation represents the merger of two or more existing school districts into one individual district. Though this can potentially result in cost savings, it is often a politically unpopular move and can result in significantly longer bus routes, and with that increased student transportation costs. Administrative consolidation is a politically more favorable option, as community schools do not close. Rather, under administrative consolidation, multiple districts combine under a single superintendent, and district offices merge as well. This reduces overhead and redundancy in district administrative positions.

Consolidation is currently a hot topic in New York, and Governor Cuomo has continuously stressed its merits to local governments. In May of 2012, Governor Cuomo appointed a commission to reform state education, with the specific goal of "examining New York's education system to ensure it meets the needs of students while respecting the taxpayer" (governor.ny.gov). In his press release describing this new commission, the Governor states:

> New York's education system is organized into 700 school districts, more than half of which educate fewer than 2,000 students. Each of the 700 school districts has its own administration and back office functions, creating duplication, waste, and inefficiencies in the way school districts deliver education. The Commission will examine potential strategies to reorganize the state's education system including district consolidation and/or shared services; comparing models from other states to achieve efficiencies and improved education outcomes; identifying reforms and savings in special education; maximizing informed participation in local elections; and facilitating shared services, consolidation and regional governance (governor.ny.gov).

Based on the Governor's statement, it appears that New York State could be a prime candidate for further consolidation measures.

Hu and Zinger (2008) find school district consolidation to positively correlate with home values. Examining the districts within New York State that undertook school consolidation measures between the years 1990 and 2000, Hu and Zinger (2008) conclude that consolidation boosts home values and rents by about 25 percent in very small school districts, but find that this effect declines with increases in enrollment and is non-existent in districts with more than 1,700 students.[70] Interestingly, Hu and Zinger (2008) also find that the impact of consolidation on housing prices declines as home values increase, and within the wealthiest neighborhoods, the effect is negative. These findings suggest that school district consolidation is only advantageous in certain situations, and it is thus important for officials to consider each situation individually. Administrative consolidation, as opposed to school consolidation, is likely a better fit for many larger communities - allowing for cost savings, without requiring schools to close.

Outsourcing represents another technique for reducing administrative costs. Capital Region schools should consider outsourcing certain administrative function, such as payroll services, records management and benefit administration, to private contractors. For example, in recent years, some school districts in Texas have asked the State Comptroller of Public Accounts' Office to conduct performance reviews (Johnson and Moser 2002). The office then provides the district with fiscal recommendations, including recommendations for outsourcing.

[70] Only 14 of the 29 school districts included within our sample have an enrollment under this threshold.

CHAPTER SEVEN

Suggestions and Conclusions

A. Suggestions for Future Study

Our sample contains 445 houses, each located on one of 22 district borders. Each of these houses is situated within upstate New York's Capital Region. In comparison to other recent studies, our sample size is quite small and fairly narrow in its geographic breadth. For instance, Dhar and Ross's (2012) sample contains a total of 68,000 houses on 218 district boundaries, and Brasington's (1999) sample represents 27,000 homes from 128 different Ohio communities. Due to their larger sample sizes and geographic breadth, one views the results of these studies with a greater degree of confidence. The results of our study are intriguing, and it is clear that our question of whether district administrative spending influences home prices deserves further investigation within the economic literature.

Future studies should work to secure a larger data set, and use a greater number of district boundaries. They should also consider working with a property database other than Zillow, such as a local real estate database. Though Zillow's data is readily accessible, gathering data on thousands of homes from the site is no small task. Utilizing a pre-existing sample of home data, as CNR (2005) and Dhar and Ross (2012) do with the Banker and Tradesmen data is ideal.

In addition, future studies should consider reducing the width of their school district boundary areas. In this study, all houses are located within one mile of the school boundary in urban and suburban areas, with most located within one half mile of the district boundary. In rural areas, the density of houses is often significantly less, and we thus by necessity expand this boundary to one and a half miles. We recognize that this is a wider than ideal boundary, and that some neighborhood variation may potentially exist within our sample. Only considering house that sold within 2012 or 2013, drastically limits the number of houses we can include within the sample, as does only considering houses within the Capital Region. To have a sufficient number of houses and boundaries for our sample, we are required to use a wider than optimal boundary width.

To avoid this issue, future studies should consider doing two things: using a longer time period and / or utilizing a more densely populated area. With a longer time period, one must also consider the long-term trends in the housing market and changes in school districts. Dhar and Ross (2012) do this well, utilizing a difference-in-difference method to account for these changes.

Our final concern with the boundary technique is that on occasion this method can compare houses that are far away from one another, even though they are located on the same boundary. Fack and Grenet (2010) are amongst the first to address this concern, developing "a matching framework" that enables them to "restrict a transaction's comparison group to sales located in its immediate vicinity" (61).[71] Future studies should consider applying this technique to their samples.

B. Conclusions

We begin this study by making the assumption that school district quality is capitalized within house prices. The results of our study provide support to this initial assumption. Using boundary discontinuity methods, we find a district's amount of

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[71] We do not discuss this paper in the literature review, as Fack and Grenet's (2010) sample contains houses from Paris, France. As European school systems are significantly different from those in the United States, we do not include the findings of this paper within our literature review. The methods utilized by Fack and Grenet (2010), however, are relevant to our study.

administrative spending per pupil, to be highly significant and inversely related to district house prices. Additionally, we find the significance of district size, student-to teacher ratio and test scores, to district house prices, to vary by specification, and do not find race or teacher salaries to be significant. We conclude that school spending within the Capital Region is currently above its optimal level, as when administrative spending and district expenditures per pupil rise, home prices fall. To reduce spending levels and maximize school quality, we recommend that Capital Region districts consider consolidation and outsourcing measures.

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I hereby affirm that I have carried out my endeavors with full academic honesty.
CAD

APPENDICES

Figure 1: Map of Capital Region School Districts (in Red), Counties (in Yellow) and Municipalities (in Green). Source: *Capital District Regional Planning Commission*

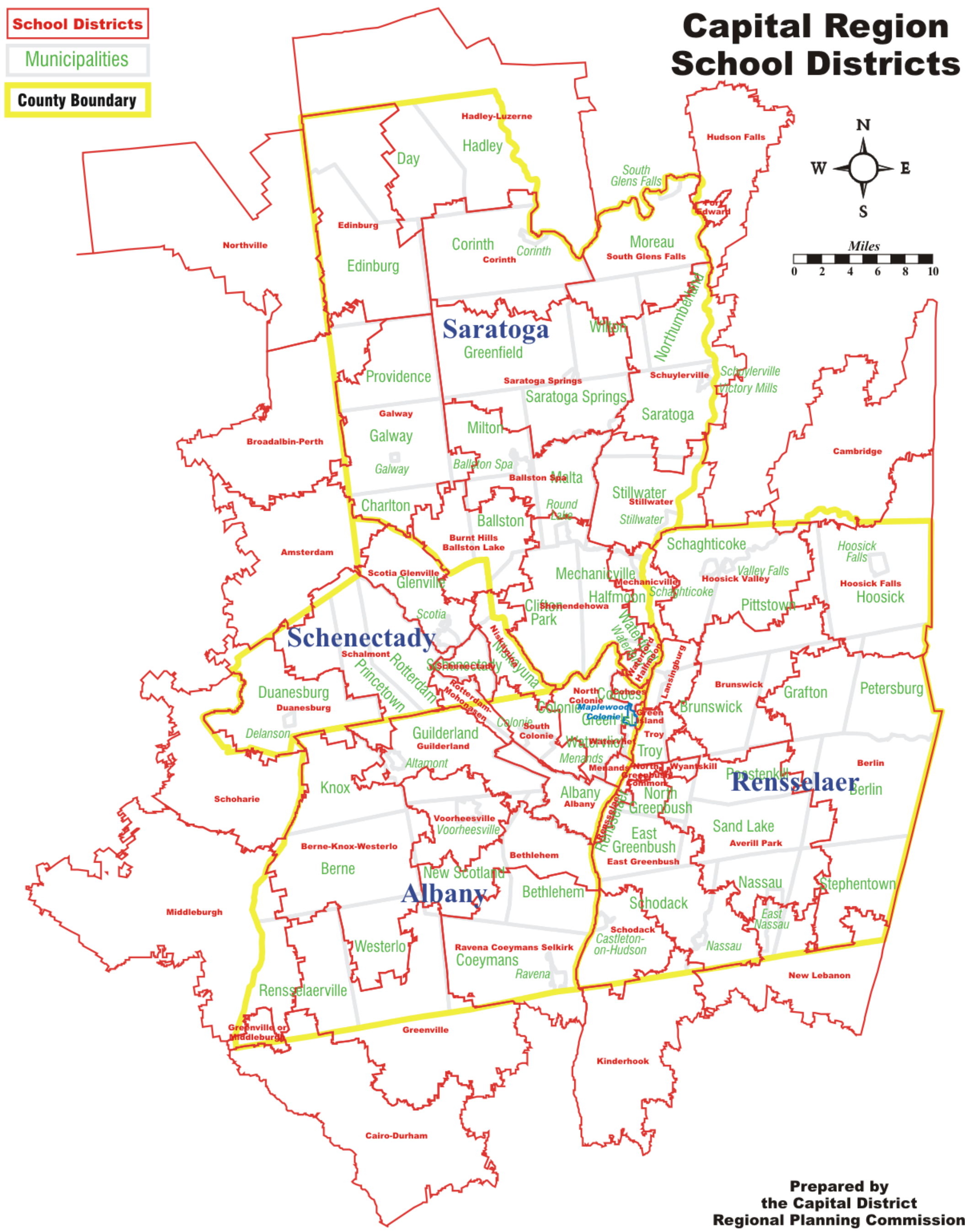

Figure 2: Descriptive statistics of school district characteristics for all of the 29 districts included in the sample.

Summary Statistics

Variable	Mean	Median	Minimum	Maximum
ADMNSPND_PP	1046.05	1039.30	825.758	1324.82
ADMNSAL_PP	630.656	635.252	503.571	810.928
SQ_ADMNSPND_PP	1112180.	1080150.	681876.	1755150.
SQ_ADMNSAL_PP	403045.	403545.	253584.	657604.
NON_ADMSAL_PP	17033.6	15786.7	13620.4	22161.2
NON_ADMNSPND_PP	16618.2	15364.7	13228.1	21696.4
NUMSCHOOLS	5.41124	5.00000	2.00000	12.0000
STUDENTS_NUM	3354.13	3367.00	911.000	9854.00
LOCALREV_PCNT	0.534781	0.551326	0.332320	0.717494
STDNT_TO_TEACH	12.7590	13.0100	10.0200	14.7700
NONWHITE	0.0729530	0.0488550	0.0138776	0.193054
RGNTS_ENGLISH	0.929685	0.930000	0.760000	1.00000
RGNTS_MATH	0.879978	0.890000	0.680000	0.990000
TEACHER_SALARY	56965.9	57725.0	43876.0	67499.0

Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
ADMNSPND_PP	134.129	0.128224	0.0449399	-0.945997
ADMNSAL_PP	73.0083	0.115766	0.453343	0.0323406
SQ_ADMNSPND_PP	282023.	0.253578	0.250592	-0.777240
SQ_ADMNSAL_PP	94773.6	0.235144	0.769935	0.624626
NON_ADMSAL_PP	2540.06	0.149121	0.735200	-0.657242
NON_ADMNSPND_PP	2505.41	0.150763	0.759593	-0.610029
NUMSCHOOLS	2.70707	0.500269	0.683534	-0.0740535
STUDENTS_NUM	2332.83	0.695510	1.16685	1.21108
LOCALREV_PCNT	0.101225	0.189283	-0.206882	-1.08331
STDNT_TO_TEACH	1.14475	0.0897215	-0.717989	0.417254
NONWHITE	0.0519035	0.711465	1.09956	0.0271278
RGNTS_ENGLISH	0.0407297	0.0438102	-1.42191	3.47184
RGNTS_MATH	0.0792035	0.0900063	-0.826027	0.129364
TEACHER_SALARY	5074.06	0.0890719	-0.295433	0.362678

Figure 3: Descriptive statistics of home characteristics for all of the 445 houses included in the sample.

Summary Statistics

Variable	Mean	Median	Minimum	Maximum
LOG_SALE_PRICE	12.2814	12.3400	10.3090	13.8145
BEDS	3.28539	3.00000	1.00000	6.00000
BATHS	2.09326	2.00000	1.00000	5.50000
SQFT	1953.58	1837.00	720.000	4516.00
YEAR	1966.85	1977.00	1760.00	2012.00
LOG_ACRES	0.194968	-0.0202027	-2.20727	5.25932
STORY	1.65393	2.00000	1.00000	2.00000
PROP_TXRTE_ASMT	0.0370640	0.0279204	0.0102906	0.117011

Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
LOG_SALE_PRICE	0.488561	0.0397807	-0.770639	1.91411
BEDS	0.757478	0.230559	0.158439	0.679893
BATHS	0.758406	0.362309	0.325979	0.117696
SQFT	726.230	0.371742	0.863840	0.764230
YEAR	43.3695	0.0220503	-1.94961	4.32541
LOG_ACRES	1.39756	7.16813	0.868096	0.552576
STORY	0.476250	0.287950	-0.647163	-1.58118
PROP_TXRTE_ASMT	0.0230161	0.620983	1.86061	2.41918

Figure 4: Each of these 22 border dummies represents the border between two specific Capital Region school districts.

BEGRN_SCHODACK = East Greenbush / Schodack
BBETH_VOOHERS = Bethlehem / Voorheesville
BGUILDER_VOOHER = Guilderland / Voorheesville
BAP_VOOHER = Averill Park / Voorheesville
BAP_EGRN = Averill Park / East Greenbush
BBALLSTPA_BURNT = Ballston Spa / Burnt Hills
BMIDDLE_SCHOH = Middleburgh / Schoharie
BBALLSTSPA_SHEN = Ballston Spa / Shenendehowa
BBERNEKW_DUANES = Berne Knox Westerlo / Duanesburg
BBROADP_GALWAY = Broadalbin Perth / Galway
BBRUNS_HOOSICV = Brunswick / Hoosic Valley
BBNTHILLS_SHEN = Burnt Hills / Shenendehowa
BCMBDGE_HSCKF = Cambridge / Hoosick Falls
BDUANES_SCHOH = Duanesburg / Schoharie
BEGRN_KINDER = East Greenbush / Kinderhook
BGREENVILLE_RAV = Greenville / Ravena Coeymans Selkirk
BGREENVILLE_MID = Greenville / Middleburgh
BGUILDER_SCHAL = Guilderland / Schalmont
BMECHANIC_STILL = Mechanicville / Stillwater
BNISKY_SOUTHCOL = Niskayuna / South Colonie
BNCOL_SCOL = North Colonie / South Colonie
BROTTMO_SCHAL = Rotterdam Mohonasen / Schalmont

Figure 5: Estimates for the primary OLS regression using the log of house price (LOG_SALE_PRICE) as the dependent variable and total administrative spending per pupil (SQ_ADMNSPND_PP) as the regressor or primary interest. Note that * represents statistical significance at the .10 level, ** the .05 level, and *** the .01 level.

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	3.29979	2.43544	1.3549	0.17620	
BEDS	-0.0149991	0.0230067	-0.6519	0.51481	
BATHS	0.109062	0.0293515	3.7157	0.00023	***
SQFT	0.000255699	3.02431e-05	8.4548	<0.00001	***
LOG_ACRES	0.088768	0.0142549	6.2272	<0.00001	***
YEAR	0.00268703	0.000383268	7.0108	<0.00001	***
STORY	0.0336387	0.0349241	0.9632	0.33602	
PROP_TXRTE_ASMT	-2.52124	1.04145	-2.4209	0.01592	**
BEGRN_SCHODACK	0.232597	0.128292	1.8130	0.07057	*
BBETH_VOOHERS	0.0128519	0.123771	0.1038	0.91735	
BGUILDER_VOOHER	-0.131759	0.113562	-1.1602	0.24663	
BAP_VOOHER	0.186073	0.123071	1.5119	0.13134	
BAP_EGRN	0.0833994	0.119777	0.6963	0.48665	
BBALLSTPA_BURNT	-0.0731296	0.123763	-0.5909	0.55493	
BMIDDLE_SCHOH	-0.02923	0.169217	-0.1727	0.86294	
BBALLSTSPA_SHEN	0.0343707	0.128145	0.2682	0.78867	
BBERNEKW_DUANES	0.0855844	0.144568	0.5920	0.55418	
BBROADP_GALWAY	-0.0351465	0.154802	-0.2270	0.82051	
BBRUNS_HOOSICV	-0.0995524	0.133794	-0.7441	0.45727	
BBNTHILLS_SHEN	-0.123505	0.139089	-0.8880	0.37509	
BCMBDGE_HSCKF	-0.224585	0.194045	-1.1574	0.24780	
BDUANES_SCHOH	0.217504	0.153314	1.4187	0.15676	
BEGRN_KINDER	0.113374	0.13493	0.8402	0.40127	
BGREENVILLE_RAV	-0.201393	0.149147	-1.3503	0.17767	
BGREENVILLE_MID	0.0557914	0.165227	0.3377	0.73579	
BGUILDER_SCHAL	-0.194119	0.100733	-1.9271	0.05467	*
BMECHANIC_STILL	0.0795611	0.10827	0.7348	0.46286	
BNISKY_SOUTHCOL	0.063048	0.165486	0.3810	0.70341	
BNCOL_SCOL	0.0317703	0.158284	0.2007	0.84102	
STUDENTS_NUM	-2.54391e-05	4.85693e-05	-0.5238	0.60073	
NUMSCHOOLS	0.0340791	0.0424022	0.8037	0.42204	
LOCALREV_PCNT	1.65896	0.596624	2.7806	0.00568	***
STDNT_TO_TEACH	-0.0600647	0.0375596	-1.5992	0.11056	
TEACHER_SALARY	-2.63759e-06	7.1907e-06	-0.3668	0.71396	
RGNTS_ENGLISH	-1.30775	0.77828	-1.6803	0.09367	*
RGNTS_MATH	1.49557	0.551061	2.7140	0.00693	***
NONWHITE	-1.52283	1.19139	-1.2782	0.20191	
NON_ADMNSPND_PP	-2.78254e-05	1.4037e-05	-1.9823	0.04812	**
SQ_ADMNSPND_PP	-4.02312e-06	1.69246e-06	-2.3771	0.01791	**
ADMNSPND_PP	0.00755387	0.00354031	2.1337	0.03347	**

Mean dependent var	12.28138	S.D. dependent var	0.488561
Sum squared resid	33.24718	S.E. of regression	0.286517
R-squared	0.686286	Adjusted R-squared	0.656077
F(39, 405)	22.71757	P-value(F)	4.40e-79

Figure 6: Estimates for the secondary OLS regression using the log of house price (LOG_SALE_PRICE) as the dependent variable and the district's level of total administrative salary spending per pupil (SQ_ADMNSAL_PP) as the regressor or primary interest.

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	6.63364	2.11218	3.1407	0.00181	***
BEDS	-0.015589	0.0231182	-0.6743	0.50049	
BATHS	0.110303	0.0294457	3.7460	0.00021	***
SQFT	0.000251372	3.02906e-05	8.2987	<0.00001	***
LOG_ACRES	0.0860992	0.0142948	6.0231	<0.00001	***
YEAR	0.00262524	0.000386463	6.7930	<0.00001	***
STORY	0.0367455	0.0350458	1.0485	0.29503	
PROP_TXRTE_ASMT	-2.26995	1.05582	-2.1499	0.03215	**
BEGRN_SCHODACK	0.056736	0.110294	0.5144	0.60725	
BBETH_VOOHERS	0.00574024	0.119313	0.0481	0.96165	
BGUILDER_VOOHER	-0.125872	0.11176	-1.1263	0.26072	
BAP_VOOHER	0.163765	0.123823	1.3226	0.18672	
BAP_EGRN	-0.0325375	0.113368	-0.2870	0.77425	
BBALLSTPA_BURNT	-0.0434341	0.123306	-0.3522	0.72484	
BMIDDLE_SCHOH	-0.0549654	0.169477	-0.3243	0.74586	
BBALLSTSPA_SHEN	0.0564005	0.127761	0.4415	0.65912	
BBERNEKW_DUANES	0.031231	0.144666	0.2159	0.82919	
BBROADP_GALWAY	-0.0188184	0.145544	-0.1293	0.89719	
BBRUNS_HOOSICV	-0.120071	0.132707	-0.9048	0.36612	
BBNTHILLS_SHEN	-0.108114	0.139169	-0.7769	0.43770	
BCMBDGE_HSCKF	-0.299719	0.187387	-1.5995	0.11050	
BDUANES_SCHOH	0.15723	0.148448	1.0592	0.29016	
BEGRN_KINDER	-0.0418322	0.126774	-0.3300	0.74159	
BGREENVILLE_RAV	-0.278407	0.161257	-1.7265	0.08502	*
BGREENVILLE_MID	0.000500649	0.162708	0.0031	0.99755	
BGUILDER_SCHAL	-0.165256	0.101693	-1.6250	0.10493	
BMECHANIC_STILL	0.0906323	0.111225	0.8149	0.41564	
BNISKY_SOUTHCOL	-0.0743533	0.170686	-0.4356	0.66335	
BNCOL_SCOL	0.0283989	0.17238	0.1647	0.86923	
STUDENTS_NUM	-8.95594e-05	4.69126e-05	-1.9091	0.05696	*
NUMSCHOOLS	0.102257	0.0417639	2.4485	0.01477	**
LOCALREV_PCNT	1.65963	0.623122	2.6634	0.00804	***
STDNT_TO_TEACH	-0.0917807	0.0443458	-2.0697	0.03912	**
TEACHER_SALARY	-1.27644e-05	6.85427e-06	-1.8623	0.06329	*
RGNTS_ENGLISH	-1.82975	0.861296	-2.1244	0.03424	**
RGNTS_MATH	1.6977	0.513016	3.3093	0.00102	***
NONWHITE	-0.678229	1.11941	-0.6059	0.54493	
NON_ADMNSAL_PP	-3.77928e-05	1.31922e-05	-2.8648	0.00439	***
SQ_ADMNSAL_PP	-6.01868e-06	3.89569e-06	-1.5450	0.12314	
ADMNSAL_PP	0.00621839	0.00515352	1.2066	0.22828	

Mean dependent var	12.28138	S.D. dependent var	0.488561
Sum squared resid	33.46834	S.E. of regression	0.287468
R-squared	0.684199	Adjusted R-squared	0.653789
F(39, 405)	22.49882	P-value(F)	1.59e-78

Figure 7: Correlation Matrix

Correlation coefficients, using the observations 1 - 445
5% critical value (two-tailed) = 0.0930 for n = 445

BEDS	BATHS	SQFT	LOG_ACRES	YEAR	
1.0000	0.4632	0.4961	0.0056	-0.0088	BEDS
	1.0000	0.6590	0.0539	0.3504	BATHS
		1.0000	0.2073	0.0724	SQFT
			1.0000	-0.1492	LOG_ACRES
				1.0000	YEAR

STORY	PROP_TXRTE_ ASMT	STUDENTS_ NUM	NUMSCHOOLS	LOCALREV _PCNT	
0.2931	-0.0352	0.1264	0.1381	0.1395	BEDS
0.3577	-0.1471	0.1534	0.1760	0.2343	BATHS
0.4535	-0.0702	0.1098	0.1250	0.2036	SQFT
0.0528	0.2669	-0.3028	-0.3086	-0.3300	LOG_ACRES
-0.1304	-0.0434	0.1226	0.1130	0.1219	YEAR
1.0000	-0.1056	-0.0041	0.0128	0.0529	STORY
	1.0000	-0.2643	-0.2739	-0.4311	PROP_TXRTE_ASMT
		1.0000	0.9659	0.6398	STUDENTS_NUM
			1.0000	0.7195	NUMSCHOOLS
				1.0000	LOCALREV_PCNT

STDNT_TO_ TEACH	TEACHER_ SALARY	RGNTS_ ENGLISH	RGNTS_MATH	NONWHITE	
0.0893	-0.0132	0.1635	0.0530	0.1405	BEDS
0.2232	0.1086	0.1224	0.1866	0.1194	BATHS
0.1461	0.0406	0.1559	0.1852	0.0546	SQFT
-0.2019	-0.2254	-0.0988	-0.1765	-0.3259	LOG_ACRES
0.1787	0.0925	-0.0215	0.0854	0.0498	YEAR
0.0439	0.0005	-0.0068	0.0177	0.0183	STORY
-0.1172	-0.3376	-0.0548	-0.3300	-0.3008	PROP_TXRTE_ASMT
0.5655	0.4372	0.4998	0.5078	0.6542	STUDENTS_NUM
0.5715	0.5559	0.5043	0.5671	0.7049	NUMSCHOOLS
0.3378	0.6300	0.3605	0.6177	0.7275	LOCALREV_PCNT
1.0000	0.1177	0.2388	0.5401	0.1961	STDNT_TO_TEACH
	1.0000	0.0318	0.4211	0.5467	TEACHER_SALARY
		1.0000	0.3374	0.2753	RGNTS_ENGLISH
			1.0000	0.4083	RGNTS_MATH
				1.0000	NONWHITE

NON_ADMSAL_PP	NON_ADMNSPND_PP	ADMNSPND_PP	ADMNSAL_PP	
-0.0762	-0.0741	-0.0560	0.0053	BEDS
-0.1304	-0.1299	-0.0452	-0.0028	BATHS
-0.0720	-0.0737	0.0572	0.0826	SQFT
0.0724	0.0670	0.1072	-0.0253	LOG_ACRES
-0.1366	-0.1369	-0.0594	-0.0543	YEAR
-0.0019	-0.0012	-0.0065	0.0107	STORY
-0.1275	-0.1277	-0.2184	-0.3460	PROP_TXRTE_ASMT
-0.3809	-0.3770	-0.1784	-0.0144	STUDENTS_NUM
-0.2877	-0.2825	-0.1467	0.0442	NUMSCHOOLS
-0.0294	-0.0227	0.0505	0.3393	LOCALREV_PCNT
-0.5651	-0.5612	-0.3653	-0.2669	STDNT_TO_TEACH
0.1359	0.1433	-0.0186	0.1552	TEACHER_SALARY
-0.2134	-0.2123	-0.1194	-0.0824	RGNTS_ENGLISH
-0.1794	-0.1742	-0.0164	0.2342	RGNTS_MATH
-0.0878	-0.0758	-0.2143	0.0603	NONWHITE
1.0000	0.9996	0.4626	0.3622	NON_ADMSAL_PP
	1.0000	0.4411	0.3492	NON_ADMNSPND_PP
		1.0000	0.8817	ADMNSPND_PP
			1.0000	ADMNSAL_PP